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SSIC 5000-33a

FINAL WORK PLAN, BASEWIDE RADIOLOGICAL SUPPORT

12/08/2015

CB AND I FEDERAL SERVICES, LLC

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FINAL
WORK PLAN
Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California

Contract Number: N62473-12-D-2005
Contract Task Order: 0008

Document Control Number: CBI-2005-0008-0005

December 2015

Submitted to:

Base Realignment and Closure
Program Management Office West Naval Facilities Engineering Command
33000 Nixie Way, Bldg. 50
San Diego, California 92147

Submitted by:

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Approved by: _____ Date: December 8, 2015

John R. Hackett, PE, CHP, PMP
Project Manager

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Acronyms and Abbreviations

CB&I	CB&I Federal Services LLC
HPNS	Hunters Point Naval Shipyard
MOU	Memorandum of Understanding
Navy	U.S. Department of the Navy
RASO	Radiological Affairs Support Office
RCT	radiological control technician
RPP	radiation protection plan
RWP	radiological work permit

1.0 Introduction

CB&I Federal Services LLC (CB&I) has been contracted by the Naval Facilities Engineering Command Southwest to provide basewide radiological support to the Hunters Point Naval Shipyard (HPNS), located in San Francisco, California (Figure 1) under CB&I's U.S. Nuclear Regulatory Commission License 20-31389-30 and California Agreement State License Broad Scope Radioactive Material License 7889-07 in order to maintain radiological controls and postings throughout the base, ensure radiation protection to those at the base, and support other contractors completing chemical removal and remediation work in radiologically impacted areas. A Memorandum of Understanding (MOU) among the contractors working on radiologically controlled sites at HPNS helps to define CB&I's role and responsibilities for basewide radiological support under this task order. Figure 1 depicts the current radiological areas under contract. The MOU will be revised and updated if radiological boundaries change or individual contractor responsibilities change.

The work presented herein is authorized under the U.S. Department of the Navy (Navy) Contract No. N62473-12-D-2005, Contract Task Order 0008. This Work Plan describes the technical approach that will be implemented to provide basewide radiological support according to the U.S. Department of the Navy Statement of Work. In general, basewide radiological support includes the following:

- Performing routine surveys of radiologically impacted buildings and sites
- Maintaining basewide radiological postings and controls for radiologically impacted areas and radiological work areas
- Providing site-specific radiological training for visitors or contractors working in radiologically impacted areas
- Providing radiological screening and sampling to contractors performing non-radiological work in a radiologically impacted site
- Operation and maintenance of a radiological portal monitor for incoming and outgoing trucks
- Other support activities to be performed as needed

Work performed under this Work Plan will follow the provisions of the Radiation Protection Plan (RPP; Appendix A) and the project *Accident Prevention Plan, Basewide Radiological Support, Hunters Point Naval Shipyard, San Francisco, California* (CB&I, 2015).

1.1 Project Organization

Figure 2 presents the project organization and CB&I points of contact for this project.

1.2 Project Schedule

The project schedule is presented as Figure 3.

1.3 Work Plan Organization

This Work Plan is organized into the following three sections and four appendices:

- Section 1.0, "Introduction"—Provides the project team organization, project schedule, and Work Plan organization.
- Section 2.0, "Basewide Support Activities"—Provides an overview of planned support activities.
- Section 3.0, "References"—Includes a list of documents used to compile this Work Plan.
- Appendix A, "Radiation Protection Plan"—Details radiological posting and control requirements, survey procedures, and training requirements.
- Appendix B, "Waste Management Plan"—Describes the waste sampling design and rationale; laboratory analyses; sampling methods and locations; and sample frequency.
- Appendix C, "Abbreviated Sampling and Analysis Plan"—Addresses the specific analytical requirements for soil and water samples required to support non-radiological contractors.
- Appendix D, "HPNS Basewide Stockpile Inventory (as of October 2, 2015)"
- Appendix E, "Contractor Quality Control Plan"—Addresses lines of communication, technical review procedures, activity documentation, definable work features, quality control staff and their responsibilities, proposed outside organizations (vendors, subcontractors) and their responsibilities and reporting requirements, project inspection requirements, required submittals, and other procedures to be followed to ensure technical quality throughout the project.
- Appendix F, "Project Work Instructions"—Includes all current and relevant project Work instructions that have been prepared for the basewide radiological support task.

2.0 Basewide Support Activities

The following subsections summarize the radiological support activities to be performed for Contract Task Order 0008. Detailed information on the procedures described in the following subsections is provided in the appendices as noted.

2.1 Radiological Controls and Postings

CB&I will implement and maintain radiological controls for radiologically impacted areas that are not covered by an on-site radiological remediation contractor according to the current memorandum of understanding, which will be posted within the on-site trailer. Sites will be posted according to existing radiological conditions. Radiological postings will be placed and maintained every 15 meters along perimeter fencing for radiologically impacted sites. Postings and fencing will be inspected on a minimum quarterly basis. Additional fencing will be procured and set up as needed.

Radiological controls and postings are further described in Section 14 of the RPP and CMS-710-07-PR-04014, "Radiological Labeling, Postings and Access Control" (Appendix A).

CB&I will assume the radiological controls of the following areas upon transition from the previous basewide contractor:

- Radiological Screening Yards 3 and 4 in Parcel E
- Three piers located directly south of Gun Mole Pier
- IR-02 exclusive of the IR-03 Former Oily Waste Pond within IR-02
- IR-12 (Salvage Yard)
- Parcel F
- Buildings 253, 211, 224, and 205
- Building 258 Device and Sample Storage Areas, Instrument Shop
- Kleinfelder Perimeter (Baker Tank)
- Portal Monitor (location to be determined)
- Drydocks 2, 3, and 4

Changes (additions or removals) to the list above will be documented in an updated MOU. CB&I will maintain a basewide-tracking table of waste piles within the radiologically controlled areas and impacted areas at HPNS. The current version of the table (as of October 2, 2015) is provided

as Appendix D. Information from other contractors performing radiological work at HPNS will be consolidated and updated on a regular basis. The radiological status of the waste piles will be verified at a minimum of every two weeks.

2.1.1 Radiological Screening of Soil Stockpiles of Unknown Origin

Details on the soil/debris stockpile sampling approach and analyses are provided in Appendix B (Waste Management Plan) and Appendix C (Abbreviated Sampling and Analysis Plan) and/or summarized in task specific work instructions.

Details on the waste sampling approach and analyses are provided in Appendix B (Waste Management Plan) and Appendix C (Abbreviated Sampling and Analysis Plan) and/or summarized in task specific work instructions.

2.1.2 Relocation of Radiologically Cleared Soil and Debris Stockpiles

CB&I will relocate radiologically cleared soil and debris stockpiles outside of radiologically controlled areas to designated areas for transfer to and disposal by the Basewide Transportation and Disposal contractor, Arcadis. Stormwater and erosion best management practices will be maintained on the stockpiles until formal transfer to the Basewide Transportation and Disposal contractor.

2.2 Radiological Surveys

Routine weekly, monthly, and quarterly surface surveys will be performed for those areas that are radiologically impacted at HPNS, but not currently controlled by another licensed radiological contractor. Surface surveys shall cover all radionuclides of concern for each site. Survey activities include dose monitoring, and the collection of swipe samples and static measurements. The main purpose of the surveys is to ensure that there is no change in dose reading at the perimeter that could negatively impact the public or environment and to ensure all security measures are in place. Routine surveys are discussed further in the RPP (Appendix A) and will be documented in a project work instruction. Routine surveys include building surfaces and land areas.

2.3 Incoming and Outgoing Surveys

Equipment and materials brought into radiologically impacted areas controlled by CB&I will be subject to an incoming survey by a radiological control technician (RCT) prior to entry into the controlled area. Surveys of incoming equipment will be performed in accordance with CMS-710-07-PR-04011, “Radiological Surveys and Monitoring,” (Appendix A). Equipment being removed from a radiologically impacted area will also be surveyed for free release. Free release surveys will be performed in accordance with project work instructions.

2.4 Radiological Support to Other Contractors

Prior to providing radiological support to other contractors, the Radiation Safety Officer will review the proposed scope of work and determine the level of effort needed by CB&I to provide coverage for the work activities. The Radiation Safety Officer will identify potential radionuclides of concern for the work area and determine the appropriate level of control. CB&I will develop project work instructions as needed and submit to Radiological Affairs Support Office (RASO) for review and concurrence prior to the start of fieldwork.

Radiological support and supervision of non-radiological contractors performing work in radiologically impacted areas (Figure 1) that are not currently under the license control of another contractor, will be provided by qualified CB&I RCTs. At a minimum, the support includes radiological training and escort into and out of an impacted area. The radiological technician assigned to this task must ensure all personnel entering and exiting the impacted areas are properly trained, briefed, supervised, and scanned for radiological contamination upon exiting the site per U.S. Nuclear Regulatory Commission license requirements. Additionally, if the contractor is performing intrusive work, surveys of equipment may be required during work efforts.

CB&I shall conduct radiological awareness briefings for non-radiological remediation contractors executing work in radiologically impacted areas and requiring an escort. Briefings will be specific to the area(s) of concern where access is needed, but will cover at a minimum:

- Applicable portions of 10 Code of Federal Regulations 19, 10 Code of Federal Regulations 20, the RPP, radiation work permits (RWPs), site-specific reference documents (e.g., historical radiological assessment), and supporting standard operating procedures
- Alpha, beta, and gamma emitting radionuclides
- A description of radiation exposure risks and monitoring requirements
- Access and egress protocol specific to the radiologically impacted location(s) requiring entry
- Radiation exposure reduction techniques for an embryo/fetus
- Completion of applicable briefing/exposure monitoring documentation
- Notification of contacts as needed to complete training requirements

Prior to entry to an impacted area, CB&I will ensure non-radiological remediation contractors entering the area have the required dosimetry (if necessary), have completed the radiological awareness briefing, and have been briefed on the requirements established in the RWP in accordance with applicable standard operating procedures. Persons entering an impacted area

will sign in and out on an access log and comply with requirements established in the RWP. In addition, personnel exiting an impacted area will be subject to a personnel survey by an RCT.

CB&I will perform radiological sampling and laboratory analysis (as required) in the event that a non-radiological contractor has to perform intrusive activities in an impacted area. Prior to the start of fieldwork, the contractor will submit their scope of work for review and CB&I will develop project work instructions, which will be reviewed by the Navy and RASO prior to the start of fieldwork.

2.5 Incoming and Outgoing Surveys

In support of other contractors, surveys are required for both incoming equipment brought to HPNS and outgoing equipment leaving radiologically impacted areas in accordance with CMS-710-07-WI-40111, "Performing and Documenting Radiation and Contamination Surveys" (Appendix A). During these survey activities, accessible surfaces will be surveyed for removable and fixed surface contamination and the results documented. An equipment tracking log will be maintained for equipment entering and exiting radiologically impacted areas.

2.6 Portal Monitor Operation

CB&I will procure, maintain, and operate a portal monitor (Ludlum Model 375P-1000 or similar) for incoming and outgoing trucks loaded with both radiologically and non-radiologically contaminated soils and debris. The purpose of the portal monitor scan is to prevent the inadvertent shipment of materials or equipment exhibiting elevated radiation levels on to or off of HPNS. Hand screening may be required in instances when the portal monitor malfunctions or is unavailable. Portal monitor and supplemental hand surveys will be conducted in accordance with CMS-710-07-WI-40115, "Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation" (Appendix A). Loads that fail the portal monitor or hand scan will be escorted by a RCT back to the contractor who generated the soil, or will be dumped and radiologically screened in a controlled area. Additionally, the Base Realignment and Closure Caretaker Site Office Activity point of contact, the Navy Remedial Project Manager, and RASO will be notified immediately (same day) if a load fails. A project work instruction for the portal monitor will be submitted to RASO review prior to setup and implementation.

CB&I will provide a monthly summary report of the portal monitor usage and activities. The report will include the origin of the load, information on if the load passed or failed the portal monitor and support hand screening documentation (if necessary), and a quantification of net increase in portal monitor alarms as compared to the previous month.

2.7 Personnel Dosimetry

As part of the radiological health and safety program, occupational whole-body radiation exposures will be monitored, tracked, and recorded. CB&I will provide non-radiological remediation contractors working in impacted areas with personal dosimetry. In addition, all basewide support personnel entering or surveying impacted areas will wear personal dosimetry. Visitors entering impacted areas under RCT escort do not require dosimetry as long as they do not perform or supervise hands-on work. Examples include site walks, surveying, utility marking, and other short-term periodic visits.

Only National Voluntary Laboratory Accreditation Program-approved dosimeters from an National Voluntary Laboratory Accreditation Program-certified provider will be used. Records will be maintained according to CB&I recordkeeping procedures. Dosimeters will be read on a monthly or quarterly basis, depending on the exposure risk and/or duration of the contractor's work activity. Dosimeter results will be provided to the contractor health and safety representative.

2.8 Work Instructions

CB&I will develop work instructions, on an as-needed basis, for task-specific activities that require radiological oversight. Work instructions will be reviewed and approved by the U.S. Department of the Navy and/or RASO prior to finalization. In addition, a Contractor Quality Control Plan is included in Appendix E to the Work Plan. The Contractor Quality Control Plan describes the quality control actions and procedures that will be followed during execution of work under this contract task order. Work instructions developed for the basewide radiological support program will be inserted into Appendix F of this Work Plan and maintained onsite. Work instructions that are no longer applicable will be removed from Appendix F of this Work Plan.

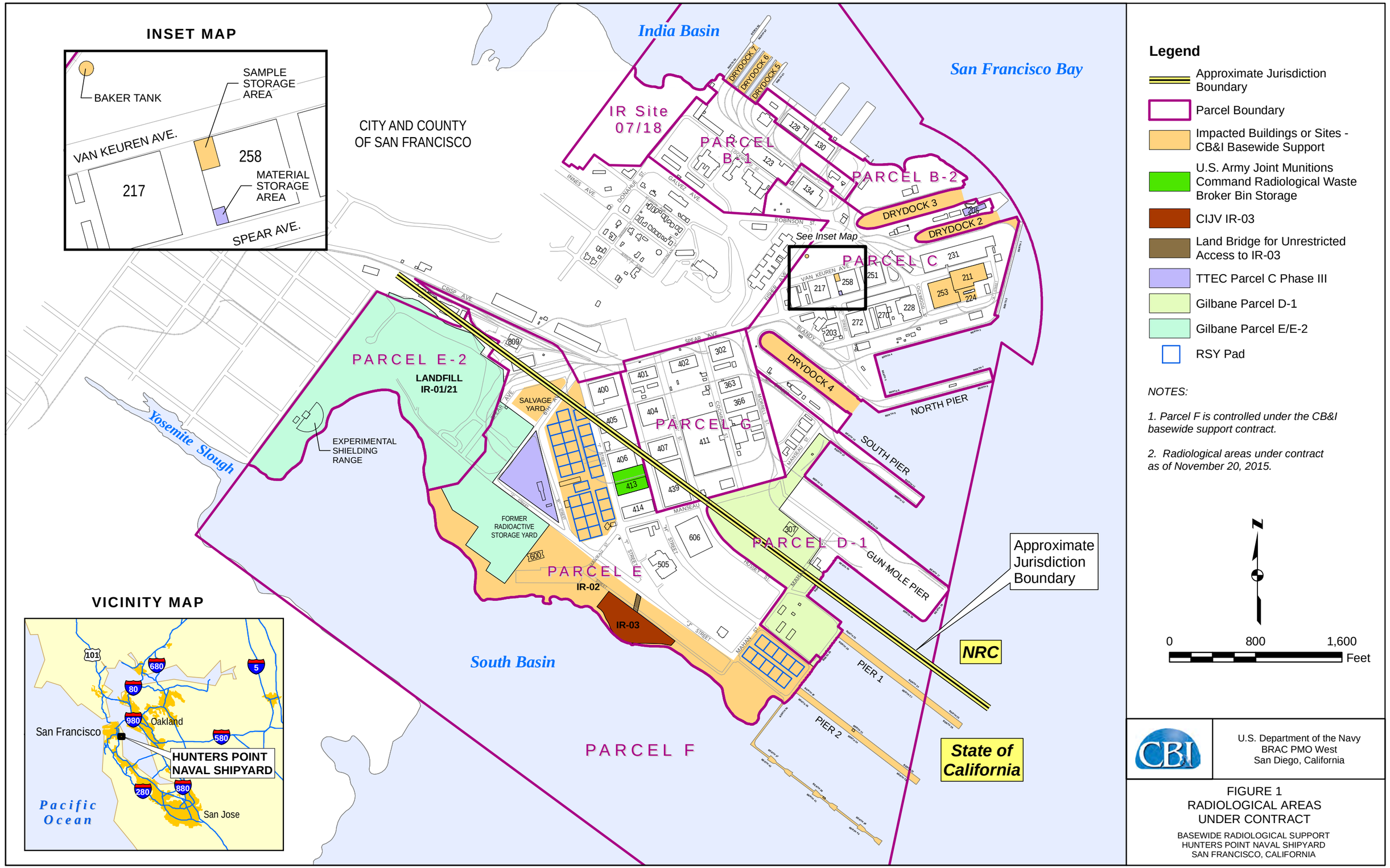
3.0 References

10 CFR 19, *Notices, Instructions And Reports To Workers: Inspection And Investigations*, current version.

10 CFR 20, *Standards For Protection Against Radiation*, current version.

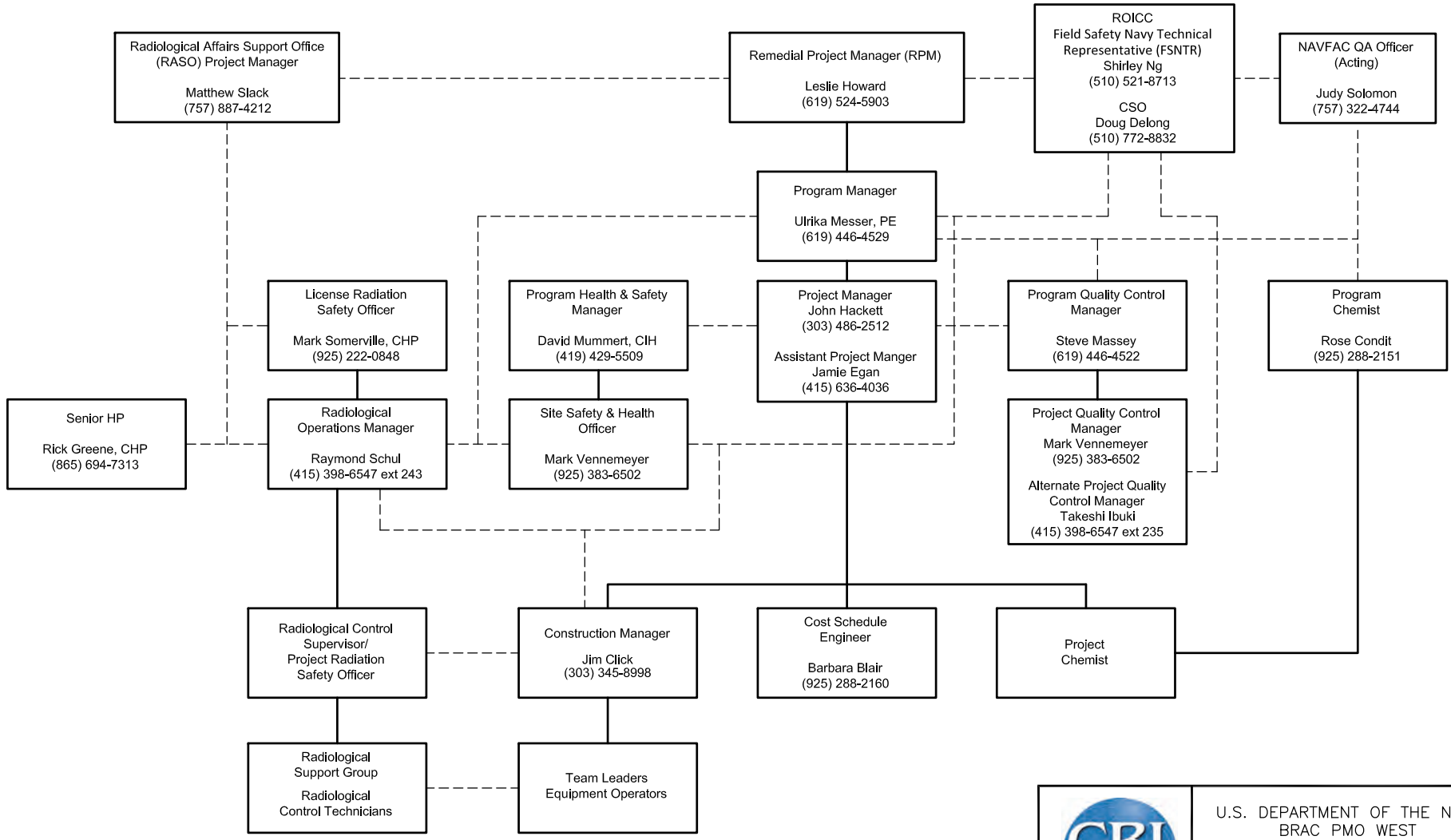
CB&I Federal Services LLC, 2015, *Accident Prevention Plan, Basewide Radiological Support, Hunters Point Naval Shipyard, San Francisco, California*.

Figures



C:\GIS\HUNTERS_PT\GIS_Documents\Project_Maps\Basewide\HPNS_001_Contract_Areas.mxd 11/19/2015

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	500523-A1
---	---	Concord	*BLACK*	*10/8/15*						



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- - - - - - - - LINES OF COMMUNICATION

———— LINES OF AUTHORITY

U.S. DEPARTMENT OF THE NAVY
BRAC PMO WEST
SAN DIEGO, CALIFORNIA

FIGURE 2
ORGANIZATION CHART

BASEWIDE RADIOLOGICAL SUPPORT
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

ID	Task Mode	Task Name	Duration	Start	Finish
1		X020 Award	1 day	Tue 9/8/15	Tue 9/8/15
2		Project Management	255 days	Wed 9/9/15	Fri 9/9/16
3		**Project Meetings**	**255 days**	**Tue 8/4/15**	**Thu 8/4/16**
4		Kick-Off Meeting	1 day	Tue 9/22/15	Tue 9/22/15
5		Contractor Integration Meetings	255 days	Wed 9/9/15	Fri 9/9/16
6		Coordination Meetings	255 days	Wed 9/9/15	Fri 9/9/16
7		**Planning Documents**	**52 days**	**Wed 9/9/15**	**Thu 11/19/15**
8		Preparation of Work Plans	22 days	Wed 9/9/15	Thu 10/8/15
9		Internal Draft Review	22 days	Fri 10/9/15	Mon 11/9/15
10		Respond to Internal Draft Comments	5 days	Tue 11/10/15	Mon 11/16/15
11		Issue Final	3 days	Tue 11/17/15	Thu 11/19/15
12		**Field Work**	**201 days**	**Fri 11/20/15**	**Wed 9/7/16**
13		Radiological Controls and Postings	201 days	Fri 11/20/15	Wed 9/7/16
14		Radiological Surveys	201 days	Fri 11/20/15	Wed 9/7/16
15		Radiological Support to Other Contractors	201 days	Fri 11/20/15	Wed 9/7/16
16		Incoming and Outgoing Surveys	201 days	Fri 11/20/15	Wed 9/7/16
17		Portal Monitor	201 days	Fri 11/20/15	Wed 9/7/16
18		Personal Dosimetry	201 days	Fri 11/20/15	Wed 9/7/16
19		Work Instructions	201 days	Fri 11/20/15	Wed 9/7/16

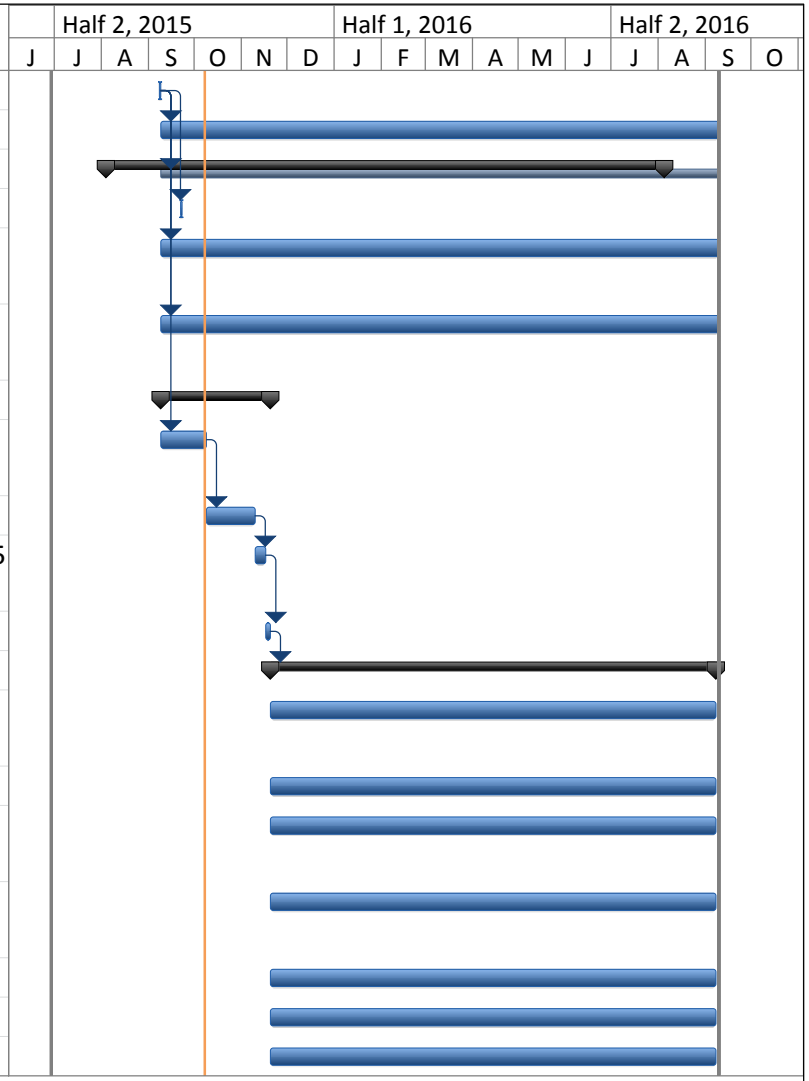

Figure 3 Project Schedule
Project: D2005 CTO008 HPNS Sch
Date: Thu 10/8/15

Task		External Milestone		Manual Summary Rollup	
Split		Inactive Task		Manual Summary	
Milestone		Inactive Milestone		Start-only	
Summary		Inactive Summary		Finish-only	
Project Summary		Manual Task		Deadline	
External Tasks		Duration-only		Progress	

Appendix A
Radiation Protection Plan

APPENDIX A

FINAL
SITEWIDE RADIATION PROTECTION PLAN
Hunters Point Naval Shipyard
San Francisco, California

Contract Number: N62473-12-D-2005
Contract Task Order: 0008

Document Control Number: CBI-2005-0008-0005

December 2015

Submitted to:

Base Realignment and Closure
Program Management Office West Naval Facilities Engineering Command
33000 Nixie Way, Building 50
San Diego, California 92147

Submitted by:

CB&I Federal Services LLC
4005 Port Chicago Highway, Suite 200
Concord, California 94520-1120

Radiation Protection Plan

Project Number: CTO 008—500523

Date Effective: November 2015

This radiation protection plan is applicable to the following activities:

- Maintenance of radiological controls at specified areas at Hunters Point Naval Shipyard (HPNS)
- Performance of radiological compliance surveys, including operation of truck portal monitor for screening of non-radiological soil leaving HPNS
- Radiological characterization and release of waste soil and debris present within radiologically controlled areas at HPNS
- Additional work tasks as directed by the U.S. Department of the Navy.

Prepared by: _____ Date: December 8, 2015
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Reviewed by: _____ Date: December 8, 2015
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License Radiation Safety Officer

Approved by: _____ Date: December 8, 2015
John R. Hackett, PE, CHP, PMP
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Approved by: _____ Date: December 8, 2015
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Attachment 3 License Standard Operating Procedures
Attachment 4 CB&I Management System Procedures
Attachment 5 CB&I Management System Work Instructions

Acronyms and Abbreviations

^{137}Cs	cesium-137
^{226}Ra	radium-226
^{90}Sr	strontium-90
ALARA	as low as reasonably achievable
CB&I	CB&I Federal Services LLC
CDPH	California Department of Public Health
CFR	Code of Federal Regulations
CMS	CB&I Management System
DOT	U.S. Department of Transportation
MOU	memorandum of understanding
mrem	millirem
NRC	U.S. Nuclear Regulatory Commission
PM	project manager
PPE	personal protective equipment
PRSO	Project Radiation Safety Officer
QC	quality control
RCS	Radiological Control Supervisor
RCT	Radiological Control Technician
ROC	radionuclide of concern
ROM	Radiological Operations Manager
RPP	radiation protection plan
RSO	Radiation Safety Officer
RWP	radiological work permit
SOP	standard operating procedure
SSHP	site safety and health plan

1.0 Introduction

This Radiation Protection Plan (RPP) is provided to detail the CB&I Federal Services LLC (CB&I) requirements for activities conducted under Radioactive Material License (RML) No. 20-31340-01 and State of California RML 7889-07, issued and subject to regulatory enforcement by the U.S. Nuclear Regulatory Commission (NRC) and the California Department of Public Health (CDPH), respectively. Locations of current work sites are shown on Figure 1. Overall guidance of the projects at HPNS is contained in task order-specific approved work plans.

This RPP describes the elements of CMS-710-07-PR-04000, "Radiation Safety Program," that are applicable to this work. References to applicable Standard Operating Procedures (SOPs) have been provided below. CB&I procedure SPL-SOP-8.10, *Radiation Protection Program*, requires the preparation of this site-specific RPP for activities involving the possession, use of, or work with materials with the potential for exposure to ionizing radiation. This site-specific RPP complies with CB&I policies and procedural requirements and provides the overall guidance to project management and personnel to execute the project scope of work in a manner that protects workers, the public, and the environment. Regulatory agency contact information is provided in Table 1. The CB&I procedures governing the site-specific development and radiation protection program implementation requirements are described in the following sections and are listed in Table 2. Additional work instructions may be prepared for task-specific work activities.

The primary radionuclides of concern (ROCs) known or suspected within Hunters Point Naval Shipyard (HPNS) areas are radium-226 (^{226}Ra), cesium-137 (^{137}Cs), and strontium-90 (^{90}Sr), based on the *Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard* (Navy, 2004). Other ROCs and applicable radiological control requirements may be associated with specific project sites and will be addressed in the project Work Plan or Task Specific Plan, in alignment with Navy acceptance.

Radiological artifacts such as radium deck markers, gages, or other radioluminescent devices may be encountered. Radium-containing artifacts meet the definition of the NRC's byproduct rule Section 11e.(4) for ^{226}Ra , which includes any discrete source of ^{226}Ra that is produced, extracted, or converted after extraction for use for a commercial, medical, or research activity.

2.0 Radiation Protection Personnel

Personnel involved with radiological work at HPNS are required to follow this RPP. The personnel acknowledgement form for each project is provided as Attachment 1. Additional roles and responsibilities are provided in the following subsections. Key radiation protection personnel are listed in Table 3.

2.1 License Radiation Safety Officer

The License Radiation Safety Officer (RSO) is responsible for implementing the CB&I NRC and California Radioactive Materials Licenses including all communications to the NRC or CDPH, when required, and identifying and training qualified authorized users. Implementation responsibilities include identifying and assigning the Project Radiation Safety Officer (PRSO), other authorized users, reviewing and approving this RPP, coordinating investigation of any radiological occurrence, and reviewing and approving any corrective action plan addressing causes identified for a radiological occurrence. The License RSO also performs and documents a review of compliance with this RPP annually, at a minimum. The License RSO is also responsible for ensuring compliance with all applicable regulatory requirements for radiation protection of the workers, public, and environment. When license activities at a site end, the License RSO shall notify NRC and/or CDPH in writing within 30 days of the termination of activities.

2.2 Radiological Operations Manager

The Radiological Operations Manager (ROM) is responsible for radiation protection staffing and providing technical direction and guidance on implementation of the RPP. The ROM may assume some or all of the duties assigned to the PRSO as required.

2.3 Project Radiation Safety Officer

The PRSO is the individual assigned to implement this RPP at HPNS. The PRSO, or his/her designee, is authorized by the License RSO and is named as an Authorized User on NRC license 20-31340-01 and California license 7889-07. Whenever radiological work is performed, the PRSO or designee shall be present at the project site. The PRSO is responsible for the following:

- Being the first point of contact when regulators arrive at the project site
- Correcting identified deficiencies in the allotted time frame
- Preparing and maintaining this RPP
- Implementing the as low as reasonably achievable (ALARA) principle in all radiological work

- Identifying and obtaining appropriate instrumentation, protective devices, dosimetry, and other items needed to perform work in accordance with elements of this RPP
- Providing radiological worker training
- Reviewing and approving radiological work permit (RWP)
- Maintaining communication with the Project Manager (PM), and License RSO, as needed to ensure that this RPP is fully implemented
- Assessing the proper operation of radiation measuring equipment, including the performance of daily operational and quality control (QC) checks, and verifying out-of-compliance instruments are removed from service
- Overseeing and assessing the performance of radiological surveys and sampling in accordance with this RPP, CB&I SOPs, and site-specific work instructions
- Ensuring survey findings and instrument performance data are reviewed for accuracy, completeness, and compliance with project, procedural, and regulatory requirements
- Ensuring work is performed in accordance with this RPP, project plans, and applicable RWPs
- Participating in periodic internal and external reviews of RPP content and implementation
- Performing and supporting self-assessments and management reviews
- Preparing and maintaining reports and notices as required by this RPP and as requested by the Navy
- Ensuring that data records are properly managed, secured, and stored
- Maintaining a safety conscious work environment, with radiation safety as the primary focus

The PRSO reports to and receives license compliance direction from the License RSO, advises the PM on radiation protection and radiological operation matters, and coordinates with the PM on day-to-day project activities. The PRSO also communicates and coordinates radiation protection and radiological operation activities with the License RSO, Navy, CDPH and/or NRC, as appropriate.

2.4 Project Manager

The PM is responsible for ensuring the following:

- Work is conducted safely and in compliance with all applicable permits, client contracts, and other applicable controlling documents

- Adequate resources and staffing are available to develop and implement this RPP in compliance with applicable regulations and requirements, and empowered to complete the project safely in all facets, including radiological safety

2.5 Construction Manager/Project Superintendent

The Construction Manager and/or Project Superintendent are responsible for the following:

- Assurance that personnel under their direction comply with radiological requirements, including applicable site-specific procedures, training requirements, RWPs and verbal instructions provided by radiological control personnel
- Provide on-going and timely information to the PRSO about projected work activities
- Immediate notification to the PRSO and PM of any radiological problems or issues encountered
- Assurance that workers have successfully completed required training to perform assigned duties and that necessary tools and equipment are available to minimize the amount of time spent in radiologically posted areas
- Assurance that escorted visitors are supervised while in a radiologically-controlled area and that visitors maintain safe work practices in accordance with the written instructions or as directed by the PRSO or designee

The Project Superintendent reports to the Construction Manager who reports to the PM.

2.6 Radiological Control Supervisor

The Radiological Control Supervisor (RCS) is the CB&I individual assigned to supervise the Radiological Control Technicians (RCTs) and oversee daily radiological operations. The RCS may serve as the PRSO's designee with documented License RSO approval. The RCS is responsible for the following:

- Preparing and implementing RWPs, per requirements of site-specific work instructions
- Supervising the proper use and management of radiation measuring equipment, including the performance of daily operational and QC checks, and verifying out-of-compliance instruments are removed from service
- Directing and supervising the performance of radiological surveys and sampling in accordance with this RPP, survey plans, and CB&I SOPs
- Reviewing survey findings and instrument performance data for accuracy, completeness, and compliance with project, procedural, and regulatory requirements

- Assigning and supervising the performance of radiological surveys and sampling in accordance with this RPP, CB&I SOPs, and site-specific work instructions
- Participating in periodic internal and external reviews of RPP content and implementation and supporting self-assessments and management reviews
- Correcting identified deficiencies, per the corrective action plan or at the direction of the PRSO, in the allotted time frame
- Maintaining communication with the PM, License RSO, and PRSO as needed to fully implement this RPP

The RCS reports to and receives technical direction from the PRSO.

2.7 Radiological Control Technicians

RCTs may be CB&I or subcontract employees. The RCTs are responsible for the following:

- Performing work in compliance with this RPP, SOPs and applicable site-specific work instructions
- Supporting the RCS in the preparation of RWPs, as needed
- Providing radiation safety oversight of employees working in radiologically-controlled areas
- Providing RWP briefings and ensuring all RWP requirements are followed during authorized work activities
- Performing radiological surveys, investigations, sampling, decontamination, and job coverage, per the requirements of the work instructions, and as directed by the RCS and PRSO
- Properly using and maintaining radiation safety instrumentation and equipment
- Posting radiologically-controlled areas and labeling radioactive material per the requirements of the site-specific work instruction
- Ensuring that radioactive material is properly labeled, stored and secured when not in use
- Stopping work when radiological conditions are changing or are unknown
- Keeping the RCS and PRSO informed of site radiological conditions

The RCTs report to and receive technical direction from the RCS and/or PRSO.

2.8 Radiation Workers

Radiation workers (radiologically trained general labor force) performing work in radiologically-controlled areas are expected to:

- Successfully complete required radiation safety training
- Safely perform assigned work activities per the requirements of the applicable RWP or as directed by RCT, RCS or PRSO
- Maintain personal responsibility for individual dose control
- Immediately report lost dosimetry devices to the RCT
- Report medical radiation treatments to direct supervisor and the RCS and/or PRSO prior to returning to work or wearing dosimetry
- Notify the RCT of any potentially unsafe radiological conditions or concerns with personal protective equipment (PPE) or radiation monitoring equipment

Radiation workers report to the Project Superintendent and receive direction from the Project Supervisors for non-radiological requirements and the RCT for radiation safety requirements.

3.0 Radiation Protection Plan Assessment and Audit

To assure compliance and evaluate implementation of this RPP, QC measures including self-assessment and management reviews are employed.

3.1 Self-Assessment, Reviews and Corrective Actions

Periodic self-assessments and management reviews shall include evaluation of exposure rates present during excavation, radiological monitoring data, and efficacy of established radiological work practices, ALARA practices, and use and effectiveness of PPE. Additional management reviews should be performed at four to six week intervals. Results of self-assessments and management reviews shall be reported to and reviewed for concurrence by the License RSO.

A review of the entire radiation protection program content and implementation shall be performed and documented by the License RSO or delegate annually, at a minimum. Project personnel including the PM, PRSO, and on-site personnel shall support and cooperate with any audit.

Deficiencies identified during self-assessment, management review, or an audit must be tracked and corrected. At a minimum, a corrective action plan shall be developed and be approved by the License RSO. Completion of corrective actions must be documented, verified and approved as implemented to close the self-assessment or management review. 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 corrective action(s). Responses to findings must be submitted to the License RSO for review and approval.

Unplanned exposures, internal uptakes, any personnel skin or personal clothing contamination, personnel injuries (with radiological significance), or deficiency or finding resulting from such an event shall be tracked as a radiological occurrence. A corrective action plan shall be prepared for any radiological occurrence by the PRSO and the PM, and submitted to the License RSO and Project QC Manager for review and approval. All radiological occurrences shall be reported to the License RSO and the NRC or CDPH within 24 hours of identification

As required by applicable contract, an informational copy of any CB&I-approved corrective action plan shall be provided to the Navy. All radiological occurrences shall be reported in accordance with Subpart M of Title 10 Code of Federal Regulations (CFR) 20.

3.2 RPP Audit

Information regarding the audit and self-assessment program can be found in CMS-710-07-PR-04002, “Radiation Safety Audit Program.”

4.0 Evaluation of Potential Occupational Exposures

CB&I is committed to maintaining employee exposures ALARA and ensuring that no regulatory or administrative limits are exceeded. The personnel dosimetry program is used to monitor external occupational doses to its employee and subcontractor radiation workers.

4.1 Planned Special Exposures

No planned special exposures are anticipated during this work.

4.2 Likely Annual Dose Evaluation

In accordance with 10 CFR 20, occupationally exposed workers who are likely to be exposed to 10 percent or more of applicable regulatory limits shall be appropriately monitored for exposure to ionizing radiation. For HPNS, all CB&I radiation workers permitted unescorted access to radiologically-controlled areas, or are performing radiological work tasks, regardless of anticipated exposure, shall be monitored for exposure to direct ionizing radiation. Form CMS-710-01-FM-04007, "ALARA Program" (Attachment 2) is used to evaluate likely dose.

4.3 Administrative Dose Limits

In addition to maintaining exposures ALARA, occupational radiation doses shall be administratively controlled in a manner that ensures that no worker receives exposure in excess of any regulatory limits established in 10 CFR 20. To implement that policy, lower administrative limits have been developed. The administrative exposure occupational limit for HPNS is established at 10 percent of 10 CFR 20 limits, equal to 500 millirems (mrem)/year.

4.4 Declared Pregnant Worker

Workers may declare pregnancy in writing in accordance with CMS-710-01-PR-00200, "Embryo/Fetus Protection Program," and 10 CFR 20. Further guidance on this issue may be found in NRC Guide 8.13, *Instruction Concerning Prenatal Radiation Exposure* (NRC, 1999) and NRC Guide 8.29, *Instruction Concerning Risks from Occupational Radiation Exposure* (NRC, 1996).

Due to the anticipated low (less than 120 mrem/year; assuming 12 months of data reported at less than the typical detection limit of 10 mrem) whole body annual dose from work activities at HPNS, it is unlikely that separate or supplemental dose tracking will be required. Managing individual exposures to this level meets the NRC requirement of maintaining a dose equivalent of less than 500 mrem and CB&I's administrative limit of 50 mrem to the embryo/fetus during the term of pregnancy of a declared pregnant worker.

5.0 Controlling Agencies and Licenses

CB&I has been issued RMLs by both the U.S. Nuclear Regulatory Commission and the State of California. The radiation protection program is implemented at HPNS in compliance with a series of license SOPs, procedures, and work instructions. These documents ensure that work activities comply with the license commitments. California Code of Regulations, Title 17, Division 1, Chapter 5, Subchapter 4, are applicable to radiological work performed at the HPNS within State of California jurisdiction. A large portion of 10 CFR 20 is incorporated by reference into California Code of Regulations, Title 17.

U.S. Environmental Protection Agency regulations addressed in 40 CFR may also have applicability at HPNS for a variety of regulatory subjects including Comprehensive Environmental Response, Compensation, and Liability Act of 1980; the Resource Conservation and Recovery Act; and the National Emission Standards for Hazardous Air Pollutants.

More than one company is contracted by the Navy to perform radiological work at HPNS. A memorandum of understanding (MOU) has been approved by License RSO outlining the responsibilities of each contractor as applicable to their respective scopes of work and RML requirements at HPNS.

6.0 Radiation Safety Training Program

All personnel assigned to one or more HPNS projects and performing field activities at HPNS must meet the training requirements of the Site Safety and Health Plan (SSHP). Workers, including subcontract personnel, who may be exposed to occupational radiation shall receive additional training commensurate with the requirements of radiation workers as defined in accordance with CMS-710-07-PR-04005, "Radiation Safety Training," and any project- or site-specific work instructions. Visitors, at a minimum, must receive a site briefing (Section 5.1), complete a "Visitor Access Form" and be escorted by radiological control personnel anytime they are in a radiologically-controlled area.

Additionally, site radiological workers involved with the transportation of radioactive materials shall receive task-specific training as required by U.S. Department of Transportation (DOT) regulations (49 CFR 172, Subpart H).

6.1 Site Briefing—General Employee Radiation Training

The site briefing is presented to site visitors who may access restricted areas with an escort. 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, potential exposure to radiation and radioactive material and other applicable information. Visitors must also complete a visitor access control form or visitor log in accordance with site-specific work instructions. Visitors are prohibited from entering the following areas:

- Contamination Areas
- High Contamination Areas
- Radiation and High Radiation Areas
- Airborne Radioactivity Areas

Contamination Areas are mostly likely to be present in areas under CB&I control. Access to High Contamination Areas, Radiation/High Radiation Areas, and Airborne Radioactivity Areas is unlikely during this project.

6.2 Radiation Worker Training

Site-specific annual radiation worker training is required for all individuals who may access radiologically-controlled areas without escort. Radiation worker training contains the following in addition to the training required by the applicable SSHP:

- Review of CB&I Procedure CMS-710-05-PR-01700, "Work Place Hazard Assessment," for the specific site or task
- Review of the accident prevention plan and SSHP
- Review of this RPP
- Review of the applicable project work plans

Annual radiation worker training is conducted by group briefings, video, and/or printed training material approved by the PRSO. A written examination will be given to each radiation worker. Successful completion of radiation training requires a passing grade of 80 percent or higher on the examination.

Training shall include the following, at a minimum:

- Principles of ionizing radiation
- Function-specific training in accordance with 49 CFR 172 Subpart H
- Health effects from exposure to radioactive material
- Radiation emissions and associated risks of the types of radioactive material that have been found at HPNS
- ALARA work principals and techniques, such as methods used to minimize exposure, purposes, and functions of protective devices
- Purpose and proper use of dosimetry
- Storage, transfer, or use of radioactive material
- Radiologically-controlled area restrictions and postings
- Applicable regulations and licenses for the protection of personnel from exposure to radioactive material
- Recognition of site-specific radioactive material and/or radiation producing devices (e.g., soil, foils, buttons, beads, gauges, fragments, items, LLROs)
- Who to contact if radioactive material is found in an area where it is not anticipated

- Who to contact and expected actions in the event of an emergency, breakage, or spill of radioactive material

6.3 Radiological Control Technician Training Qualification

The PRSO shall evaluate and qualify RCTs for assignment to this project. RCT qualifications are evaluated in accordance with the requirements contained in CMS-710-07-PR-04015, "Radiation Safety Staff Credentials," and any project- or site-specific work instructions. Project-specific training and evaluation is provided to RCTs commensurate to their assigned duties.

7.0 Evaluation of Public Dose

All licensed operations shall be conducted so that the dose limits to individual members of the public are not exceeded, in accordance with Section 1301 of 10 CFR 20.

The PRSO shall ensure that licensed material is used, transported, stored, and disposed of in such a manner that members of the public does not receive more than 100 mrem total effective dose equivalent in one year. The PRSO shall also ensure that Controlled Area boundaries are established such that if an individual were present in an unrestricted area, the dose from external sources would not exceed 2 mrem in any 1 hour and 100 mrem in a year excluding background; routine surveys shall be performed to verify this. Public dose excludes doses received from background radiation and from medical procedures. Public dose from external and internal (air effluent) exposure sources is evaluated in accordance with the requirements contained in CMS-710-07-PR-04006, "Evaluation of Public Dose," and 10 CFR 20.1302.

As noted previously, CB&I may perform air sampling at work areas where remediation and materials handling may disturb radioactive contamination. Air sampling requirements shall be evaluated and stipulated in the applicable RWP.

The PRSO shall determine if passive area monitoring dosimetry should be posted at the Controlled Area boundaries of work sites. In general, passive environmental monitoring will be employed when the project duration is greater than 90 days. The environmental dosimetry results shall be periodically reviewed by the PRSO to validate conformance to public dose expectations and reported to the License RSO.

A dose assessment for members of the public shall be conducted and documented on an annual basis. The assessment shall incorporate results of all radiological surveys and any available and applicable air monitoring data. Passive environmental dosimeter readings will be used to confirm public dose. The annual public dose assessment demonstrates compliance with regulatory limits and documents actions taken to maintain the dose to the public ALARA.

8.0 As Low as Reasonably Achievable Program

Elements of a successful ALARA program include:

- Management commitment, engineering, and administrative control levels for control of radiation exposure to workers and members of the public
- ALARA goals/radiological performance goals
- ALARA job/experiment planning review
- Records of ALARA program elements

The concept of optimizing protection lends itself to a program with formal elements, plans, and measures that, when implemented, serves to reduce radiation exposures as far below regulatory dose limits as is reasonably achievable. CB&I is committed to conducting operations in a manner that protects the safety and health of workers and the public, minimizes damage or loss to property, and protects the environment. CB&I is further committed to ensuring that potential safety and health risks, such as exposure to ionizing radiation, are reduced to and maintained ALARA.

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 program. Development of the RWP and associated controlled shall be performed by personnel who are experienced and knowledgeable in health physics principles, practices, and procedures and who fully understand the scope of work and operations that require handling radioactive material or waste and how these operations affect the potential exposures of personnel to radiation.

Assessment of radiological work practices and conditions is necessary to evaluate the efficiency of ALARA actions. At a minimum, radiation surveys to assess radiological conditions in work areas and at publically accessible boundaries (Controlled Areas) shall be performed monthly and when changing conditions are identified.

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 advanced planning. Daily pre-job meetings shall include a review of activities planned and associated hazards and the RWP authorizing work. The RWP specifies the applicable radiological controls, radiological postings, survey requirements, and control limits and any necessary hold points, per requirements of applicable site-specific work instruction. All work in radiologically-controlled areas must be performed per the requirements of the applicable RWP.

9.0 Control of Radiological Work

All radiological work activities shall be planned in consultation with the PRSO, PM, and other project personnel. Work instructions providing specific direction for the performance of routine radiological work activities (e.g., radiological surveys, monitoring airborne radioactivity) shall be prepared as necessary. The PRSO shall review, control, and issue approved work instructions for use. All radiological control staff shall be trained to applicable work instructions prior to performing work.

All work in radiologically-controlled areas requires a RWP. 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.

9.1 Radiological Work Permits

All personnel who are required to enter radiologically-controlled areas shall do so only in compliance with an approved RWP.

The RWP is typically initiated by an RCS or designee. RWPs are reviewed and approved by the PRSO or designee. Radiation workers performing work under a job-specific RWP receive an initial briefing on the RWP requirements and limitations prior to performing any covered work. The workers and RCTs will sign the RWP acknowledging that they have been briefed and have read, understand and will comply with the RWP requirements. Standing RWPs are used for lower hazard work activities and must also be reviewed, read, understood and signed by the workers and RCTs. Daily pre-job briefings are not required for standing RWPs. An RWP shall contain a description of the scope of the task and descriptions of the hazardous conditions in the work area, the dosimetry and PPE requirements, work steps, required surveys, and special precautions. Additional details for writing and approval of an RWP are provided in the applicable project implementing instruction.

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 radiological work area.

Authorization for the job-specific RWP shall be limited to a specific time period. This time period may be anywhere from one day up to a maximum of one year from the time of issue and an RWP shall be automatically terminated at the end of that time period. Specific site or area radiological conditions and scope of work are considered when determining the length of

authorization. Standing RWPs may be authorized for a period of up to one year. The PRSO or designee may also terminate the RWP at any time.

9.2 Task-Specific Work Instructions

Non-routine activities and activities that have greater potential for personnel exposure or the spread of contamination may require the preparation of task-specific work instructions. These work instructions provide the detailed steps for executing the required work. Task-specific work instructions are required for work activities not specifically addressed in this RPP, and for other tasks as determined by the PM, License RSO, PRSO, or the Construction Manager. The PM, PRSO, or designee shall finalize, control, and issue task-specific work instructions for Navy and regulatory review as required.

10.0 External Exposure Control and Monitoring

External exposure controls and monitoring shall be performed in accordance with CMS-710-07-PR-04009, "External Exposure Control and Monitoring."

10.1 External Exposure Control

External exposures will be maintained ALARA (Section 8) using the concepts of time, distance, and shielding to control external exposure and minimize dose.

10.2 Monitoring and Measuring External Exposure

The device or method for external monitoring has been selected to ensure that the emissions from the ROCs and potential ROCs at HPNS will be appropriately detected. At HPNS, external monitoring of each qualified radiation worker is accomplished using a thermoluminescent dosimeter. As required by the RWP, some radiation workers may be required to wear extremity thermoluminescent dosimeter (finger rings). Dosimetry will be selected, utilized, and positioned so that effects on ambient dose rates can be identified. Supplemental monitoring, such as self-reading dosimeters, may also be required for a particular work-task. This additional monitoring will be specified in the applicable RWP.

11.0 Internal Exposure Control and Monitoring

Internal exposure controls and monitoring shall be performed in accordance with CMS-710-07-PR-04010, "Internal Exposure Control and Monitoring."

11.1 Internal Exposure Control

Internal exposures of radioactive materials will be controlled during construction activities by use of dust control and standard exclusion zone practices (e.g., no eating, drinking, smoking, etc., within exclusion zones). Internal radiological exposure hazards are not anticipated for work areas where dust controls are applied.

11.2 Monitoring and Measuring Internal Exposure

For purposes of assessing occupational dose used to determine compliance with Section 1502 of 10 CFR 20, determination of internal exposure shall comply with the requirements of Section 1204 (a) through (g) of 10 CFR 20.

Although not anticipated for the scope of work covered by this RPP, if radiation workers are required to participate in an internal exposure monitoring program they will be required to submit initial bioassay samples prior to initial performance of work in radiologically- controlled areas at the site. Personnel whose estimated intake may exceed 40 derived air concentration-hours shall be monitored for intake by bioassay. The PRSO may also request a bioassay any time as necessary for internal dose assessment.

Based upon an evaluation of work activities and surface and soil contamination levels, the PRSO shall determine the need for air sampling. Whenever air sampling is required, the sampling data shall be routinely reviewed by the PRSO, or designee, to determine if RWP control limits are adequate. If airborne radioactivity levels reach or exceed RWP control limits, the work is promptly stopped and properly reviewed for additional controls per requirements of site-specific work instructions.

12.0 Surveys and Monitoring

Specific radiological survey and monitoring requirements at HPNS will be established in project-specific work plans, task-specific plans, or work instructions. At a minimum, survey frequency and type will follow CMS-710-07-WI-40111, "Performing and Documenting Radiation and Contamination Surveys."

12.1 Radiological Surveys of Equipment and Materials

Equipment and material released from areas controlled for radiological purposes shall be surveyed following the methods defined in CMS-710-07-WI-40111, "Performing and Documenting Radiation and Contamination Surveys." Table 4 provides the criteria for the unconditional release of materials and equipment. In the event that survey results indicate that levels of contamination exceed the limits listed in Table 4, appropriate decontamination methods may be performed to minimize radioactive waste. If decontamination methods are unsuccessful, the material shall be disposed of as low-level radioactive waste.

12.2 Action Levels

Action levels are specific levels of radioactivity used to determine when additional response (e.g., PPE upgrades or changed work techniques) and/or investigation may be necessary. Action levels for radiological controls are listed in Table 5.

When an action level is exceeded, the measurement shall be confirmed to ensure that the initial measurement/sample actually exceeds the particular action level. This may 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.

13.0 Contamination Control

Site controls and contamination control practices are established to preclude the spread of contamination into uncontrolled areas. A Contamination Area shall be established and posted as defined in Section 15.

13.1 Entry

Any entry into a posted Contamination Area requires that the work be performed per 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.

13.2 Exit

Personnel shall exit a Contamination Area at the designated Access Control 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 Control Point.

13.3 Limitations on Entry

Personnel with unprotected open wounds or sores shall not enter any Contamination Area. If appropriate bandaging is verified, planned work activities are unlikely to compromise the bandaging, and there is no other medical reason to restrict entry, than an exception may be authorized by the PRSO.

Personal clothing beyond what is necessary for modesty should not be worn into Contamination Areas. Jewelry 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 nonessential materials and items shall be removed, collected, and properly secured prior to entry.

13.4 Control of Items

Equipment, tools, and other items removed from a Contamination Area must meet unconditional release criteria (Table 7) or be managed as radioactive material. 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, marked 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 Materials Area controlled by the PRSO.

13.5 Control of High Contamination Areas

Although unlikely, entry into High Contamination Areas will have additional requirements as specified in the RWP, such as extra layers of PPE, face shield, special engineering controls and/or procedures, double step-off-pad for removal of outer layer(s) of PPE, and continuous RCT monitoring.

14.0 Instrumentation

CB&I shall provide all of the radiation detection and monitoring equipment for use during HPNS projects, except where designated by the PRSO. Project instrumentation has been selected based on its ability to detect the ROC(s) at the appropriate levels. Details regarding the calibration, operation, and QC requirements for the use of radiation detection and monitoring equipment are in CB&I procedure SPL-SOP-8.10.2, *Radiation Monitoring Instrumentation*, and project- or site-specific work instructions. Survey instruments are calibrated by the manufacturer in accordance with the manufacturers' instructions at least annually and after repairs. Replacement of batteries, equivalent cords, and equivalent Mylar windows do not require recalibration unless the instrument fails a response check. Instruments are removed from service on or before the date calibration expires and sent for recalibration. A list of typical instruments is provided in Table 8.

15.0 Radiological Areas and Posting

Boundaries are established to identify and control access to work areas, prevent (to the extent practical) unauthorized access. Additionally, it is meant to protect members of the public from exposure to radiation or radioactive materials as a result of site activities. The required postings and definitions in the following sections and summarized in Table 6. Additional details, including area de-posting and item labeling, are provided in CMS-710-07-PR-04014, "Radiological Labeling, Postings, and Access Control," and in project-specific work plans.

16.0 Radiation Safety Staff Credentials

The PRSO shall assess and document the training and qualifications of the RCS and RCTs in accordance with CMS-710-07-PR-04015, "Radiation Safety Staff Credentials," and any site-specific work instructions. The License RSO is responsible for identifying and verifying the qualifications of the PRSO and Alternate PRSO and conducting required license-specific training with the PRSO and with any other authorized users.

An American Board of Health Physics Certified Health Physicist in CB&I's Radiological Safety organization is available to support the project.

17.0 Procurement, Receipt and Inventory

Receipt of radioactive materials shipments, except exempt-quantity radioactive check sources and the return of samples from an off-site laboratory, are not anticipated for HPNS projects. Sources and radioactive material samples are controlled, stored, posted, and managed as radioactive material. Specific instructions for these activities are provided in CB&I Procedure CMS-710-07-PR-04016, "Procurement, Receipt, Transfer and Accountability of Radioactive Material."

A source storage location at the on-site instrument laboratory consists of a lockable storage cabinet that can be secured inside a lockable room. The PRSO or authorized designee shall control the keys or combination to the storage cabinet. When sources are present in the storage cabinet, it is posted as radioactive materials.

An area for the storage and operational checks of radiological monitoring and survey instruments is established in the on-site laboratory 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 and sources shall be returned to the storage cabinet immediately after any use.

Only project personnel trained in the requirements for use and handling of radioactive sources and authorized in writing by the PRSO 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 CB&I Radiological Equipment Group or a vendor approved by the CB&I Quality Services 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
- Manufacturer's name and address

17.1 Leak Testing

If required, 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. The smear counting instrument shall be able to detect less than 0.005 millicuries of activity. Results of the leak test shall be documented as a contamination survey per the requirements of the applicable site-specific work instruction.

Any leak test result with detectable activity above twice the area/instrument background shall immediately be reported to the PRSO 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 shall be returned to the provider in accordance with their procedures and applicable state and federal transportation regulations.

17.2 Transport of Sources

Radioactive check sources shall be employed only for the period of time necessary to execute planned work, shall not be brought to a project location prior to project initiation, and shall be returned to the provider immediately following the completion of planned field activities.

Radioactive check sources shall be transported in a CB&I vehicle by an authorized CB&I employee trained in the task-specific functions of (49 CFR 172 Subpart H), and packaged and labeled in accordance with DOT regulations (49 CFR 172, Subpart H). Radioactive check sources shall be shipped in accordance with DOT regulations.

17.3 Reporting Lost, Damaged, or Stolen Sources

If a source is lost, damaged, or stolen, the event shall be reported immediately to the PRSO by the discovering individual. The PRSO shall immediately notify the License RSO, who notifies the PM, the Navy, and other project staff, and initiate appropriate actions to control site access and recover a missing or damaged source. If a source is missing, a search by radiological control personnel shall be initiated. In consultation with the Navy, a report shall be filed with the appropriate law enforcement agency if it is determined that radioactive material was stolen. The License RSO shall make any necessary notifications to NRC or CDPH.

18.0 Shipping and Transportation of Radioactive Material

A third-party low-level radioactive waste broker is contracted to the Navy through U.S. Army Joint Munitions Command to provide brokerage services including waste characterization sampling, waste containers, and transportation of radioactive materials/waste generated from this project. A MOU identifying the protocols for the transfer of radioactive material or radioactive waste from CB&I to the waste broker shall be executed prior to the initial transfer and shall remain in force for the duration of HPNS projects. The MOU shall be modified as necessary in response to changed conditions.

Environmental samples shipped for off-site analysis and exempt-quantity radioactive check sources are packaged and shipped in accordance with DOT regulations (49 CFR 172, Subpart H) via commercial carriers.

Transport of DOT-regulated radioactive material between HPNS radiologically restricted areas by CB&I shall be done in accordance with the following:

- DOT regulations (49 CFR 172, Subpart H)
- CMS-710-07-WI-40111, "Performing and Documenting Radiation and Contamination Surveys"

All employees and subcontractors involved in shipment or transportation of radioactive materials shall have current task-specific training in accordance with the requirements of Subpart H of 49 CFR 172.

19.0 Control of Radioactive Waste

Radioactive waste shall be minimized by compliance with contamination control practices (Section 13) combined with segregation and survey practices. A third-party low-level radioactive waste broker is contracted to the Navy through the U.S. Army Joint Munitions Command to provide brokerage services including providing waste containers and transportation of radioactive materials/waste generated from HPNS projects. Contaminated soil and used PPE are placed in bins, and the filled bins are transferred to the custody and controls of the waste broker. Discrete objects or sources are stored in a locked area posted as radioactive materials (additional postings may also be necessary), controlled by the PRSO, and will be packaged and transferred to the authorized shipper for disposal after completion of the project or sooner to reduce the activity to ensure ALARA exposure to workers and members of the public. Radioactive material shall be packaged, stored, shipped, and disposed as required by DOT regulations (49 CFR 172, Subpart H).

Work practices shall be instituted to minimize the generation of liquid waste (waste water) during work activities. Excavations and sampling locations may fill with water during rainstorms. Water may also infiltrate open excavations in areas under influence of tides. If dewatering is required, a task-specific work instruction shall be prepared and approved by the Navy to facilitate the process. Excavated saturated soil shall be transported to a laydown pad to facilitate drying of the soil and any contained water by evaporation. Details about the location and construction of laydown pads may be found in the applicable work plan. Steps shall be taken to minimize the impact of equipment and materials 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 originating from a radiological work area, if any, shall be handled as radioactive waste, collected in DOT-approved containers, labeled accordingly, radiologically characterized, sampled for release, and transferred to a licensed broker, processor, or waste disposal facility for final disposition.

20.0 Radiation Protection Records

The PRSO 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 dosimetry records for personnel are reviewed for positive results. Project personnel exposure records are transmitted to the CB&I Radiation Safety Records in Concord, California. . 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 listed in Table 2 and any project, or site-specific work instructions.

Records relating to radiological characterization, radiation and contamination control (e.g., instrumentation, surveys, logs, and RWPs), training, personnel dose, waste characterization, unconditional 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 CB&I as part of the official project record. All records are maintained for durations specified by contractual, CB&I, license, and regulatory requirements.

21.0 Review and Approval of Radiation Protection Plans

The PRSO or designee prepares this RPP, which is reviewed and approved in accordance with CB&I CMS-710-07-PR-04000, “”Radiation Safety Program.” In addition, the Navy shall have an opportunity to review, provide input, and indicate acceptance of this RPP. Significant (safety-related) changes to this RPP shall be reviewed and accepted following the same process.

22.0 References

California Code of Regulations, 2010, Title 17, Division 1, Chapter 5, Subchapter 4, Radiation, http://www.cdph.ca.gov/programs/Pages/RHB-Regulations.aspx, November 12.

CB&I, 2015, *CB&I Management System*.

Code of Federal Regulations (CFR), Title 10, Part 20, *Standards for Protection Against Radiation*, U.S. Nuclear Regulatory Agency, U.S. Government Printing Office, June 11, 2010, Washington, D.C., <http://www.gpoaccess.gov/cfr/index.html> (August 2011).

CFR, Title 40, *Protection of Environment*, U.S. Government Printing Office, Washington, D.C., October 13, 2010, < http://www.access.gpo.gov/nara/cfr/waisidx_10/40cfrv1_10.html> (August 2011).

CFR, Title 49, Part 172, *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans*, Subpart H, Training, U.S. Department of Transportation, U.S. Government Printing Office, Washington, D.C., March 11, 2011, <http://www.gpoaccess.gov/cfr/index.html> (August 2011).

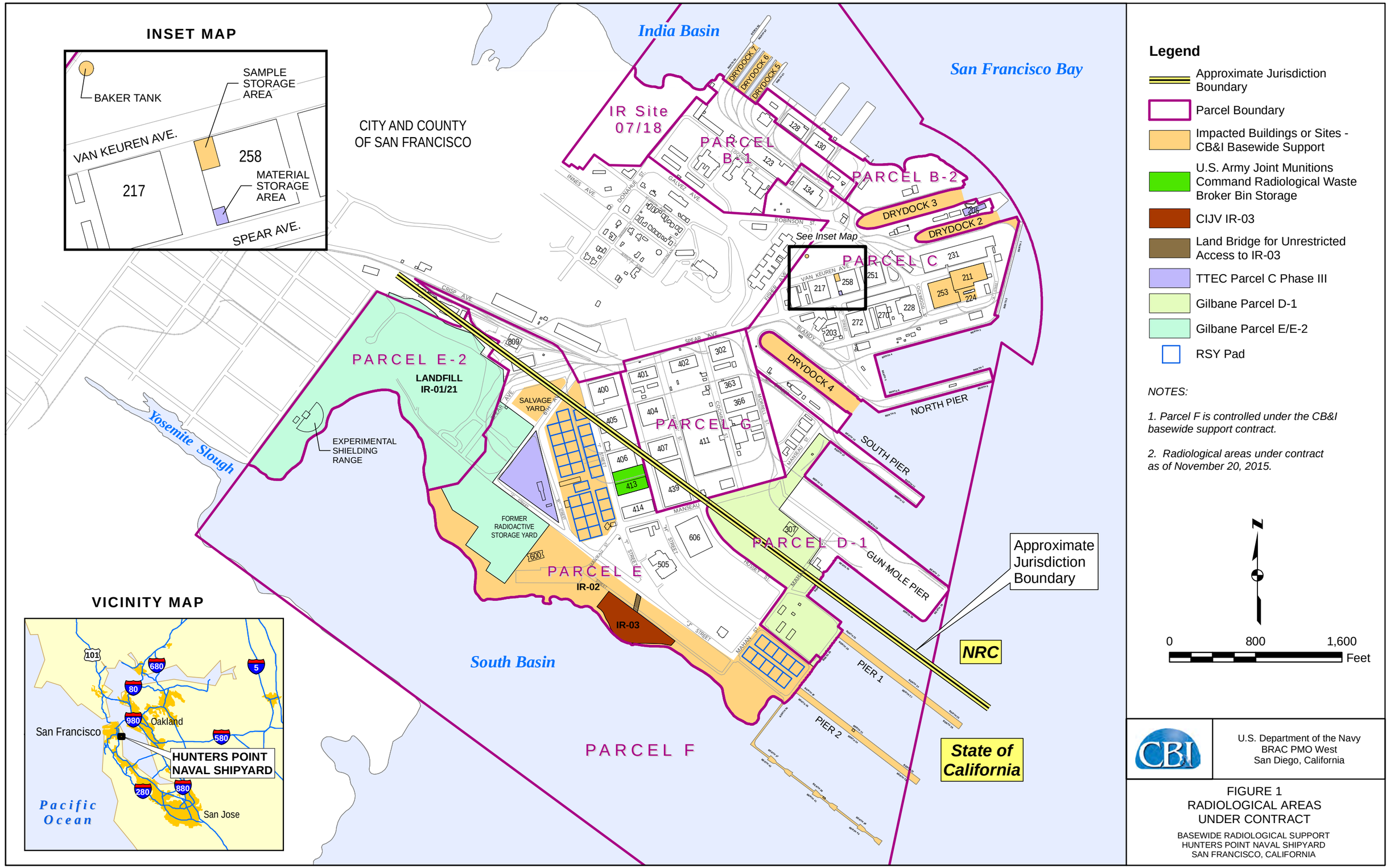
Navy, 2004, *Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard*.

U.S. Department of Energy, 1997, *The Procedures Manual of the Environmental Measurements Laboratory*, HASL.300, New York, New York.

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.

Figure



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Tables

Table 1
Agency Contact Information

Contact	Address and Phone Number
U.S. Environmental Protection Agency, Region 9 Attention: Melinda M. Garvey	75 Hawthorne Street, SFD-8-3 San Francisco, California 94105-3901 Phone: 415.947.4184 Fax: 415.947.3520
California Department of Public Health Radiologic Health Branch Attention: Eugene Forrer	850 Marina Bay Parkway, Building P, 1st Floor Richmond, California 94804 Phone: 510.620.3416
California Department of Public Health California Environmental Management Branch Attention: Sheetal Singh	PO Box 997413 Mail Station 7405 Sacramento, California 95899-7413 Phone: 916.449.5675
Department of Health Services California Department of Toxic Substances Control Attention: Remedios (Medi) Sunga	700 Heinz Avenue, Suite 200 Berkeley, California 94710 Phone: 510.540.3840 Fax: 510.540.3819
U.S. Department of the Navy BRAC PMO West Remediation Project Manager Attention: Leslie Howard	33000 Nixie Way, Bldg 50 San Diego, California 92147 Phone: 619.524.5903
U.S. Department of the Navy ROICC San Francisco Bay Area Attention: Shirley Ng	2450 Saratoga Street, Suite 200 Alameda, California 94501-7545 Phone: 510.521.8713 Fax: 510.749.5949
Naval Sea Systems Command Detachment Radiological Affairs Support Office Attention: Matthew Slack	160 Main Road, Building 1959 Yorktown, Virginia 23691 Phone: 757.887.4212 Fax: 757.887.3235

Notes:

BRAC PMO West *Base Realignment and Closure Program Management Office West*

ROICC *Resident Officer in Charge of Construction Notes:*

Table 2
CB&I Federal Services LLC License Standard Operating Procedures, Procedures, and Work Instructions

License Standard Operating Procedure Number	License Procedure Title
SPL-SOP-8.10	Radiation Protection Program
SPL-SOP-8.10.2	Radiation Monitoring Instrumentation
SPL-SOP-8.10.6	Safe Handling of Radioactive Materials and Emergency Procedures
CMS-710-07-PR-04005	Radiation Safety Training
CMS-710-07-PR-04013	Radiation Monitoring Instrumentation
CMS-710-07-PR-04015	Radiation Safety Staff Credentials
Procedure Number	**Procedure Title**
CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-PR-04001	Radiation Safety Committee
CMS-710-07-PR-04002	Radiation Safety Audit Program
CMS-710-07-PR-04003	Evaluation of Potential Occupational Exposures
CMS-710-07-PR-04004	Radiation Safety Controlling Agencies and Licenses
CMS-710-07-PR-04005	Radiation Safety Training
CMS-710-07-PR-04006	Evaluation of Public Dose
CMS-710-07-PR-04007	ALARA Program
CMS-710-07-PR-04008	Control of Radiological Work
CMS-710-07-PR-04009	External Exposure Control and Monitoring
CMS-710-07-PR-04010	Internal Exposure Control and Monitoring
CMS-710-07-PR-04011	Radiological Surveys and Monitoring
CMS-710-07-PR-04012	Contamination Control
CMS-710-07-PR-04013	Radiation Detection Instrumentation
CMS-710-07-PR-04014	Radiological Labeling, Postings and Access Control
CMS-710-07-PR-04015	Radiation Safety Staff Credentials
CMS-710-07-PR-04016	Procurement, Receipt, Transfer, Inventory of Radioactive Sources
Work Instruction Number	**Work Instruction Title**
CMS-710-07-WI-04000	Self-Assessment of the Radiation Protection Plan
CMS-710-07-WI-04008	Radiological Work Permits (RWPs)
CMS-710-07-WI-04009	Proper Handling of Dosimetry Data
CMS-710-07-WI-40111	Performing and Documenting Radiation and Contamination Surveys
CMS-710-07-WI-40112	Gamma Walkover Surveys Using a Global Positioning System
CMS-710-07-WI-40113	Sample Collection for Radiological Analysis
CMS-710-07-WI-40114	Performance of Gamma Surveys Using RSI RS-700 System
CMS-710-07-WI-40115	Screening of Trucks Using Stationary Portal Monitor and Portable Survey Instrumentation

Notes:

License standard operating procedures are applicable to both NRC License 20-31340-01 and State of California RML 7889-07

Table 3
CB&I Federal Services LLC Key Personnel Responsible for Radiation Protection

Individual	Project Role	Phone Number	Email
Ray Schul	Radiological Operations Manager/ Project Radiation Safety Officer	518.496.5533	Ray.Schul@cbifederalservices.com
John Hackett	Project Manager	303.486.2512	john.hackett@cbifederalservices.com
Mark Somerville	License Radiation Safety Officer	925.222.0848	Mark.Somerville@cbifederalservices.com
Takeshi Ibuki	Alternate Project Radiation Safety Officer	415.398.6547 X235	takeshi.ibuki@cbifederalservices.com
Minh Chi	Alternate Project Radiation Safety Officer	415.741.8299	minhsec.chi@cbifederalservices.com

Table 4
Material and Equipment Free Release Criteria and Thresholds for Use of Administrative or Engineering Controls

Measured Parameter/ Threshold	Alpha[1] Removable Contamination (dpm/100 cm^2)	Alpha[1] (Fixed + Removable) Contamination (dpm/100 cm^2)	Beta/Gamma[1] Removable Contamination (dpm/100 cm^2)	Beta/Gamma[1] (Fixed + Removable) Contamination (dpm/100 cm^2)
Free Release[2]	<20	<100	<1,000	<5,000
Administrative Controls Required[3]	≥20	≥100	≥1,000	≥5,000
Engineering Controls Required[4]	≥2,000	≥10,000	≥20,000	≥100,000

Notes:

[1] Not applicable to volumetric contamination.

[2] Material found to exceed the free release criteria shall be segregated from material that does not exceed the free release criteria. Contamination Area boundary.

[3] Minimum administrative controls include establishment of physical boundaries, postings, controls for access and egress, Radiological Work Permits, and the use of personal protective equipment.

[4]Engineering controls supplement administrative controls, are specified in the applicable Radiological Work Permit, and though not required, will be applied at lower values.

<	*less than*
≥	*greater than or equal to*
dpm/100 cm^2	*disintegration per minute per 100 square centimeter*

Table 5
Action Levels

Type	Action Level
Action level for requiring individual monitoring	Greater than 100 mrem Total Effective Dose Equivalent annual expected dose (Requires thermo luminescent dosimeter monitoring by license conditions. Site-specific requirement that all radiation workers must wear external dosimetry.
Action level for requiring decontamination, labeling or storage/disposal as radioactive materials in properly posted radiological area	Greater than Table 4 free release criteria.
Action level for RCT assistance, notification of the PRSO, License RSO, PM, and the Navy, and decontamination of personnel	Readings above background levels on personnel.
Action level for notification of License RSO PM, and the Navy, and suspending work in the area until otherwise directed (if an RWP approved by PRSO is not in place)	Exposure rates > 500 microroentgen per hour Occupational airborne radioactivity > 10 percent of ^{226}Ra DAC (3E-11 µCi/mL) Site boundary airborne radioactivity > ^{226}Ra AE value (9E-13 µCi/mL) Removable surface contamination > 2,000 dpm/100 cm2 alpha Removable surface contamination > 20,000 dpm/100 cm2 beta Soil activity concentration exceeds 200 pCi/g ^{226}Ra

Notes:

>	*greater than*
µCi/mL	*microcurie per milliliter*
^{226}Ra	*radium-226*
AE	*air effluent concentration (10 CFR 20, Appendix B)*
DAC	*derived air concentration (10 CFR 20, Appendix B)*
dpm/100 cm^2	*disintegration per minute per 100 square centimeter*
Navy	*U.S. Department of the Navy*
pCi/g	*picocurie per gram*
PM	*Project Manager*
PRSO	*Project Radiation Safety Officer*
RCT	*Radiological Control Technician*
RSO	*Radiation Safety Officer*
RWP	*Radiological Work Permit*

Table 6
Radiological Area Posting

Area	Definition	Required Posting
Controlled Area	An area, outside of a Restricted Area, but inside the site boundary, access to which can be limited by the licensee for any reason.	CONTROLLED AREA
Restricted Area	An area to which access is limited for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials and to prevent the inadvertent release of radioactive material to the unrestricted areas.	RESTRICTED AREA
Radioactive Materials	An area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in 10 Code of Federal Regulations 20 Appendix C.	CAUTION, RADIOACTIVE MATERIALS
Radiation Area	Radiation levels could result in an individual receiving a dose equivalent of ≥ 5 mrem but < 100 mrem in one hour at 30 cm.	CAUTION, RADIATION AREA
High Radiation Area	Radiation levels could result in an individual receiving a dose equivalent of ≥ 100 mrem in one hour at 30 cm.	CAUTION, HIGH RADIATION AREA
Contamination Area	Any area accessible to individuals, where surface contamination levels exceed or are likely to exceed the surface contamination values specified in Table 7 (Reg. Guide 1.86), but do not exceed 100 times those values.	CAUTION, CONTAMINATION AREA
High Contamination Area	An area, accessible to individuals, in which surface contamination levels on equipment or solid surface materials are equal to or exceed 100 times the values provided in Table 7 (Regulatory Guide 1.86, Table 1).	CAUTION, HIGH CONTAMINATION AREA
Airborne Radioactivity Area	An area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations: (1) In excess of the derived air concentrations (DACs) specified in Appendix B, to Sections 20.1001-20.2401. (2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake or 12 DAC-hours. Airborne radioactivity levels ≥ 10 percent radium-226 DAC (3.0E-11 µCi/mL)	CAUTION, AIRBORNE RADIOACTIVITY AREA

Notes:

[1] Radiological Work Permit (RWP) sign-in, equipment/materials survey, and personnel frisk not required in areas where radioactive check sources are stored or used.

U.S. Nuclear Regulatory Guide 1.86, Table 1

≥	*greater than or equal to*
<	*less than*
µCi/mL	*microcurie per milliliter*
cm	*centimeter*
DAC	*derived air concentration*
dpm/100 cm²	*disintegration per minute per 100 square centimeter*
mrem	*millirem*
pCi/g	*picocurie per gram*

Table 7
Regulatory Guide 1.86 (Table 1)
(U.S. Atomic Energy Commission, 1974)

Radionuclide[a]	Disintegrations/minute/100-square-centimeters (dpm/100 cm^2)		
	Average[b c f]	Maximum[b d f]	Removable[b e]
U-nat, ^{235}U, ^{238}U & associated decay products	5,000 (α)	15,000 (α)	1,000 (α)
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100	200	20
Th-nat, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000	3,000	200
β-γ emitters (nuclides with decay modes other than α-emissions of SF) except ^{90}Sr and others noted above.	5,000 (β-γ)	15,000 (β-γ)	1,000 (β-γ)

Notes:

U.S. Atomic Energy Commission, 1974, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, Washington D.C.

[a]Where surface contamination by both α- and β-γ-emitting nuclides exists, the limits established for α- and β-γ-emitting nuclides should apply independently. [The values apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item.]

[b]As used in this table, dpm means the rate of emission by radioactive material as determined by correcting the counts per minute observed by the appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contamination should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent material, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. [The use of dry material may not be appropriate for tritium.] When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire area should be wiped. [Except for transuranics and ^{226}Ra, ^{227}Ac, ^{230}Th, ^{228}Th, ^{231}Pa, and α-emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination (i.e., removable and fixed) are within the limits for removable contamination.]

[[f]The average and maximum radiation levels associated with surface contamination resulting from β-γ-emitting nuclides should not exceed 0.2 mrad/hr @ 1 cm and 1.0 mrad/hr @ 1 cm, respectively, measured through 7 milligrams per square centimeter (mg/cm^2) of total absorber.]

Note: Comments in brackets [ ] have been added by CB&I.

Table 8
Instrumentation for Radiological Surveys

Measurement/ Technique for Emission	Primary Use	Type of Instrumentation	
		Detector Type, Make, and Model Number	Meter Description, Make, and Model Number
Static/Scan Alpha/Beta Static/Scan Alpha/Beta	Equipment, material, debris, and personnel	Gas-flow proportional Ludlum Model 43-68 (126 cm^2) Alpha/beta scintillation Ludlum Model 43-93 (100 cm^2)	Alpha/beta dual channel Ludlum Model 2360
Static/Scan Gamma	Surface soil	Gamma scintillation Ludlum Model 44-10, 2-inch by 2-inch NaI	Scaler/ratemeter data logger Ludlum Model 2221
Static/Scan Gamma	Surface soil	Gamma scintillation Ludlum Model 44-20, 3-inch by 3-inch NaI	Scaler/ratemeter data logger Ludlum Model 2350
Static/Scan Gamma	Surface soil	Gamma scintillation –RSX-1 256 cubic inch NaI detectors	RSI RS-700 multi-channel analyzer
Exposure Rates Gamma	Contact and general area dose rates (µR/hr)	Gamma scintillation 1-inch by 1-inch NaI	MicroR meter Ludlum Model 19
Exposure Rates Gamma	Contact and general area exposure rates mR/h, µR/h	Ion chamber	Ludlum Model 9
Sample Counting/ Alpha/Beta	Smears and air filters	Alpha/beta scintillation	Sample Counter Ludlum Model 3030

Notes:

µR/hr	*microroentgen per hour*
cm^2	*square centimeters*
mR/h	*milliroentgen per hour*
NaI	*sodium iodide*

Attachment 1
Radiation Protection Plan Acknowledgement Form

Radiation Protection Plan Acknowledgement Form

I have reviewed, understand, and agree to follow the Radiation Protection Plan for the _____ project. Additionally, I understand that there are additional non-radiological health and safety requirements, which are presented in the Site Health and Safety 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

Attachment 2
Likely Annual Radiation Dose Evaluation Form

Likely Annual Radiation Dose Evaluation Form

1. Project/Facility:	
2. Address:	
3. Date of Evaluation:	
4. Individual/Group:	

5. Describe Method Used to Evaluate Likely External Dose:

6. Describe Method Used to Evaluate Likely Internal Dose:

7. Based upon the methods described above the annual external radiation dose to this individual/group is unlikely to exceed:

_____ **mrem DDE**, _____ **mrem LDE**, and _____ **mrem SDE.**

8. Based upon the methods described above the annual internal radiation dose to this individual/group is unlikely to exceed:

_____ **mrem CEDE** and _____ **mrem CDE** to _____
(Organ or Tissue)

Evaluation performed by: _____
(Print Name)

Signature: _____

Attachment 3
License Standard Operating Procedures

PROCEDURE

Procedure Title:	Radiation Safety Training	CMS Number:	CMS-710-07-PR-04005
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

RADIATION SAFETY TRAINING

Rev	Changes	Approved	Date
2	CMS-710-01-GL-04005, revised to align with radiation safety documents, responsibilities, titles and format. Added reference to HSE Training Attendance Sheet (CMS-710-05-FM-01905).	MOS	03 Nov 2014
1	Issued for Use – Corrected Issuing Authority initials in revision block for R/0. No change to content	ARM	03 Dec 2013
0	Issued for Use	PO	27 Nov 2013

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1.0 PURPOSE

The purpose of this procedure is to provide the radiation safety training requirements and details to be included in each site-specific Radiation Protection Plan (RPP). This procedure is to be used to determine radiation safety training requirements when developing RPPs to support CB&I projects involving the potential for occupational exposure to sources of ionizing radiation.

2.0 SCOPE

This procedure addresses radiation safety training for work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation that are governed by federal or state regulations.

3.0 RESPONSIBILITIES

The following people have responsibilities defined in this procedure.

- Director, Radiation Safety (DRS)
- Project or Program Radiation Safety Officer (PRSO)

4.0 PROCEDURE

All RPPs shall include procedures for the training of personnel. The level of training for different groups shall be commensurate with the level of exposure anticipated and shall be compliant with applicable regulations, requirements, and commitments. Outlines of topics to be covered shall be developed and qualified trainers shall be identified. A system of documenting training and, as applicable, examination results shall be established and maintained. Periodic retraining shall be established. Groups for whom training programs should be established include general employees, radiation workers, radiation controls technicians, and visitors.

4.1 Responsibilities

4.1.1 Director, Radiation Safety (DRS)

- Responsible for approving qualified radiation safety trainers.
- Responsible for review and approval of the radiation safety training standards required for project personnel, and for ensuring that all training is conducted in accordance with those specified standards.

4.1.2 Project or Program Radiation Safety Officer (PRSO)

- Establish and implement training standards that are consistent with the requirements of all applicable government, industry, and CB&I standards.
- Develop and obtain approval for, standards, procedures, and guidelines that relate to employee training, development, and qualification activities.
- Authorize and document the use of escorts in lieu of training.
- Establish appropriate training requirements for visitors. Document all training.

4.1.3 Radiation safety training shall be provided to all individuals before being allowed unescorted access to radiologically restricted areas or being occupationally exposed to ionizing radiation , whether escorted or not (10 CFR 19.12 and 10 CFR 835.901(a)).

4.1.4 Radiation safety training shall include topics to the extent appropriate to the individual's prior training, work assignments, and degree of exposure to potential radiological hazards (10 CFR 19.12 and 10 CFR 835.901(c)). Radiation safety training requirements should be established in project specific procedures that address, at a minimum, the topics outlined in this guideline.

4.1.5 A satisfactory training program for radiation safety shall include training evaluations and provisions for maintaining training records.

4.2 Determination of Required Training

4.2.1 If an individual will be permitted unescorted access to radiologically restricted areas or receive occupational exposure to ionizing radiation during escorted or unescorted access, a determination must be made regarding the appropriate level of knowledge and the type of training to be provided. The RPP should clearly establish training requirements for individuals who will be potentially exposed to ionizing radiation.

4.2.2 Challenge examinations may be offered based on the individual's prior experience, education, and/or training. With successful completion of the challenge examination, the student may be granted an exemption from the appropriate core training course or lesson. Procedures should be developed that govern the processes used to grant exceptions.

4.3 General Employee Radiation Training

4.3.1 General employee radiation training (GERT) provides the appropriate level of training for individuals who:

- Enter radiologically restricted areas escorted
- Likely to receive less than 0.1 rem per year total effective dose equivalent occupational exposure
- Do not work with unsealed sources
- Do not work in radiation fields greater than 0.1 rem per hour

4.3.2 GERT does not provide the appropriate level of training for individuals who enter radiologically restricted areas unescorted or for those individuals who perform unescorted duties as a radiological worker.

4.3.3 GERT training covers the following topics:

- Basic radiological fundamentals and radiation protection concepts
- Relative risks from exposure to radiation and radioactive materials, including prenatal radiation exposure
- Physical design features, controls, limits, policies, procedures, alarms, and other measures implemented at the project to control dose
- Individual rights and responsibilities as related to implementation of the radiation protection program including the as low as reasonably achievable (ALARA) program.
- Actions implemented to control doses under emergency conditions
- Exposure reports or other exposure data that may be provided and how to request these reports

4.4 Visitors

4.4.1 Visitors should at a minimum receive GERT training and additional training depending on area access. Training may be waived in accordance with the authorization of the PRSO provided visitors are escorted by a trained individual.

4.5 Radiation Workers

4.5.1 All project personnel designated as radiation workers shall be qualified or trained as radiation workers prior to beginning work in radiologically restricted areas. Those personnel qualified as radiation workers shall re-qualify on a yearly basis. Training and/or qualification shall be conducted in accordance with the one or more of the following training standards:

- Training provided by a NRC Licensee, as required by 10 CFR 19, Section 19.12
- U.S. Department of Energy (DOE) G 441.1-1C, Radiation Protection Programs Guide

- Any project-specific training that is determined to meet the requirements of the applicable standards noted above, especially demonstrations of practical factors such as the use of protective clothing and equipment, frisking procedures, use of radiation work permits, etc.

4.6 Radiological Controls Technicians

4.6.1 Senior radiological controls technician candidates shall be qualified if they meet the requirements of one or more of the following categories:

- Verifiable evidence of training, experience, or combination of training and experience consistent with the requirements of American National Standards Institute/American Nuclear Society, Selection, Qualification, and Training of Personnel for Nuclear Power Plants (reaffirmed 1999) for senior health physics technicians
- National certification with The National Registry of Radiation Protection Technologists
- Certification as a DOE radiological controls technician consistent with the requirements of 10 CFR 835, Section 835.103
- Evidence of NAVSHIPS 389-0288, Radiological Controls for Shipyards or NAVSEA 389-0153, Radiological Controls, Article 108, Qualification
- Two-Year Technical Degree in Health Physics or related field

4.6.2 Senior technicians shall have a **completed qualification card** that includes a formal evaluation of knowledge and skills prior to providing job coverage alone. They shall also participate in ongoing radiation safety training consistent with their duties and responsibilities.

4.6.3 Junior radiological controls technicians shall meet the basic education and training requirements established in the RPP. They shall participate in ongoing radiation safety training consistent with their duties and responsibilities.

4.7 Radiation Safety Training for Supervisors and Managers

4.7.1 The goal of the radiological safety training for supervisors and managers is to provide a basic understanding of the knowledge and skills required to safely and effectively supervise work conducted in radiological areas, work with radioactive material, and work with sealed radioactive sources. Upon successful completion, trainees will understand the requirements of the regulations, standards, license, and the RPP and supporting documents and the managers and supervisor's roles and responsibilities for implementing those requirements and guidance.

4.8 Radiation Safety Training for Technical Support Personnel

4.8.1 Appropriate technical support personnel (i.e., engineers, planners, schedulers, procedure writers) may be considered to be subject to the education, training, and skill requirements of the project RPP. Depending on their job assignments, they should be trained in the ALARA fundamentals and dose reduction techniques. Planners who develop detailed work plans involving or associating with radioactivity, radioactive material, or radiation producing machines and equipment should have radiological worker training to the level required by the workers using the work plans.

4.9 Project-Specific Training Materials

4.9.1 To implement an effective radiation safety training program, the core courses should be augmented with facility-specific information as necessary to adequately address the course content requirements of 10 CFR 19.12 or 10 CFR 835.901(c). The following information should be considered in developing facility-specific training materials:

- Procedures for entering and exiting the authorized areas, including use of radiation work permits

- Controls on radiation exposure, including administrative control levels and fetal exposure control
- Measures for use of protective equipment, including protective clothing and respiratory protective devices
- Alarms, warning signals, and response actions
- ALARA measures implemented at the facility
- Requirements for interfacing with the radiation safety organization
- Skills required by the worker to execute his/her radiation safety responsibilities
- Worker responsibilities for self and co-worker protection, including exercise of stop work authority
- Measures for requesting personal dose records and reports

4.10 Conduct of Radiation Safety Training

4.10.1 Training shall be conducted by a qualified individual approved by the DRS, such as a person who meets the qualifications of the radiation safety officer or authorized user (or a knowledgeable radiation protection staff person designated by the radiation safety officer) and who is familiar with the radiation safety program.

4.10.2 Radiation safety training should be conducted in an appropriate training facility, such as a classroom or computer-based training facility, augmented by suitable mock-up and/or laboratory facilities and on-the-job training and evaluation capabilities. Training media, such as handouts, slides, and video presentations, should be appropriate to the subject matter and the audience. Training should address both normal and abnormal situations in radiological control.

4.11 All training shall be documented by:

4.11.1 A written test.

4.11.1.1 To successfully complete the course/module, a score of 80% or greater is required.

- No true/false or open book examination questions
- Randomly selected questions from a bank of questions
- Acknowledgment by signature that the student participated in a post-examination review
- Competence in required skills using performance-based demonstrations
- Definition of remedial actions for failure to meet the minimum score
- Testing of what the student is expected to remember months after the training

4.11.1.2 To successfully complete the course, a student may miss no more than 10% of the total course time. If the student misses more than 10% of the total course, the student shall be required to be scheduled in the next available course, or at the discretion of the facilitator, the student may makeup that part of the course/module missed.

4.11.1.3 Test shall be graded and returned to the participants for their review at the end of the course. Time shall be allotted to allow for a question and answer period. Once reviewed, the test shall be returned to the facilitator for retention.

4.11.1.4 Individuals who do not pass all required examinations and performance demonstration requirements shall not be allowed to proceed with unescorted tasks involving exposure to radioactive materials or radiation until they have completed remedial actions. Remedial actions for failure to pass a written examination or meet performance demonstration requirements should include remedial instruction and re-examination,

repetition of the training program, or restriction from job duties. The choice and extent of remedial actions shall be determined based upon the extent of the knowledge or skill deficiencies demonstrated by the individual.

4.11.2 The HSE Training Attendance Sheet (CMS-710-05-FM-01905).

4.11.3 Training records shall be entered into the CB&I Electronic Data Management System (EDMS) within 10 working days of completion of the course.

4.12 Document Retention and Distribution

4.12.1 The original copies of the written test and other applicable documents shall be maintained by the PRSO throughout the project and copies routinely transmitted to the Radiation Safety Records Manager for retention.

4.12.2 The HSE Training Attendance Sheet and meeting minutes shall be kept in the project/facility Radiation Safety records file for the duration of the project.

4.12.3 Employee training records are the property of CB&I, and CB&I will not provide such training records to entities or individuals outside the company unless specifically requested by the employee, as required by law and/or as required by contract (such as contracts with customers). If it is the employee who is requesting his/her training records, the employee must make the request in writing specifying what records are needed. The records will be sent to the employee only for their distribution.

4.13 Periodic Radiation Safety Training

In addition to the initial training provided before an individual is granted access to the specified areas, radiation safety retraining shall be conducted at least annually and whenever significant changes are implemented that might affect the individual. This periodic training should review initial key principles, provide more detailed knowledge of the subject matter required, and stress new program requirements and/or seldom-used knowledge and skills.

4.14 Use of Escorts In Lieu of Training

4.14.1 The use of a constant escort may obviate the need for certain types of training by making the escort responsible for the protection and actions of the affected individual. This approach should only be used when:

- The individual will enter the area for a short period of time (i.e., no more than a few hours).
- Provision of an escort will provide for an adequate level of safety.
- Provision of an escort will not result in significant adverse dose effects (ALARA considerations). This determination should be based upon consideration of the resources (including collective dose) that must be expended to escort the individual versus those necessary to provide the appropriate training.

4.15 Training Effectiveness Evaluations

The effectiveness of radiation safety training should be verified by periodic self assessments. Self assessments can be used to determine whether qualified workers have retained all the required knowledge and skills and are applying the knowledge and skills properly. Feedback should be used as an important form of evaluation that encourages improvements and upgrades to the training programs. Comments from supervisors, instructors, and trainees should be used to enhance course effectiveness.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-05-FM-01905	HSE Training Attendance Sheet
Code of Federal Regulations	Occupational Radiation Protection, U.S. Government Printing

(CFR), Title 10, Part 835	Office, Washington, D.C.
CFR, Title 10, Part 19,	Notices, Instructions, and Reports to Workers: Inspection and Investigation, U.S. Government Printing Office, Washington, D.C.
CFR, Title 10, Part 20	Standards for Protection Against Radiation, U.S. Government Printing Office, Washington, D.C.
Naval Ships Systems Command, NAVSHIPS 389-0288,	Radiological Controls for Shipyards
Naval Sea Systems Command, NAVSEA 389-0153	Radiological Controls
U.S. Department of Energy (DOE), 2008	Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection, DOE G 441.1-1C. Washington, D.C., May 19.
American National Standards Institute/American Nuclear Society, 1993	Selection, Qualification, and Training of Personnel for Nuclear Power Plants (reaffirmed 1999), ANSI/ANS-3.1-1993.
The National Registry of Radiation Protection Technologists	

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
DRS	Director, Radiation Safety
EDMS	CB&I Electronic Data Management System
GERT	General Employee Radiation Training
PRSO	Project Radiation Safety Officer
rem	The **roentgen equivalent** in **man** (rem) is a unit of equivalent dose, effective dose, and committed dose. The international system (SI) unit for dose equivalent is the seivert (Sv). One rem is equivalent to 0.01 Sv 1mrem = millirem (mrem).
RPP	Radiation Protection Plan

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

8.0 ATTACMENTS

None.

PROCEDURE

Procedure Title:	**Radiation Detection Instrumentation**	**CMS Number:**	**CMS-710-07-PR-04013**
Procedure Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

RADIATION DETECTION INSTRUMENTATION

1	Previously CMS-710-01-GL-04014. Procedure revised to align with radiation safety document content and update CMS references.	MOS	10 Nov 2014
0	Issued for Use	PO	09 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure provides the minimum requirements of the CB&I *Radiation Safety Program* (CMS-710-07-PR-04000) element "Radiation Detection Instrumentation". The principles, concepts, and requirements in this program document are to be used, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation that are governed by regulation.

2.0 SCOPE

The procedure is to be followed when developing a task- or site- specific Radiation Protection Plan (RPP) intended to support sites involving the potential for exposure to sources of occupational ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities in this procedure:

- Project/Program Radiation Safety Officer (PRSO)
- Director, Radiation Safety (DRS)

4.0 PROCEDURE

In accordance with CB&I *Radiation Safety Program* (CMS-710-07-PR-04000) the RPP shall document which radiation detection instruments are suitable for the required survey measurements. The PRSO shall develop and document a technical basis for verifying that the instruments used are appropriate for the radionuclides of concern and have sufficient sensitivity for the required measurements and monitoring for review and approval by the DRS. The information may be included or referenced in the task- or site-specific RPP.

Operating instructions and calibration and quality assurance procedures shall be maintained for each instrument and should be consistent with ANSI N323A. These requirements apply to both portable and fixed instruments.

4.1 Responsibilities

4.1.1 Project/Program Radiation Safety Officer (PRSO):

4.1.1.1 Periodically reviews the site procedure(s) for applicability and efficacy at least annually or when changing radiological conditions, instruments, project objectives, quality assurance/quality control (QA/QC) requirements, license, or regulatory changes warrant.

4.1.1.2 Establishes project and/or site-specific requirements for radiological survey and fixed instruments including the selection of parameters to be measured and specific instrumentation to be used.

4.1.1.3 Ensures that instrument surveys performed for the demonstration of compliance conform to the requirements of the RPP and applicable regulations.

4.1.1.4 Maintains an adequate inventory of functional, calibrated instruments including support equipment e.g., planchets, tools, and check sources.

4.1.1.5 Controls the use, storage and operation of all portable and fixed instruments.

4.1.1.6 Ensures that the calibration and operational checks of portable and fixed instruments are properly documented and conform to the requirements of this procedure.

4.1.2 Director, Radiation Safety (DRS)

The DRS shall review and approve technical basis decisions addressing instrument sensitivity to detect the nuclides present at a fraction of the control levels.

4.2 Prerequisites

- Only personnel with appropriate, documented training shall issue or use radiation protection instruments. Training and documentation shall comply with 10 CFR 20.19 for NRC licensees and 10 CFR 835.103 and DOE G 441.1-1C for DOE Projects. Activities conducted under agreement state regulation shall have training compliant with those regulations. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites shall have training programs equivalent to those required by the appropriate regulatory group.
- Instruments and detectors shall be inspected for mechanical damage and shall be response tested prior to use.
- Instruments with mechanical damage or that do not pass the response test shall be removed from service and immediately tagged with a *Do Not Use* tag.
- Labels denoting current calibration shall be affixed to instruments in use.

4.3 Precautions and Limitation

- As Low as Reasonably Achievable (ALARA) practices shall be observed to minimize personnel exposure and the spread of contamination when using radiation protection instrumentation.
- Instruments removed from service for calibration, repair, or failure of a response test shall be physically segregated as practical from those instruments available for issue and shall be tagged or labelled to indicate their status.
- Portable survey instruments are susceptible to damage from physical and environmental stresses. Project procedures shall specify the environmental limits (e.g., temperature, humidity, etc.) for each instrument as specified by the manufacturer, if restrictive.
- Instruments will have been surveyed for contamination and decontaminated as necessary, prior to returning to the issue location.
- QA/QC requirements shall be established to include applicable calibration, daily response, and general operations acceptance criteria.
- Inspections, establishing acceptable ranges and daily performance checks shall only be performed by individuals trained and successfully tested on these tasks.

4.4 Characteristics, Accountability, Maintenance, and Calibration of Radiation Detection Instrumentation

4.4.1 Operating Characteristics

The PRSO shall ensure instrumentation is appropriate for the detection of the radionuclides of interest, including energy response, and that the expected Minimal Detectable Activity (MDA's) will meet project requirements. Operational characteristics should be verified with source testing once the instrumentation has been received and the results documented in a technical basis document. Any environmental limitations or special use conditions should be specified along with the required actions if those conditions are exceeded.

4.4.2 Receipt of Radiation Protection Instrumentation

Site-specific instrument procedure(s) shall define the requirements for placing radiation protection instruments in service in accordance with recommendations in Section 9.2.1 of ANSI N323A-1997 (ANSI, 1997).

The instrument may be used for 'information only', until:

- The required procedures have been written, reviewed, and approved.
- The calibration requirements have been satisfied.
- Successful passing of the general operations and source test in accordance with ANSI N323A-1997 (ANSI, 1997).

4.4.3 Performance Testing for Portable and Fixed Instruments

Site-specific instrument procedure(s) shall address the performance testing requirements before initial use, after maintenance that could affect performance, and periodically over the life of the Project to verify that they continue to meet the Project and or Site Measurement Quality Objectives. The site-specific instrument procedure(s) shall define the requirements for the testing and calibration of instruments. The testing and calibration of instruments should be performed under a group of controlled conditions called standard test conditions as described in Table 1 and Section 3.3 of ANSI N323A-1997 (ANSI, 1997).

4.4.4 Instrument Control and Accountability for Portable and Fixed Instruments

Site-specific instrument procedure(s) shall address the instrument accountability requirements including short-term and long-term use as appropriate, physical inventories by serial number, documentation and record keeping, and record disposition. Instrument issue and use should be limited to qualified personnel within the specified use parameters, including proper pre- and post-use checks, and required recordkeeping.

4.4.5 Maintenance for Portable and Fixed Instruments

Maintenance should be performed in accordance with the manufacturer's recommendations and preferably by the manufacturer. Recalibration shall be required following maintenance.

4.4.6 Pre-Calibration for Portable and Fixed Instruments

Instruments must be properly set-up, either at the work site or by the calibration service, in accordance with the instruction manuals prior to calibration. Set-up includes proper adjustment of high voltage, window settings, response time, battery checks, instrument zero, counting gas flow rate, and recording "as found" readings for the instrument. If the meter and detector are maintained as a set, ensure the proper detector is paired with the meter and that the cable is of the proper length. Check instruments for contamination and physical damage as well.

4.4.7 Calibration for Portable and Fixed Instruments

The PRSO shall ensure that the calibration frequency has been established for all instruments. Calibrations shall be performed using NIST traceable sources of the appropriate energy, source strength, and size for the intended use of the instrument. Source jigs shall be used to establish reproducible calibration geometries. Instrument scales to be calibrated shall be specified including whether at the low end, midpoint, or high end of the scale and the acceptance criteria. Specify the calibration data that must be recorded including as left conditions and alarm set points as appropriate. MDAs should be determined following calibration in accordance with NUREG-1507 (NRC, 1999).

4.4.8 Recordkeeping for Portable and Fixed Instruments

Accurate and complete records of instrument inventories, calibrations, repair history, and performance checks must be maintained. Information required on calibration labels must be specified.

4.4.9 Fixed Counting System General Requirements

The requirements for fixed counting systems are the same as described above and include the following requirements as well:

- Physical inspections.
- Counting gas requirements if appropriate.
- System set-up parameters.
- Range for background.
- Operational parameters.
- Performance testing and acceptable testing criteria.
- Appropriate response when instrument response is out of range.
- Sample counting operations, establishing required MDAs or Minimum Detectable Contamination (MDC's).
- Safety precautions.
- Record keeping requirements including data package and data verification and validation.

5.0 REFERENCES

ANSI N323A-1997	American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments. American National Standards Institute. Published by the Institute of Electrical and Electronics Engineers, Inc. New York, New York.
CMS-710-07-PR-04000	Radiation Safety Program
DOE	Occupational Radiation Protection. U.S. Department of Energy, Title 10 Code of Federal Regulations, Part 835, Subpart E, 835.401 – 835.405, Subpart F, 835.501 - 835.502, Subpart G, 835.601 – 835.606, Subpart L, 835.1101 – 835.1102, and Appendix E. Washington, D.C.
DOE	Radiation Protection Programs Guide. DOE G 441.1-1C. U.S. Department of Energy, Washington, D.C.
NRC	Standards for Protection Against Radiation. U.S. Nuclear Regulatory Commission, Title 10 Code of Federal Regulations, Part 20, 1004, and Subpart F, 20.1501 – 20.1502
Technical Report	Abelquist, E. W., W. S. Brown, G. F. Powers, A. M. Huffert. 1998. Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. U.S. Nuclear Regulatory Commission NUREG-1507. Washington, D.C.
Technical Report	Manufacturer's Instrument Technical and Users Manuals and Technical Reports

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOE	Department of Energy
DRS	Director, Radiation Safety
MDA	Minimal Detectable Activity
MDC	Minimum Detectable Contamination
NIST	National Institute of Standards and Technology, the national organization for establishing the quality standards for radiation sources used for instrument calibration.
PRSO	Project Radiation Safety Officer
QA/QC	Quality Assurance/Quality Control
RPP	Radiation Protection Plan

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	**Radiation Safety Staff Credentials**	**CMS Number:**	**CMS-710-07-PR-04015**
Procedure Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

RADIATION SAFETY STAFF CREDENTIALS

1	Previously CMS-710-01-WI-04117. Procedure has been revised to align with radiation safety documents and updated to include responsibilities and minimum requirements.	MOS	08 Jan 2015
0	Issued for Use	JPO	11 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure describes the CB&I Radiation Safety Program minimum requirements credentialing radiation safety staff. This procedure provides the required qualifications, through training and experience, for individuals who have responsibilities for radiation protection and/or nuclear safety at CB&I radiological sites. The qualifications, responsibilities, and successful completion of training of personnel shall be reviewed and evaluated prior to personnel beginning radiological operations. The form, CMS-710-07-FM-04015, *Radiological Training Evaluation Form*, or equivalent, shall be used to document training and qualifications.

Before using licensed material, authorized users will receive the training described in Appendix H of NUREG-1156, Vol, 18, *Consolidated Guidance About Materials Licenses: Program-Specific Guidance about Service Provide Licenses,* dated November 2000.

2.0 SCOPE

This procedure will be implemented, as appropriate, to support projects and work involving the potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following people have responsibilities outlined in this guideline:

- Director, Radiation Safety (DRS)
- Project/Responsible Manager (PM/RM)
- Project/ Program Radiation Safety Officers (PRSO)
- License Radiation Safety Officer (License RSO)

4.0 PROCEDURE

Each Radiation Protection Plan (RPP) shall include a procedure for a documented review of the qualifications of the radiation safety staff. Refer to CMS-710-07-PR-04000, *Radiation Safety Program* for additional information. Depending on project/agency-specific requirements and terminology, these individuals may include program/project managers, health and safety managers, radiation protection managers, radiation safety officers, radiological control supervisors, and senior technicians and other supervisory personnel. The qualifications of the individuals named for some of these positions, particularly the Project/Program Radiation Safety Officer (PRSO), may require review and approval by the cognizant regulatory agency or client. The qualifications of the PRSO also must be reviewed and approved by the Project/Responsible Manager (PM/RM) and the Director, Radiation Safety (DRS).

4.1 Regulatory Agency Requirements

Table 1 below summarizes, by agency, example regulations and associated guidance that collectively define and provide information on the necessary qualifications of project/site personnel with responsibility for radiation protection. Project/site Quality Assurance Program Plans (QAPP) (or similar documents) must provide the supplemental Quality Assurance (QA)/Quality Control (QC) protocols necessary to verify and validate that the qualifications of personnel have been properly evaluated and documented, and that all personnel with responsibility for radiation protection are qualified for assigned positions in accordance with the applicable agency and associated client requirements and/or license conditions.

TABLE 1 Qualifications of Personnel with Responsibility for Radiation Protection

DOE	NRC	USACE	NAVAL REACTORS
• 10 CFR 835.103, "Occupational Radiation Protection – Education , Training and Skills" • DOE O 462.2 , "Personnel Selection, Training, Qualification and Certification Requirements for DOE Nuclear Facilities" • ANSI/ANS N3.1-1993, "Selection, Qualification and Training of Personnel for Nuclear Power Plants"	• Regulatory Guide 1.8, "Training and Qualification of Personnel at Nuclear Power Plants", or • ANSI/ANS N3.1-1993, "Selection, Qualification and Training of Personnel for Nuclear Power Plants" • Based on site Technical Specifications	• ER 385-1-80, "Ionizing Radiation Protection," Section 6 (Authorized User and Qualifications) • EM 385-1-80, Radiation Protection Manual, Chapt.2, "Personnel Responsibilities and Qualifications" • Memorandum of Understanding (MOU) between USACE and the Nuclear Regulatory Commission (NRC) defers to 10 CFR 20 and CERCLA • EM 385-1-1; "Safety and Health Requirements Manual", 06.E.02 (Qualified Personnel)	• Article 106, "Radiological Control Training Requirements" • Article 107, "Radiation Worker Training Standard" • Article 108, "Radiological Controls Technician Training Standard" • Article 112, Training Standard for Engineers of Radiological Work" • Site/Project specific contract "Technical Specification"

4.2 Change in Required Qualifications

Project/site staff must possess a combination of training and experience which allows them to ensure worker and public safety when dealing with radioactive materials and activities conducted under at specific project/site or under a license. As projects become more complex, and/or quantities of radioactive material and/or radiation levels increase, the duties and responsibilities of personnel with radiation protection responsibilities increase in a commensurate fashion. Accordingly, the appropriate levels and degree of training and experience required for successful radiation safety program development and implementation must be considered and re-evaluated on a regular basis as project/site conditions and requirements change.

4.3 Radiation Staff Qualifications and Approvals

4.3.1 The License Radiation Safety Officer (License RSO) or PRSO shall perform a review of the training and qualification records for each candidate. Only qualified candidates shall be permitted to work.

4.3.2 If the candidate meets the qualifications and project-specific selection criteria, he/she is considered qualified to staff the project without further approval. Successful completion of annual radiation safety training is also required prior to beginning work with licensed radioactive material.

4.3.3 A file shall be kept for each successful candidate. This file shall contain the resume, qualification certificates, if appropriate, and any testing or evaluation results.

4.4 Project Radiation Safety Officer (PRSO)

The PRSO shall be qualified by training and experience in radiation protection and be available for advice and assistance on radiological safety matters. The PRSO's training and experience shall include the uses of licensed material identified on the license so that the PRSO is able to oversee the radiation safety program during normal and emergency conditions. The PRSO must have at least five years of documented direct, hands-on radiological controls experience.

4.5 Authorized Users

Authorized Users shall have adequate training and experience to use, possess, or provide services involving licensed materials. Duration of training and experience shall be commensurate with the expected hazards personnel may encounter during routine and emergency conditions and shall be successfully completed annually. Before using licensed material, authorized users will receive the training described in Appendix H of NUREG-1156, Vol, 18, *Consolidated Guidance About Materials Licenses: Program-Specific Guidance about Service Provide Licenses,* dated November 2000.

4.5.1 Criteria for acceptable training and experience shall include classroom training in the form of lecture, videotape, or self-study that emphasizes practical subject matter important to the safe handling of licensed materials. The duration and technical level of training shall be commensurate with the expected hazards encountered during routine and emergency conditions.

4.5.2 Training shall be required prior to the authorized user assuming duties with or in the vicinity of radioactive materials and whenever there is a significant change in duties, regulations, or terms and conditions of the license. Annual refresher training shall also be required.

4.5.3 Past experience should include similar radionuclides and quantities as the current assignment.

4.6 Radiological Controls Technicians

4.6.1 A Radiological Controls Technician (RCT) must have at least 12 months of documented direct, hands-on radiological controls experience. In addition to the minimum experience and education requirements, nationally recognized training and qualification requirements, such as DOE Radiological Controls Technician, U.S. Navy Article 108, Radiological Control Monitor, or other client-mandated training requirements, may be imposed on a project-specific basis.

4.6.2 All RCT candidates shall be considered qualified if they meet the requirements of one or more of the following categories:

- Verifiable evidence of training, experience, or a combination of training and experience consistent with the requirements of American National Standards Institute/American Nuclear Society, Standard N3.1 - 1993, American National Standard for Selection, Qualification and Training of Personnel for Nuclear Power Plants (reaffirmed 1999), for Senior Health Physics Technicians.
- National Certification with the National Registry of Radiation Protection Technologists.
- Certification as a DOE Radiological Controls Technician consistent with the requirements of Title 10 CFR, Part 835, Section 835.103.
- Evidence of NAVSHIPS 389-0288, Radiological Controls for Shipyards or NAVSEA 389-0153, Radiological Controls, Article 108, Qualification.
- Two-year technical degree in health physics or related field.

4.6.3 The candidate shall supply training and qualification records for review. Copies of these records shall be maintained as part of the project record. All RCTs must also successfully complete annual radiation safety training.

4.7 Radiation Workers

All project personnel designated as Radiation Workers shall be qualified or trained as radiation workers prior to beginning work in Restricted Areas. Those personnel qualified as radiation workers shall re-qualify on a yearly basis. Training and/or qualification shall be conducted in accordance with the one or more of the following training standards:

- Training as required by CFR, Title 10, Part 19, Section 19.12
- Training as required by CFR, Title 29, Part 1910.1096
- Any project-specific training that is determined by the License RSO to meet the requirements of the applicable standards noted above.

4.8 Radiation Safety Instructors

A qualified individual, such as a person who meets the qualifications of the RSO or authorized user on the license (or other knowledgeable radiation protection staff person approved by the PRSO) and is familiar with the program, shall conduct the training. Instructors shall have adequate training and experience and possess a thorough understanding of the licensee operations.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-FM-04015	Radiological Training Evaluation Form
American National Standards Institute (ANSI)/American Nuclear Society (ANS), 1993, Standard N3.1	American National Standard for Selection, Qualification and Training of Personnel for Nuclear Power Plants (reaffirmed 1999), for Senior Health Physics Technicians
Code of Federal Regulations (CFR), Title 10, Part 20	Standards for Protection Against Radiation, U.S. Government Printing Office, Washington, D.C.
CFR, Title 10, Part 835.103	Occupational Radiation Protection – Education , Training and Skills, U.S. Government Printing Office, Washington, D.C.
CFR, Title 10, Part 19, Section 19.12	Instructions to Workers
CFR, Title 29, Part 1910.1096	Ionizing Radiation
NUREG-1556, Vol. 18, 2000	Consolidated Guidance About Materials License
U.S. Army Corps of Engineers (USACE), 1997, Engineer Manual (EM) 385-1-80	Radiation Project Manual, Department of the Army, Washington, D.C., May 30
USACE, 2008, EM 385-1-1	Safety and Health Requirements Manual, U.S. Department of the Army, Washington, D.C., September 15
USACE, 2010, Engineer Regulation (ER) 385-1-80	Ionizing Radiation Protection, U.S. Department of the Army, Washington, D.C., June 30
U.S. Department of Energy (DOE), 2011	Personnel Selection, Training, Qualification, and Certification for DOE Nuclear Facilities, DOE O 426.2, National Nuclear Security Administration
U.S. Naval Sea Systems Command (NAVSEA), 389-0153	Radiological Controls
U.S. Naval Ship Systems Command (NAVSHIPS) 389-0288	Radiological Controls for Shipyards

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOE	Department of Energy
DRS	Director, Radiation Safety
MOU	Memorandum of Understanding
NRC	Nuclear Regulatory Commission
PM/RM	Project Manager/Responsible Manager
PRSO	Project/Program Radiation Safety Officer

Term (Acronym)	***Definition***
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
RCT	Radiological Controls Technician
RPP	Radiation Protection Plan
USACE	U.S. Army Corps of Engineers

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	**Radiation Protection Program**	**CMS Number:**	**SPL-SOP-8.10**
Procedure Owner:	**Mark Somerville**	**Issuing Authority:**	**CFS Radiation Safety Group**

RADIATION PROTECTION PROGRAM

00	Reformatted into CB&I CMS format	MOS	19 November 2014
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

The purpose of this procedure is to outline CB&I Federal Services LLC (CB&I) radiation safety program requirements for the radiologically safe performance of operations and the requirement for development of a task- or site-specific Radiation Protection Plan (RPP). The provisions of the program shall be implemented by specific procedures, which may be more restrictive than the requirements herein. This procedure is intended to supplement existing CB&I procedures as well as applicable federal and state rules and regulations.

2.0 SCOPE

This procedure applies to all CB&I activities and personnel involved with radiological operations. The direction provided by this document may be augmented to comply with specific client, project, program, or regulatory requirements that are more restrictive when compared to the requirements of this document. All procedures shall be implemented with proper documentation in project records and approval by the radiation safety staff and proper project authority.

All CB&I sites where work-related activities may result in workers and/or the public being exposed to ionizing radiation above background levels are required to implement the requirements in the approved task- or site-specific RPP.

3.0 RESPONSIBILITIES

3.1 License Radiation Safety Officer (License RSO).

The License RSO is responsible to maintain and implement the Service Provider License (SPL) in strict compliance with the regulations, requirements of this document, the conditions of the license, and the associated radiation safety program. The LRSO shall notify the Nuclear Regulatory Commission (NRC) at least 14 days prior to initiating work at a temporary location using licensed material and will notify the NRC within 30 days of cessation of use of licensed material at a specific location.

The License RSO shall:

- Act as the official point of contact between the Regulator and CB&I for all license-related issues, including making regulatory notification of license implementation and the termination of license use on a project site
- Review and document approval of the qualifications of authorized users on the license
- Maintain all required license records at the location specified on the license
- Establish written agreements between licensees as needed
- Review and approve each task- and site-specific RPP

3.2 Project Radiation Safety Officer (PRSO)

PRSOs 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 CB&I projects where the license is in use. PRSOs must be approved by the License RSO and shall report directly to the License RSO in matters involving the implementation of the SPL.

The PRSO is responsible for the development of the task- or site-specific RPP that provides the operating and emergency procedures to be followed. The PRSO's training and experience shall include the uses of licensed material identified on the license to ensure the PRSO is able to oversee the radiation safety program during normal and emergency conditions. The PRSO is an authorized user listed on the license.

4.0 PROCEDURE

No operational or related activities shall proceed unless the applicable requirements of this procedure are properly implemented through the use of operating procedures or site-specific plans and work instructions identified in each RPP. The requirements of 10 CFR Part 20, *Standards for Protection Against Radiation;* 10 CFR Part 19, *Notices, Instructions, and Reports to Workers: Inspection and Investigations;* 29 CFR Section 1910.1096, *Ionizing Radiation*; and California Code of Regulations, Title 17, *Public Health*, will be met without exception, as they apply to specific projects and situations.

- Radiation Protection Plans (RPPs)

  RPPs shall be developed to support consistent application of program requirements. The RPP and associated procedures provide information to meet license specific requirements, regulations, and commitments. At a minimum, the RPP shall define and quantify sources of radiation and identify risks to occupational workers and members of the public managed under the RPP and required procedures. Controlling documents shall be identified and/or incorporated into the RPP, as appropriate. Task- or site-specific work instructions shall be developed and applied as necessary to ensure safe handling of radioactive material and control personnel exposure to ionizing radiation. CB&I procedures and/or project-specific work instructions shall be utilized to support RPP requirements and as a means of employing the best practices and consistent methods.

- The RPP or other site-specific procedures shall contain the organizational structure of the CB&I project and shall also detail individual responsibilities of those involved with implementation of the RPP.

- Qualifications and Training

  Prior to beginning work using licensed material all project personnel including the PRSO, Radiological Control Technician, authorized users, radiation workers and ancillary personnel, shall receive and successfully complete training described in Appendix H of NUREG-1556, Volume 18, dated November, 2000, *Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Service Provider Licenses* (NUREG-1556, Vol. 18, 2000). The training shall be commensurate with the hazards of the work site and personnel shall successfully complete annual refresher training.

  Radiation safety training shall include topics appropriate to the individual's prior training, work assignments, and degree of exposure to potential radiological hazards.

  A satisfactory training program for radiation safety should also include training evaluations and shall include provisions for maintaining training records.

  Each task- or site-specific RPP shall include procedures for the training of personnel. Outlines of topics to be covered, practical and/or on-the-job training and designated trainers shall be identified. A system of documenting training and examination results shall be established and maintained.

4.1 Audits

CB&I shall review the content and implementation of the RPP annually to:

- Ensure compliance with applicable regulatory requirements
- Ensure occupational doses and doses to members of the public are ALARA
- Ensure that records of audits and other reviews of program content are maintained for at least five (5) years from the date of record.

4.2 Radiation Monitoring Instruments

CB&I will use instruments that meet the radiation monitoring instrument specifications published in Appendix J of NUREG-1556, Vol.18, 2000. CB&I reserves the right to upgrade survey instruments as necessary.

Each task- or site-specific RPP shall include procedures for the selection, use and calibration of radiation monitoring instruments. Program details are provided in SPL-SOP 8.10.2*, Radiation Monitoring Instruments*.

4.3 Radioactive Material Receipt and Accountability

Ordering licensed material and package receipt and opening will follow the model procedures in Appendix K of NUREG-1556, Vol. 18, 2000.

Physical inventories will be conducted at intervals not to exceed 6 months, to account for specifically licensed material and device received and possessed under the license. Records of inventory shall be maintained for a period of five (5) years from the date of each inventory, and shall include the radionuclides, quantities, manufacturer's name and/or model numbers, and the date of the inventory.

Each task- or site-specific RPP shall include procedures for the radioactive material procurements, receipt and accountability.

4.4 Occupational Dose

CB&I will have a prospective evaluation and determine that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10 percent of the allowable limits in 10 CFR Part 20, or CB&I will monitor individuals in accordance with the criteria in the section entitled 'Occupational Dose' in NUREG-1556, Vol. 18, 2000.

Each task- or site-specific RPP shall include or reference technical basis documents or procedures for evaluation and monitoring of individuals.

4.5 Public Dose

Each project shall have a task- or site-specific radiation protection plan (RPP) and procedures which address the specific controls appropriate for ensuring public dose will not equal or exceed 100 mrem (1 mSv) in one year and that the dose in any unrestricted area will not exceed 2 mrem (0.02 mSv) in any one hour, from licensed operations. All RPP's shall be reviewed annually to ensure compliance with the terms of the License and applicable regulations. The review shall ensure that 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.

4.6 Operating and Emergency Procedures

CB&I activities shall maintain personnel radiation exposure ALARA. An on-going effort is required to meet this goal by developing and implementing improvements to work procedures and work performance. 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 or work instruction and Radiation Work Permit (RWP).
- Individual work procedures, RWPs and job-specific instructions 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. All controls/actions shall be documented.

- 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 10 CFR 20.1001 and this ALARA policy. All such planning shall be performed and documented 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.
- All radiological areas shall be properly posted and controlled to ensure adequate hazard communication and security of material.
- 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.
- Dose to the public must be maintained ALARA, and documentation showing compliance shall be kept in the appropriate record system.

4.6.1 Each task- or site-specific RPP shall include or provide reference to operating and emergency response procedures. Program details are provided in SPL-SOP-8.10.6, *Safe Handling of Radioactive Materials and Emergency Procedures.* The License RSO shall approve all radiation safety procedures and work instructions.

4.5.2 Procedures and Work Instructions

Work in a Restricted Area shall be performed under the direction of a task-specific procedures, RWP and/or work instruction. Development, issue and use of SOPs, RWPs or WIs shall be described in the task- or site-specific RPP. Procedures, RWPs or WIs shall describe the task, radiological conditions, required radiological controls, and emergency response procedures.

A pre-job briefing shall be held prior to beginning work under an SOP, RWP or WI to ensure that all personnel understand the task, radiological conditions, emergency response procedures and radiological controls.

4.6 Radiological Surveys

CB&I will conduct surveys and maintain contamination levels in accordance with the survey frequencies and contamination levels in accordance with the criteria in the section entitled “Surveys” in NUREG-1556, Vol. 18, 2000.

4.7 Leak Tests

Leak tests, when required by the license, will be performed at intervals approved by NRC or an Agreement State and specified in the Sealed Source and Device Registration Sheet. Leak tests will be performed by an organization authorized by NRC or an Agreement State to provide leak testing services to other licensees or using a leak test kit supplied by an organization authorized by NRC or an Agreement State to provide leak test kits or other licensees and according to the kit supplier’s instructions.

4.8 Records System

CB&I will implement and maintain procedures for conducting routine maintenance of all material, source and device areas. All records required or created as a result of CB&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.

Records of audits and other reviews of program content are maintained for at least five years from the date of record. The following records shall be maintained on site during operations:

- Personnel radiation exposure records
- Personnel training records
- Radiation/contamination survey records, including personnel surveys

- RWP records, inspection and self-assessment reports
- Radioactive material and source control records
- Radioactive waste records
- Effluent records
- Environmental monitoring records
- Instrumentation records, including routine checks and calibration reports

4.9 Transportation

CB&I procedures shall be identified in the task- or site-specific RPP establishing requirements for the safe shipment of radioactive materials, including mixed waste, by CB&I Federal Services LLC (CB&I) radioactive materials brokers. Procedures shall incorporate the transportation requirements of 49 CFR, 10 CFR 71, 10 CFR 61, 10 CFR 20 and other applicable parts of the Code of Federal Regulations and the applicable regulations of the various Agreement States as applicable by reference. The list of procedural steps included shall be used to describe typical activities incident to cooperative efforts with licensed transportation brokers or shippers.

4.10 Waste Management

CB&I will use the model waste procedures published in Appendix N of NUREG-1556, Volume 18.

5.0 REFERENCES

- Code of Federal Regulations, 10 CFR 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR 19, *Notices, Instructions, and Reports to Workers: Inspection and Investigations*
- Code of Federal Regulations, 10 CFR 61, *Licensing Requirements of Land Disposal of Radioactive Material*
- Code of Federal Regulations,10 CFR 71, *Packaging and Transportation of Radioactive Materials*
- International Air Transportation Association (IATA) regulations
- Code of Federal Regulations, 29 CFR Section 1910.1096, *Ionizing Radiation*
- Code of Federal Regulations, 49 CFR, *Transportation*
- National Council for Radiation Protection and Measurements Report Number 39, *Basic Radiation* Protection Criteria
- NUREG-1556, Vol. 18, dated November, 2000, *Consolidated Guidance About Materials License.*

6.0 TERMINOLOGY

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 User - a person whose training and experience meet applicable criteria, who is named either explicitly or implicitly on the license and who uses or directly supervises the use of licensed materials; also may be designated as the Project Radiation Safety Officer (PRSO).

Contamination - The deposition of unwanted radioactive material on surfaces or in media.

Dosimetry - The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

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 dose equivalents.

Project Radiation Safety Officer (PRSO) - an individual who is responsible for radiation safety and compliance with the regulations for the use of radioactive material for a specific project

Radiation Worker - An individual who is properly trained, in accordance with the personnel training requirements of 10 Code of Federal Regulations (CFR) 19.12, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

Radiological Control Technician- 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 Permit (RWP) - 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.

Restricted Area - An area to which access 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.

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.

7.0 EXHIBITS

None

8.0 ATTACHMENTS

None

PROCEDURE

Procedure Title:	**Radiation Monitoring Instrumentation**	**CMS Number:**	**SPL-SOP-8.10.2**
Procedure Owner:	**Mark Somerville**	**Issuing Authority:**	**CFS Radiation Safety Group**

RADIATION MONITORING INSTRUMENTATION

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1.0 PURPOSE

This procedure provides the requirements for the proper control, calibration, and quality control checks of portable and fixed radiation monitoring instrumentation selected for use by CB&I Federal Services LLC (CB&I) projects. The requirements for documentation of instrument performance are also provided.

2.0 SCOPE

This procedure applies to all CB&I radiological projects and personnel who utilize radiation monitoring instrumentation. This procedure specifies standard practices for the performance of portable and fixed instrumentation operations. CB&I will use instruments that meet the radiation monitoring instrument specifications published in Appendix J of NUREG-1556, Vol. 18, *Consolidated Guidance About Material Licenses: Program-Specific Guidance About Service Provide Licenses*, dated November 2000 (NUREG-1556, Vol.18, 2000). CB&I reserves the right to upgrade survey instruments, as necessary.

The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are more restrictive, when compared to the requirements of this document. Additional requirements shall be implemented by the License Radiation Safety Officer (License RSO) and/or the Project Radiation Safety Officer (PRSO), with proper documentation in project records and approval by the proper project authority. These additional requirements will be applicable only for specific project use and may be documented in a site-specific work instruction.

Only personnel with appropriate documented training shall issue or use radiation monitoring instruments. Training and documentation shall comply with 10 Code of Federal Regulations 20.19 and/or other applicable regulations such as Title 17, California Code of Regulations, *Public Health*.

Site-specific instrument procedures shall address the performance testing requirements before initial use, after maintenance that could affect performance, and periodically over the life of the project to verify that they continue to meet the project objectives. The site-specific instrument procedures shall define the requirements for the testing and calibration of instruments.

3.0 RESPONSIBILITIES

Responsibilities for ensuring that radiation monitoring instrumentation is properly utilized shall be determined in the site-specific radiation protection plan or in associated work instructions.

3.1 License Radiation Safety Officer (License RSO)

The License RSO is responsible to ensure that appropriate project specific procedures are established to implement the requirements of this procedure.

3.2 Project Radiation Safety Officer (PRSO)

The PRSO is responsible for implementing this procedure and notifying the License RSO of any issues or noncompliance.

3.3 Radiological Control Technician (RCT)

The assigned RCT is responsible for performing required radiological surveys and implementing radiological controls for work activities.

4.0 PROCEDURE

4.1 Types and Quantities of Instruments

Prior to initiating radiological work the PRSO, with License RSO concurrence, shall determine the appropriate types and quantity of radiation monitoring instrumentation for a project based on what is known regarding the isotopes of concern for the project. The following will be considered:

- Isotope to be measured
- Types of measurements to be taken (count rate, dose rate etc.)
- Purpose of the measurements, sensitivity required (Data Quality Objective)

Instruments and detectors shall be inspected for mechanical damage (including light leaks, battery response and source response tested) prior to use. Instruments with mechanical damage or that do not pass the response test shall be immediately tagged with a “Do Not Use” tag.

4.2 Calibration

Portable and fixed radiological instrumentation, self-reading dosimetry, counter-scalers, and air sampling equipment shall be properly calibrated prior to use, at least annually, and following maintenance, using NIST traceable sources. The PRSO is responsible for ensuring that all radiological instrumentation, 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.

- Calibration of survey instruments used in assessing dose or exposure rates must be conducted at required intervals, in accordance with vendor recommendations, recognized standards or documented evaluation.
- Linear readout instruments with a single calibration control for all scales must be adjusted at the point recommended by the manufacturer or at a point within the normal range of use. Instruments with calibration controls for each scale should be adjusted on each scale. After adjustment, the instrument should be checked at approximately 20% and 80% of full scale and readings should be within +/-15% of the true values for the lower point and +/- 10% of the upper point.
- Logarithmic readout instruments with a single readout scale spanning several decades should have two or more adjustments for each scale, per site specifications or the manufacturer’s specifications. After adjustment, the instrument should be checked at a minimum of one point on each decade and instrument readings should be no more than more than 10% of the full decade value.

4.2.1 Calibration Records

Calibration records, for all survey instruments, shall indicate the procedure used and the data obtained. The description of the calibration shall include:

- The owner or user of the instrument;
- A description of the instrument, including the manufacturer's name, model number, serial number, and type of detector;
- A description of the calibration source, including the exposure rate at a specified distance or activity on a specified date;
- For each calibration point, the calculated exposure rate or count rate, the indicated exposure rate or count rate, the deduced correction factor (the calculated exposure rate or count rate divided by the indicated exposure rate or count rate), and the scale selected on the instrument;
- For exposure rate meters, the source isotope used to calibrate the instrument (with correction factors) for each scale;

- Instrument efficiency shall be determined, by an approved calibration service provider or by project staff, in accordance with an approved procedure;
- For each scale or decade not calibrated, an indication that the scale or decade was checked only for function but not calibrated;
- The exposure rate or count rate from a check source, if used;
- The name of the person who performed the calibration and the date it was performed.

4.2.2 Calibration Sticker and Tag

Calibration stickers and tags shall include the following information as appropriate:

- The date of calibration and the next calibration due date;
- The apparent exposure rate or count rate from the check source, if used;
- Initials of the person performing the calibration.

4.3 Typical Instruments

Portable Instruments Used for Contamination and Ambient Radiation Surveys			
Detectors	**Radiation**	**Energy Range**	**Efficiency**
Exposure Rate Meters	Gamma, x-ray	RF-R	N/A
Count Rate Meters			
GM	Alpha	All energies (dependent on window thickness) Moderate	Moderate
	Beta	All energies (dependent on window thickness) Moderate	Moderate
	Gamma	All energies	1-13%
Gas Proportional	Alpha	All energies	High
	Beta	All energies	Moderate
Nal Scintillator	Gamma	All energies (dependent on crystal thickness)	Moderate
Stationary Instruments Used to Measure Wipe, Bioassay, and Effluent Samples			
Detectors	**Radiation**	**Energy Range**	**Efficiency**
Liquid Scintillator Counter (LSC)	Alpha	All energies	High
	Beta	All energies	High
	Gamma	All energies	Moderate
Gamma Counter (Nal)		All energies	High
Gas Proportional	Alpha	All energies	High
	Beta	All energies	Moderate

4.4 Pre-Operational Requirements

4.4.1 Ratemeter

Project-specific requirements for instrument/detector operation verification shall be identified during the project planning. A copy of each manufacturer's operating instructions shall be available, and instruments shall be operated in accordance with these instructions.

Prior to the use of ratemeter-type instruments and detectors, the following inspections/operational verifications shall be performed.

- Calibration Verification
- Physical Check
- Battery Check
- High-Voltage Check
- Response Check to a known source

4.4.2 Scaler

Per specific project procedures, 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 6.4 for ratemeter-type instruments (i.e., calibration verification, physical check, battery check, HV check):

- Background Measurement
  Perform the background measurement of the instrument.
- Instrument Efficiency, if applicable
  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).
- Calculation of Minimum Detectable Concentrations
  Minimum detectable concentrations (MDC) of each instrument shall be determined upon initial setup of the counting system and as needed following modification, calibration, repair, or replacement (i.e., new detector, cables, calibration, etc.).
- High Voltage Plateau
  The high-voltage plateau (HVP) 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 HVP shall be investigated. If necessary, a new HVP shall be performed in accordance with the specific instrument's manufacturer's technical manual.

4.4.3 Fixed Counting System General Requirements

The site-specific instrument procedure shall provide the methodology and guidelines for the operation of site fixed counting systems to include:

- Physical inspections

- Counting gas requirements if appropriate
- System setup, acceptable
- Range for background
- Operational parameters
- Calibration, precautions, and limitations
- Performance testing and acceptable testing criteria
- Appropriate response when instrument response is out of range
- Sample counting operations, establishing required minimum detectable activity or MDCs
- Safety precautions
- Record-keeping requirements, including data package and data verification and validation.

4.5 Records

The PRSO shall be responsible for maintaining instrument/detector physical checks and performance verification records. In addition, all instrumentation problems and corrective actions shall be recorded on the appropriate data sheets.

All records, forms, and memos shall be maintained in the on-site project file throughout the duration of the project.

5.0 REFERENCES

- Title 10 Code of Federal Regulations, Part 20, *Standards for Protection Against Radiation*
- Title 10 Code of Federal Regulations, Part 30, *Rules of General Applicability to Domestic* Licensing of Byproduct Material
- National Council on Radiation Protection, Report No. 58, *A Handbook of Radioactivity* Measurements
- Manufacturer's Technical Manual(s)
- U.S. Nuclear Regulatory Commission, NUREG-1556, Vol. 182, *Consolidated Guidance About* Materials Licenses, dated November 2000
- American National Standards Institute N323A-1997, *Radiation Protection Instrumentation Test* and Calibration, Portable Survey Instruments.
- "The Health Physics & Radiological Health Handbook, Revised Edition," edited by Bernard Shleien, 1992.

6.0 TERMINOLOGY

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.

Background Radiation - Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation, terrestrial radiation, consumer products, and 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). 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 Nuclear Regulatory Commission (NRC).

Calibration - The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

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 **Scanning**—A type of direct-measurement monitoring performed by moving a detector slowly over the surface or area being evaluated.

Source Check or Response Check - An assessment of the operability of a monitoring instrument that is performed daily or prior to each intermittent use. Typically, a source check is performed daily when an instrument is to be used during that day.

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.

7.0 EXHIBITS

None

8.0 ATTACHMENTS

None

PROCEDURE

Procedure Title:	**Safe Handling of Radioactive Materials and Emergency Procedures**	**CMS Number:**	**SPL-SOP-8.10.6**
Procedure Owner:	**Mark Somerville**	**Issuing Authority:**	**CFS Radiation Safety Group**

SAFE HANDLING OF RADIOACTIVE MATERIALS AND EMERGENCY PROCEDURES

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1.0 PURPOSE

The purpose of this procedure is to establish the requirements applicable to radiological safety considerations for handling radioactive material associated with CB&I Federal Services LLC (CB&I) 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 radioactive materials.

2.0 SCOPE

This procedure applies to all CB&I projects involving the use of radioactive materials. This radiation safety program does not address Cat 1 or Cat 2 material.

The direction provided by this document may be augmented to comply with specific client, project, State, or program requirements that are more restrictive than the regulatory requirements. These additional site- or client-specific requirements shall be implemented with proper documentation in project records and approval by the proper project authority.

3.0 RESPONSIBILITIES

3.1 License Radiation Safety Officer (License RSO)

The License RSO shall ensure that appropriate site specific procedures are established to implement the requirements of this procedure. Work plans or other documents that discuss responses to unexpected conditions may substitute for additional, specific procedures. The License RSO or designated authorized user is responsible for all regulatory and emergency notifications.

3.2 Project Radiation Safety Officer (PRSO)

The PRSO is responsible for implementing this procedure and site specific procedures. The PRSO is also responsible for notifying the License RSO of any issues or noncompliance.

4.0 PROCEDURE

4.1 Receipt of Radioactive Material.

If a radioactive material receipt procedure is required by a project the License RSO shall approve prior to ordering materials. CB&I requires specific control procedures be in place to ensure that adequate radiological safety precautions are observed, both in unpacking and in subsequent use of the material. The procedure shall address potential radiological problems including external exposure, surface contamination, and airborne radioactivity. The procedure shall also address special precautions if damage is suspected during shipment. The minimum requirements for receipt of radioactive materials procedure shall include the following;

- Receipt Inspection - 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 three 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 three 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 PRSO. For packages that are shipped, this inspection shall verify that the package was shipped in accordance with U.S. Department of Transportation, state, and federal regulations, and other federal and state requirements for notification and permitting.

- Damaged/Contaminated Package - If damage to the radioactive material package has occurred, or removable surface contamination exceed the regulatory limits for

transportation (10 Code of Federal Regulations [CFR] 71.87), or the external radiation level exceeds the regulatory transport limits (10 CFR 71.47), the PRSO shall immediately notify the final delivery carrier and the U.S. Nuclear Regulatory Commission (NRC) Operations Center and the appropriate Agreement State contact by telephone.

- Investigate in accordance with CB&I Health and Safety Procedure CMS-710-05-PR-02300, *Incident Investigation*.
- Inventory - Received packages shall be inventoried as soon as possible.
- Records - 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.

4.2 Packaging and Shipping Radioactive Materials

Site specific procedures for shipping radioactive materials shall require that radioactive materials be packaged and treated as required by U.S. Department of Transportation regulations, applicable federal and state regulations, and applicable disposal site criteria. Packaging for transport and other transportation related activities require function specific training as specified in 49 CFR 172 Subpart H.

4.3 Radioactive Material Storage

At a minimum, all radioactive material storage areas shall be posted in accordance with 10 CFR Part 20, *Standards for Protection Against Radiation*. This means that a room or area containing 10 times 10 CFR 20 Appendix C quantities will be posted as “Caution – Radioactive Material”. Individual containers will be labeled in a manner appropriate to the contents of the container. Typically, a container holding an “Appendix C” quantity of radionuclides singly or as a sum of the fractions will be labeled “Radioactive Materials”, include the trefoil, and contain information appropriate to adequately inform individuals about internal and external radiological conditions.

4.3.1 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.

4.3.2 Contamination Control

Storage locations should routinely be assessed for radiological contamination. Personnel in these areas, particularly if they handle contaminated material, shall wear necessary anti-contamination clothing when such a precaution is appropriate based on the results of surveys. 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.

4.3.3 Radiation Exposure Control

Storage of radioactive materials can result in possible personnel radiation exposure in the storage area and 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.

4.3.4 Loss of Radioactive Material

If radioactive material associated with CB&I operations is suspected of being lost, the following actions shall be taken:

- Immediately notify the PRSO 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.
- Notify Regulatory Agencies, as required.
- Follow up with the proper reports and investigation in accordance with CB&I Health and Safety Procedure CMS-710-05-PR-02300, *Incident Investigation* and CMS-710-02-WI-02301*, Incident Review Board Process.*

4.4 Operating and Emergency Response Procedures

Task and site-specific operating and emergency response procedures shall be developed and included in or referenced from the RPP. The operating and emergency response procedures include the following, as a minimum:

- Methods or procedures for preventing the release of contamination material and equipment;
- Methods or procedures for preventing personnel contamination, including proper use of personnel protective equipment and donning/doffing procedures;
- Decontamination techniques for areas, equipment and personnel;
- Radiation safety procedures and the authorized users responsibilities unique to each type of service operation;
- Equipment, techniques, and corresponding radiation safety procedures associated with providing services involving either sealed sources or unsealed materials.

5.0 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, 10 CFR 30.50, Section 5, *Reporting Requirements*
- NUREG-1556, Vol. 18, *Program-Specific Guidance About Service Provider Licenses*, dated November 2000.
- CMS-710-05-PR-02300, *Incident Investigation*
- CMS-710-02-WI-02301, *Incident Review Board Process*

6.0 TERMINOLOGY

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.

Contamination—The deposition of unwanted radioactive material on surfaces or in media.

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

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.

7.0 EXHIBITS

7.1 Emergency/Regulatory Notifications - NRC

8.0 ATTACHMENTS

None

Exhibit 7.1 EMERGENCY/REGULATORY NOTIFICATIONS – NRC

Incident Notifications			
Event	**Telephone Notification**	**Written Report**	**Requirement**
Theft or loss of material	Immediate	30 days	10 CFR20.2201(a)(1)(i)
Whole body dose > 25 rem (0.25 Sievert [Sv])	Immediate	30 days	10 CFR20.2202(a)(1)(i)
Extremity dose > 250 rem (2.5 Sv)	Immediate	30 days	10 CFR20.2202(a)(1)(iii)
Whole body dose > 5 rem (0.05 Sv) in 24 hours	24 hours	30 days	10 CFR20.2202(b)(1)(i)
Extremity dose > 50 rem (0.5 Sv) in 24 hours	24 hours	30 days	10 CFR20.2202(b)(1)(iii)
Whole body dose > 5 rem (0.05 Sv)	None	30 days	10 CFR20.2203(a)(2)(i)
Dose to individual member of the public > 100 rem (1 mSv)	None	30 days	10 CFR20.2203(a)(2)(iv)
Defect in equipment that could create a substantial safety hazard	2 days	30 days	10 CFR21.21(d)(3)(i)
Filing petition for bankruptcy under 11 U.S.Code	None	Immediately after filing petition	10 CFR30.34(b)
Expiration of license	None	60 days	10 CFR30.36(d)
Decision to permanently cease licensed activities at entire site	None	60 days	10 CFR30.36(d)
Decision to permanently cease licensed activities in any separate building or outdoor area that is unsuitable for release for unrestricted use	None	60 days	10 CFR30.36(d)
No principal activities conducted for 24 months at entire site	None	60 days	10 CFR30.36(d)
No principal activities conducted for 24 months in any separate building or outdoor area that is unsuitable for release for unrestricted use	None	60 days	10 CFR30.36(d)
Event that prevents immediate protective actions necessary to avoid exposure to radioactive material that could exceed regulatory limits	Immediate	30 days	10 CFR30.50(a)
Equipment disabled or fails to function as designed when required to prevent radiation exposure in excess of regulatory limits	24 hours	30 days	10 CFR30.50(b)(2)
Unplanned fire or explosion that affects the integrity of any licensed material or device, container, or equipment with licensed material	24 hours	30 days	10 CFR30.50(b)(4)

Incident Notifications			
Event	**Telephone Notification**	**Written Report**	**Requirement**
Note: Telephone notifications shall be made to the NRC Operations Center at (301) 816-5100 or at (301) 951-0550.			

Attachment 4
CB&I Management System Procedures

PROCEDURE

Procedure Title:	Radiation Safety Program	CMS Number:	CMS-710-07-PR-04000
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

RADIATION SAFETY PROGRAM

Rev	Changes	Approved	Date
2	Revised responsibilities throughout, clarified radiation safety committee scope and added reference to applicable CMS documents. Included requirements for Notice of Violation (NOV) response review/approval by the Director, Radiation Safety (DRS) and notification of the responsible manager of potential NOVs. Procedure number changed from CMS-710-01-PR-04000 to CMS-710-07-P-04000 to reflect move to the CMS HSE Radiation Safety Folder.	MOS	30 Oct 2014
1	Issued for Use	JPO	05 Dec 2013
0	Issued for Use	JPO	20 Jun 2013

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1.0 PURPOSE

This purpose of this procedure is to define and establish the CB&I Radiation Safety Program (RSP) and to provide the required components, responsibilities and oversight of each site-specific radiation protection plan (RPP) developed to ensure safe, efficient, and compliant work with radioactive material and sources of ionizing radiation.

2.0 SCOPE

This document prescribes the specific requirements for RPPs that are developed and implemented for all CB&I sites and licensed activities that involve the possession, use or work with radioactive materials and the potential for exposure to sources of ionizing radiation.

All CB&I sites where work-related activities may result in workers and/or the public being exposed to ionizing radiation above background levels are required to implement the requirements in the approved site-specific RPP. When contractors are performing radiation work for CB&I, verification that the contractor's radiation safety program meets applicable regulatory standards and CB&I ALARA policy must be completed and documented in the site-specific RPP by a qualified individual and approved by the Director, Radiation Safety (DRS), prior to beginning radiation work.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure:

- CB&I Managers
- CB&I Supervisors
- CB&I Employees
- CB&I Contractors
- CB&I Subcontractors

4.0 PROCEDURE

4.1 General

4.1.1 Radiation Safety Committee (RSC)

- Provide executive oversight for the CB&I Radiation Safety Program (RSP), including assurance that exposures to ionizing radiation are maintained As Low As Reasonably Achievable (ALARA). See CMS-710-07-PR-04001, *Radiation Safety Committee*.

4.1.2 Health, Safety and Environment (HSE) Director

- Appoint members to the Radiation Safety Committee.
- Ensure necessary resources are available to safely and compliantly execute projects and contracts in accordance with the RPP.
- Ensure that the radiation safety organization supporting the RSP maintains sufficient organizational independence to review and evaluate company activities involving the use of radioactive materials, radiation-producing machines, and project sites where radioactive materials are present.
- Responsible to ensure that lessons learned from radiation safety programs are shared and applied as appropriate on projects.

4.1.3 Director, Radiation Safety (DRS)

- Direct the Radiation Safety Group, which includes guiding the development, management, and implementation of the CB&I RSP, management of radiation resources (equipment and personnel), on-going improvement of the program, management of the Project Health Physicists and Project Radiation Safety Officers (PRSO) to provide technically sound support to field activities to ensure compliance with applicable regulatory, license and contract technical requirements.

- Direct independent radiation safety audits of sites and licenses for which an RPP is required. This includes pre-operation, periodic, and episodic reviews. Long duration projects shall be reviewed annually. An independent audit of short duration (less than one year) projects shall be performed at the discretion of the DRS.
- Review and approve requisitions for services and materials involving potential exposure to ionizing radiation or radioactive materials.
- Review and approve RPPs developed for projects, licenses, sites, task orders, etc.
- Provide oversight of NRC and Agreement State radioactive materials license requirements during the performance of radiation investigations, remedial actions, laboratory processes or handling/storage of radioactive material. Designate Authorized Users in accordance with NRC and state license requirements.
- Serve as the contact person for NRC or State regulator's site inspections of operations and lead technical authority in programmatic regulatory matters. Maintain records of regulatory interfaces. The DRS may designate the assigned PRSO to serve as the point of contact for site inspections, as documented in the site-specific RPP.
- Lead radiation emergency response efforts.
- Verify adequacy of contractor Radiation Safety Program through approval of project-specific RPP.

4.1.4 Project Manager (PM)/Responsible Manager (RM)

- Project Managers/Responsible Managers are responsible for conducting work safely and in compliance with all applicable permits, licenses, client contracts and other applicable radiation safety controlling documents.
- Manage work to ensure radiation exposure is kept ALARA.
- Make resources and staffing available to develop and implement the RPP in compliance with applicable regulations, requirements and commitments and see that it is approved in a timely manner.
- In collaboration with PRSO or assigned Health Physicist, address all radiation issues during proposal/plan development.

4.2 Procedure

4.2.1 It is CB&I'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 radiation hazards may not begin unless an approved RPP is in place ensuring that work can be performed in a safe and compliant manner. CB&I endorses and applies ALARA principles to radiological work so that personnel exposures to radiation are maintained as low as reasonably achievable (ALARA).

4.2.2 Development of Radiation Protection Plans (RPP)

RPPs shall be developed to support consistent application of program requirements. This section describes key elements required for an RPP that shall be considered and included directly in the RPP or by reference to a specific procedure. Individual items may be tailored for applicability based on project hazard assessment. A client format may be used if specified by contract or when working to client procedures.

The RPP and associated procedures provide information to meet project or license specific requirements, regulations, and commitments. At a minimum, the RPP shall define and quantify sources of radiation and identify risks to occupational workers and members of the public managed under the RPP. Controlling documents shall be identified and/or incorporated into the RPP, as appropriate. Project specific work instructions shall be developed and applied as necessary to ensure safe handling of radioactive material and control personnel exposure to ionizing radiation. CB&I

procedures and/or project-specific work instructions shall be utilized to support RPP requirements and as a means of employing the best practices and consistent methods. Refer to the reference section of this procedure for applicable work instructions and forms.

4.2.3 Identification of Radiation Hazards

Each RPP shall include requirements to provide on-going evaluation and documentation of radiation hazards that may be present. The RPP shall be developed from the best available information about the radiation sources involved. This will include information about quantities and concentrations of the specific radionuclides to be handled and the characteristics of any devices that may produce ionizing radiation when energized. If the available information is not conclusive, conservative assumptions shall be made. The RPP must be periodically reviewed and maintained to reflect current radiation conditions.

4.2.3.1 Evaluation of Potential Exposure to Workers

All RPPs shall include an evaluation of external and internal exposures that are likely to occur during routine operations. This is a key step in development of site-specific radiation protection procedures. A graded approach shall be implemented; the higher the potential exposures the more detail must be included in the RPP. RPPs for activities that involve the use of radioactive material other than sealed sources must include an evaluation of intakes that are likely to occur during normal operations. These projections drive the development of the bioassay and air sampling technical basis documents and programs, engineering controls, personal protective equipment (PPE), etc. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04003, *Evaluating Potential Occupational Exposures*.

4.2.4 Controlling Agencies and Licenses

Controlling documents shall be identified and may include contracts, licenses, regulations, client RPPs, regulatory guides and other documents. These documents are to be examined, understood and align with corporate requirements assessed prior to the start of the project.

All aspects of licenses, including the RPP are considered contractual agreements between the company and the licensing agency. All licensing actions shall be subject to review by the DRS prior to submission to the Regulator.

Controlling documents shall be maintained as part of the RPP documentation package until conclusion of the program or project or termination of the applicable license.

Copies of radioactive material and radiography licenses for CB&I projects shall be maintained by the Radiation Safety Group Licensing Manager and made available on the Radiation Safety website. Additional requirements for industrial radiography programs are provided in CMS-710-07-PR-04019, *Industrial Radiography.*

Record management and retention must meet requirements of Section 4.2.19 below. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04004, *Radiation Safety Controlling Agencies and Licenses*.

4.2.5 Radiation Safety Training Program

All RPPs shall include requirements for the radiation safety training of personnel. The level of training for personnel shall be commensurate with the level of exposure anticipated and shall be compliant with applicable regulations, requirements, and commitments. Radiation safety training must be established for general employees, radiation workers, and visitors and meet applicable regulatory requirements and requirements of CMS-710-05-PR-1900, *HSE Education and Training*.

Records of radiation worker training and general employee radiation safety training shall be maintained with project records and entered into the CB&I Electronic Data Management System (EDMS). Periodic retraining shall be established with a frequency of no less than every two years. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04005, *Radiation Safety Training*.

4.2.5.1 Declared Pregnant Woman Program

RPPs shall include provisions allowing radiation workers to declare pregnancy in writing. These programs shall be developed so as to comply with 10 CFR 20, USNRC Regulatory Guides 8.13 and 8.29, and any other applicable regulations, requirements, and commitments. CMS-710-01-PR-00200, *Embryo-Fetus Protection Program*.

4.2.6 Evaluation of Public Dose

Each RPP shall include a project-specific procedure for demonstrating compliance with internal and external public dose limits and commitments. A review of public dose shall be evaluated and reported to the DRS annually for those projects lasting greater than 12 months. The annual public dose report shall include a description of the type of monitoring used and public dose calculation assumptions. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04006, *Evaluation of Pubic Dose*.

4.2.7 ALARA Program

ALARA principles shall be addressed in all RPPs. All RPPs shall include a written plan for review of ALARA efforts. The resources directed towards dose reduction should be proportional to the magnitude of the potential reduction and shall be focused on those areas in which the greatest potential dose reduction exists. An ongoing ALARA review program is required; the frequency of ALARA reviews shall be, at a minimum, annual. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04007, *ALARA Program*.

4.2.8 Control of Radiation Work – Radiological Work Permits

Control of work involving radioactive materials, sources and radiation-producing machines shall be accomplished by establishing radiation standards and responsibilities, using first-line supervisors and radiation protection personnel to monitor performance of radiation work, training workers in radiation hazards, and providing personnel with operating procedures and/or Radiological Work Permits (RWPs) that establish job-specific radiation protection measures and controls necessary for safe and compliant completion of the job. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04008, *Control of Radiological Work*.

4.2.9 External Exposure Control and Monitoring

All RPPs authorizing the use of radionuclides that present external hazard shall include procedures for controlling and minimizing external exposure. In addition to time, distance and shielding, provisions should include practice, in the form of mock-ups and dry runs, before high activity sources are manipulated. Special consideration shall be given to storage areas. Provisions for documented periodic and episodic measurements of radiation fields are essential.

Each RPP shall include the process for assigning external dosimetry to individuals based upon evaluations of the likely external exposures. As appropriate, external dosimetry obtained from, and processed by, a National Voluntary Laboratory Accreditation Program (NVLAP) or Department of Energy Laboratory Accreditation Program (DOELAP) certified dosimeter processor shall be furnished. Dosimetry reports shall be promptly reviewed by the PRSO on receipt and actions are to be taken as required to maintain exposures ALARA. All administrative and engineering external exposure controls and external dosimetry shall be included in the project or task-specific operating procedure or RWP. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04009, *External Exposure Control and Monitoring*.

4.2.10 Internal Exposure Control and Monitoring

All RPPs for activities in which unsealed radioactive material is handled shall include procedures for minimizing intakes of radioactive material. Engineering controls such as dust suppression and air handling are the preferred means of reducing risks of intakes and shall be evaluated. In addition, personal protective equipment (PPE) may be used. When engineering controls cannot meet exposure reduction goals for airborne material, respiratory protective equipment (RPE) may be used in conjunction with an approved, documented RPE program.

Each RPP developed for work involving the use unsealed radioactive material shall include a process for assessing internal exposure. A technical basis for the Internal Exposure program shall be established. Determination of intakes may be made by bioassay (direct or indirect measurement) or determining airborne levels of radioactive material in an individual breathing zone or by a combination of the above. Refer to regulations, requirements and commitments for preferred methods. A technical basis for the Internal Exposure program shall be established. All administrative and engineering internal exposure controls and bioassay requirements shall be included in the project or task-specific operating procedure or RWP. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04010, *Internal Exposure Control and Monitoring*.

4.2.11 Surveys and Monitoring

Each RPP shall include procedures that provide guidance for developing the survey and monitoring plans necessary to evaluate exposure to personnel and concentrations of radioactive material. Methods used to perform these surveys include air sampling, smear testing, collection and analysis of samples, measurement of the intensity of radiation fields, calculations and observations. Surveys as used in this context may be routine periodic occurrences, or may be prompted by an event such as movement of a source, shielding redesign, or request to move equipment from a contamination zone. A schedule for performing routine surveys of various types shall be established. A technical basis document showing that instruments have the required sensitivity and range shall be used for selecting instruments used for measurement and monitoring. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04011, *Radiological Surveys and Monitoring*.

4.2.12 Contamination Control

Each RPP shall include provisions for limiting the spread of radioactive contamination. The key component of contamination control is the identification and demarcation of zones where contamination is likely. Contamination control shall emphasize controlling the flow of personnel, equipment, and supplies into and out of these areas. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04012, *Contamination Control*.

4.2.13 Instrumentation

The RPP shall include a section in which radiation detection instruments suitable for the required measurements are listed and the guidelines for developing operational procedures are presented. Operating instructions, calibration and quality assurance procedures shall be maintained for each instrument. This requirement applies to portable and fixed instruments. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04013, *Instrumentation*.

4.2.14 Radiological Labelling, Posting and Access Control

Each RPP shall include provisions to identify, label, post and provide access control of radiologically-controlled (and/or restricted) material and areas. The results of surveys shall be used to establish boundaries and controls for radioactive material areas, radiation and high radiation areas, contamination and high contamination areas, and airborne radioactivity areas. All radiological areas shall be posted as required by the

controlling documents. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04014, *Radiological Labelling, Posting and Access Control*.

4.2.15 Radiation Safety Staff Credentials

Each RPP shall include a procedure for a documented review and acceptance of the credentials of health physics staff. Minimal qualification requirements shall be established or approved by the Manager, Radiation Safety Program Performance. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04015, *Radiation Safety Staff Credentials*.

4.2.16 Procurement, Receipt, Transfer and Inventory of Radioactive Material

Each RPP shall include a procedure for maintaining an inventory of radioactive material under its control. As appropriate, the procedure shall include provisions for procuring, receiving, and checking-in shipments of radioactive material in accordance with the requirements of the controlling documents. Transfers of radiation sources to other licensed entities must be documented in accordance with the requirements of the controlling documents. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04016, *Procurement, Receipt, Transfer and Inventory of Radioactive Material*.

4.2.17 Shipping and Transportation of Radioactive Materials

Each RPP shall contain procedures for shipping and transportation of radioactive material. Radioactive material that is shipped by the company shall be packaged, surveyed, and labelled by a qualified shipper in accordance with USDOT regulations, found in Title 49 CFR and in accordance with any other applicable regulations such as Part 71 of Title 10 CFR. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04017, *Shipping and Transportation of Radioactive Material*.

4.2.18 Control of Radioactive Waste

Each RPP shall include procedures for minimizing the amount of waste generated. The amount of waste that must be disposed of on site or that must be sent off site to licensed disposal facilities shall be minimized. Disposal of radioactive waste may be done only as allowed by the controlling documents. Minimum requirements of this RPP element can be found in CMS-710-07-PR-04018, *Control of Radioactive Waste*.

4.2.19 Radiation Protection Records

Records shall be maintained in order to document implementation of each RPP and to demonstrate compliance with regulations, requirements, and commitments. Records relating to a license program shall be maintained for the duration of the USNRC or state license, or disposed of as authorized by the USNRC or applicable state agency. Record retention requirements should be determined by examination of controlling documents. Each RPP shall include specific record maintenance and retention requirements unique to the project/program, regulatory requirement and applicable requirements of CMS-870-02-PR-10005, *General Document Management*.

4.2.20 Reports and Notifications

- Each RPP shall include procedures for developing, communicating, and delivering required reports and notification. These procedures shall include provisions to notify the DRS of all incidents and notifications and reports to regulators. Each RPP shall include provisions for dealing with radiation occurrences including the issuance and distribution of Radiation Improvement Reports (RIRs). In addition, the DRS and PM/RM shall be informed of all regulatory inspections, proposed regulatory Notices of Violation (NOV), fines, or escalated enforcement actions. As appropriate these procedures should include provisions for required reports to workers. The DRS shall review and approve responses to proposed NOVs.

Planned Special Exposures (PSE)

RPPs that include provisions for allowing planned special exposures shall require the written approval of the PRSO, PM/RM and the DRS. The RSC shall review and approve PSEs.

4.2.21 Review and Approval of RPPs

The RPP is not issued or in effect until it has been reviewed and approved by a designated radiation safety technical reviewer and approved by the DRS or designee. The RPP will state any specific conditions of approval and will specify the limit of the duration of approval, if any. Time for development of the RPP must include sufficient time for the required reviews.

RPPs shall be reviewed when work conditions change and reviewed periodically (annually) during the project. When the RPP must be modified to fit changing site conditions the changes shall be made as an amendment to the RPP. The original text of the RPP shall not be deleted but shall be lined through to indicate that it is no longer applicable.

The RPP shall be reviewed with all project personnel before work begins. All project personnel governed by the program shall sign acknowledging their understanding of site rules and site hazards prior to beginning work. This may be coordinated with acknowledgement of the site Health and Safety Plan.

4.2.22 Self-Assessment, Reviews, and Corrective Actions

4.2.22.1 Self-Assessment

Periodic self-assessments shall be conducted in accordance with ALARA goals. Self-assessments shall evaluate radiation safety, RPP implementation, and compliance with regulations. The CB&I I-CARE radiation safety cards can be used to supplement periodic self-assessments. The frequency of the self-assessments shall be no less than once per quarter. For projects with durations less than a quarter, at least one self-assessment must be performed and documented.

4.2.22.2 Radiation Protection Plan Audits

Audit Plans shall be developed for each site and documented in the Radiation Audit Plan. All documents related to radiation safety shall be reviewed and recorded per requirements of CMS-710-07-PR-04002, *Radiation Safety Audit Program*. An RPP audit must be completed annually. Short-term duration projects of less than one year must have at a minimum of one RPP audit.

4.2.22.3 Incident Notification and Corrective Actions

Deficiencies shall be documented using the RIR and incident notification process, per requirements of CMS-710-07-PR-04020, *Incident Notification and Reporting*. If serious deficiencies are noted, immediate action will be required. The PRSO and PM/RM shall develop and implement a corrective action plan with specifically assigned tasks and a schedule for completion. The corrective action plan requires review by the DRS and RSC, Chair. Corrective actions must be completed in a timely manner. Less serious deficiencies may be resolved immediately without a corrective action plan. Radiation Corrective Action plans shall be developed for all deficiencies and corrective actions managed in the CB&I EDMS.

5.0 REFERENCES

CMS-701-01-PR-00200	Embryo-Fetus Protection Program
CMS-710-07-PR-04001	Radiation Safety Committee
CMS-710-07-PR-04002	Radiation Safety Audit Program
CMS-710-07-PR-04003	Evaluation of Potential Occupational Dose
CMS-710-07-PR-04004	Radiation Safety Controlling Agencies and Licenses
CMS-710-07-PR-04005	Radiation Safety Training
CMS-710-07-PR-04006	Evaluation of Public Dose
CMS-710-07-PR-04007	ALARA Program
CMS-710-07-PR-04008	Control of Radiological Work
CMS-710-07-PR-04009	External Exposure Control and Monitoring
CMS-710-07-PR-04010	Internal Exposure Control and Monitoring
CMS-710-07-PR-04011	Surveys and Monitoring
CMS-710-07-PR-04012	Contamination Control
CMS-710-07-PR-04013	Radiation Safety Instrumentation
CMS-710-07-PR-04014	Radiological Labelling, Posting and Access Control
CMS-710-07-PR-04015	Radiation Safety Staff Credentials
CMS-710-07-PR-04016	Procurement, Receipt, Transfer and Inventory of Radioactive Material
CMS-710-07-PR-04017	Shipping and Transportation of Radioactive Waste
CMS-710-07-PR-04018	Radioactive Waste Control
CMS-710-07-PR-04019	Industrial Radiography
CMS-710-07-PR-04020	Incident Notification and Reporting
CMS-870-02-PR-10005	General Document Management
Title 49 CFR	Code of Federal Regulations
Title 10 CFR, Part 71	Code of Federal Regulations
USNRC 10 CFR 20	Regulatory Guides 8.13 and 8.29

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
DOELAP	Department of Energy Laboratory Accreditation Program
DRS	Director of Radiation Safety
EDMS	CB&I Electronic Data Management System
HSE	Health, Safety and Environment
NOV	Notice of Violation
NRC	Nuclear Regulatory Commission
NVLAP	National Voluntary Laboratory Accreditation Program

Term (Acronym)	***Definition***
PM	Project Manager
PPE	Personal Protective Equipment
PRSO	Project Radiation Safety Officer
PSE	Planned Special Exposures
Radiation Protection Plan (RPP)	Provides license reference and procedures used by a specific site or project to detail methods involved with safe handling of radioactive materials, radiation sources and/or devices.
RIR	Radiation Improvement Report
RM	Responsible Manager
RPE	Respiratory Protective Equipment
RSC	Radiation Safety Committee
Radiation Safety Group	Group of professional responsible for design and implementation of CB&I Radiation Safety Program. The Radiation Safety Group is managed by the Director, Radiation Safety.
Radiation Safety Program (RSP)	Comprehensive set of policies and plans developed and implemented to achieve and ensure compliance to regulatory requirements involving the use of radioactive materials and/or radiation sources.
RWP	Radiological Work Permit

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

Attachment 8.1	RPP Template

PROCEDURE

Procedure Title:	Radiation Safety Committee	CMS Number:	CMS-710-01-PR-04001
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

RADIATION SAFETY COMMITTEE

0	Issued for Use	MOS	30 Oct 2014
Rev	Changes	Approved	Date

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CMS Number:	Revision:	Approval Date:
CMS-710-01-PR-04001	0	30 Oct 2014

1.0 PURPOSE

This purpose of this Work Instruction is to define the membership, authority, responsibilities and operating rules of the CB&I Radiation Safety Committee.

2.0 SCOPE

The Radiation Safety Committee (RSC) is a standing committee and serves as the governing body for all aspects of radiation protection, including contractor provided services, for activities involving the use of ionizing radiation material, sources or devices (collectively referred to as “radiation sources”) at CB&I project and work sites. The RSC shall ensure that all possession, use and disposition of radiation sources by CB&I personnel and contractors complies with pertinent federal and state regulations and with the specific conditions of licenses issued to CB&I, and that all concomitant radiation exposures are maintained As Low as Reasonably Achievable (ALARA).

3.0 RESPONSIBILITIES

The RSC is a CB&I standing committee that is responsible for oversight of the Corporate Radiation Safety Program (RSP). The Committee has the responsibility and authority to grant, deny, require changes or withdraw permission for the use of radiation sources at a CB&I site to ensure compliance with regulation or to meet reasonable standard for health and safety.

The RSC reports to the Federal Services Health, Safety, Environment & Quality (HSE&Q) Director. The RSC shall be composed of not more than ten nor less than five members exclusive of ex-officio members. Members shall be appointed by the HSE&Q Director for three year renewable terms on the basis of knowledge of the principles and practices of the control of radiation hazards and on experience and management in the use of radiation sources. The membership shall reflect the diversity of CB&I field and site operations and shall include, at a minimum, the Director, Radiation Safety (DRS), and the Manager, Radiation Safety Program Performance.

3.1 President, Business Line

- Recommend appointment of member(s) to the CB&I Radiation Safety Committee

3.2 HSE&Q Director – Federal Services

- Approve members appointed to the RSC
- Responsible to ensure that lessons learned from CB&I radiation safety program are shared and applied as appropriate on projects.

3.2 Chair, Radiation Safety Committee

- Approve members appointed to the RSC
- Committee members elect the Chair from committee membership for a renewable three-year term.
- Responsible for conducting annual RSC meetings.
- Works closely with the DRS to ensure that the RSP implements the directive of the RSC.

3.3 Director, Radiation Safety (DRS) – Federal Services

- The DRS shall act as Secretary to the RSC responsible for scheduling and documenting RSC meeting minutes and ensuring RSC records are properly maintained.
- Duties may be delegated to the Manager, Radiation Safety Program Performance.

3.4 Manager, Radiation Safety Program Performance – Federal Services

- Serves as the Deputy DRS.
- Provides reports to the RSC of Radiation Safety Program assessment and audit findings and status of corrective and preventative actions.

3.5 Radiation Safety Manager (RSM) – Business Line

- Compiles Radiological Work Permits (RWP) or similar and associated documentation for presentation at RSC annual meetings for committee approval, as required.
- Informs DRS of operation activities requiring RSC review and approval to allow adequate time for meeting coordination to ensure quorum is present.

4.0 PROCEDURE

4.1 Meetings

The RSC shall meet at least once each calendar year. Additional meetings may be called by the RSC Chair to review and approve higher hazard radiation uses, review and act on radiation incidents, and/or consider matters referred by the DRS or members of the RSC.

A quorum, consisting of a simple majority of the voting membership, shall be present at all meetings and will include the Chair and DRS or designee. Minutes of the meetings shall be kept by the DRS or designee. Copies of the minutes shall be sent to members of the RSC and maintained on the Radiation Safety Program website.

4.2 Radiological Work Permit Review

Radiological Work Permits (RWPs) shall be reviewed and approved as listed below. The RWP program is provided in CMS-710-01-WI-04008, *Radiological Work Permit.* Questions and concerns identified during the review of the Class III RWP shall be directed by the DRS to the RSC for resolution prior to approval. RSC members responsible for the work under review will abstain from voting.

Approval of radioactive material and radiation-producing source/device use:

RWP Class I - reviewed and approved by the Project Radiation Safety Officer (PRSO).

RWP Class II - reviewed and approved by the PRSO following documented ALARA review.

RWP Class III - reviewed and approved by the PRSO and DRS following documented ALARA review.

The RSC, in collaboration with the DRS, may at any time prohibit controlled radiation activities which it deems to be unduly hazardous, or contrary to regulations or good practice. In such cases, the RSC shall inform the appropriate Business Line Managers and provide engineering and/or administrative controls necessary to ensure activities are properly controlled.

4.3 Radiation Safety Performance Review

The RSC provides oversight to the radiation safety compliance inspections carried out by the Radiation Safety and Quality Assurance Groups. The Manager of HSEQ and Radiation Safety Program Performance shall report to the RSC on radiation safety performance by CB&I projects. Also, on a case by case basis the DRS may bring individual compliance issues before the RSC for consideration and resolution. If radiation safety performance of a CB&I project site is found to be unsatisfactory, the RSC may recommend appropriate corrective actions to the Project Manager and/or Business Line Manager.

The RSC shall also provide oversight to the CB&I Radiation Safety Program (RSP). Periodically the DRS will provide reports to the committee on the performance in discharging policy and CB&I Management System (CMS) procedural radiation safety responsibilities. The

RSC may independently evaluate CB&I radiation safety procedures, obtain feedback from customers regarding RSP functions, and make recommendations to the HSE&Q Senior Director, or the DRS.

The RSC shall maintain records of all its activities including but not limited to regular or special meetings, investigation reports, and programmatic reviews. Throughout the year, any ad hoc committee meeting minutes and other reports shall be transmitted to the HSE&Q Director in a timely fashion. The RSC shall meet with the HSE&Q Director at least annually to discuss issues and review the RSC's activities. An annual activities report shall be prepared for the Director.

4.4 Facility Design Review

As deemed necessary by the DRS, the RSC shall review and recommend for approval radiological design reviews conducted by members of the Radiation Safety Program or other qualified individual.

4.5 ALARA

The RSC shall review and approve CB&I ALARA goals for occupational and public exposure to radiation during the annual meeting. Periodically, the Manager of Radiation Safety Program Performance shall provide reports documenting performance, trends, and explanations for recorded dose relative to these targets. At its discretion, or at the request of the DRS, the RSC may perform independent ALARA reviews of selected CB&I work activities. In such cases HSE&Q and project staff shall provide appropriate technical support.

4.6 Investigations

The RSC may investigate radiological incidents or other conditions affecting regulatory compliance or radiation protection. These investigations may be requested by the DRS, HSE&Q Director or Responsible Manager. The RSC Chair will determine the Committee's involvement in the investigation. The extent of the RSC's involvement will be determined by the nature of the situation or occurrence and its impact on the Radiation Safety Program. Investigations will be coordinated with the appropriate affected organizations. At least one member of the RSC will be on the investigation committee. A copy of the Investigation Report will be sent to the RSC and any corrective or preventative actions will be entered into the Electronic Data Management System.

5.0 REFERENCES

CMS-710-01-WI-04008	Radiological Work Permits

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low as Reasonably Achievable
CMS	CB&I Management System
DRS	Director, Radiation Safety
HSE&Q	Health, Safety, Environment & Quality
PRSO	Project or Program Radiation Safety Officer
RSC	Radiation Safety Committee
Radiation Safety Group	Group of professional responsible for design and implementation of CB&I Radiation Safety Program. The Radiation Safety Group is

Term (Acronym)	***Definition***
	managed by the Director, Radiation Safety Group.
Radiation Safety Program (RSP)	Comprehensive set of policies and plans developed and implemented to achieve and ensure compliance to regulatory requirements involving the use of radioactive materials and/or radiation sources.
Radiation Protection Plan (RPP)	Set of procedures used by a specific site or project to detail methods involved with safe handling of radioactive materials and/or radiation sources.
RSM	Radiation Safety Manager
RWP	Radiological Work Permit

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

Attachment 8.1	CB&I RSC Membership Appointment

CB&I Radiation Safety Committee
Membership Appointment Form

Nomination

As President of the _____
Name of Business Line

I nominate _____
Name of Candidate

To represent our Business Line on the Radiation Safety Committee

Signature _____ Date _____

Acceptance

I, _____
Name of Candidate

agree to serve on the Radiation Safety Committee.

_____ Date _____
Signature

Approvals

HSE&Q Director _____ Date _____
Signature

Director, Radiation Safety _____ Date _____
Signature

Appointment

Business Line President _____ Date _____

Procedure Title:	Radiation Safety Audit Program	CMS Number:	CMS-710-07-PR-04002
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

RADIATION SAFETY AUDIT PROGRAM

1	Revised to align with radiation safety program documents. Incorporated changes addressing integrated radiation safety audit scheduling, CMS audit requirements, and corrective action tracking via electronic data management system. Previously numbered CMS-710-01-WI-04502.	MOS	03 Nov 2014
0	Issued for Use	JPO	20 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

The purpose of the Radiation Safety Audit Program is to provide management with an objective evaluation and verification of performance and compliance with federal, state, and local government regulations, and company policies and procedures, as related to the areas of radiological safety.

2.0 SCOPE

This procedure may be used to meet the requirement for performing a periodic review of the radiation protection program of a facility or project as required by 10 CFR 20 and 10 CFR 835. The Radiation Safety Audit Program scope can be modified by the Director, Radiation Safety in instances where the established criteria are less than adequate or where there are extenuating/sensitive circumstances at the audited facility.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure

- Director, Radiation Safety (DRS)
- Project or Program Radiation Safety Officer (PRSO)
- Radiation Safety Lead Auditor
- CB&I Project Managers (PM), Responsible Managers (RM)
- CB&I Supervisors

4.0 PROCEDURE

4.1 General

4.1.1 Director, Radiation Safety (DRS)

The DRS is responsible for ensuring that an audit program is established and implemented. Sufficient personnel will be qualified and available to implement the program. The Director is responsible for assuring that audit reports and associated findings are analyzed and identified trends reported to management. The Director is responsible for qualifying radiation safety audit personnel including Radiation Safety (RS) Lead Auditors in accordance with the guidelines in NCRP # 162, *Self-Assessment of Radiation Safety Programs*, June 3, 2009.

4.1.2 Project or Program Radiation Safety Officer (PRSO)

The PRSOs are responsible for supporting the annual radiation safety audits by providing requested documentation, necessary site-specific information, and access to personnel to support audit activities and inquiries.

4.1.3 Project Manager/Responsible Manager

4.1.3.1 The PM/RM shall provide access to all personnel and material required for the performance of audit activities. He or she shall also ensure necessary and timely corrective action for issues identified during audit activities. He or she shall disseminate any relevant corrective actions or lessons learned to their affected organizations to preclude recurrence.

4.1.3.2 Responsible management shall respond in writing to audit reports indicating planned, completed, and/or preventive actions to address identified issues, cause(s) of identified issues, and a schedule for completion of associated corrective actions.

4.1.4 Radiation Safety Lead Auditor

The Radiation Safety Lead Auditor (Lead Auditor) is assigned by the DRS and has responsibility for managing a specific audit and making final decisions regarding the conduct of the audit and any findings. The Lead Auditor must be an experienced radiation safety professional. Specific responsibilities include assisting with selection of other audit team members (if needed), preparing the audit plan, representing the audit team with audited area management, submitting the audit report, and ensuring evaluation of audit responses and verification of resolution of findings. The Lead Auditor shall, within their discretion, escalate any issues to an appropriate level of management to help facilitate timely cooperation.

4.2 Scheduling

4.2.1 An audit schedule shall be developed for each calendar year. The audit schedule shall be made available to the DRS for review. The schedule will be revised as needed to reflect changes to planned activities, status of completion, importance of activities, results of previous audits, etc. Integration of audits with Health & Safety and/or quality audits should be considered to minimize impact on project staff.

4.2.2 Audits are scheduled to evaluate effectiveness of implementation of all processes defined in the project-specific Radiation Protection Plan in accordance with CMS-710-07-PR-04000, *Radiation Safety Program*. Additional audits may be scheduled at the request of Operations or Business Management.

4.3 Numbering

Audits completed by individual projects shall be uniquely identified. Audit numbering may be based on a systematic approach that meets the needs of the site and CMS requirements. Numbering may be assigned through the Electronic Data Management System (EDMS).

4.4 Audit Planning

4.4.1 Input from the Responsible Manager and the PRSO should be solicited by the Radiation Safety Lead Auditor in developing audit scope. Audit planning should include review of all documents and requirements relative to the subject and scope of the audit. Documents to be reviewed may include the following, as applicable:

- CB&I procedures that apply to the activity, product, or service.
- Legal and contractual documents.
- Codes, standards, or regulatory requirements.
- Project work plans, instructions, drawings, and project-specific procedures.

- Project status reports.
- Input from senior and/or project management.

4.4.2 The Lead Auditor should complete and sign an audit plan. A typical audit plan format is referenced in Form CMS-710-07-FM-40024, *Radiation Safety Audit Plan*. The audit plan should identify the following:

- Audit Number.
- Contract Number (if applicable).
- Audited Organization and Location.
- Audit Purpose and Scope.
- Audit Personnel.
- Audit Schedule.
- Audit Criteria/Reference Documents (e.g., regulations, codes, standards, applicable implementing procedures).
- Follow-up items, special concerns/items provided as input by the Management Sponsor, etc.
- Audit Team Assignments (if appropriate).

4.5 Audit Preparation

4.5.1 Based upon the scope and the documented requirements, the Lead Auditor should determine the method for conducting the audit. Methods may include personnel interviews, observing activities, and/or reviewing documentation.

4.5.2 The Lead Auditor shall ensure that preparations for the audit are complete. The audit team may include auditors, auditors-in-training, and technical specialists. The RS Lead Auditor will assure that if other audit team members are selected, they will be prepared prior to performance of the audit. Relevant information for audit preparation may include the audit plan; applicable policies, procedures and instructions; codes, standards, and regulations; contracts and specifications; prior audit reports; or management input. The Lead Auditor shall ensure that the audit team is familiar with the audited organization and key individuals applicable to the audit scope. The Lead Auditor shall ensure objectivity and impartiality of audit activities; auditors shall not audit their own work.

4.5.3 The Lead Auditor is responsible for ensuring that audit checklists sufficiently cover the scope of the audit and are appropriate for the specific work scope. New or existing checklists may be used. Existing checklists may be modified to meet the needs of the audit scope. Auditors and technical specialists may support the development of audit checklists.

4.6 Audit Notification

Appropriate management personnel of the audited organization (PR/RM and PRSO) shall be notified in advance of each audit. Notification shall be documented by the Lead Auditor. Notification shall include the audit number, objectives, scope, schedule, and team lead and members. Notifications may be transmitted via email; records should be maintained of correspondence. CMS-710-07-FM-40021, *Radiation Safety Audit Notification*, or equivalent shall be used.

4.7 Audit Process

4.7.1 Pre-Audit Meeting

The Lead Auditor shall offer to conduct a brief pre-audit meeting with management or supervisory personnel of the organization to be audited to accomplish the following:

- Confirm the audit scope and purpose.
- Introduce the audit team.
- Meet escorts and contacts.
- Discuss any site Health and Safety requirements or concerns.
- Discuss the audit sequence.
- Establish a tentative time for the post-audit meeting.
- Establish channels of communication.

4.7.2 Audit Performance

4.7.2.1 Audits shall be performed by document reviews, personnel interviews, evaluation of products, and direct observations of activities, as applicable. Objective evidence shall be evaluated in sufficient depth to determine if selected elements are being effectively implemented. Details of audit activities should be documented on audit checklists, procedures, photographs, other guidance documents used, or in auditor notes. Completed checklists provide documented information to support development of the final audit report.

4.7.2.2 The Lead Auditor and assigned team members shall discuss potential findings as identified with individuals being audited to ensure any finding(s) reported are accurate and clearly understood. Supporting details must be available for development of audit findings. The Lead Auditor shall ensure responsible management or appointed audit contacts are kept informed of emerging audit issues.

4.7.3 Post-Audit Meeting

The Lead Auditor shall offer to conduct a post-audit meeting with management or supervisory personnel of the organization or activity audited. This post-audit meeting should accomplish the following:

- Discuss results of the audit including scope and activities observed.
- Present the audit findings.
- Discuss significance of findings.
- Discuss expectations of reporting and any required corrective action reporting (CMS-710-07-FM-40025, *Radiation Safety Corrective Action Report*).

4.8 Audit Reporting

4.8.1 The Lead Auditor shall prepare and distribute a final audit report within 30 working days of completion of the audit (post-audit conference). The Lead Auditor shall submit the report under cover of a letter or memorandum to the Responsible Manager of the audited organization or activity.

4.8.2 Project audits, distribution should include the Project Manager, PRSO and DRS, as a minimum.

4.8.3 Report Content

The report shall provide the following information, at a minimum:

- Cover Page
  - Audit Number.
  - Organization/Activity Audited.
  - Location.
  - Audit Dates(s).
  - Audit Report Approval.
- Audit Report
  - Executive Summary.
  - Audit Purpose/Scope.
  - Audit Team (including role of each team member).
  - Audit Results (includes activities observed, areas audited, reference documents, conclusions and supporting information).
  - Audit Findings.
  - OFIs.
  - Attachments listing audit participants (personnel contacted), documents reviewed, and copies of corrective action documents issued.

CMS-710-07-FM-40022, *Radiation Safety Audit Report Cover Memo* and CMS-710-07-FM-40023 *Radiation Safety Audit Report*, or equivalent documents, shall be used to document and transmit audit results.

4.8.4 Opportunities for Improvement and Findings

Opportunities for Improvement shall be included in the text of the report under the applicable audited element and in abstract form in the associated table.

The report shall document any findings identified as a result of the audit.

4.8.5 Issues Resolved During the Audit

Audit identified issues that are resolved during the course of the audit should be noted in the audit report. In-process corrective actions taken during the audit to address the identified issue should be included in the discussion. These items should be documented on a Corrective Action Report, *CMS-710-07-FM-40025*, or similar, and documented as verified and closed during the audit; these issues require no further response from the audited organization.

4.9 Audit Finding Response, Follow-up, and Closure

4.9.1 Audit Finding Response

The PM/RM must develop and approve a written corrective action report (CAR) to each programmatic or process-related finding issued. Approval may be indicated by signature or e-mail cover page for electronic submittals. A written

response is required within 30 days of receipt of the audit finding/report. The response must include the following:

- The basic cause(s) that lead to the condition reported in the finding.
- The steps that have been or will be taken to correct the condition reported in the finding.
- The steps that have been or will be taken to preclude recurrence (if appropriate).
- The dates when indicated action was or will be complete.
- Responsible manager approval of response.

NOTE: If required information is included on the associated CAR form, that form may be submitted for review by the Lead Auditor in lieu of supplemental correspondence.

4.9.1.1 Response Extensions

The audited organization shall monitor the status of the audit response. If more than 30 days is required for completion than originally indicated on a finding response, a documented request for extension and revised due date shall be submitted to the Lead Auditor (e-mail is acceptable) and DRS. The Lead Auditor shall evaluate the request and make a formal response to the requesting organization.

4.9.1.2 Overdue Responses

When responses are overdue, the Lead Auditor will notify the responsible organization, the next level manager and the DRS by e-mail that responses are overdue. The audited organization should request a new response due date.

4.9.1.3 Evaluation of Responses

The Lead Auditor, upon receipt of responses to audit findings, will coordinate with the assigned audit team members for the evaluation of responses. Audit responses must meet the satisfaction of the Lead Auditor. Unacceptable audit responses will be documented and distributed to the responsible organization with the reason for rejection within two weeks of receipt of the response. A revised response will be solicited to include a new response due date. The final audit response shall be acceptable to the Lead Auditor.

4.9.2 Audit Finding Corrective Action Completion, Tracking, Verification, and Closure

4.9.2.1 Corrective and preventive actions shall be completed as defined in the audit response. Upon completion, the audited organization (RM or designee) shall notify the Lead Auditor. Objective evidence of completed action should be submitted with the notification if possible.

4.9.2.2 The Lead Auditor will coordinate with the applicable audit team members for the verification of corrective actions. The Lead Auditor shall ensure that corrective action implementation is verified and shall document the results of verification. Verification may be performed by evaluation of objective evidence, field inspection, or other methods.

Corrective actions that are determined unacceptable will be documented and the reason provided to the responsible organization.

4.9.2.3 Findings will be closed when the Lead Auditor determines that corrective actions have been verified as complete. Tracking of findings, corrective actions and closure will be managed through the EDMS.

4.9.2.4 Corrective Action Extensions

The audited organization shall monitor the status of audit corrective actions. If additional time is required for completion than originally indicated on the audit response, a request for extension stating the reason for the delay and the suggested revised due date shall be submitted to the Lead Auditor. The Lead Auditor shall evaluate the request and make a formal response to the requesting organization.

4.9.2.5 Overdue Corrective Action

When corrective actions are overdue, the Lead Auditor will notify the responsible organization by e-mail or via the EDMS that responses are overdue.

4.10 Audit Follow-Up and Close-Out

The Lead Auditor shall evaluate completed response, corrective actions, and conduct verification activities. Auditors may be assigned follow up and closure activities but the responsibility for closure is maintained by the assigned Lead Auditor. If verification activities find ineffective or incomplete corrective actions, correspondence on the findings shall be forwarded to responsible audit area management for additional action.

Upon close-out of all audit findings, the Lead Auditor will notify the Project Manager/Responsible Manager from the audited organization by memorandum, e-mail, or via the EDMS that all actions are complete, corrective actions have been approved, and that the audit is closed.

4.11 Records

Original records shall be retained in a suitable records management system. The Lead Auditor shall be responsible for compiling a completed record of the audit. If project requirements mandate that files be maintained at the project location, a copy of audit related information should be forwarded by the Lead Auditor. Records required shall include:

- Completed Audit Schedule (end of year status).
- Audit Plan/Checklists (or other supporting documents if needed).
- Audit Report.
- Completed Finding Reports (CFRs).
- Audit Correspondence (initial response, and correspondence associated with delinquent, incomplete, or completed corrective action).
- Audit Follow up Report (if applicable).

NOTE: Completed checklists, auditor notes, or marked up guidance documents or procedures are not required as permanent records if the audit report includes adequate objective evidence to support report conclusions (e.g., list of documents reviewed, specific activities observed, audit objectives/criteria evaluated and results of each, etc.).

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-CK-40021	Radiation Safety Audit Checklist – Service Provider Licenses
CMS-710-07-CK-40022	Radiation Safety Audit Checklist – Radiography
CMS-710-07-FM-40021	Radiation Safety Audit Notification
CMS-710-07-FM-40022	Radiation Safety Audit Report Cover Memo
CMS-710-07-FM-40023	Radiation Safety Audit Report
CMS-710-07-FM-40024	Radiation Safety Audit Plan
CMS-710-07-FM-40025	Radiation Safety Audit Corrective Action Report
NCRP # 162	Self-Assessment of Radiation Safety Programs, June 3, 2009
10 CFR 20	Standards for Protection Against Radiation
10 CFR 835	Occupational Radiation Protection

6.0 TERMINOLOGY

Term	***Definition***
CAR	Corrective Action Report
CFR	Code of Federal Regulations
DRS	Director, Radiation Safety
EDMS	CB&I Electronic Data Management System
Finding	A documented statement of fact concerning a non-compliance or deviation from established requirements
Opportunity for Improvement (OFI)	A recommendation for improvement not based upon requirements but focused upon process improvement opportunities. An OFI may also be a statement of fact regarding the potential for a noncompliance that could lead to a more serious problem if not identified and/or corrected, but that does not constitute a lack of compliance with established requirements.
PM	Project Manager
PRSO	Project Radiation Safety Officer
RM	Responsible Manager
RS	Radiation Safety

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	**Evaluating Potential Occupational Exposures**	**CMS Number:**	**CMS-710-07-PR-04003**
Procedure Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

EVALUATING POTENTIAL OCCUPATIONAL EXPOSURES

1	Revised to align with Radiation Safety Program document remapping. Revised position titles and added responsibilities. Clarified documentation and reporting requirements.	MOS	03 Nov 2014
0	Issued For Use	JPO	20 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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CMS Number:	Revision:	Approval Date:
CMS-710-07-PR-04003	1	03 Nov 2014

1.0 PURPOSE

This procedure describes the CB&I Radiological Safety Program requirement for evaluating potential exposures. The principles, concepts, and guidance in this instruction are to be utilized, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation.

2.0 SCOPE

This procedure will be implemented, as appropriate, to support sites involving the potential for occupational exposure to sources of ionizing radiation. This procedure addresses routine annual dose evaluations. Planned special exposures are addressed in CMS-710-07-GL-04003, *Planned Special Exposures*.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure:

Director, Radiation Safety (DRS)
Project or Program Radiation Safety Officer (PRSO)

4.0 PROCEDURE

All Radiation Protection Plans (RPPs) must include an evaluation of exposures that are likely to occur during routine operations. A higher potential exposure will necessitate a more detailed RPP. RPPs for activities that involve the use of radioactive material other than sealed sources must include an evaluation of intakes that are likely to occur during normal operations. These projections drive the development of the bioassay and air sampling programs, use of engineering controls, personal protective equipment requirements, dosimetry requirement.

4.1 Information Gathering

Many types of information may be useful in evaluating potential radiation doses. These include procurement records, licensing documents, incident reports, survey data, site characterization reports, work plans, and historical dosimetry data (this and similar sites). The information shall be identified and assembled as needed. Consult the referenced sources listed for additional information.

4.2 Identifying Groups of Workers

Potential radiation doses for groups of workers who have similar radiological work conditions shall be evaluated as applicable. Typically, similarity of work conditions will be based upon frequency of access to particular restricted or controlled areas. It is important to re-evaluate an individual's likely exposure if their radiological work conditions change during a year.

4.3 Existing Monitoring Data

Potential occupational radiation doses using individual monitoring data and air sampling data from the current activity shall be evaluated as applicable. It may also be appropriate to use data acquired from other sites conducting similar work. When using data acquired from other sites, the sources of radiation including radionuclides, concentrations, and amounts must be similar to those at the site of the current or proposed activity. Likewise, work activities, including engineering controls, must also be similar. It is important to re-evaluate potential radiation doses if radiological work conditions change.

4.4 Survey Data

Measurements or calculations of dose rates and projections of occupancy times shall be used to evaluate potential external radiation doses as applicable. When appropriate, evaluate Deep Dose Equivalent (DDE), Lens Dose Equivalent (LDE), and Shallow Dose Equivalent (SDE). Potential inhalation intakes of radioactive material may be evaluated by measurement or calculation of airborne concentrations and occupancy times. For example, a person performing light work is assumed to respire 20 liters of air per minute. Credit for respiratory protective

equipment may be included in the calculation. As a rule of thumb first estimates of likely annual intakes may be set at $1x10^{-6}$ of annual throughput of loose radioactive material if engineering controls are not used. For laboratory work, fume hoods are assumed to provide a factor of 10 reduction in likely intakes and glove boxes are assumed to provide a factor of 100 reduction in likely intakes as compared to work on an open bench. Dust suppression during soil remediation typically furnishes an additional protection factor of 1000.

4.5 Documenting Evaluations

The PRSO is responsible for completing CMS-710-07-FM-04003, *Likely Annual Radiation Dose Evaluation* form and submitting with or incorporating in the RPP to the DRS for review and concurrence (CMS-710-07-PR-04000, *Radiation Safety Program*). All supporting documentation used to determine likely dose shall be provided with the form.

Methods used to evaluate potential doses and the dose projections shall be included or submitted with the RPP, and shall also be maintained with the site records.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-FM-04003	Likely Annual Radiation Dose Evaluation Form
CMS-710-07-GL-04003	Planned Special Exposures

6.0 TERMINOLOGY

Term	***Definition***
DDE	Deep dose equivalent, the dose to the whole body at a tissue depth of 1000 milligrams per square centimeter (mg/cm2).
DRS	Director, Radiation Safety
LDE	Lens dose equivalent, the dose to the lens of the eye at a tissue depth of 300 mg/cm2.
PRSO	Project or Program Radiation Safety Officer
RPP	Radiation Protection Plan
SDE	Shallow dose equivalent, the dose to the skin of the body and the extremities at a tissue depth of 7 mg/cm2.

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 - Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 - Technical Glossary

8.0 ATTACHMENTS

None

PROCEDURE

Procedure Title:	Radiation Safety Controlling Agencies and Licenses	CMS Number:	CMS-710-07-PR-04004
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

RADIATION SAFETY CONTROLLING AGENCIES AND LICENSES

1	Merged two documents, CMS-710-01-WI-04002 and CMS-710-01-GL-04123, and renumbered to new radiation safety folder. Formatted to align with radiation safety documents revisions and responsibilities.	MOS	03 Nov 2014
0	Issue for Use	JPO	12 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure describes the CB&I CMS-710-07-PR-04000, *Radiation Safety Program* requirements for defining the project- or program-specific Controlling Agencies and Licenses. Controlling agencies and licenses must be detailed in each site-specific Radiation Protection Plan (RPP).

2.0 SCOPE

This procedure is to be used to support CB&I work sites and projects involving potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure.

- Director, Radiation Safety (DRS)
- Project or Program Radiation Safety Officer (PRSO)
- Radiation Safety License Manager

4.0 PROCEDURE

4.1 Introduction

4.1.1 Controlling documents may include contracts, licenses, regulations, project-specific RPP regulatory guides, and other documents. The PRSO must list applicable controlling agencies and licenses in the site- or task-specific RPP. Copies of controlling documents are to be maintained as part of the site Radiation Safety records until conclusion of the program, project, or termination of the applicable license.

4.1.2 The DRS shall ensure that each RPP has identified the correct controlling agencies, documents and applicable license prior to authorizing work with sources of ionizing radiation.

4.1.3 Each CB&I License is maintained by the designated Radiation Safety License Manager.

4.1.4 Attachment 1, *Regulatory Requirements, Guidance, and Standards*, provides a list of controlling documents for radiological work performed in various regulatory environments. A description of the regulatory agencies is provided in the following sections.

4.2 U.S. Nuclear Regulatory Commission (NRC)

4.2.1 The NRC regulates reactors in the form of commercial power reactors, and test, research, and training reactors. The NRC regulates the use of fuel cycle material in non-agreement states and in all areas of exclusive federal jurisdiction within agreement states. The Department of Energy (DOE) facilities and their prime contractors are exempt from NRC regulations.

4.2.2 NRC does not regulate accelerator produced material or naturally occurring radioactive material (NORM), or electronically produced radiation. NRC licensees are required to control the total occupational dose, even that component arising from unlicensed sources. If the site is in possession of these unlicensed sources of ionizing radiation, there may be more than one regulator. The regulator could be the state or it could be a U.S. Department of Defense (DoD) radiation safety committee.

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4.2.3 The NRC issues import/export licenses under 10 CFR 110.

4.3 U.S. Department of Energy

The DOE exercises its authority through regulations in 10 CFR 835 and through orders and rules. The DOE regulates the activities at DOE sites but specifically excludes material during transportation, sites which are regulated by the NRC or agreement states, activities conducted under the Naval Nuclear Propulsion Program and the Nuclear Explosives and Weapons Surety Program.

4.4 U.S. Department of Transportation

4.4.1 The U.S. Department of Transportation regulates the offering of hazardous materials for transportation and transportation of hazardous materials in interstate, intrastate, and foreign commerce by rail car, aircraft, motor vehicle, and vessel."

4.4.2 Under interpretations of these regulations an offerer is anyone who participates in the preparation of a shipment. Acts that may result in one being considered an offerer include selection of packaging, loading the package, closing the package, sealing the package, labelling the package, preparation of shipping papers, performing smear tests, measuring radiation fields around the package, presenting the package to the shipper, and loading a package onto the transport vehicle.

4.4.3 Per 49 CFR 172.700 through 172.704, hazmat employees, those individuals who participate in the receipt, shipment, or transport of hazardous material, must be trained in hazmat operations upon assignment and retrained at intervals not to exceed three years.

4.5 U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) is involved in the regulation of radioactive material including remediation of uranium mill tailings under the Uranium Mill Tailings Radiation Control Act of 1978. Under the Resource Conservation and Recovery Act (RCRA) of 1976 the EPA regulates accelerator produced and naturally occurring radioactive waste. The Safe Drinking Water Act as amended grants the EPA regulatory authority over any radioactive material that may appear in drinking water. The Clean Air Act as amended grants the EPA jurisdiction over emissions of radioactive material. The National Emissions Standards for Hazardous Air Pollutants for radionuclides is in 40 CFR 61. The Comprehensive Environmental Response, Compensation, and liability Act (CERCLA) grants the EPA jurisdiction over remediation of releases or threats of releases of hazardous substances.

4.6 Occupational Safety and Health Administration

The Occupational Safety and Health Administration (OSHA) regulates occupational radiation exposure under the Occupational Safety and Health Act. The OSHA regulations governing ionizing radiation exposure are found in 29 CFR 1910.1096 and can be located through the OSHA website. Occupational exposure to ionizing radiation to all but government employees is governed by OSHA regulations. Title 29 CFR 1910.1096 (p)(3) is applicable only to material covered under the agreement between the NRC and the state. Accelerator produced radioactive material and NORM is not included and remains subject to OSHA regulation. Title 29 CFR 1910.1096 (p)(3) provides that licensed or registered sites having programs in compliance with the standards of the agreement state licensing authority shall be deemed in compliance with OSHA standards.

4.7 Naval Nuclear Propulsion Program

The Naval Nuclear Propulsion Program is a self-regulating joint DOE/U.S. Navy program. With the approval of the president, the director of the Naval Nuclear Propulsion Program is

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appointed by both the Secretary of the Navy and the Secretary of the DOE. For activities conducted under this program the source of regulatory control will be clear.

4.8 U.S. Department of Defense

Licensable radioactive materials on DoD installations are regulated by the NRC. The U.S. Air Force and U.S. Navy have Master Materials Licenses and issue internal Radioactive Material Permits. The U.S. Marine Corps is covered under the U.S. Navy's license. The NRC issues site-specific licenses to U.S. Army installations. Other sources of ionizing radiation with the exception of nuclear propulsion reactors are controlled by the Air Force Radioisotope Committee, the Army Material Command, Office of the Army Surgeon General, or the Navy Radiation Safety Committee. The DOE may have jurisdiction over some material on DoD installations.

4.9 U.S. Army Corps of Engineers

The USACE does not regulate the possession or use of radioactive material. The USACE safety and health requirements are prescribed in EM 385-1-1 (2008). This manual implements and supplements the safety and health standards and requirements contained in 29 CFR 1910, 29 CFR 1926, 29 CFR 1960, 30 CFR 56, Executive Order 12196, DODI G055.1, 6055.3, AR 40-5, AR 385-10, AR 385.11, AR 385-40, and FAR clause 52.236-13.

4.10 Department of Commerce

The Department of Commerce controls the export and import of some radioactive material, equipment, and information under the Export Administration Act.

4.11 Agreement States

Agreement states are those that have assumed regulatory authority from the NRC over some radioactive material within their boundaries. Reactors are excluded from these agreements. Some agreement states and some non-agreement states specifically regulate sources that are outside of NRC agreements such as accelerator produced radioactive material, NORM, and electronic sources of ionizing radiation.

4.12 Licenses and Registrations

4.12.1 Licenses may be issued by the States or the NRC. Licenses are specific or general.

4.12.2 General licenses are issued to everyone and allow one to possess and use specific material or devices in exchange for agreeing to comply with a few provisions of the regulations. General licenses do not allow the transfer of the generally licensed devices to other general licensees unless the device is not relocated and the licensing agency notified of the transfer. Some generally licensed devices must be registered with the licensing agency and often there is a fee associated with the registration. Examples of devices that may be generally licensed in some jurisdictions include tritium exit signs, x-ray fluorescence analyzers, and static eliminators.

4.12.3 Specific licenses are issued to allow a person to manufacture, produce, transfer, receive, acquire, own, possess, or use quantities of radioactive material greater than those allowed under a general license. Specific licenses are issued after the licensing agency has determined that the person requesting the license has sufficient training and experience and has developed and will implement a radiation safety program, which will allow the safe and legal use of the licensed material.

Specific licenses are issued for a set period of time and are subject to the processes of renewal and inspection on a periodic basis.

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5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
Code of Federal Regulations (CFR), Title 10, Parts 1 – 199	Nuclear Regulatory Commission, U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 10, Part 835	Occupational Radiation Protection, U.S. Department of Energy (DOE), U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 29, Part 1910.1096	Occupational Safety and Health Standards, U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 30, Part 56	Safety and Health Standards—Surface Metal and Non-metal Mines, U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 40, Parts 61, 141, 190, 192, 220-229, 440	U.S. Environmental Protection Agency, U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 49	Transportation, U.S. Government Printing Office, Washington, D.C., (September 2012)
CFR, Title 49, Part 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans, U.S. Government Printing Office, Washington, D.C., (September 2012)
CFR, Title 49, Part 173	Shippers—General Requirements for Shipments and Packaging, U.S. Government Printing Office, Washington, D.C., (September 2012).
U.S. Nuclear Regulatory Commission (NRC),	Radiation Regulations, Agreement State Regulations
NRC, Procedure Number SA-200	Compatibility Categories and Health and Safety Identification for NRC Regulations and Other Program Elements(July 2012),
NRC, Procedure Number SA-500	Jurisdiction Determinations
U.S. Army Corps of Engineers (USACE), 2008	Safety and Health Requirements Manual, Safety, EM 385-1-1, November 15, Washington, D.C. (July 2012).

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Nuclear Regulatory Commission (NUREG) 0980	• Atomic Energy Act of 1954 as Amended • Energy Reorganization Act of 1974 • Uranium Mill Tailings Radiation Control Act of 1978 • DOE Organization Act of 1977 • Resource Conservation and Recovery Act of 1976 • Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Comprehensive Environmental Response, Compensation and Liability Act of 1980 • NUREG 1575, Multi-Agency Radiation Survey and Site Investigation Manual, US Government, 2000. • NUREG 1556, Consolidated Guidance About Materials Licenses.

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DoD	Department of Defense
DOE	Department of Energy
DRS	Director, Radiation Safety
EPA	Environmental Protection Agency
NORM	Naturally Occurring Radioactive Material
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PRSO	Project Radiation Safety Officer
RCRA	Resource Conservation Recovery Act
RPP	Radiation Protection Plan
USACE	U.S. Army Corps of Engineers

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 - Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 - Technical Glossary

8.0 ATTACHMENTS

Attachment 8.1	Regulatory Requirements, Guidance, and Standards

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Attachment 8.1: Regulatory Requirements, Guidance, and Standards

PRIORITY ISSUE	DOE	NRC	USACE	NAVAL REACTORS
1. Qualifications and training of project personnel with responsibility for radiation safety and related compliance; e.g., project managers, supervisors, project radiation safety "officers", project / site health physicists, radiological control / health physics technicians	• 10 CFR 835.103, "Occupational Radiation Protection – Education , Training and Skills" • DOE O 462.2, "Personnel Selection, Training, Qualification and Certification Requirements for DOE Nuclear Facilities" • ANSI/ANS N3.1-1993, "Selection, Qualification and Training of Personnel for Nuclear Power Plants"	• Regulatory Guide 1.8, "Training and Qualification of Personnel at Nuclear Power Plants" • ANSI/ANS N3.1-1993, "Selection, Qualification and Training of Personnel for Nuclear Power Plants"	• ER 385-1-80, "Ionizing Radiation Protection", Section 6 (Authorized Users…and Qualifications) • EM 385-1-80, Radiation Protection Manual, Chapt.2, "Personnel Responsibilities and Qualifications" • MOU between USACE and NRC defers to 10 CFR 20 and CERCLA • EM 385 -1-1; "Safety and Health Requirements Manual", 06.E.02 (Qualified Personnel)	• Article 106, "Radiological Control Training Requirements" • Article 107, "Radiation Worker Training Standard" • Article 108, Radiological Controls Technician Training Standard" • Article 112, Training Standard for Engineers of Radiological Work" • Site/Project specific contract "Technical Specification"
2. Adequacy and currency of training and "awareness" of general employees / personnel working at "radiological projects" and of "radiation workers"	• 10 CFR 835.901 (Occupational Radiation Protection – Radiation Safety Training) • DOE G 441.1-1C (Radiation Protection Programs Guide)	• 10 CFR 19, "Notices, Instructions and Reports to Workers"	• ER 385-1-80, "Ionizing Radiation Protection", Section 8 (Notices, Instructions and Reports to Workers) • EM 385 -1-1, " Safety and Health Requirements Manual", 06.E.03 (Radiation Safety Program) • MOU between USACE and NRC defers to 10 CFR 20 and therefore 10 CFR 19	• Article 104, "Summary of Responsibilities" • Article 106, "Radiological Control Training Requirements" • Article 107, "Radiation Worker Training Standard" • Article 108, Radiological Controls Technician Training Standard" Article 112, Training Standard for Engineers of Radiological Work"

PRIORITY ISSUE	DOE	NRC	USACE	NAVAL REACTORS
3. Record keeping and reporting of employee radiation exposure	• 10 CFR 835, subparts H and I (Occupational Radiation Protection – Records and Reports to Individuals) • DOE 441.1-1C, " Radiation Protection Programs Guide"	• 10 CFR 20, Subpart L (Records) and Subpart M (Reports) • Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Exposure Data" • NRC Forms 4 and 5	• ER 385 – 1- 80, Section 11 (Personnel Dosimetry) and equivalent of NRC Form 5; also defers to 10 CFR 19, 20 and OSHA requirements @ 29 CFR 1910.1020 • EM 385 – 1 – 80, paragraph 5-5 (Monitoring Requirements – defers to OSHA and NRC requirements) • EM 385 -1-1, 06.E.05 (Radiation Monitoring, Surveys and Dosimetry), 06.E.10 (Records) and 06.E.11 (Reports) • Army Regulation 11-9, "Army Radiation Safety Program", 5-2.b (Dosimetry) – requirements tied to OSHA limits @ 29 CFR 1910.1096 and 1926.53 or NRC standards if more protective	• Article 237, "Exposure Records" • Article 238, "Exposure Reports"

PRIORITY ISSUE	DOE	NRC	USACE	NAVAL REACTORS
4. Documentation of release of radioactive material to environment (from controlled areas and/or effluents), and of radiation exposure of the public above background	• DOE O 458.1, "Radiation Protection of Public and Environment" • MARRSIM NUREG-1575 (site by site basis)	• 10 CFR 20 • NRC Regulatory Guide 4.15, ""Quality Assurance for Radiological Monitoring Programs, Normal Operations – Effluent Streams and the Environment" • MARRSIM NUREG-1575	• ER 385-1-80 appears silent on this subject? • MOU between USACE and NRC defers to 10 CFR 20 and applicable elements of CERCLA • EM 385 -1-80, paragraph. 5-6 (Doses to the Public) • EM 385-1-1, 06.E.10.c (records of dose to public) • ER 385-1-80 ,Section 9 (Dose Limits) • ER 385-1-17 (Waste Disposal) defers to 10 CFR 20 for environmental effluents	• Article 341, "Environmental Monitoring Program" • Article 342, "Records and Reports" • Article 343, "Compliance with Environmental Protection Agency Airborne Radionuclide Regulations" • Article 520, "Requirements and Procedures for Releasing for Unrestricted Use Facilities and Areas Previously Used to Support Radiological Work"
5. Compliance to DOE "Nuclear Safety Rules" under Price Anderson Amendments Act (PAAA) of 1988 including identification , tracking and self- reporting of unusual occurrences	• 10 CFR 820, Procedural Rules for DOE Nuclear Activities • 10 CFR 830, Nuclear Safety Management • * DOE O 414.1B, Quality Assurance	N/A	N/A	• Article 110, "Radiological Incident Reports" • Article 111, "Radiological Deficiency Reporting System"

PROCEDURE

Procedure Title:	Radiation Safety Training	CMS Number:	CMS-710-07-PR-04005
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

RADIATION SAFETY TRAINING

Rev	Changes	Approved	Date
2	CMS-710-01-GL-04005, revised to align with radiation safety documents, responsibilities, titles and format. Added reference to HSE Training Attendance Sheet (CMS-710-05-FM-01905).	MOS	03 Nov 2014
1	Issued for Use – Corrected Issuing Authority initials in revision block for R/0. No change to content	ARM	03 Dec 2013
0	Issued for Use	PO	27 Nov 2013

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1.0 PURPOSE

The purpose of this procedure is to provide the radiation safety training requirements and details to be included in each site-specific Radiation Protection Plan (RPP). This procedure is to be used to determine radiation safety training requirements when developing RPPs to support CB&I projects involving the potential for occupational exposure to sources of ionizing radiation.

2.0 SCOPE

This procedure addresses radiation safety training for work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation that are governed by federal or state regulations.

3.0 RESPONSIBILITIES

The following people have responsibilities defined in this procedure.

- Director, Radiation Safety (DRS)
- Project or Program Radiation Safety Officer (PRSO)

4.0 PROCEDURE

All RPPs shall include procedures for the training of personnel. The level of training for different groups shall be commensurate with the level of exposure anticipated and shall be compliant with applicable regulations, requirements, and commitments. Outlines of topics to be covered shall be developed and qualified trainers shall be identified. A system of documenting training and, as applicable, examination results shall be established and maintained. Periodic retraining shall be established. Groups for whom training programs should be established include general employees, radiation workers, radiation controls technicians, and visitors.

4.1 Responsibilities

4.1.1 Director, Radiation Safety (DRS)

- Responsible for approving qualified radiation safety trainers.
- Responsible for review and approval of the radiation safety training standards required for project personnel, and for ensuring that all training is conducted in accordance with those specified standards.

4.1.2 Project or Program Radiation Safety Officer (PRSO)

- Establish and implement training standards that are consistent with the requirements of all applicable government, industry, and CB&I standards.
- Develop and obtain approval for, standards, procedures, and guidelines that relate to employee training, development, and qualification activities.
- Authorize and document the use of escorts in lieu of training.
- Establish appropriate training requirements for visitors. Document all training.

4.1.3 Radiation safety training shall be provided to all individuals before being allowed unescorted access to radiologically restricted areas or being occupationally exposed to ionizing radiation , whether escorted or not (10 CFR 19.12 and 10 CFR 835.901(a)).

4.1.4 Radiation safety training shall include topics to the extent appropriate to the individual's prior training, work assignments, and degree of exposure to potential radiological hazards (10 CFR 19.12 and 10 CFR 835.901(c)). Radiation safety training requirements should be established in project specific procedures that address, at a minimum, the topics outlined in this guideline.

4.1.5 A satisfactory training program for radiation safety shall include training evaluations and provisions for maintaining training records.

4.2 Determination of Required Training

4.2.1 If an individual will be permitted unescorted access to radiologically restricted areas or receive occupational exposure to ionizing radiation during escorted or unescorted access, a determination must be made regarding the appropriate level of knowledge and the type of training to be provided. The RPP should clearly establish training requirements for individuals who will be potentially exposed to ionizing radiation.

4.2.2 Challenge examinations may be offered based on the individual's prior experience, education, and/or training. With successful completion of the challenge examination, the student may be granted an exemption from the appropriate core training course or lesson. Procedures should be developed that govern the processes used to grant exceptions.

4.3 General Employee Radiation Training

4.3.1 General employee radiation training (GERT) provides the appropriate level of training for individuals who:

- Enter radiologically restricted areas escorted
- Likely to receive less than 0.1 rem per year total effective dose equivalent occupational exposure
- Do not work with unsealed sources
- Do not work in radiation fields greater than 0.1 rem per hour

4.3.2 GERT does not provide the appropriate level of training for individuals who enter radiologically restricted areas unescorted or for those individuals who perform unescorted duties as a radiological worker.

4.3.3 GERT training covers the following topics:

- Basic radiological fundamentals and radiation protection concepts
- Relative risks from exposure to radiation and radioactive materials, including prenatal radiation exposure
- Physical design features, controls, limits, policies, procedures, alarms, and other measures implemented at the project to control dose
- Individual rights and responsibilities as related to implementation of the radiation protection program including the as low as reasonably achievable (ALARA) program.
- Actions implemented to control doses under emergency conditions
- Exposure reports or other exposure data that may be provided and how to request these reports

4.4 Visitors

4.4.1 Visitors should at a minimum receive GERT training and additional training depending on area access. Training may be waived in accordance with the authorization of the PRSO provided visitors are escorted by a trained individual.

4.5 Radiation Workers

4.5.1 All project personnel designated as radiation workers shall be qualified or trained as radiation workers prior to beginning work in radiologically restricted areas. Those personnel qualified as radiation workers shall re-qualify on a yearly basis. Training and/or qualification shall be conducted in accordance with the one or more of the following training standards:

- Training provided by a NRC Licensee, as required by 10 CFR 19, Section 19.12
- U.S. Department of Energy (DOE) G 441.1-1C, Radiation Protection Programs Guide

- Any project-specific training that is determined to meet the requirements of the applicable standards noted above, especially demonstrations of practical factors such as the use of protective clothing and equipment, frisking procedures, use of radiation work permits, etc.

4.6 Radiological Controls Technicians

4.6.1 Senior radiological controls technician candidates shall be qualified if they meet the requirements of one or more of the following categories:

- Verifiable evidence of training, experience, or combination of training and experience consistent with the requirements of American National Standards Institute/American Nuclear Society, Selection, Qualification, and Training of Personnel for Nuclear Power Plants (reaffirmed 1999) for senior health physics technicians
- National certification with The National Registry of Radiation Protection Technologists
- Certification as a DOE radiological controls technician consistent with the requirements of 10 CFR 835, Section 835.103
- Evidence of NAVSHIPS 389-0288, Radiological Controls for Shipyards or NAVSEA 389-0153, Radiological Controls, Article 108, Qualification
- Two-Year Technical Degree in Health Physics or related field

4.6.2 Senior technicians shall have a **completed qualification card** that includes a formal evaluation of knowledge and skills prior to providing job coverage alone. They shall also participate in ongoing radiation safety training consistent with their duties and responsibilities.

4.6.3 Junior radiological controls technicians shall meet the basic education and training requirements established in the RPP. They shall participate in ongoing radiation safety training consistent with their duties and responsibilities.

4.7 Radiation Safety Training for Supervisors and Managers

4.7.1 The goal of the radiological safety training for supervisors and managers is to provide a basic understanding of the knowledge and skills required to safely and effectively supervise work conducted in radiological areas, work with radioactive material, and work with sealed radioactive sources. Upon successful completion, trainees will understand the requirements of the regulations, standards, license, and the RPP and supporting documents and the managers and supervisor's roles and responsibilities for implementing those requirements and guidance.

4.8 Radiation Safety Training for Technical Support Personnel

4.8.1 Appropriate technical support personnel (i.e., engineers, planners, schedulers, procedure writers) may be considered to be subject to the education, training, and skill requirements of the project RPP. Depending on their job assignments, they should be trained in the ALARA fundamentals and dose reduction techniques. Planners who develop detailed work plans involving or associating with radioactivity, radioactive material, or radiation producing machines and equipment should have radiological worker training to the level required by the workers using the work plans.

4.9 Project-Specific Training Materials

4.9.1 To implement an effective radiation safety training program, the core courses should be augmented with facility-specific information as necessary to adequately address the course content requirements of 10 CFR 19.12 or 10 CFR 835.901(c). The following information should be considered in developing facility-specific training materials:

- Procedures for entering and exiting the authorized areas, including use of radiation work permits

- Controls on radiation exposure, including administrative control levels and fetal exposure control
- Measures for use of protective equipment, including protective clothing and respiratory protective devices
- Alarms, warning signals, and response actions
- ALARA measures implemented at the facility
- Requirements for interfacing with the radiation safety organization
- Skills required by the worker to execute his/her radiation safety responsibilities
- Worker responsibilities for self and co-worker protection, including exercise of stop work authority
- Measures for requesting personal dose records and reports

4.10 Conduct of Radiation Safety Training

4.10.1 Training shall be conducted by a qualified individual approved by the DRS, such as a person who meets the qualifications of the radiation safety officer or authorized user (or a knowledgeable radiation protection staff person designated by the radiation safety officer) and who is familiar with the radiation safety program.

4.10.2 Radiation safety training should be conducted in an appropriate training facility, such as a classroom or computer-based training facility, augmented by suitable mock-up and/or laboratory facilities and on-the-job training and evaluation capabilities. Training media, such as handouts, slides, and video presentations, should be appropriate to the subject matter and the audience. Training should address both normal and abnormal situations in radiological control.

4.11 All training shall be documented by:

4.11.1 A written test.

4.11.1.1 To successfully complete the course/module, a score of 80% or greater is required.

- No true/false or open book examination questions
- Randomly selected questions from a bank of questions
- Acknowledgment by signature that the student participated in a post-examination review
- Competence in required skills using performance-based demonstrations
- Definition of remedial actions for failure to meet the minimum score
- Testing of what the student is expected to remember months after the training

4.11.1.2 To successfully complete the course, a student may miss no more than 10% of the total course time. If the student misses more than 10% of the total course, the student shall be required to be scheduled in the next available course, or at the discretion of the facilitator, the student may makeup that part of the course/module missed.

4.11.1.3 Test shall be graded and returned to the participants for their review at the end of the course. Time shall be allotted to allow for a question and answer period. Once reviewed, the test shall be returned to the facilitator for retention.

4.11.1.4 Individuals who do not pass all required examinations and performance demonstration requirements shall not be allowed to proceed with unescorted tasks involving exposure to radioactive materials or radiation until they have completed remedial actions. Remedial actions for failure to pass a written examination or meet performance demonstration requirements should include remedial instruction and re-examination,

repetition of the training program, or restriction from job duties. The choice and extent of remedial actions shall be determined based upon the extent of the knowledge or skill deficiencies demonstrated by the individual.

4.11.2 The HSE Training Attendance Sheet (CMS-710-05-FM-01905).

4.11.3 Training records shall be entered into the CB&I Electronic Data Management System (EDMS) within 10 working days of completion of the course.

4.12 Document Retention and Distribution

4.12.1 The original copies of the written test and other applicable documents shall be maintained by the PRSO throughout the project and copies routinely transmitted to the Radiation Safety Records Manager for retention.

4.12.2 The HSE Training Attendance Sheet and meeting minutes shall be kept in the project/facility Radiation Safety records file for the duration of the project.

4.12.3 Employee training records are the property of CB&I, and CB&I will not provide such training records to entities or individuals outside the company unless specifically requested by the employee, as required by law and/or as required by contract (such as contracts with customers). If it is the employee who is requesting his/her training records, the employee must make the request in writing specifying what records are needed. The records will be sent to the employee only for their distribution.

4.13 Periodic Radiation Safety Training

In addition to the initial training provided before an individual is granted access to the specified areas, radiation safety retraining shall be conducted at least annually and whenever significant changes are implemented that might affect the individual. This periodic training should review initial key principles, provide more detailed knowledge of the subject matter required, and stress new program requirements and/or seldom-used knowledge and skills.

4.14 Use of Escorts In Lieu of Training

4.14.1 The use of a constant escort may obviate the need for certain types of training by making the escort responsible for the protection and actions of the affected individual. This approach should only be used when:

- The individual will enter the area for a short period of time (i.e., no more than a few hours).
- Provision of an escort will provide for an adequate level of safety.
- Provision of an escort will not result in significant adverse dose effects (ALARA considerations). This determination should be based upon consideration of the resources (including collective dose) that must be expended to escort the individual versus those necessary to provide the appropriate training.

4.15 Training Effectiveness Evaluations

The effectiveness of radiation safety training should be verified by periodic self assessments. Self assessments can be used to determine whether qualified workers have retained all the required knowledge and skills and are applying the knowledge and skills properly. Feedback should be used as an important form of evaluation that encourages improvements and upgrades to the training programs. Comments from supervisors, instructors, and trainees should be used to enhance course effectiveness.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-05-FM-01905	HSE Training Attendance Sheet
Code of Federal Regulations	Occupational Radiation Protection, U.S. Government Printing

(CFR), Title 10, Part 835	Office, Washington, D.C.
CFR, Title 10, Part 19,	Notices, Instructions, and Reports to Workers: Inspection and Investigation, U.S. Government Printing Office, Washington, D.C.
CFR, Title 10, Part 20	Standards for Protection Against Radiation, U.S. Government Printing Office, Washington, D.C.
Naval Ships Systems Command, NAVSHIPS 389-0288,	Radiological Controls for Shipyards
Naval Sea Systems Command, NAVSEA 389-0153	Radiological Controls
U.S. Department of Energy (DOE), 2008	Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection, DOE G 441.1-1C. Washington, D.C., May 19.
American National Standards Institute/American Nuclear Society, 1993	Selection, Qualification, and Training of Personnel for Nuclear Power Plants (reaffirmed 1999), ANSI/ANS-3.1-1993.
The National Registry of Radiation Protection Technologists	

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
DRS	Director, Radiation Safety
EDMS	CB&I Electronic Data Management System
GERT	General Employee Radiation Training
PRSO	Project Radiation Safety Officer
rem	The **roentgen equivalent** in **man** (rem) is a unit of equivalent dose, effective dose, and committed dose. The international system (SI) unit for dose equivalent is the seivert (Sv). One rem is equivalent to 0.01 Sv 1mrem = millirem (mrem).
RPP	Radiation Protection Plan

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

8.0 ATTACMENTS

None.

PROCEDURE

Procedure Title:	Evaluation of Public Dose	CMS Number:	CMS-710-07-PR-04006
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

EVALUATION OF PUBLIC DOSE

1	Previously CMS-710-01-WI-04104. Updated to align with radiation safety documents and clarify responsibilities.	MOS	03 Nov 2014
0	Issued for Use	JPO	18 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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CMS Number:	Revision:	Approval Date:
CMS-710-07-PR-04006	1	03 Nov 2014

1.0 PURPOSE

This document describes the CB&I Radiation Safety Program element "Evaluation of Public Dose." The principles, concepts, and guidance in this program document are to be utilized, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation that are governed by Federal or State regulations.

2.0 SCOPE

This procedure will be implemented, as appropriate, to support CB&I sites involving the potential for exposure to sources of ionizing radiation (refer to CMS-710-07-PR-04000, *Radiation Safety Program*). An exception to this requirement is when work is performed under client radiation protection programs and/or under the client's license where the client has the responsibility for demonstrating compliance with public dose limits.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure.

- Project or Program Radiation Safety Officer (PRSO)
- License Radiation Safety Officer (License RSO)
- Director, Radiation Safety (DRS)
- Project Managers

4.0 PROCEDURES

Each Radiation Protection Plan (RPP), except as noted above, shall include the processes for demonstrating compliance with internal and external public dose limits.

4.1 Project or Program Radiation Safety Officer (PRSO)

- Determines the applicable public dose limits and monitoring requirements for the project.
- Selects the method(s) to be used in complying with the requirements and guidance in this document.
- Develops the site procedure(s) necessary to implement a public dose monitoring program, as needed
- Prepare the annual dose report and provide to License RSO and DRS for review and approval.

4.2 Director, Radiation Safety (DRS)

- Reviews and approves public dose methods selected to ensure compliance with public dose monitoring program.
- Reviews and approves annual dose reports.

4.3 Public Dose Limits

The PRSO must determine the applicable public dose limits and requirements for the project. PRSO must examine NRC, DOE, EPA, DOT, and State requirements, as applicable.

4.3.1 Project Management and the PRSO are responsible to ensure that radioactive material and sources of radiation are used and stored in such a way that members of the public will not receive more than 100 millirem (mrem) or 1 millisievert (mSv) in 1 year, and that the dose in any unrestricted area will not exceed 2 mrem in any hour, from site operations. In addition, for NRC and agreement state licenses the total effective dose equivalent (TEDE) to an individual member of the public expected to receive the highest dose from air emissions must not be expected to exceed 10 mrem (0.1 mSv)

per year, and doses to members of the public must be maintained as low as reasonably achievable (ALARA).

4.3.2 Public dose is the dose received by a member of the public from exposure to radiation, radioactive material, or any other source of radiation under project control. Public dose excludes doses received from background radiation and from medical procedures. Members of the public include all persons who are not radiation workers.

4.3.3 Compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR part 61) may be required for some projects. This regulation applies to specific pollutants (e.g., asbestos) and sources (uranium mines, DOE facilities, phosphorous plants, etc.). CB&I Projects where 40 CFR 61 might be applicable include DOE projects and projects at federal facilities other than NRC or Agreement State licensees. The PRSO must determine if NESHAPS is applicable to the project or site.

4.3.4 Nuclear fuel cycle operations under NRC jurisdiction must comply with 10 CFR 20.1301(e) which invokes the provisions of the EPA's generally applicable environmental radiation standards of 40 CFR 190. This regulation requires that operations be conducted so that the annual dose equivalent does not exceed 25 mrem (0.25 mSv) to the whole body, 75 mrem (0.75 mSv) to the thyroid, and 25 mrem (0.25 mSv) to any other organ of any member of the public as a result of exposures to planned discharges of radioactive materials.

4.4 ALARA

The RPP shall describe the methods to be used to achieve doses to members of the public that are as low as reasonably achievable (ALARA). The US Nuclear Regulatory Commission (NRC) expects that site-specific ALARA goals on the order of 20% of 10 CFR 20, Appendix B values can be achieved by almost all facilities. Approval of the RPP by the DRS provides concurrence and approval of the methods used to monitor and maintain public doses ALARA.

4.5 Exposure Pathways

Examination of all of the possible ways that a member of the public may be exposed to radiation or radioactive material from project operations shall be made and documented. In general, dose is delivered by external exposure, airborne radioactive material, and waterborne radioactive material. The project monitoring program, if applicable, should account for all identified pathways. The specifics of this monitoring program will depend upon the amount and type of radioactive material and the administrative controls, engineering controls, and process controls instituted.

4.6 Demonstrating that Individual Members of the Public Will Not Receive Dose Exceeding the Allowable Limits

A methodology shall be developed and documented that estimates public dose. Factors to consider when developing this estimate may include the amount and location of the use and storage of radioactive material, the dose rates associated with this material during project operations, the occupancy and use factors associated with each location, and the physical processes involved with the transport of radioactive material from its source to a location where it becomes available to expose a member of the public. The methods described below are applicable to NRC and Agreement State licensees. Sites under other jurisdictions should determine applicable methods for demonstration of compliance with public dose limits.

4.6.1 The project may show compliance with the annual dose limit for individual members of the public by:

- Demonstrating that the TEDE to an individual likely to receive the highest dose from project operations does not exceed 100 mrem; or
- Demonstrating that the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the

unrestricted area does not exceed the values specified in Table 2, Appendix B, 10 CFR part 20 (or similar limits imposed by other regulators, e.g., EPA, DOE); and if an individual were continuously present in an unrestricted area the dose from external sources would not exceed 2 mrem in any hour and 50 mrem (0.5 mSv) in a year.

4.6.2 Air emissions (10 CFR 20.1101(d)) must be controlled such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions.

4.6.3 Measurements may be used to demonstrate that the TEDE to the individual member of the public likely to receive the highest dose does not exceed 100 mrem (1 mSv) per year. These measurements must include both dose rate surveys for radiation exposures from external sources and measurements of radionuclides in air and water effluents.

4.6.4 Calculations used to demonstrate compliance with the public dose limits must determine the highest dose an individual member of the public is likely to receive from project operations. These calculations must take all exposure pathways into account (external, waterborne, airborne).

4.6.5 Public dose calculations shall be as realistic as practical and based upon the actual dose received by the member of the public likely to receive the highest dose.

4.6.6 Within 60 days of receipt of final environmental sample and monitoring results, the PRSO must prepare and submit an annual public dose report to the License RSO, as applicable, and the DRS for approval. The report shall detail the methodology used to determine the public dose, including but not limited to the radionuclide(s) of concern, pathways of exposure, occupancy and use factor assumptions.

4.7 Project management shall consider available engineering options to control the release of effluents to the environment. Available options include filtration, encapsulation, adsorption, containment, decay storage, recycling of process fluids, leakage reduction, and facility modifications.

4.8 Records

All records relevant to the calculation or measurement of public dose must be in the project records. Records may include ALARA determinations, pathway analyses, effluent release measurements, off-normal occurrences and recovery actions, administrative and engineering controls instituted to reduce collective dose, and surveys in support of public dose determination.

4.8.1 Public dose records shall be made a permanent part of the project records and maintained in the CB&I Radiation Safety office.

4.9 Public Dose – Portable and Fixed Gauges, Radiography Devices, Irradiators

4.9.1 The primary method of controlling public dose is source and device security. Storage must be secure from unauthorized removal or use consistent with the Increased Controls regulations. Constant monitoring and control must be maintained over devices when not in secure storage. In the case of fixed gauges, examination of the location of use should be made to ensure that they are permanently installed and not subject to unauthorized removal. The written RPP must contain elements that address these requirements.

4.9.2 Public dose will be affected by the choice of storage location, conditions and shielding. Due consideration shall be given to magnitude and a real extent of the radiation field at the storage location. Every attempt shall be made to store devices as far away as possible from areas that are occupied by other employees and members of the public. Shielding should be used to reduce ambient dose rates.

4.9.3 Public dose from permanently installed radiographic equipment will be affected by the type and strength of the sources, the frequency of use, and scatter radiation from operations. The location of the equipment, the use of collimators, and the direction of the beam are additional factors that must be considered when evaluating public dose. Routine radiation surveys are not sufficient to demonstrate compliance with public dose limits. Area monitors and environmental dosimeters, e.g. TLDs must be employed.

4.9.4 New or changes to existing equipment configuration including shielding, location, beam quality and strength, occupancy factors, and use factors require a re-evaluation of potential exposure scenarios to ensure dose limits are not exceeded. The PRSO shall document changes to the RPP and provide revised document to the License RSO/DRS for review and approval.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
U.S. Nuclear Regulatory Commission Title 10 Code of Federal Regulations, Part 20	Standards for Protection Against Radiation
Title 40 Code of Federal Regulations, Part 61	National Emissions Standards for Hazardous Air Pollutants subparts H and I
Title 40 CFR, Part 190	Environmental Radiation Protection Standards for Nuclear Power Operations
USNRC Regulatory Guide 8.37	ALARA Levels for Effluents from Materials Facilities
USNRC NUREG 1556	U. S. Nuclear Regulatory Commission Nuclear Regulations 1556

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable, the goal of minimizing dose to workers and the public.
CEDE	Committed effective dose equivalent, the sum of the products of tissue weighting factors times the Committed Dose Equivalent to the organs.
DDE	Deep dose equivalent, the dose to the whole body at a tissue depth of 1000 mg/cm2.
DOE	Department of Energy
DOT	Department of Transportation
DRS	Director, Radiation Safety
EPA	Environmental Protection Agency
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NRC	Nuclear Regulatory Commission

Term (Acronym)	***Definition***
PRSO	Project Radiation Safety Officer
Radiation Worker	A trained member of the project work force whose daily activities expose them to radiation or radioactive materials, not considered "members of the public.
rem	The **roentgen equivalent** in **man** (rem) is a unit of equivalent dose, effective dose, and committed dose. The international system (SI) unit for dose equivalent is the sievert (Sv). One rem is equivalent to 0.01 Sv 1 mrem = 1000 millirem (mrem)
RPP	Radiation Protection Plan
RSO	Licensed Radiation Safety Officer
Sievert (Sv)	The international system (SI) unit for dose equivalent equal to 1 Joule/kilogram. The sievert has replaced the unit rem. One sievert is equivalent to 100 rem. 1 Sv = 1000 millisievert (mSv)
TEDE	Total effective dose equivalent. The sum of the deep dose equivalent (DDE) and the committed effective dose equivalent (CEDE) to be determined for reporting dose to the public.
TLD	Thermoluminescent dosimeter is used to monitor low-level gamma radiation and some high energy beta radiation.

7.0 EXHIBITS

Exhibit 6.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 6.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	ALARA Program	CMS Number:	CMS-710-07-PR-04007
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

ALARA PROGRAM

1	Previously CMS-701-01-GL-04007. Revised to align with radiation safety documents, updated definitions and added international units.	MOS	03 Nov 2014
0	Issued for Use	PO	25 Nov 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

The purpose of this procedure it to provide the minimum requirements and expectations of CB&I's As Low As Reasonably Achievable (ALARA) radiation safety program. This procedure is to be used to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation which are governed by federal or state regulations. All CB&I work will be performed in a manner that assures occupational exposures are maintained ALARA.

2.0 SCOPE

This procedure is to be used when developing a task or site-specific Radiation Protection Plan (RPP) intended to support CB&I projects involving the potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following people have responsibilities outlined in this guideline:

- Director, Radiation Safety (DRS)
- Project Managers (PM)s
- Project or Program Radiation Safety Officers (PRSOs)
- Individual Workers

4.0 PROCEDURE

4.1 General

ALARA principles shall be incorporated into all RPPs. All RPPs shall include a written program for review of ALARA efforts. Given the wide range of work that CB&I manages, the specific details and complexity of the ALARA programs must be commensurate with the radiation exposure and complexity of the individual site. (Refer to NRC Regulatory Guide 8.10 or DOE Programs Guide G 441.1-1C for additional guidance.) The resources directed towards dose reduction should be proportional to the magnitude of the potential reduction and should be focused on those areas in which the greatest potential dose reduction exists.

4.2 Management Commitment

Approval of the RPP by the DRS and PRSO shall indicate management commitment to support ALARA efforts and to maintain individual and collective radiation doses ALARA. This commitment includes management support to establish the program, on-going support for policies and procedures to implement the RPP and foster ALARA principles, and participation in periodic reviews of program content and implementation. Management shall support modifications in procedures, equipment and facilities when the cost is justified by potential dose reductions. In addition, management will support the efforts of the PRSO to assert authority when needed.

4.3 As Low As Reasonably Achievable (ALARA) Committee

Each long duration project or facility for which projected likely occupational radiation doses exceed 10 percent of any applicable regulatory dose limit shall establish an ALARA Committee. The ALARA Committee will support the efforts of the PRSO to assert authority when needed and will provide annual ALARA updates to the CB&I Radiation Safety Committee. As a minimum, the ALARA Committee will have as members the project manager, the site PRSO, the site safety and health officer, and one non-management worker representative. The ALARA Committee may request assistance from off-project experts as needed.

4.4 Responsibilities

4.4.1 Director, Radiation Safety (DRS)

- The DRS has responsibility to ensure all RPPs incorporate appropriate ALARA tools, techniques and principles. The DRS serves as a member of the project ALARA committee.

4.4.2 Project Managers (PMs)

- CB&I PMs are the senior management representative on CB&I sites and have overall responsibility to ensure ALARA principles are applied to project activities. The PM will chair project ALARA committee meetings or designate the chair.

4.4.3 Project Radiation Safety Officers (PRSOs)

- The PRSOs have the responsibility to develop and maintain ALARA procedures for the project and to ensure ALARA principles are integrated into day-to-day operations. The PRSO is responsible to act as the secretary of the project ALARA committee and maintain minutes of ALARA committee meetings. PRSOs are responsible to develop and apply administrative and engineering controls to reduce exposure.

4.4.4 Individual Workers

- Individual workers are responsible for their own exposure. This includes, but is not limited to being knowledgeable of radiological conditions of the area they enter, the requirements to enter that area and to apply ALARA principles to their work to reduce the amount of radiation that they receive. This includes being fully prepared for radiological work; having all needed tools and supplies before entering radiological areas, for periodically checking their exposure to radiation while in radiological areas and for applying the principles of time, distance, and shielding to minimize their exposure.

4.5 Tasks

4.5.1 A dose estimate shall be established for each activity that requires a radiation work permit (RWP) hazard Class II or III, which has the likelihood of incurring personnel exposure. See CMS-71-07-WI-04008, *Radiological Work Permit*, for hazard class definitions. The estimate may be established based on radiation dose rates in the work area and expected times workers would need to spend in the area; or by use of historical information from previous work of a similar nature.

4.5.2 A separate ALARA review and plan shall be developed for jobs where the dose estimate exceeds 10 rem (0.1 Sievert [Sv]) or any individual is projected to receive an exposure greater than one rem (RWP Class III). ALARA plans should also be considered for significant projects or first-of-a-kind-evolutions that, if performed incorrectly, could have significant adverse impact on personnel exposure to radiation, such as a total dose greater than 1 rem (0.01 Sv), individual dose greater than 100 mrem (1 mSv) .

4.5.3 ALARA plans shall include the following:

4.5.3.1 Estimated dose before implementation of ALARA actions.

4.5.3.2 ALARA goals at some level below the estimated dose.

4.5.3.3 Methods to be used to reduce estimated exposure to the ALARA goals. Note: While goals should be challenging, they should also be realistic and achievable.

4.5.3.4 Critical points (attributes) within the activity. Consider use of radiological hold points for critical steps.

4.5.3.5 A review of and incorporation of requirements from applicable procedures dealing with high dose tasks, first time evolutions, complex operations, special or infrequent operations, and production or process risk evolutions where the possibly of error or consequences of any potential error are increased.

4.5.3.6 Methods to mitigate the risks identified in the significant or first time evolution.

4.5.3.7 Specialty task training for workers performing specialty task(s), including mock-ups if necessary. Once scheduled for specialty training, project manager approval is required for re-assignment that could interfere with scheduled training.

4.5.4 Changes to ALARA plans are required to be approved by the PRSO and DRS before the change is allowed to take place. Any change in critical project personnel or scope of training identified in the plan is also considered a change to the plan and requires PRSO and DRS approval.

4.5.5 For projects designated as Significant Project or First Time Evolutions that are greater than $100K, greater than 10 rem (0.1 Sv) dose, or that are less than eight hours off a project critical path schedule, the project manager (or designee) is responsible for reviewing proposed project plans and implementing procedures.

A readiness review should be conducted prior to work being scheduled.

4.5.6 The PRSO or the designated individual may elect to implement additional administrative controls or hold-points for the work. All additional controls must be documented in the governing work control document or Radiological Work Permit (RWP).

4.5.7 A pre-job brief shall be conducted before work starts.

4.5.8 The ALARA program will include provisions for PRSO review of new tasks, changes in procedures, and changing work conditions as necessary for work involving radiation or where project activities could affect the amount of radiation that a worker or member of the public could be exposed to receive.

4.5.9 Post job reviews shall be conducted with workers at the completion of the job to capture lessons learned and best practices to be applied to future work of a similar nature.

4.6 Review of the As Low As Reasonably Achievable Program

Periodically, and at least annually, the PRSO will re-evaluate the effectiveness of the RPP program. The review shall include investigations of doses in excess of ALARA goals and investigations of deviations from good ALARA practice. The PRSO shall prepare a report of each review and distribute the report to the project manager, DRS, and Project ALARA Committee and the CB&I Radiation Safety Committee Chair. As appropriate, the report shall include reports of investigations and recommendations for changes. For projects shorter than 12 months, the end-of-project review may replace the annual review.

4.7 Supervisors

Job supervisors shall work closely with the PRSO and occupationally exposed workers to assure that good ALARA practices are followed. Job supervisors shall notify the PRSO of potential improvements in ALARA practices and of pending changes in work conditions, which could impact radiation exposure risks, and of concerns which they or the workers may have.

Job supervisors will ensure that the supervised individuals are trained in and proficient in good health physics practices.

4.8 Occupationally Exposed Individuals

Workers shall be trained in the ALARA concept and its relationship to work procedures and work conditions. Workers shall be encouraged to make suggestions to reduce personnel exposure to radiation.

4.9 Investigational Levels

ALARA programs for projects having dosimetry or internal monitoring programs shall establish two quarterly ALARA Investigational Levels consistent with Table 1. These levels should be developed during the project planning phase by considering the planned scope of work, the amount and type of radioactive material/radiation source and, where available, actual doses associated with similar activities. An ALARA Level I value should be set at some fraction of the applicable annual dose limit(s) close to the upper limit or range of expected dose. The ALARA Level II value should be set at some fraction of the applicable annual dose limit(s) that represent unexpectedly high exposure. ALARA levels should be developed for all relevant dose limits (e.g., deep dose equivalent, CEDE, lens dose equivalent, shallow dose equivalent, total effective dose equivalent) and collective dose.

Table 1
As Low As Reasonably Achievable Investigation Levels

INVESTIGATION LEVELS (mrem (mSv)/quarter)		
	Level I	**Level II**
Deep Dose Equivalent	100 (1)	500 (5)
Lens Dose Equivalent	300 (3)	1500 (15)
Shallow Dose Equivalent	1000 (10)	5000 (50)

4.9.1 Unless the PRSO deems it necessary, no action is required for doses not reaching Level I.

4.9.2 The PRSO shall review quarterly radiation doses, which reach Level I but remain below Level II. Doses will be reviewed in comparison to the doses of others performing similar work. Unless deemed necessary by the PRSO, management, or the ALARA Committee, no further action is required.

4.9.3 The PRSO shall investigate all personnel radiation doses, which reach or exceed Level II in a timely manner and shall take action, as necessary, to reduce future doses. The PRSO shall furnish a report of the investigation, any actions taken, and a copy of the exposed individual's Form NRC 5 or equivalent. Actions that should be considered include adjustment of projected radiation doses.

4.10 Adjustment of Investigational Levels

ALARA Levels shall be reviewed periodically and adjusted only with the written permission of a duly constituted ALARA Committee and the director, radiation safety. Typical reasons for adjustments include changes in the scope of work, changes in the amount and type of radioactive material expected or planned for, and re-evaluation of work area dose rates based upon actual measurements. All adjustments to ALARA Investigational Levels are subject to review by the Radiation Safety Committee.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-WI-04008	Radiological Work Permits (RWPs)
Code of Federal Regulations (CFR), Title 10, Part 20	Standards for Protection Against Radiation, U.S. Nuclear Regulatory Commission (NRC) , U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 10, Part 835	Occupational Radiation Protection, U.S. Department of Energy (DOE), U.S. Government Printing Office, Washington, D.C. (September 2012).
U.S. Army Corps of Engineers 2008	Safety and Health Requirements Manual, Safety, EM 385-1-1, November 15, Washington, D.C. (July 2012).

6.0 TERMINOLOGY

Term	***Definition***
ALARA	ALARA ("as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part 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.
rem	The **roentgen equivalent** in **man** (rem) is a unit of equivalent dose, effective dose, and committed dose. The international system (SI) unit for dose equivalent is the sievert (Sv). One rem is equivalent to 0.01 Sv 1 mrem = 1000 millirem (mrem)
RPP	Radiation Protection Plan
Sievert (Sv)	The international system (SI) unit for dose equivalent equal to 1 Joule/kilogram. The sievert has replaced the unit rem. One sievert is equivalent to 100 rem. 1 Sv = 1000 millisievert (mSv)

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

8.0 ATTACHMENTS

None

PROCEDURE

Procedure Title:	Control of Radiological Work	CMS Number:	CMS-710-07-PR-04008
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

CONTROL OF RADIOLOGICAL WORK

1	Previously CMS-710-01-GL-04016. This procedure has been revised to align with radiation safety documents and reference the CMS-710-07-WI-04008, Radiological Work Permits (RWPs), work instruction. Added RWP hazard class requirements for ALARA reviews and Direct, Radiation Safety (DRS) approval. Revised responsibilities section to include DRS.	MOS	06 Nov 2014
0	Issued for Use – Minor formatting changes, no changes to content.	JPO	06 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure describes the CB&I Radiation Safety Program element Control of Radiological Work. The principles, concepts, and requirements in this document are to be utilized, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation, which are governed by federal or state regulations.

2.0 SCOPE

This procedure is to be used when developing task- or site-specific Radiation Protection Plans (RPP) intended to support CB&I sites involving the potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this guideline:

- Project or Program Radiation Safety Officer (PRSO)
- Director, Radiation Safety (DRS)
- Project Manager (PM)/Responsible Manager (RM)
- CB&I Workers

4.0 PROCEDURE

In accordance with CB&I Radiation Safety Program (CMS-710-07-PR-04000) the control of work involving radioactive materials and radiation-producing machines/sources shall be accomplished by:

- Establishing radiological standards and responsibilities
- Developing work plans (as required by clients)
- Using first-line supervisors and radiological protection personnel to monitor performance of radiological work
- Training workers in radiation hazards
- Providing personnel with work instructions and/or authorizing document, such as a Radiation Work Permits (RWP), that include the radiological protection measures and controls necessary for safe and compliant completion of the job.

4.1 Regulatory Drivers

Federal regulations require that projects involved with work with radioactive material or radiation sources create a written program that addresses worker protection (10 CFR 20.1101; 10 CFR 835.101, 10 CFR 830.200 and Appendix A to Subpart B, 48 CFR 970.5223-1). The overall purpose of these regulations and corporate documents is to limit, to the extent practicable, the exposure of people and the environment to radiation and radioactive materials associated with project operations.

If work is being performed in DOE nuclear facilities as formally defined as hazard categories 1, 2, or 3 in 10 CFR 830, Subpart B, the requirements therein (Safety Basis Requirements) must be reviewed and integrated into work control procedures and practices as applicable (see also DOE G 441.1C).

4.2 Work Planning

The DRS and assigned PRSO must ensure that adequate radiation protection resources are provided to support the scope of work activities, including personnel, equipment and support facilities.

4.2.1 Daily work plans are required for radiological work. The objectives of the radiological planning of work shall be to ensure that the worker's external and internal radiation exposures are maintained ALARA, to minimize the creation and spread of surface

contamination, to minimize the creation and spread of airborne radioactive material, and to minimize the creation of radioactive waste. Workers must be adequately briefed on the work plan prior to starting work in order to ensure compliance. All workers must successfully complete required radiation worker training prior to performing unescorted work.

4.3 Work Execution

The performance of radiological work shall be governed by a work authorizing document, such as an RWP, Hazardous Work Permit or equivalent document, developed from the information obtained during the work planning phase. This authorizing document is generated by the assigned PRSO or designee and is usually approved by radiation protection supervisions and operations supervision. This document specifies all of the relevant information concerning the task to be performed. See CMS-710-07-WI-04008, *Radiological Work Permits*, for additional instructions.

4.3.1 The information contained in the authorizing document shall include such information as the effective date and termination date, the tasks to be performed, an entry/exit log, the expected radiological conditions, radiological survey and monitoring requirements, protective clothing and equipment requirements, training and dosimetry requirements, and the radiological conditions which, if exceeded, would require the task to be terminated.

4.3.2 Control of higher hazard radiological work shall be authorized by a Class II or Class III RWP, as defined in CMS-710-07-WI-04008, *Radiological Work Permits*. These job or task-specific RWPs are used to control work with a potential for significant cumulative or individual dose and require documented and approved ALARA reviews. Class III RWPs require review and approval by the DRS prior to initiating defined work.

4.3.3 Adequate supervision and surveillance is required to ensure that the appropriate procedures are followed, and that all potential radiation hazards are addressed in a timely and appropriate manner.

4.3.4 Worker communication should permit timely exchanges of information and avoid unnecessary exposure by limiting the number of individuals that have to enter the work zone.

4.4 Post-Job Activities

Formal or informal post operational debriefings with the personnel who performed the task provides valuable information concerning shortcomings in planning, procedures, special tools, and other factors that contributed to the increased dose received.

Licensees must maintain records of receipt, use, transfer, and disposal of all licensed material and sources. Records must be maintained as follows:

- Receipt records must be maintained for as long as the material is possessed until three years after transfer or disposal.
- Transfer records must be maintained for three years after transfer.
- Disposal records must be maintained until the NRC terminates the license.
- Records important to decommissioning must be maintained until the site is released for unrestricted use.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-WI-04008	Radiological Work Permits (RWPs)
Code of Federal Regulations (CFR), Title 10, Part 20	Standards for Protection Against Radiation, U.S. Nuclear Regulatory Commission (NRC), U.S. Government Printing Office, Washington, D.C., (September 2012).

CFR, Title 10, Part 830	Nuclear Safety Management, U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 48, Part 970.5223	Integration of Environment, Safety, and Health into Work Planning and Execution, U.S. Government Printing Office, Washington, D.C., (September 2012).

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	The operating principle that requires radiation exposure to be maintained not only within regulatory limits but also be maintained as low as reasonably achievable (ALARA) in order to minimize worker risk.
CFR	Code of Federal Regulations
DOE	Department of Energy
DRS	Director, Radiation Safety
NRC	Nuclear Regulatory Commission
PM	Project Manager
PRSO	Project Radiation Safety Officer
RM	Responsible Manager
RPP	Radiation Protection Plan
RWP	Radiological Work Permit

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	**External Exposure Control and Monitoring**	**CMS Number:**	**CMS-710-07-PR-04009**
Procedure Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

EXTERNAL EXPOSURE CONTROL AND MONITORING

Rev	Changes	Approved	Date
1	Merged two CMS documents (CMS-710-01-GL-04008 and CMS-710-01-GL-04010) to align with radiation safety document requirements. Updated responsibilities and expectations and referenced applicable CMS documents. Included additional requirements for Director, Radiation Safety review and approval of shielding designs and use of passive dosimetry to assign personnel doses.	MOS	06 Nov 2014
0	Issued for Use	PO	25 Nov 2013

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1.0 PURPOSE

This procedure provides requirements for the design and implementation of an external radiation exposure control and monitoring program. This document is to be used to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation that are regulated by federal or state regulations.

2.0 SCOPE

This procedure provides the requirements for developing task-or site-specific Radiation Protection Plans (RPP) intended to support CB&I sites involving potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure.

- Director, Radiation Safety (DRS)
- Project or Program Radiation Safety Officer (PRSO)
- CB&I Radiation Workers

4.0 PROCEDURE

4.1 General

Radiation Protection Plans (RPPs) must include provisions for reducing external exposure and for monitoring occupational external exposure of workers. The PRSO is responsible for executing the elements of this program consistent with contract requirements. The PRSO defines the external exposure control program and selects the method(s) to be used in measuring external dose in the task- or site-specific RPP for review and approval by the DRS.

4.2 External Radiation Exposure Control Program

4.2.1 An external radiation exposure control program must be established and documented for any activity or project where workers are likely to receive a dose that exceeds 0.1 rem (1 milliSievert [mSv]) or where members of the public are likely to receive a dose of 0.05 rem (0.5 mSv) in one year from external radiation sources. For RPPs that require such a program, the scope of the program should be proportional to the potential for dose reduction.

4.2.2 Administrative dose guidelines that are less than the regulatory dose limits shall be established as part of the external radiation exposure control program. Attention to radiation doses must be maintained to assure the principles of “as low as reasonably achievable” (ALARA) are demonstrated.

4.2.3 Engineered Controls

Facilities, projects, or activities that involve the use of radioactive material or radiation-generating equipment (devices/sources) shall use appropriate engineered controls to reduce exposure to radiation. The engineered controls are the primary means to control external exposures. Examples of engineered controls include distance and shielding, remote-handling equipment, robots, and interlocks.

4.2.4 Administrative Controls

Administrative controls shall be established and documented for radiological work. Administrative controls are also used as a means of controlling external doses. Examples of administrative controls include safety procedures, radiation work permits, conservative administrative dose limits, and radiation monitoring.

4.2.5 Site Selection for Radioactive Materialand Source/Device Use

4.2.5.1 Facilities in which radioactive material will be handled, the site selection process must consider the following:

- Types and quantities of radioactive material
- Physical and chemical forms of radioactive material
- Type of work to be performed
- Potential for dispersing the radioactive material to the environment
- Potential pathways for release of radioactive material

4.2.5.2 For facilities in which radiation-generating equipment is operated, the site selection process must consider the following:

- Types of radiation to be produced
- Energy and intensity of the radiation
- Levels of direct radiation that could be produced outside the facility
- Potential for producing activation products
- Potential for releasing activated material to the environment
- Potential pathways for release of activated material

4.2.6 Shielding provides a reliable means of limiting personnel exposure by reducing the dose rate. Shielding may be necessary to reduce the potential for exposure to workers and visitors at a facility, and to members of the public in the vicinity of the facility. The factors used in determining the type of shielding include the type and intensity of the radiation source, the need for structural integrity, space limitations, the need for the ability to move the shield for operational reasons, and the cost. Shielding designs require approval by the DRS, designee or appropriate radiation safety professional.

4.2.7 Surveys

4.2.7.1 Where there is potential for exposure to external radiation fields, surveys shall be conducted to:

- Characterize the radiation field so that it can be properly posted and controlled
- Provide information needed for planning work activities
- Ensure the prompt discovery of excess radiation fields caused by changing conditions

When performed, radiation surveys shall be conducted at a frequency commensurate with the potential for changes in the radiation fields and the magnitude of the changes. Radiation surveys shall include both routine and non-routine surveys. The frequency of required routine surveys shall be defined in project-specific documents or the RPP. Surveys shall be documented in accordance with CMS-710-07-PR-04011, *Radiological Surveys and Monitoring.*

4.2.7.2 Instrumentation that is used to perform surveys must be capable of measuring accurately the types of radiation and dose rates that could be encountered (CMS-710-07-PR-04013, *Radiation Safety Instrumentation*).

4.2.8 Area Monitors

Area monitors may be used in potentially occupied areas to monitor the ambient radiation levels. Area monitors provide a continuous radiation survey at their predetermined location. Area monitors consist of active or passive detectors. Active detectors must be used when the potential exists for a significant increase in ambient radiation levels. Passive detectors (e.g., thermoluminescent detectors) are useful in supplementing or replacing personnel detectors. Passive dosimetry may be used where the annual external effective dose equivalent is expected to be below the

regulatory threshold for individual monitoring and documenting public dose. A technical basis shall be developed when passive dosimetry is used in lieu of assigned personnel dosimeters. The documented technical basis shall be reviewed and approved by the DRS, or designee, and included in or appended to the project documents or the task- or site-specific RPP.

4.3 External Exposure Monitoring Program

4.3.1 Occupational radiation doses from external sources may be monitored through the use of measurements obtained by individual monitoring devices. These devices must be issued if doses above the regulatory thresholds are likely. Workplace monitoring data and other personnel monitoring data shall be used to evaluate an external dose if personnel dosimeters fail or are lost. Doses to individuals who are unlikely to receive radiation doses above the regulatory thresholds requiring individual monitoring may be evaluated by other means such as calculated doses based upon passive dosimetry results, occupancy and survey data. Calculated doses methodology shall be included in the RPP and detail the number and location of passive dosimetry use, frequency and type of surveys to be performed and assumed occupancy factors.

4.3.2 Types of Dosimeters

4.3.2.1 Personal dosimeters provide an integrated measurement of the radiation dose to the device and may consist of either active or passive devices. Dosimetry requirements shall be included in task- or site-specific Radiological Work Permits, or equivalent.

4.3.2.2 Active or direct reading dosimeters provide a real-time readout of the integrated radiation dose and should be used whenever an immediate indication is needed that a dose or dose rate control level is being approached.

4.3.2.3 Passive dosimeters involve the storage of dose information by the dosimeter in such a way that the dosimeter has to be removed from the wearer and processed to obtain individual dose results. Examples of passive dosimeters include polycarbonate foils, photographic film, thermoluminescent materials, optically stimulated material, nuclear-track film, and fission-track-counting systems. Passive devices are typically the dose of record device.

4.3.3 Performance Requirements

All dosimetry devices used for the permanent record of worker doses must be capable of accurately measuring the types and energies of the radiation that will be encountered. Dosimeter processing services used for recording the permanent worker doses must be accredited by a recognized dosimetry accreditation program. For DOE work, the appropriate accreditation program is the DOELAP in accordance with 10 CFR 835.402(b). For non-DOE contracts, accreditation by the NVLAP is appropriate. Nuclear Regulatory Commission (NRC) and agreement state licensees are required to use NVLAP accredited labs in accordance with 10 CFR 20.1501(c).

4.3.4 Dose Limits

The annual regulatory dose limits for radiation workers require that doses shall not exceed the following limits.

Occupationally Exposed Individuals U.S. Nuclear Regulatory Commission and U.S. Department of Energy limits

- The total dose from both internal and external sources of 5 rem (0.05 Sievert [Sv]).

- The sum of the DDE or equivalent dose for external exposures and the CDE other than the lens of the eye of 50 rem (0.5 Sv).
- A lens of the eye dose of 15 rem (0.15 Sv).
- A shallow dose of 50 rem (0.5 Sv) to the skin or any extremity.

4.3.5 Planned Special Exposures

DOE and NRC regulations allow additional dose from planned special exposures that may be necessary during operations. Planned special exposures may call for special dosimetry (CMS-710-07-WI-04003 *Planned Special Exposures*).

4.3.6 Developing Embryo/Fetus

A limit of 0.5 rem (0.005 Sv) dose equivalent or equivalent dose during the period from conception to birth applies to a developing embryo/fetus of an occupationally exposed, declared pregnant worker. The dose to the developing embryo/fetus must avoid substantial variation above a uniform exposure rate that would satisfy the limit (0.05 rem [0.5 mSv] per month) to the declared pregnant worker. Positioning of the dosimetry device to properly monitor dose to the embryo/fetus should be included as part of the external dosimetry program (CMS-710-01-PR-00200 *Embryo-Fetus Protection Program*).

4.3.7 Minors and Members of the Public

CB&I policy is not to expose minors to occupational radiation exposure. CB&I will conduct operations such that no member of the public is exposed to doses in excess of 100 mrem (0.001 Sv) per year.

4.3.8 Administrative Dose Limits

The CB&I administrative control limit should not exceed 2 rem per year per person total effective dose equivalent (TEDE). The RPP shall establish administrative controls to ensure that these limits are not exceeded.

4.4 Dosimeter Issuance Criteria

4.4.1 Radiation Workers

The DOE requires external exposure monitoring of workers who are likely to exceed the following doses:

- An equivalent dose to the whole body of 0.1 rem (0.001 Sv).
- A shallow equivalent dose to the skin or any extremity of 5 rem (0.05 Sv).
- An equivalent dose to the lens of the eye of 1.5 rem (0.015 Sv).
- An equivalent dose from external exposure to any organ or tissue other than the lens of the eye of 5 rem (0.05 Sv).

NRC regulations require licensees to provide individual radiation monitoring for all occupationally exposed individuals who are likely to exceed 10 percent of any applicable limit. A prospective dose evaluation should be performed for individuals or categories of individuals to determine if the 10 percent criterion is likely to be exceeded (CMS-710-07-PR-04003, *Evaluation of Potential Occupational Exposure*).

4.4.2 Visitors

Visitors are not usually allowed to enter restricted or controlled areas under circumstances that would result in an annual dose exceeding 0.1 rem. The RPP must include provisions for determining and documenting likely radiation doses to visitors. It may be prudent to issue individual dosimeters to visitors likely to receive a dose

exceeding 0.05 rem in a year. PRSO notification is required if a visitor requests to wear a personnel dosimeter issued by another entity.

4.4.3 Declared Pregnant Workers

Declared pregnant workers who are likely to receive a dose equivalent or equivalent dose of greater than 50 mrem (0.5 mSv), to the developing embryo/fetus from external sources, must be issued individual monitoring devices.

4.4.4 High Radiation Area and Very High Radiation Areas

Individuals entering a High Radiation Area or Very High Radiation Area must be issued individual monitoring devices. Direct reading, alarming devices are strongly recommended.

4.4.5 Documentation of Prior Exposures

For those individuals for whom it is determined that monitoring is required, determination of current year exposure at other facilities is required by NRC regulations. The individual to be monitored must provide a signed NRC Form 4 or equivalent in accordance with 10 CFR 20.2104. NRC Form 4 provides the names of all facilities that provided monitoring for occupational exposure to radiation during the current year and an estimate of the dose received. It is recommended that an exposure history be obtained for all radiation workers.

4.4.6 NRC regulations also require that licensees attempt to obtain the records of lifetime cumulative occupational radiation dose for all individuals for whom it is determined that monitoring is required.

4.4.7 NRC regulations require that, prior to allowing an individual to participate in a planned special exposure; records of all prior exposures must be acquired. Records of prior dose must be maintained on NRC Form 4 or its equivalent.

4.5 Monitoring Intervals

The routine monitoring interval depends on the measurement method and associated lower limit of detection. The monitoring interval must be chosen such that it is unlikely that an individual will exceed any of the dosimeter issuance criteria from external radiation without detection. Normally, this criterion can be achieved with passive dosimeters processed on a quarterly basis. More frequent processing (i.e., monthly) should be utilized if there is potential for exceeding the pre-established administrative dose guidelines in a monthly period.

4.6 Multi-Badging

4.6.1 A single personal dosimeter worn on the trunk of the body will properly characterize the worker's dose when the radiation fields to be encountered are reasonably uniform. If the radiation fields are not uniform or if the head or extremities are likely to be exposed to higher radiation fields, additional dosimeters may be required (extremity dosimeters should be worn when the dose to the extremities could exceed 5 times the whole body dose and total more than 100 mrem). Multiple dosimeters shall be utilized to assess whole body exposures when radiation fields vary by more than 50 percent over the area of the whole body and the anticipated dose exceeds 100 mrem (1 mSv). Refer to NRC Regulatory Guide 8.40 for guidance.

4.6.2 When multi-badging is used, the dose measured by the highest responding whole body dosimeter may be used to assign the whole body dose of record. When multiple dosimeters are used more than once during the year, dosimeter results may be summed by location and the highest total assigned as the whole body dose of record. All dosimeter results must be recorded.

4.6.3 When supplemental dosimeters are used, the results shall be compared to the results from the primary dosimeter for the same monitoring periods. If the dose results differ

by more than 50 percent for the primary dosimeter and the dose from the primary dosimeter is greater than 100 mrem (1 mSv), an investigation must be conducted to explain the difference.

4.7 Lost, Damaged, or Contaminated Dosimetry

During work operations, an individual who discovers that his/her dosimetry is lost, damaged, or contaminated should place work in a safe condition, immediately exit the area, and report the occurrence to the radiation protection organization. The person may return to the work area only after a review has been conducted and documented, a dose for the wear period established and new dosimetry has been issued.

4.8 Nuclear Accident Dosimetry

4.8.1 If the nature of the work involves fissile material (uranium-233, uranium-235, and/or plutonium-239) in sufficient quantities that an uncontrolled chain reaction (nuclear criticality accident) could occur, then nuclear criticality dosimeters must be utilized. In these cases the PRSO shall contact the DRS for appropriate technical assistance.

The nuclear accident dosimetry program must include a method to conduct initial screening of personnel involved in a nuclear accident to determine whether significant exposure to radiation and/or contamination occurred, methods and equipment for analysis of biological materials, and a system of fixed nuclear accident dosimeter units. All personnel who enter any area requiring an installed criticality alarm system must wear personnel nuclear accident dosimeters. Counting facilities must be available to evaluate fixed and/or personnel dosimeters, sodium-24 activity in blood, and phosphorus-32 activity in hair.

4.8.2 The system of fixed nuclear accident dosimeter units must be capable of yielding estimated radiation dose and the approximate neutron spectrum at their locations within the performance criteria specified in DOE G 441.1-1C.

4.8.3 The placement of fixed nuclear accident dosimeter units should take into consideration the nature of the operations, structural design characteristics, accessibility of areas to personnel, and recovery of units in the event of a criticality accident.

4.8.4 Personnel nuclear accident dosimeters should be capable of determining dose from 10 rads (0.1 Gray) to 1,000 rads (10 Grays) with an accuracy of plus or minus 25 percent without dependence on fixed nuclear accident dosimeter data.

4.8.5 Unlike doses received during planned special exposures, there are no provisions for excluding doses received from accidents from occupational doses. Therefore, doses received as a result of nuclear criticality accidents must be included with occupational doses and used to decrease the lifetime planned special exposure limit.

4.9 Required Dose Calculations

Results of external exposure monitoring must be used to determine the following:

- Equivalent dose or effective dose equivalent from external sources received during the year.
- Total effective dose or TEDE received during the year.
- Lens of the eye dose received during the year.
- Shallow dose to the skin received during the year.
- Shallow dose to the extremities received during the year.
- The sum of the DDE for external exposures and the committed equivalent dose or CDE for internal exposures to any organ or tissue, other than the lens of the eye, received during the year.

4.10 Dose from Non-uniform Skin Exposure or Discrete Particles

For work supporting nuclear reactor facilities, consideration must be given to monitoring for discrete particles. Discrete particles are small particles containing beta or beta-gamma emitting radionuclides that can settle on or near the body and irradiate the skin. Discrete particles are generally not visible with the naked eye and range in size from a few to 250 micrometers. In reactor facilities discrete particles can originate from fuel or activation products and can lead to small amounts of tissue being exposed to very large, non-uniform doses.

Methods shall be established to calculate and assign the associated doses from exposure to discrete particles. Skin dose evaluations must be conducted in accordance with DOE, NRC, or Agreement State criteria, as appropriate.

4.11 Recording External Doses and Related Information

4.11.1 External radiation dose records must be maintained to demonstrate compliance with regulatory dose limits and administrative dose guidelines, and to assist in the evaluation of the effectiveness of the external dose control program. External dose records should include the following:

- Annual occupational radiation dose for each year that the worker was monitored.
- Cumulative occupational radiation dose received by the worker.
- Respective doses for those parts of the body that were monitored separately.
- Any significant unplanned exposures.
- Any planned special exposures.
- Any special evaluations of personal dose that resulted in adjustment to the measured dose to obtain an assigned dose.

4.11.2 The DOE requires that the results of individual external dose measurements that are performed be recorded even if the likely dose was below the required monitoring threshold. NRC regulations do not require that record keeping or recording of dose measurements for individuals whose prospective dose evaluation indicates that monitoring is not required.

4.11.3 Dose records must include the following quantities for external dose received during the year:

- Equivalent dose or effective dose equivalent from external sources of radiation (DDE may be used for external exposure).
- Lens of the eye dose received during the year.
- Shallow dose to the skin received during the year.
- Shallow dose to the extremities received during the year.

4.11.4 Dose records must include the following for the summation of external and internal dose:

- The total effective dose in a year.
- For individual organs other than the lens, summation of the equivalent dose or effective dose equivalent (or DDE) from external radiation and the committed equivalent dose or CDE to the organ receiving the highest dose from intake of radioactive material incurred during the year.
- The cumulative total effective dose or cumulative TEDE, which is the sum of the total effective dose or TEDE values since January 1, 1989.

4.11.5 NRC regulations do not require organ doses (CDE) to be calculated if the Committed Effective Dose Equivalent (CEDE) does not exceed 1 rem (0.01 Sv) and there are no overexposures in any dose category within the monitoring year, including doses previously reported by other licensees. When the CEDE and total organ dose equivalent for the maximally exposed organ must be calculated, guidance can be

found in NRC Regulatory Guide 8.34, "Monitoring Criteria and Methods To Calculate Occupational Doses."

4.11.6 Dose records must include the dose to the embryo/fetus of a declared pregnant worker. The dose to the embryo/fetus may be calculated as the summation of the DDE to the mother for external exposure and the CEDE to the embryo/fetus from intake of radioactive material by the mother incurred during the entire gestation period.

4.11.7 To demonstrate compliance with the annual limits, documentation of all occupational exposure received during the year must be obtained. In the absence of formal records of previous occupational exposure during the year, a written estimate signed by the individual is acceptable. For individuals without records of exposure for the current year who were engaged in activities that could have resulted in occupational radiation exposure, work activities must be controlled to limit exposure to less than the facility administrative control level. Additionally, these individuals should not be considered for planned special exposures.

4.11.8 Efforts to obtain prior years occupational exposures must be made. Three written requests to previous employers constitute adequate effort to obtain records. To show compliance with the DOE lifetime control level, an exposure of 1 rem (0.01 Sv) should be assigned for each prior year for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure.

4.11.9 All records required by DOE must be transferred to the DOE upon cessation of activities at the site that could cause exposure to individuals.

4.11.10 Records of radiological incidents involving personnel exposure must be retained.

4.11.11 All dose records must be maintained for the life of the license plus additional time for discovery. Dosimetry records are usually identified by an individual's social security number and therefore must be protected under the applicable privacy laws. Records of all monitored visitors must be maintained.

4.12 Dose Evaluation Records

4.12.1 All data used to evaluate individual doses must be recorded. These records should include the following:

- Dosimeter measurement results.
- Evaluations of non-uniform doses.
- Dose reconstructions from lost or damaged dosimeters.
- Evaluations resulting from anomalous dosimeter results.

4.12.2 All information that is necessary to review or recalculate each evaluated dose shall be recorded including uncensored data, models, assumptions, parameters, and additional measurement data as appropriate. The names of the evaluator and reviewer and the outcome of the review must be recorded. Any re-evaluation of external dose performed must be documented and approved by the DRS, or qualified designee, such that a record of the preliminary and final effective dose equivalent is retained.

4.13 Reporting Requirements

4.13.1 DOE and NRC regulations state that records of the radiation exposures of all individuals be maintained for which personnel monitoring are required. An annual written radiation dose report must be provided to each individual for whom monitoring is required. For DOE, the report must include the data specified in 10 CFR 835. For NRC or equivalent state licensees, dose records are submitted to the regulator on an NRC Form 5 in accordance with 10 CFR 20.2106 or on paper or electronic media, which includes all the information requested on an NRC Form 5. NRC Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure Data," provides guidance for submitting required dose information to the NRC in electronic media.

4.13.2 Information concerning any individual's exposure must be made available to the individual upon request by that individual. Time constraints on issuing reports are included in the regulations and vary by jurisdiction.

4.13.3 Upon the request of an individual terminating employment, exposure records must be provided as soon as data is available. If the records are not complete because the results of individual monitoring analysis are not available, an estimate, clearly marked as such, should be provided. Time constraints on issuing final reports are included in the regulations and vary by jurisdiction.

4.13.4 DOE requires that monitoring results shall be reported to each visitor within 30 days of the end of the visit.

4.13.5 For activities governed by DOE regulations, reporting requirements for the "Annual Radiation Dose Summary" for all monitored individuals can be found in DOE G 441.1-1C. NRC regulations also require that certain licensees submit an annual report of the results of individual monitoring.

4.13.6 For activities governed by the NRC or equivalent state regulations, the dose in the current year for all persons who must be monitored must be recorded on an NRC Form 4 or equivalent.

5.0 REFERENCES

CMS-710-01-PR-00200	Embryo-Fetus Protection Program
CMS-710-07-PR-04003	Planned Special Exposures
CMS-710-07-PR-04011	Radiological Surveys and Monitoring
CMS-710-07-PR-04013	Radiation Detection Instrumentation
Code of Federal Regulations (CFR), Title 10, Part 20	Standards for Protection Against Radiation, U.S. Government Printing Office, Washington, D.C.
CFR, Title 10, Part 835,	Occupational Radiation Protection, U.S. Government Printing Office, Washington, D.C.
Nuclear Regulatory Commission	Monitoring Criteria and Methods to Calculate Occupational Radiation Doses, Regulatory Guide 8.34, Washington, DC: U.S. Nuclear Regulatory Commission (1992).
U.S. Department of Energy (DOE), 2011,	Radiation Protection Programs Guide, DOE G 441.1C, Washington, D.C.

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
CDE	Committed Dose Equivalent
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
DDE	Deep dose equivalent, the dose to the whole body at a tissue depth of 1,000 milligrams per square centimeter (mg/cm^2
DOE	Department of Energy
DOELAP	Department of Energy Laboratory Accreditation Program
DRS	Director, Radiation Safety

Gray	The unit of radiation dose, Gray (Gy) expressed as absorbed energy per unit mass of tissue. 1 Gy = 1 Joule/kilogram = 100 rad.
LDE	Lens dose equivalent, the dose to the lens of the eye at a tissue depth of 300 mg/cm^2.
NRC	Nuclear Regulatory Commission
NVLAP	National Voluntary Laboratory Accreditation Program
PRSO	Project Radiation Safety Officer
rad	The unit of radiation dose, rad, expressed as absorbed energy per unit mass of tissue. 1 rad = .01 Gy
rem	The **roentgen equivalent** in **man** (rem); is an older unit of equivalent dose, effective dose, and committed dose. The international system (SI) unit for dose equivalent is the sievert (Sv). 1 rem = 0.01 Sv 1 mrem = 1000 millirem (mrem)
RPP	Radiation Protection Plan
SDE	Shallow dose equivalent, the dose to the skin of the body and the extremities at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area of 1 square centimeter.
Sievert (Sv)	The international system (SI) unit for dose equivalent equal to 1 Joule/kilogram. The sievert has replaced the rem. One sievert is equivalent to 100 rem. 1 Sv = 1000 millisievert (mSv)
TEDE	Total Effective Dose Equivalent

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	**Internal Exposure Control and Monitoring**	**CMS Number:**	**CMS-710-07-PR-04010**
Procedure Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

INTERNAL EXPOSURE CONTROL AND MONITORING

1	Merged two CMS documents (CMS-710-01-GL-04009 and CMS-710-01-GL-04011) to align with radiation safety document requirements. Updated responsibilities and expectations and referenced appropriate CMS documents.	MOS	06 Nov 2014
0	Issue for Use	JPO	02 Dec 2013
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1.0 PURPOSE

This procedure provides requirements for the design and implementation of an internal radiation exposure control and monitoring program. The principles, concepts, and requirements in this procedure are to be utilized, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation that are governed by federal or state regulations.

2.0 SCOPE

This procedure provides the requirements for developing a task-or site-specific Radiation Protection Plans (RPP) intended to support CB&I sites involving potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure.

- Director, Radiation Safety (DRS)
- Project/Program Radiation Safety Officer (PRSO)
- CB&I Radiation Workers

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 Project/Program Radiation Safety Officer (PRSO)

The PRSO establishes task- and site-specific requirements for controlling internal exposure to radionuclides including the selection of physical and administrative controls, radiological monitoring techniques and methodologies, the monitoring parameters to be measured, and the acceptable criterion for each parameter. If a technical basis document (TBD) is required the DRS shall be contacted to coordinate resources and approval of the TBD. Additional guidance addressing the development of a TBD is provided in CMS-710-07-GL-04010, *Internal Dosimetry Technical Basis Document Guidance*.

The PRSO shall assure internal exposure controls and monitoring requirements are included in each RPP and that task- or site-specific procedures are developed, reviewed, and approved to support project activities.

4.1.2 Director, Radiation Safety (DRS)

The DRS will ensure that appropriate qualified resources are assigned to develop the TBDs. The DRS shall review and approval all TBDs.

4.2 Technical Basis Document (TBD)

4.2.1 Sites that operate with unsealed or uncontained radionuclides with the potential intake of 0.02 Annual Limit on Intake (ALI) or more shall develop a TBD that provides the technical foundation for the internal dosimetry program including the controls used to eliminate or minimize internal exposure to radionuclides. The topics and elements of the TBD should be sufficiently thorough to support site-specific dose evaluations and the elements of the program must be fully supported by the site-specific processes. The TBD shall be developed prior to initiating radiological operations if uncontained/unsealed radioactive material total activity exceeds 10,000 times the ALI for inhalation, or could result in a committed effective dose equivalent to a worker greater than or equal to 500 millirem (0.05 Sievert [Sv]), or an intake greater than or equal to 0.1 ALI in accordance with 10 CFR 20.

4.2.2 U.S. Department of Energy (DOE) projects, 10 CFR 835.402(c) requires that a TBD be developed where:

1. Radiological workers, under typical conditions, are likely to receive greater than or equal to 0.1 rem (0.001 Sv) committed effective dose equivalent (CEDE) and or greater than or equal to 5 rem (0.05 Sv) committed dose equivalent (CDE) to any organ or tissue from all occupational radionuclide intakes in a calendar year.
2. Declared pregnant workers are likely to receive an intake resulting in a dose equivalent to the embryo/fetus in excess of 0.05 rem (0.0005 Sv) (DOE, 2011b).
3. The site-specific TBD shall identify the potential for intake of radionuclides via inhalation, inadvertent ingestion, and skin absorption (including wounds).

4.3 Assessment of Site-Specific Internal Exposure Risk

4.3.1 The assessment of the potential site-specific internal exposure risk should include the components specified in Section 2.1 of NCRP Report No. 87 (1986). These components include the following:

- Physical and chemical properties of the radioactive material.
- Total quantity of each radionuclide in process at one time.
- Concentration of radionuclide in the process.
- Degree of containment of the radioactive material.
- Training and experience of each person involved in the process.
- Degree of confidence in the radiation control systems.
- Prevailing level of surface contamination in the work area.
- Prevailing level of airborne contamination in the work area.
- Fraction of the work day a person is exposed.
- Nuclear properties of the nuclides associated with the process.

4.4 Physical Design Features for Controlling Internal Exposure

NRC 10 CFR 20.1101(b) that the doses received by their workers, or by members of the public, as a result of the licensees radiological activities, are as low as reasonably achievable (ALARA). Site-specific procedures at DOE projects are required under 10 CFR 835.1102(a) to identify all physical controls used to prevent the inadvertent transfer of removable contamination to locations outside of a radiological area under normal operating conditions. Site-specific procedures shall define the physical controls to be used whenever the radioactive material on bench tops, laboratory fume hoods, sample stations, glovebags, and gloveboxes is greater than or equal to 10,000 times the inhalation ALI. Site-specific procedures for USACE Formerly Utilized Sites Remedial Action Program procedures shall meet the requirements of the Safety and Health Requirements Manual (USACE, 2008) and 10 CFR 20.

4.4.1 The site-specific procedures shall identify the physical design features, which, if they should fail during specific activities or events, may result in internal exposure greater than or equal to 0.1 ALI to workers. The assessment may be based on a qualitative assessment of the potential exposure to workers, for example, unlikely or likely to be greater than or equal to 0.1 ALI during normal operational conditions. Examples of such physical design features include the following:

- Closed systems that normally contain radionuclide contaminated material but are open during maintenance activities.
- Failure of components and materials that minimize leakage across seals.
- Leaking catch basins and controlled drains.
- Failure of an engineered physical barrier used to control the spread of contamination.
- Changes in the physical, chemical, or radiological characteristics of the contaminated material without commensurate changes in the operating limits of the engineered or other physical barrier(s).

- Inadequate working space around serviceable components that hinder proper maintenance and repair.
- Air filters replacement activities.
- Inadequate space for donning and doffing of protective clothing.
- Inadequate distance between radiological areas, offices, and break areas.

4.4.2 Maintenance and Verification of Physical Controls

4.4.2.1 For licensees, the site-specific procedure shall identify the required maintenance and verification schedule for engineered physical controls that, under normal operating conditions, prevents the inadvertent transfer of removable contamination to locations outside of radiological areas if the inadvertent transfer could result in an intake exceeding 0.02 ALI.

4.4.2.2 The site-specific procedure shall identify the required maintenance and verification schedule for engineered physical controls that, under normal operating conditions, prevents the inadvertent transfer of removable contamination to locations outside of radiological areas if the inadvertent transfer could result in an intake exceeding 0.1 ALI.

4.4.2.3 At DOE project sites, the task- or site-specific procedure shall require all physical controls to be maintained and the efficiency of the physical control verified (10 CFR 835.1102(a)).

4.4.2.4 Examples of engineered physical controls that require maintenance and verification of their effectiveness may include the following:

- Confinement and containment systems.
- Ventilation systems.
- Fixed and portable high efficiency particulate activity (HEPA) filtration systems.
- Dust collectors.
- Remote handling systems.
- Sprinklers, wet scrubbers, water foggers, foam injector systems, and other wet processes.

4.4.2.5 When permanent physical design features are not adequate, temporary engineering controls shall be considered. The circumstances that usually require temporary engineering controls to supplement the installed physical controls include maintenance, system modifications, decontamination, and decommissioning. The site-specific procedure shall define any temporary engineering controls used to ensure internal exposures to workers do not exceed 40 DAC-hours.

4.4.3 High Efficiency Particulate Activity Ventilation Systems

4.4.3.1 The site-specific procedures shall address the use of portable or engineered HEPA ventilation systems if these systems are anticipated to be used to control internal exposure to workers or members of the public.

4.4.3.2 The site-specific procedure, and technical basis document as appropriate, shall address the following topics for any portable or engineered HEPA filter ventilation system:

- Assumptions regarding the size of the work area, the required flow rate for adequate protection, and the existence of complicating work activities (e.g., burning, welding, decontamination, solvent use, and fog cannons).

- Assessment of potential radioactive material buildup on the HEPA filters that may generate an unanticipated dose field.
- Concentration of particulate matter and other airborne constituents being ventilated through the HEPA filter system.
- Acceptance testing by an approved filter test facility in accordance with provisions of the appropriate standards prior to installation.
- Receipt inspection for shipping damage and verify compliance with purchase specifications, documentation of acceptance, or rejection.
- HEPA filter system documentation, labeling, storage, installation, use, testing methods for pressure, filter efficiency, and pressure gradient; testing acceptance criteria, system maintenance, and filter replacement rate.
- Need for pre-filters and their use, maintenance, and replacement.

4.4.3.3 Site-specific procedures on the purchasing and implementation of portable HEPA filter systems should comply with the recommendations and guidance found in the DOE O 420.1-1C (DOE, 2011a). The site-specific procedures should address the following elements of a portable or temporary HEPA filtration system:

- Operational considerations such as contaminants of concern, dust loading in the air, ambient and process air temperature, humidity, power availability.
- Fan assemblies.
- Filters and filter housing.
- Construction.
- Vacuum cleaning systems.
- Testing and maintenance.

4.4.3.4 Site-specific procedures shall define the criteria for replacement of in-service HEPA filters based on the following:

- Pressure drop.
- Filter degradation due to chemical or physical attributes of the air being filtered.
- Monitoring results that demonstrate that the HEPA filter performance is not acceptable.
- Failed penetration or pressure testing.

4.4.4 Respiratory Protection

4.4.4.1 Any use of respiratory protection by licensees for purposes of limiting exposure to airborne radioactive material must be fully supported by a respiratory protection program compliant with the requirements of 10 CFR 20, Subpart H. All use of respiratory protection devices must be supported by air sampling (generally a personal air sampler) primarily intended to identify the potential inhalation hazard, permit proper selection of respiratory protection equipment, and estimate and track worker internal dose.

4.4.4.2 A total effective dose equivalent (TEDE) ALARA analysis should be performed that demonstrates it is not practical or cost effective to apply engineering or physical controls to ensure the concentrations of radioactive material in air is less than the values for an airborne activity area. A TEDE ALARA assessment should take into account the total expected dose to a person regardless of the form (external or internal). When all alternatives have been considered or implemented, workers are permitted to receive internal exposure to the degree allowed by the regulatory agencies and company policies. When a

site-specific TEDE ALARA evaluation is performed to justify the use or non-use of respirators, the evaluation shall comply with the requirements and guidance in Section 2 of Regulatory Guide 8.15 (NRC, 1999).

4.4.4.3 A licensee site-specific procedure on the use of respiratory protection shall comply with the requirements and guidance in 10 CFR 20, Subpart H; Section 3 of Regulatory Guide 8.15 (NRC, 1999); NUREG/CR 0041 (NRC, 2001a); ANSI Z88.2-1992, with the exceptions noted in Section C of Regulatory Guide 8.15 (ANSI, 1992); and NUREG-1736 (NRC, 2001b). The procedure should address and implement the following respiratory protection program elements:

- Monitoring including air sampling and bioassay.
- Supervising the program, including program audits.
- Training of respirator users, including inspections, operational checks, classroom and practical instruction, and fit testing.
- Performing and documenting the required medical evaluation.
- Training and minimum qualifications of respirator program supervisors and implementing personnel.
- Selecting respirators based on hazard assessment, air monitoring, fit testing, and required protection factor to ensure TEDE ALARA.
- Needing special lenses for workers using a respirator or self-contained breathing apparatus during normal and emergency operations.
- Specifying conditions under which contact lenses may be worn with full-face respirators.
- Managing the evaluation of the effectiveness of the respiratory protection program.
- Using half-face respirators.
- Managing heat stress.
- Requiring hazard assessment prior to wearing respirator.
- Inventorying and controlling respiratory protection equipment.
- Storing and issuing respiratory protection equipment.
- Maintenance, cleaning, repairing, testing, and quality assurance of respiratory protection equipment.
- Recordkeeping.
- Limiting periods of respiratory use and relief from respiratory use
- Maintaining TEDE ALARA and performing ALARA evaluations with regard to respiratory protection.
- Routine respiratory use.
- Non-routine respirator use (e.g., un-assessed areas or for nonrecurring tasks for which engineering controls are not in place or practical).
- Emergency respirator use.

4.4.4.4 For DOE projects, the site-specific procedure for defining the respiratory protection program must address and implement the program elements listed above. In addition, the site-specific procedure must comply with the requirements and guidance in 10 CFR 835, 29 CFR 1910.134, ANSI Z88.2 (ANSI, 1992), ANSI Z88.6 (ANSI, 1984), DOE Order 440.1B (DOE, 2007), and DOE G 441.1-1C (DOE, 2011b).

4.4.5 Protective Clothing

Site-specific procedures shall state how protective clothing requirements are defined as a function of the contamination level in the work area, the anticipated work activity, worker health considerations, areas of the body likely to be exposed to removable contamination, and regard for non-radiological hazards that may be

present. Guidance on selecting the appropriate personal protective equipment is found in DOE G 441.1-1C (DOE, 2011b).

4.5 Administrative Controls

Projects where physical control of contamination is not sufficient, feasible, impractical, or cost effective will require greater emphasis on administrative controls. The administrative controls implemented to maintain exposures ALARA shall comply with the requirements and guidance established in 10 CFR 20.1702, 10 CFR 835.1001(b), and EM 385-1-1 (USACE, 2008), as appropriate. The following subsections address administrative controls that may be implemented to maintain internal exposure ALARA when physical and engineering controls are not sufficient or are not practicable.

4.5.1 Work Authorization

4.5.1.1 The site-specific procedures shall define the administrative controls, that during routine operations ensure that the anticipated occupational dose to general employees shall not exceed the following limits:

- For licensees the limit established in 10 CFR 20.1702.
- For DOE operations the limits established in 10 CFR 835.202.

4.5.1.2 Site-specific procedures for licensees shall be consistent with TEDE ALARA, document and implement the access controls, stay times, exposure limits, or other administrative controls, used to maintain internal exposure to concentrations of radioactive material in the air to values below those that define an airborne radioactivity area (10 CFR 20.1702(a)(1)(2) and (4)).

4.5.1.3 The most common work authorization for administratively controlling intakes of radioactive material to workers and members of the public are radiological work permits (RWP). The RWP is an administrative mechanism used to establish radiological controls for intended work activities.

4.5.1.4 If physical controls are not capable of controlling the concentrations of radioactive material in the air to values below those that define an airborne radioactivity, then a site-specific procedure(s) shall establish an RWP program that informs workers of area radiological conditions, entry requirements, and provides a mechanism to relate worker exposure to specific work activities.

4.5.1.5 For licensees, the site-specific procedures shall define the criteria requiring an RWP, the information required to be included on an RWP, the RWP preparation and approval process, and the implementation and record keeping of RWPs.

4.5.1.6 For DOE projects, the site-specific procedure shall define an RWP program that includes the criteria requiring an RWP, the information required to be included on an RWP, the RWP preparation and approval process, and the use of RWPs. The RWP program shall comply with the requirements established in DOE G 441.1-1C (DOE, 2011b).

4.5.2 Radiological Work Controls in Contaminated Areas

4.5.2.1 A combination of training and site-specific procedures should provide instruction and guidance on how work in contaminated areas is to be conducted in order to minimize the spread of contamination to adjacent surfaces, individuals in the area, and the workplace atmosphere. The site-specific procedures and training should address how the following controls and techniques are included in work planning and employee training:

- Dedicated contaminated tool program, if justified by the extent of the contaminated area and the work activities.

- Work techniques to minimize contamination spread.
- Judicious use of stop-work authority to correct radiological problems before they escalate.
- Aggressive work area monitoring to detect and decontaminate to reduce contamination spread.

4.5.3 Priority repair of leaks in physical controls (e.g., glove bags, glove boxes, buckets, piping, etc.) to minimize the spread of contamination. Applicable regulations and requirements necessitating a program monitoring individual exposures to internal radiation include:

4.5.3.1 NRC: 10 CFR 20.1502(b), which requires that each licensee shall monitor the occupational intake of radioactive material and assess the committed effective dose equivalent for the following:

- Adults likely to receive, in 1 year, an intake in excess of 10 percent of the applicable ALIs for ingestion and inhalation.
- Minors and declared pregnant women likely to receive, in 1 year, a CEDE in excess of 0.05 rem (0.5 milliSievert).

4.5.3.2 Agreement States: Agreement State regulatory requirements are based upon NRC requirements and will not be discussed separately in this document. Agreement State regulations and specific licenses must be reviewed to ensure that any differences are noted and incorporated in the site-specific RPP in order to ensure compliance.

4.5.3.3 DOE: 10 CFR 835.402(c) requires an internal dosimetry program be conducted for the following:

- Radiological workers who are likely to receive 0.1 rem (0.001 Sievert) in a year.
- Declared pregnant workers who are likely to receive an intake resulting in a dose to the embryo/fetus in excess of 10 percent of the dose limit.
- Occupationally exposed minors who are likely to receive a dose in excess of 10 percent of the dose limit from all radionuclide intakes.

4.5.3.4 OSHA: While OSHA requirements do not specifically define an internal dosimetry program, OSHA in 29 CFR 1910.1096(c) does provide limits for exposure to airborne radionuclides of 40 Maximum Permissible Concentration (MPC) hours in any workweek (MPC hours from the previous version of 10 CFR 20 have been replaced by derived air concentration (DAC)-hours in the current version of 10 CFR 20 but OSHA still refers to MPC-hours that are based on ICRP 2. OSHA also requires individual monitoring at 25 percent of the quarterly dose limit of 1.25 rem/quarter.

4.5.3.5 USACE: EM-385-1-1 (2008) requires that users of unsealed radioactive material sources shall institute an internal dosimetry program, when there is a potential for a worker to receive an internal dose of greater than 0.5 rem (5 mSv) per year.

- When required by 10 CFR 20.1502 to have an internal dosimetry program, the site-specific internal dosimetry procedure shall describe an internal dosimetry assessment process that complies with 10 CFR 20.1204.

4.6 Responsibilities

4.6.1 Site Radiation Safety Officer

- Establish and implement training standards that are consistent with the requirements of all applicable government, industry, and CB&I standards.

- Develop and obtain approval for, standards, procedures, and guidelines that relate to employee training, development, and qualification activities.
- Authorize the use of escorts in lieu of training.
- Establish appropriate training requirements for visitors.

4.6.2 Director responsible for Radiation Safety

- Responsible for approving the appropriate training standard required for project personnel to include technical support and planner personnel, and for ensuring that all training is conducted in accordance with those specified standards.

4.7 Design of Internal Dosimetry Program

The internal dosimetry program should be designed to identify and quantify the concentrations or activities of radionuclides that are taken into the bodies of workers through monitoring of individual workers. The internal dosimetry program shall be adequate to demonstrate compliance with dose limits and action levels established in regulations, requirements, and commitments. The Program will be implemented through written procedures and the RPP. Facility monitoring data may be used to support the internal dosimetry program. The design of the site-specific internal dosimetry program shall include a written evaluation of the following:

- Controlling regulations, requirements, and commitments impacting the internal dosimetry program along with resolution of any conflicts.
- Expected radionuclides, chemical form, respiratory class, activities, concentrations, and exposure pathways.
- Logic, assumptions, and algorithms used for calculations.
- Estimates of possible dose (TEDE, CDE, and CEDE) and/or DAC-hours to workers performing various tasks.
- Limits, reference levels, Investigation Levels (IL), and Derived Investigation Levels (DIL) based on regulations, requirements, and commitments that can be used to establish compliance with limits and action levels.
- Determination of the need for a monitoring program.
- Monitoring and assay methods, sensitivities, and frequencies necessary to demonstrate compliance with limits and action levels. Recommended references for bioassay laboratory performance include ANSI N13.30, Performance Criteria for Radiobioassay and ANSI N42.23, Measurement and Associated Instrumentation Quality Assurance for Radioassay Laboratories.
- Method for determining adequacy of monitoring and assay methods used by the site to demonstrate compliance with limits and action levels.

4.7.1 Monitoring Criteria

The requirements for monitoring the occupational intake of radioactive material by and assessing the committed effective dose equivalent to individual workers at NRC licensed facilities is addressed in 10 CFR 20.1502(b) and 10 CFR 20.1204, respectively. DOE requirements are cited in 10 CFR 835.402(c). This section gives criteria for participation in individual monitoring programs, which includes baseline, routine, special, and termination or task-ending bioassay and personal air sampling measurements when required.

4.7.2 Bioassay

The types of bioassay include baseline, routine, confirmatory, special, and termination. The requirements and guidance for each type of bioassay and the frequency of each type of bioassay are addressed in the following subsections. For licensees, the site-specific internal dosimetry procedure(s) and/or TBD should adhere to the requirements in 10 CFR 20 and guidance in NRC Regulatory Guide 8.9. For DOE projects, the termination bioassays shall comply with the requirements and guidance in DOE-G-441.1-1C.

4.7.2.1 Baseline Bioassay

Baseline monitoring involves determining the worker's radionuclide body burden and radionuclide excretion rate at the start of employment, at the start of a project, or at the start of potential exposure. The site-specific internal dosimetry procedure(s) should define which workers require baseline bioassay and specify what type(s) of bioassay should be performed. Baseline bioassay data must be collected prior to entry into a radiologically controlled area.

4.7.2.2 Routine Bioassay

The site-specific procedures should specify the periodic bioassay measurements to be conducted for workers likely to receive intakes resulting in committed dose equivalents in excess of the regulatory requirements for bioassay. The frequency of periodic measurements should be determined prior to the start of work and should consider the likely exposure of the individual and the sensitivity of the measurement methods. In determining the worker's likely exposure, the site-specific procedure(s) should consider the worker's access, work practices, measured levels of radioactive material, radioactive progeny, exposure time, and any exposure reduction methods in use. The considerations shall be documented in the internal dosimetry procedure(s) and/or internal dosimetry TBD. The site-specific procedure shall define when participation in routine individual monitoring programs may be discontinued (e.g., when sufficient facility history and experience is available to indicate that there is no need for a routine program).

4.7.2.3 Confirmatory Bioassay

Confirmatory Bioassay is a bioassay associated with a specific task or routine activity intended to confirm the effectiveness of radiation protection program monitoring of the workplace. It is not performed to confirm an intake of an individual but to confirm that radiological controls for internal exposure for a specific work activity are sufficient to reduce the intake of radionuclides to acceptable levels.

4.7.2.4 Special Bioassay

Special bioassay is used following an off-normal event when conditions indicate that an intake needing assessment may have occurred. Examples of off-normal events are higher than expected airborne concentrations of a radionuclide, a positive nasal smear, or a radioactive solution splashing on a worker's face. The site-specific procedure(s) and/or TBD shall define the types of bioassay measurements and the frequency of bioassay measurements to be conducted for special bioassay measurements following possible off-normal events.

4.7.2.5 Termination Bioassays

The site-specific internal dosimetry procedure(s) and/or TBD must define the requirements for the ending-task or termination bioassay. The requirements should describe who needs to submit a termination bioassay, when the termination bioassay is to be submitted, and the process for ending-task or employment termination bioassays.

4.7.3 Personnel Air Sampling

Projects and licenses at which airborne radionuclides are a concern may use personal air sampling (Breathing Zone [BZ] air samplers) in order to obtain intake data in a more timely fashion than is provided by bioassay. BZ air sampling is used as a method of obtaining routine air samples, and may in some cases be used to determine the dose

to individuals. The site-specific internal dosimetry procedure(s) and/or TBD must define the methods and conditions of use of BZ air samplers.

4.8 Internal Dosimetry Technical Basis Documentation

All projects and licenses where there is a likelihood for a worker to receive an intake of radioactive material shall document the levels of hazard and the internal dosimetry program in an Internal Dosimetry TBD. The TBD presents the scientific information and other rationale explaining each element of the internal dosimetry program required to support dose assessment.

4.9 Interpretation of Bioassay Measurements

NRC and DOE use parameter values and methods defined in ICRP-30 and ICRP-60, respectively. Parameter values for MPCs used by OSHA are those specified in 10 CFR 20, which are defined in ICRP-2. Use of parameter values and methods not specified by the regulatory agency is possible but in some cases requires agency approval in writing. Regulations and guidance for calculating dose are as follows:

- NRC, Agreement States, and USACE: 10 CFR 20, Agreement State regulations, and USACE guidance use parameter values and methods described in ICRP-30. NRC Regulatory Guide 8.9 provides guidance for estimating intakes based upon bioassay measurements. NRC's 10 CFR 20 Appendix B provides various values relating to intakes. NUREG/CR-4884 contains intake retention functions based on ICRP-30 methodology.
- DOE: 10 CFR 835 is based on ICRP-60. DOE programs must comply with the guidance in DOE G 441.1-1C. Potter (2002) published intake retention fractions based on ICRP-60.
- OSHA: 29 CFR 1910.1096 uses parameter values from ICRP-2. OSHA does not provide guidance on interpretation of bioassay or air sampling measurements. Annual doses for the categories provided on the NRC Form 5 in accordance with 10CFR20.2106 shall also be calculated at projects for which the regulator is OSHA.
- International regulations should be evaluated on a case by case basis and typically follow the latest ICRP guidance.

4.9.1 Verification of Intakes

4.9.1.1 Projects should estimate the intake for any bioassay measurement that indicates internally deposited radioactive material resulting from project activities. The scope of the evaluation should be commensurate with the potential magnitude of the intake. For individual intakes less than 0.02 ALI, additional available data, such as airborne measurements or additional bioassay measurements, should be used to obtain the best estimate of the actual intake. Repeated follow-up measurements or additional exposure data reviews are not necessary, provided a reasonable estimate of the actual intake can be made to confirm an intake less than 0.02 ALI. The site-specific internal dosimetry procedures or TBD shall describe how validation of an intake is performed for intakes suspected of exceeding 0.02 ALI.

4.9.1.2 The identity of radionuclides taken into the body and the amount of intake may be inferred using workplace monitoring data (e.g., airborne contamination concentration measurements, nasal-smear activity measurements, application of resuspension factors to surface contamination, etc.).

4.9.1.3 The site-specific internal dosimetry procedure(s) or TBD should be established for each route of intake, measurement type, and radioactive material of interest (taking into account site-specific information on particle size distribution, solubility, etc.) time-dependent DILs. Such DILs are to be based solely on dosimetric considerations and typically correspond to an

implied intake of one IL. For licensees, an IL corresponds to 0.5 rem CEDE; and for DOE projects; an IL corresponds to 0.1 rem. However, a site, facility, or project may wish to establish lower follow-up DILs for as low as reasonably achievable purposes.

4.9.2 Estimating Intakes

4.9.2.1 Internal doses should be evaluated for all verified intakes. For intakes verified with radiobioassay results below the DIL, no further investigation or follow-up radiobioassay are indicated. For intakes verified with radiobioassay results above the DIL or exposures greater than 40 DAC-hours, follow-up radiobioassay (if practical) and investigation should be performed.

4.9.2.2 The extent of the investigation and the number and frequency of special radiobioassay measurements following a suspected or verified intake should be determined and documented on an individual, case-specific basis, taking into account the potential magnitude of the intake, the effective clearance half-time, the health of the worker, and the number of measurements needed to evaluate the internal dose.

4.9.2.3 While the investigation should be tailored to the specific individual and exposure circumstances, the trigger levels and preliminary actions to be taken for exposures to the different radionuclides encountered at the facility, site, or project should be documented in the site-specific internal dosimetry procedure(s) or technical basis documentation.

4.9.2.4 Reference Levels

A reference level is a predetermined value of a quantity that triggers a specified course of action when exceeded or expected to be exceeded. Reference levels may be dose-based or intake-based. Derived reference levels are the measurement values for particular bioassay or air sampling results that correspond to a more general reference level under specifically defined circumstances.

- The IL is the level of intake or dose (specified as 500 millirem CEDE for licensees and 100 millirem CEDE for DOE projects) at or above which a bioassay or air monitoring result should be investigated. The intent of this level is to investigate the circumstances and, to the extent reasonable, determine actual conditions and parameters for dose evaluation, rather than use default assumptions. An investigation may involve special measurements, work history review, determination of material form, and modification of biokinetic parameters, and may culminate in a dose assessment.
- In cases where it is practical, feasible, and affordable, internal dose evaluation programs should have a goal of assessing intakes of radioactive materials that occur in a year and that deliver a CEDE at the IL, that is, intakes of 0.02 × stochastic annual limit on intake (SALI) for general employees and 0.01 SALI (or less) for declared pregnant workers, minors, and visitors. Sites are encouraged to consider using the reference level quantities given in Table 1**.**

Table 1. Example Reference Level Magnitudes

	Radiation Worker, Except Declared Pregnant Worker		General Worker, Visitor, Declared Pregnant Worker (1)	
Reference Levels (Amounts of Intake, Except for IL)	**Intake (SALI)**	**Corresponding $H_{E,50}$ (rem)**	**Intake (SALI)**	**Corresponding $H_{E,50}$ (rem)**
Verification level(2), L_v	0.02	0.1	0.005	0.025
NRC IL	0.1	0.5	0.01	0.05
DOE IL	0.02	0.1	0.01	0.05
Medical Referral Level, L_{MR}	1	5	1	5

(1) Note that in the case of a declared pregnant worker, the dose to the embryo/fetus is the dose to be considered, not the dose to the worker.
(2) ANSI N13.39 and NRC Reg Guide 8.9 refer to Evaluation Levels.

4.9.2.5 Derived Investigation Levels

DILs are levels of routine individual monitoring results, which indicate an intake resulting in a dose exceeding an IL. Examples of DILs are bioassay results, such as organ or body contents, or excreta concentrations or excretion rates. Other examples of DILs are workplace exposures, in stochastic DAC-hours modified by a safety factor, that could lead to an $H_{E,50}$ greater than an IL. Internal dosimetry programs should establish DILs for each individual monitoring method applied for the analysis of all radionuclides to which workers are likely to be exposed and document the derivation of such DILs in the internal dosimetry technical basis documentation. The physical and chemical characteristics of the radioactive material, which may be taken into the body should be taken into account in establishing DILs. If an internal dosimetry program chooses to use Reference Man (ICRP 23) default parameters in conjunction with modeling and assumptions recommended in ICRP Publications 30 and 54 in deriving a DIL, these choices should be identified in the internal dosimetry technical basis documentation. If one radionuclide is used as a surrogate for a mixture of radionuclides, the DIL should be based on the dose from the entire mixture, not just the surrogate radionuclide.

4.9.2.6 Factors Affecting the Derived Investigation Levels for Air Sampling

A given air monitoring result may indicate a concentration higher or lower than that in the air breathed by a particular worker or workers. How well an air sample reflects the concentration actually inhaled by a worker is called representativeness. Bioassay results, which are specific to an individual, do not have this property. Efforts to correlate bioassay measurements with workplace air monitoring have shown that intakes predicted on the basis of general area (GA) air monitoring results may have limited correlation with intakes based on bioassay results. BZ air samples results are more representative and reliable.

4.9.2.7 Supplementing Routine Bioassay Programs When Derived Investigation Levels Less Than Minimum Detectable Activity

- Title 10 CFR 20.1502(b)(1) requires that, with a likelihood for 0.5 rem of $H_{E,50}$, a worker must be on a dose evaluation program. There is no requirement that the program be able to detect 0.5 rem of CEDE, only that it has to detect 5 rem of CEDE. Title 10 CFR 835.402(c) requires that, with a likelihood for 0.1 rem of $H_{E,50}$, a worker must be on a dose evaluation program. There is no requirement that the program be able

to detect 0.1 rem of CEDE, only that it has to detect 5 rem of CEDE, as in 10 CFR 835.402(d).

- There is a technology shortfall for routine bioassay programs when the DIL is lower than the MDA. When a bioassay program has DIL less than MDA, BZ, or personal air monitoring, enhanced contamination controls, and enhanced engineering controls may be implemented to supplement the routine bioassay program.

4.9.2.8 Intake Retention and Excretion Fractions for Calculating Intake

For sites that require an internal dosimetry program, the site-specific internal dosimetry procedure(s) or TBD shall describe how intake retention fractions are used to calculate intake and dose. NRC Regulatory Guide 8.9 and NUREG/CR-4884 provide information on the use of intake retention functions.

4.9.2.9 Estimating Time of Exposure

The site-specific internal dosimetry procedure(s) or TBD shall describe how the time of intake is determined. Accurate estimation of intake from bioassay measurements is dependent upon knowledge of time of intake. Generally, the time of intake is known considering work activities and other monitoring data, such as air sample data. Therefore, the time of intake will be known for all but unusual situations. When the time of intake cannot be determined from monitoring data, it can often be determined from information provided by the individual. When information is insufficient to determine the time of intake, it is acceptable to assume that the intake occurred at the midpoint of the time period since the last bioassay measurement. This initial assumption should be refined by using any available information, such as the individual's work schedule, facility operations data, historical air monitoring data, and the effective half-life of the radionuclides detected.

4.10 Calculating Internal Dose from Work Place Monitoring Data

The DAC is the quotient of the annual limit on intake ALI by the volume of air that Reference Man breathes in one working year [(40 hours per week) × (50 weeks per year) × (1.2 cubic meters [m^3]/hour) = 2,400 m^3/year or 2.4 × 10^9 milliliters per year. The DACs are expressed in microcuries per milliliters or Bq/m^3, or, for radon and thoron progeny, in working levels. For a stochastic ALI (denoted SALI), breathing air at one DACs (stochastic DAC) for 2000 hours results in a committed effective dose equivalent ($H_{E,50}$) of 5 rem to Reference Man. For a nonstochastic ALI or deterministic ALI, breathing air at one DAC_n (nonstochastic DAC) for 2,000 hours results in a 50-year tissue committed dose equivalent to tissue T ($H_{T,50}$) of 50 rem. Note that the DACs listed in Appendix B, Table 1 to 10 CFR 20 may be either stochastic or nonstochastic. Nonstochastic DACs have the specific tissue or organ listed with the ALI in column with the stochastic ALI listed in parenthesis. Reference to other documents may be needed for dose assessment, such as Federal Guidance Report 11 (EPA, 1988) or the ICRP Publication 30 series for calculating dose to organs or tissues other than the bone surface, kidneys, liver, stomach wall, and thyroid.

4.10.1 Calculation of Committed Effective Dose Equivalent Due to Ingestion

If ingestion of radioactive material has occurred, the methods for determining the CEDE are similar to the methods used for estimating inhalation dose. The site-specific internal dosimetry procedure(s) or TBD should adopt the guidance on calculating the CEDE from ingestion presented in Section 4 of Regulatory Guide 8.34.

4.10.2 Calculation of Committed Effective Dose Equivalent Due to Wounds or Skin Absorption

4.10.2.1 Unless there is a contaminated wound or skin contamination where the radionuclides are in a form that permits skin absorption; skin contamination

does not result in an internal dose. The intake by skin absorption of airborne radioactive material usually does not need to be considered because it will be negligible in comparison to the intake from inhalation. It may be necessary to consider absorption through the skin when solutions containing dissolved radioactive material come in contact with the skin.

4.10.2.2 However, in accordance with 10 CFR 20.1202(d), licensees must evaluate and, to the extent practical, account for intakes through wounds or skin absorption. The site-specific internal dosimetry procedure(s) or TBD should adopt the guidance on measuring the activity on the skin and decontamination of a contaminated wound presented in NCRP Report No. 161, International Atomic Energy Agency Safety Series No. 49, and the Handbook of Health Physics and Radiological Health (Shleien, et al., 1998).

4.10.2.3 Dose from tritium absorption through the skin is taken into account by the DAC value listed in Appendix B of 10 CFR 20.

4.11 Assigned Respiratory Protection Factors for Use in Dose Evaluations

The ANSI has addressed the use of assigned respiratory protection factors (Z88.2) for planning purposes. Older information can be found in 10CFR20, Appendix A and the NUREG-0041 report on respiratory protection. In addition, protection factors for respirators are specified in Appendix A to 10 CFR 20.1001-20.2401. If a DOE site chooses to use assigned protection factors that differ from those in the ANSI standard or 10 CFR 20 Appendix A, then the technical basis for this choice must be documented.

4.12 Performance Specifications for a Bioassay Laboratory

4.12.1 Analytical laboratories that are used to support decision making processes, such as bioassay analysis used to support a 10 CFR 20.1502 internal dosimetry program, should participate in the CB&I Laboratory Alliance Program. In addition, for DOE projects, 10 CFR 835.402 requires internal dose monitoring programs implemented to demonstrate compliance with 10 CFR 835 to be accredited by the DOE Laboratory Accreditation Program for Radiobioassay. Radiobioassay laboratories utilized by the internal dose monitoring programs at DOE projects will be evaluated against the requirements of the Department of Energy Laboratory Accreditation Program for Radiobioassay, which incorporates the recommendations of ANSI N13.30.

4.12.2 The performance specifications should be based on a strategic planning approach for supporting the project internal dosimetry program. The performance specifications should be designed to ensure that the bioassay data will provide sufficient and reliable information to identify, evaluate, and technically defend the decisions made regarding the intake and resulting dose due to the exposure of workers to radioactive material. For projects requiring an internal dosimetry program, the bioassay laboratory performance specifications shall be documented in the site-specific TBD, or project quality assurance program plan.

4.12.3 Other factors that should be negotiated and put into the bioassay laboratory statement of work include turnaround time(s) and MDAs for analytical results, particularly for special bioassay; the need for prompt notification of results that exceed certain levels; and length of storage time for unused portions of samples or final analyzed preparation of samples (e.g., counting planchet) to allow for reanalysis or recounting of samples, if necessary.

4.13 Internal Dose Management

Both 10 CFR 20 and 10 CFR 835 require internal dose evaluation programs for assessing intakes of radionuclides and for maintaining adequate worker exposure records. The effective assessment of dose from intakes is highly dependent on individuals (e.g., staff, management, radiation protection, etc.) taking appropriate action. Adding dose equivalent due to external irradiation to CEDE due to irradiation by internal sources is explicitly required by both NRC and

DOE. Optimization principles should be applied to maintain internal and external doses as low as reasonably achievable (ICRP-30).

4.13.1 Routine Radiological Worker Dose Management

Radiological workers who indicate the existence or potential existence of an intake during previous work should be prevented from having additional intakes until their cumulative TEDE, current retained quantities, and current radionuclide excretion rates (if any) have been established. This action should be accomplished either through receipt of sufficient data from a previous employer(s) or by baseline bioassay measurements. If demands for the worker's services are immediate and great, the worker's signed estimate of prior dose can be used until official records are received.

4.13.2 Management of Dose from Previous Intakes (Work Restrictions)

In operation of programs for monitoring and controlling worker doses, consideration should be given to the reduced effectiveness of bioassay monitoring for workers that have internally deposited radionuclides (occupationally or medically derived). Special monitoring programs should be implemented as necessary to ensure that protection of these workers can be provided.

4.13.3 Compliance with Internal Dose Monitoring Requirements

The site-specific internal dosimetry procedure(s) should require that radiation workers:

- Comply with facility contamination control requirements
- Participate in required bioassay measurements
- Inform the SRSO and their immediate supervisor as soon as an intake is suspected

4.13.4 Accidental Dose Control

4.13.4.1 Unlike external irradiation, whose course cannot be altered after exposure, in some cases doses from retained quantities of radioactive materials can be influenced after intake occurs. While intervention following intake is usually a medical matter, it is necessary to involve the internal dosimetry program. Methods of reducing dose following an intake include enhanced decorporation ranging from washing to debridement, excision, blocking, chelation, and forcing fluids. These methods should be used at the direction of the director, radiation safety.

4.13.4.2 The RPP should include an emergency action plan for response to a potential or unplanned intake of radioactive material if the potential exists. The level of detail should be commensurate with the possible severity of an accidental intake and include the following:

- Plans for activating key response functions, such as the SRSO, analytical laboratory, medical support, Oak Ridge Radiation Emergency Assistance Center/Training Site, and/or corporate notification
- Readiness of facilities
- Training of personnel
- Pre-determined specifications for bioassay and other measurements

4.13.5 Internal Dose Control After an Incident

Before a worker is allowed to return to radiation work following a potential intake, the worker's exposure status should be evaluated. This evaluation should include consideration of the uncertainty associated with early assessments of internal dose, the dose received from external exposures during the year, and the committed effective dose equivalent for the year from all prior intakes. Temporary restrictions or

limitations from radiation work should be considered if the work could interfere with the internal dose assessment (e.g., if additional intakes of the radionuclide of interest could occur).

4.14 Records and Reports

Internal dosimetry records are an important part of an internal dosimetry program, not only to demonstrate compliance with 10 CFR 20 and 10 CFR 835, but also to support the on-going dose management of individuals following intakes. The minimum requirements for an internal dosimetry records program for licensees are specified in 10 CFR 20.2106 for workers and 10 CFR 20.2107 for members of the public. For DOE projects, the record keeping requirements are specified in 10 CFR 835.702 and 703, with additional guidance in DOE G 441.1-1C. Prior dose assessments not compatible with committed dose equivalents should be converted to provide committed organ/tissue and effective dose equivalents to the extent practicable. Records shall be maintained in compliance with CMS-710-01-WI-04121, *Radiation Safety Records*.

4.15 Quality Assurance

The site-specific internal dosimetry procedure(s) or TBDs should describe the quality assurance and quality control requirements pertinent to internal dosimetry. Quality assurance needs for various aspects of internal dosimetry programs are described by the ANSI in published standards (ANSI N13.30, N13.39, and N42.23).

5.0 REFERENCES

American National Standards Institute (ANSI),	Performance Criteria for Radiobioassay, ANSI N13.30.
ANSI	Design of Internal Dosimetry Systems, ANSI N13.39.
ANSI	Measurement and Associated Instrument Quality Assurance for Radiobioassay Laboratories, ANSI N42.23.
CMS-710-01-PR-00200	Embryo-Fetus Protection Program
CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-GL-04010	Internal Dosimetry Technical Basis Document Guidance (In preparation).
Code of Federal Regulations (CFR), Title 10, Part 835	Occupational Radiation Protection, U.S. Department of Energy (DOE), U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 29, Part 1910.1096	Occupational Safety and Health Standards, U.S. Department of Labor (DOL), U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 10, Part 20	Standards for Protection Against Radiation, U.S. Nuclear Regulatory Commission (NRC), U.S. Government Printing Office, Washington, D.C., (September 2012).
DOE,	Radiation Protection Programs Guide, DOE-G-441.1-1C, Washington, DC (2011).
International Atomic Energy Agency, Safety Series 49	Radiological Surveillance of Airborne Contaminants in the Working Environment.
International Commission on Radiological Protection (ICRP)	Report of Committee II on Permissible Dose for Internal Radiation, ICRP 2.
ICRP	Limits for Intakes of Radionuclides by Workers, ICRP 30.

ICRP	Report on the Task Group on Reference Man, ICRP 23
ICRP	Individual Monitoring for Intakes of Radionuclides by Workers, ICRP 54
ICRP	1990 Recommendations of the ICRP, ICRP 60.
National Council on Radiation Protection and Measurements	Management of Persons Contaminated with Radionuclides, NCRP-161 vols. I and II.
NRC	Manual of Respiratory Protection Against Airborne Radioactive Materials, NUREG-0041 Revision 1, Washington, D.C. (2001).
NRC	Monitoring Criteria and Methods to Calculate Occupational Radiation Doses, Regulatory Guide 8.34, Washington, DC: U.S. Nuclear Regulatory Commission (1992).
NRC	Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program, Regulatory Guide 8.9, Washington, D.C. (1993)
NRC	Interpretation of Bioassay Measurements, NUREG/CR-4884 (1987).
Potter, Charles A., 2002,	Intake Retention Fractions Developed from Models used in the Determination of Dose Coefficients for ICRP Publication 68-Particulate Inhalation, Health Physics, The Radiation Safety Journal, Vol. 83 No. 5, p 594-789, November.
Shleien, B., L. Slaback, Jr., and B.K. Birky, 1998	Handbook of Health Physics and Radiological Health, Third Edition, Silver Spring, Maryland, January.
U.S. Army Corps of Engineers, 2008	Safety and Health Requirements Manual, Safety, EM 385-1-1, November 15, Washington, D.C. (July 2012).
U.S. Environmental Protection Agency (EPA), *Federal Guidance Report 11*	Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion and Ingestion, EPA 520/1-88-020, Washington, D.C. (1988).

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
ALI	Annual Limit on Intake (ALI), a derived limit on the amount of radioactivity taken into the body in a year. The ALI results in a committed effective dose equivalent (CEDE) of 5 rem or a committed dose equivalent (CDE) of 50 rem.
CDE	Committed Dose Equivalent (CDE), the dose to organs or tissues that will be received from an intake of radioactive material by an individual during the 50 years following the intake.
CEDE	Committed Effective Dose Equivalent (CEDE), the sum of the products of the tissue weighting factors times the CDE to organs or tissues irradiated by the intake of radioactive material.
CFR	Code of Federal Regulations
DOE	Department of Energy

Term (Acronym)	***Definition***
DRS	Director, Radiation Safety
HEPA	High Efficiency Particulate Activity
NRC	Nuclear Regulatory Commission
PRSO	Project Radiation Safety Officer
RPP	Radiation Protection Plan
RWP	Radiological Work Permit
Sievert (Sv)	The international system (SI) unit for dose equivalent equal to 1 Joule/kilogram. The Sievert has replaced the unit rem. One Sievert is equivalent to 100 rem. 1 SV = 1000 millisievert (mSv).
TBD	Technical Basis Document
TEDE	Total Effective Dose Equivalent (TEDE), the sum of the external dose equivalent and the CEDE to determine the total dose to an individual from both external and internal sources.
USACE	U.S. Army Corps of Engineers

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 - Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 - Technical Glossary

PROCEDURE

Procedure Title:	Radiological Surveys and Monitoring	CMS Number:	CMS-710-07-PR-04011
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

RADIOLOGICAL SURVEYS AND MONITORING

1	Previously CMS-710-01-GL-04012. Procedure revised to align with radiation safety documents, reference applicable CMS documents, and correct terminology. Reference to radiological survey work instruction for site implementation of procedure requirements.	MOS	10 Nov 2014
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Rev	**Changes**	**Approved**	**Date**

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CMS-710-07-PR-04011	1	10 Nov 2014

1.0 PURPOSE

The procedure provides the minimum requirements of the CB&I Radiation Safety Program (CMS-710-07-PR-04000) element "Surveys and Monitoring." The principles, concepts, and requirements in this procedure are to be utilized, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation which are governed by Federal or State regulations.

2.0 SCOPE

This procedure is for use when developing a task- or site-specific Radiation Protection Plan (RPP) intended to support sites involving the potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following people have responsibilities outlined in this guideline:

- Project/Program Radiation Safety Officer (PRSO)
- Director, Radiation Safety (DRS)

4.0 PROCEDURE

Each RPP shall include requirements to evaluate and document radiological hazards which may be present. Methods used to perform these surveys include air sampling, smear testing, collection and analysis of samples, measurement of the intensity of radiation fields, calculations, and observations. Radiological surveys may be routine or may be prompted by an event such as movement of a source, shielding redesign, or request to move equipment from a radiologically-posted area.

A schedule for performing routine surveys shall be established. A technical basis showing that instruments have the required sensitivity and range shall be used for selecting instruments used for measurement and monitoring in accordance with CMS-710-07-PR-04013, *Radiation Safety Instrumentation*. The technical basis can be included in or referenced from the task- or site-specific RPP.

4.1 Survey and Monitoring Programs

4.1.1 Surveys are required actions taken to quantify and evaluate radiological conditions associated with the use of radioactive material and radiation producing machines.

Surveys are performed to:

- Comply with regulatory and program requirements,
- Effectively plan work,
- Verify the effectiveness of physical design features and engineering and administrative controls, and
- Identify areas requiring posting and control.

4.2 Monitoring of External Radiation Exposure Levels

4.2.1 Monitoring programs shall include preoperational, routine, and special surveys. Radiation safety personnel shall monitor locations where individuals may be exposed to radiation intensities that may result in radiation doses in excess of 10% of the limits specified in paragraph 20.1201(a), 20.1207 and 20.1208 of 10 CFR part 20 or 10 CFR 835 202, 206, and 207 in any calendar quarter. Monitoring shall be conducted where an individual is working with a source that could be used unshielded at any time to produce a gamma or beta dose rate exceeding 0.5 mrad/hr at 1 meter or where a member of the public could be exposed to 2 mrem/h (0.02 mSv).

4.2.2 Performance of radiation surveys shall include dose rate measurements of the general area, dose rates at a distance of 30 centimeters from a source or surface of interest to

evaluate potential whole body exposures, and dose rates on contact with potential sources of radiation where there is potential for hands-on work, and within 1 meter on the outside of work area boundaries to ensure contamination has not spread beyond the boundary.

4.2.3 At work sites where a monitoring program will not be established due to the low potential for an individual to be exposed to radiation intensities requiring monitoring and, a written technical basis for this decision shall be developed and included or referenced in the task- or site-specific RPP. This document shall be reviewed and approved by the DRS.

4.3 Measurements of Radioactive Material Concentrations in Air

4.3.1 The radiation safety staff shall perform measurements of radioactive material concentrations in air for areas where radioactive materials are handled or processed in unencapsulated form and when operations could expose a worker to the inhalation of quantities of radioactive materials exceeding those specified in 10 CFR 20.1502(b) (10% or more of the specified Annual Limit on Intake (ALI) values (200 Derived Air Concentration (DAC) hours) for projects under NRC or Agreement State jurisdiction or 10CFR 835.403 for DOE. For projects working under DOE rules, air sampling shall be used in occupied areas where, under normal conditions, a worker is likely to receive an annual intake of 2% or more of the specified ALI values (40 DAC hours). Project-specific air monitoring requirements may also be defined in the RPP.

4.3.2 Air samples should be representative of the air in the worker's breathing zone. When obtaining representative samples from the breathing zone is not practicable, every effort should be made to locate the sample collection media in a location known or suspected of containing a higher concentration of radioactive material than the breathing zone (e.g., position the sample collection device between the worker and the source of airborne radioactive material). Air samples shall be obtained for all work activities requiring respiratory protection. In cases where not all workers in a crew are issued a Breathing Zone Analyser (BZA), the unit should be worn by the worker(s) most likely to be exposed to the highest level of airborne radioactivity.

4.3.3 A continuous air monitor (CAM) be used to verify that that the concentration of airborne radioactive material is not likely to exceed 25% of the values given in, 10 CFR 20, Appendix B, Table I. For projects falling under DOE rules, CAM shall be installed in occupied areas where a person without respiratory protection is likely to be exposed to a concentration of radioactivity in air exceeding 1 DAC or where there is a need to alert potentially exposed workers to unexpected increases in the airborne radioactivity levels. Continuous air monitoring equipment shall have alarm capability and sufficient sensitivity to alert personnel that immediate action is necessary in order to minimize or terminate inhalation exposures.

4.4 Surface Contamination Surveys

The RPP shall address routine monitoring for radioactive contamination as a necessary part of the survey program. Failure to control surface contamination may result in unnecessary exposure to personnel. Limiting contamination to areas where it can be adequately controlled will assist in detecting any loss of control as early as possible and reduce worker exposure.

4.4.1 Removable contamination (smearable contamination) is that fraction of the total contamination present that can be easily transferred to the skin and clothing of workers, to tools and instruments, and is readily available to become airborne. Fixed contamination is that fraction of total contamination that is not removable by repeated decontamination.

4.4.2 The instruments used to detect contamination shall be sensitive enough to detect the nuclides present at a fraction of the control levels. Consideration shall be given to low energy emitters and whether special instrumentation is required for their detection.

This evaluation shall be documented in a technical basis reviewed and approved by the DRS.

4.4.3 Control and release limits for the project should be established. Contamination limits in unrestricted areas and limits for unrestricted release of material are nuclide specific and found in United States Nuclear Regulatory Commission (USNRC) Regulatory Guide 1.86.

4.5 Equipment Contamination Surveys

Potentially contaminated equipment shall be surveyed, decontaminated if necessary, or controlled as radioactive material. Site-specific guidelines should be developed which address the actions to be taken to control, store, decontaminate, and dispose of contaminated tools and equipment. Methods to deal with “difficult to survey” items should be included. Site-specific documents should include consideration of factors such as the use, the potential for personnel exposure, the value of the equipment, and the required storage and decontamination effort.

4.6 Personnel Surveys

Workers who enter posted Contamination Areas and High Contamination Areas shall be required to don protective clothing prior to entry and to remove it prior to exiting, per applicable Radiological Work Permit requirements. After removal of this protective clothing the worker shall be required to perform a whole body frisk or similar e.g., portal monitor. This survey includes exposed body surfaces as well as any clothing (such as modesty garments, personal clothing, and hard hats) that will be worn outside of this restricted area. Details of personnel survey requirements must be included in the work control document or radiological work permit (RWP).

4.7 Unrestricted Release Surveys

4.7.1 Surveys of all material and equipment removed from radiologically-controlled or restricted area shall be performed and documented.

4.7.2 The type and complexity of the survey performed for each item shall be commensurate with its potential to be contaminated. This potential is assessed by considering such factors as the level of contamination in the area of use, the specific use of the item, the physical structure and materials of construction of the item, and the potential for the item to have contamination on internal or inaccessible areas. In areas with significant neutron radiation, consideration must be given to the potential for neutron activation of components.

4.7.3 The program shall address the release of potentially contaminated liquids, if applicable. Site-specific limits must be developed and documented in the RPP or technical basis reviewed and approved by the DRS.

4.8 Surveys in Unrestricted Areas

4.8.1 Unrestricted areas adjacent to radiologically-controlled areas shall be surveyed to ensure that radiation levels and radioactive material are being adequately controlled. Radiation surveys shall be performed and documented at frequencies consistent with the potential for personnel exposure and the potential to exceed 10 CFR 20.1301 (dose limits for individual members of the public) requirements. Surveys should include areas one meter beyond work area boundaries to account for material that has migrated, previously undetected radioactive materials, and elevated radiation levels.

4.8.2 Movement of radioactive material within or between radiologically-controlled/restricted areas shall be assessed for its impact on general area and boundary dose rates. The accumulation of radioactive materials and their proximity to boundaries can change radiation levels requiring revision of boundaries or postings.

4.9 Workplace Surveillance

4.9.1 Components of a workplace monitoring program shall include provisions for a regular inventory of radioactive materials and their locations (including waste storage, amounts of material in process, and instrument calibration sources), regular discussions with workers to assess their understanding of basic radiation safety practices and the application of basic radiation safety principles, and regular surveillances to assess personnel protection and site safety in the field.

4.10 Survey Instrumentation

The radiation detection instruments used to monitor the site and the workers must be demonstrated to be appropriate for the physical environment, the amount and type of radiation to be detected, and the skill level of the radiation protection technician. Each instrument shall have procedural guidance on its operating characteristics, use, detection levels, maintenance and calibration, preparation and use of control charts, daily use checks, and training requirements for its operators. See CMS-710-07-PR-04013, *Radiation Detection Instrumentation.*

4.11 Frequency of Surveys

4.11.1 The frequency of surveys depends on the nature, quantity, and use of radioactive materials, as well as the specific facilities, equipment, and procedures that are designed to protect the workers. Surveys shall be performed before, during, and at the completion of work that has the potential for causing changes in levels of radiation and radioactivity. Established survey frequencies shall be documented in the task- or site-specific RPP or project documents.

4.11.2 Baseline surveys shall be performed before any work is initiated or any radioactive material is introduced into the facility. Initial surveys should be performed as soon as normal operations commence so that general levels can be evaluated. Surveys shall be conducted after any circumstance that has the potential to cause a significant change in conditions. Assessment of radiological conditions shall include a sufficient number of survey points to characterize the radiation present and to verify boundaries.

4.12 Records of Radiological Surveys

4.12.1 Records shall be clear, legible, understandable, and authenticated by authorized personnel. The signature of the person making the record should be on the same page as the record. See CMS-710-07-WI-04011, *Performing and Documenting Radiological Surveys,* for additional details.

4.12.2 Recordkeeping requirements shall be formalized in the task- or site-specific RPP and should conform to the requirements of 10 CFR 20 and/or 10 CFR 835 and CMS-870-02-PR-10005, *General Document Management*.

4.12.3 Additional recordkeeping requirements exist for radioactive material surveys not addressed in this guidance (e.g., shipping, receipt, and special nuclear material). See CMS-710-07-PR-04016, *Procurement, Receipt, Transfer and Inventory of Radioactive Sources,* for additional details.

4.12.4 Records must be maintained in formats that are retrievable and lend themselves to long-term storage, such as an Electronic Data Management System (EDMS). At a minimum, survey records shall be scanned and sent to the Radiation Safety group for long-term retention.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-WI-04011	Performing and Documenting Radiological Surveys

CMS-710-07-PR-04013	Radiation Safety Instrumentation
CMS-710-07-WI-04000	Self-Assessment of the Radiation Protection Plan
CMS-870-02-PR-10005	General Document Management
Title 10 Code of Federal Regulations, Part 20	Standards for Protection Against Radiation
Title 10 Code of Federal Regulations, Part 835	Occupational Radiation Protection
U.S. Nuclear Regulatory Commission	Health Physics Surveys for By-product Material at NRC-Licensed Processing and Manufacturing Plants, Regulatory Guide 8.21, Washington, D.C.
U.S. Nuclear Regulatory Commission	Radiation Safety Surveys at Medical Institutions, Regulatory Guide 8.23, Washington, D.C.
U.S. Nuclear Regulatory Commission	Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, Washington, D.C.

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALI	Annual limit on intake, the derived limit on the amount of radioactivity taken into the body in a year. The ALI results in a CEDE of 5 rem or a CDE of 50 rem.
BZA	Breathing Zone Analyser
CAM	Continuous Air Monitor
DAC-hour	Derived air concentration-hour, the product of the air concentration of radioactive material and the time of exposure in hours. 2000 DAC-hours equals 1 ALI.
DOE	Department of Energy
DRS	Director, Radiation Safety
CEDE	Committed effective dose equivalent, the sum of the products of the tissue weighting factors and the CDE to organs or tissues irradiated by the intake of radioactive material.
EDMS	Electronic Data Management System
NRC	Nuclear Regulatory Commission
PRSO	Project Radiation Safety Officer
rem	The **roentgen equivalent** in **man** (rem) is a unit of equivalent dose, effective dose, and committed dose. The international system (SI) unit for dose equivalent is the sievert (Sv). One rem is equivalent to 0.01 Sv 1 mrem = 1000 millirem (mrem)
RPP	Radiation Protection Plan
RWP	Radiological Work Permit
Sievert (Sv)	The international system (SI) unit for dose equivalent equal to 1 Joule/kilogram. The sievert has replaced the unit rem. One sievert is equivalent to 100 rem. 1 Sv = 1000 millisievert (mSv)

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	Contamination Control	CMS Number:	CMS-710-07-PR-04012
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

CONTAMINATION CONTROL

1	Previously CMS-710-01-GL-04013. Procedure has been revised to align with radiation safety documents and reference updated CMS documents. Responsibilities and requirements clarified.	MOS	10 Nov 2014
0	Issued for Use	JPO	11 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure provides the minimum requirements of the CB&I Radiation Safety Program element "Contamination Control." The principles, concepts, and requirements in this program document are to be utilized, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation which are governed by applicable regulations.

2.0 SCOPE

This procedure is to be followed when developing a task- or site-specific Radiation Protection Plan (RPP) intended to support CB&I sites involving the potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities in this procedure:

- Project/Program Radiation Safety Officer (PRSO)
- Director, Radiation Safety (DRS)

4.0 PROCEDURE

In accordance with CB&I *Radiation Safety Program* (CMS-710-07-PR-04000) each RPP shall include provisions for limiting the spread of radioactive contamination. The PRSO shall identify and document the key components of site-specific contamination control program, including identification and demarcation of zones where contamination is likely. Contamination control shall emphasize controlling the flow of personnel, equipment, and supplies into and out of these areas.

4.1 Introduction

Work with unsealed sources of radioactive material creates the potential for generating radioactive contamination. An effective contamination control program includes monitoring to provide adequate warning of the presence of contamination.

4.1.1 Activities that have the potential to generate contamination must be evaluated to ensure that appropriate controls are established.

4.1.2 Physical design features incorporated during the construction of a facility or initial setup of a temporary facility is the first level of control. Additional engineering controls may be instituted on a case-by-case basis when the built-in design features are inadequate. In addition to physical and design features, engineering controls and administrative controls (e.g., access restrictions or specific work practices that are known minimize the spread of contamination) are instituted to control exposure. Contamination monitoring is necessary to identify hazards, to evaluate the control program, and to provide accurate and timely information which may be necessary for recovery actions.

4.2 Physical Design Features

The physical design features of a facility shall consider the importance of contamination control. The controls shall be appropriate to the extent of the hazards and the potential adverse effects of uncontrolled releases.

4.2.1 Contamination control design features that shall be considered when designing new facilities or evaluating the installed physical design features of existing facilities include:

- containment of process materials
- components and materials that minimize leakage across seals
- catch basins and controlled drains
- multiple barriers to control the spread of contamination

- adequate working space around serviceable components to facilitate maintenance and repair
- filtered ventilation drawing from areas of lower to areas of higher contamination levels
- adequate space for donning and doffing of protective clothing
- low-background contamination monitoring stations
- offices and break rooms located away from radiological areas.

4.2.2 The physical layout and materials of construction shall consider operations, maintenance, decontamination, and decommissioning. Construction materials used shall be capable of being decontaminated without relying upon hazardous compounds. Smooth and corrosion resistant materials facilitate decontamination.

4.3 Engineering Controls

When permanent physical design features are not adequate to minimize the spread of contamination, temporary engineering controls shall be considered. If engineering controls are deemed to be inadequate, additional administrative controls must be established.

4.3.1 Temporary containment devices should be considered to limit the spread of contamination from system leaks and during maintenance of contaminated systems.

4.3.2 Portable air filtering devices shall be used when there is a potential for the generation of airborne contamination. The type of radioactive contaminant likely to be generated from an activity must be known in order to select the appropriate engineering control (e.g., high efficiency particulate air (HEPA) filtered units will not be effective for radioactive noble gases). Such devices include large volume HEPA filtered ventilation units and HEPA filtered vacuums. The build-up of radioactive material on the filter media and ductwork must be considered as it may become a significant source of exposure.

4.3.3 The benefits of the use of engineering controls must be weighed against the potential costs of installation, use, and decontamination. The use of these controls may require additional worker dose to set-up, maintain, and remove.

4.4 Administrative Controls

When the use of physical design features and engineering controls to limit exposures is impractical, administrative controls shall be implemented to maintain exposures “As Low As Reasonably Achievable” (ALARA). The following administrative controls shall be considered when developing a project contamination control program.

4.4.1 Project or task-specific work authorizations or radiological work permits (RWPs) shall be developed to authorize performance of work in a Radioactive Material Area (RMA), Contamination Area (CA), High Contamination Area (HCA), or Airborne Radioactivity Area (ARA). See CMS-710-07-PR-04014, *Radiological Labelling, Posting and Access Control*.

4.4.2 Access control is required to ensure that personnel entering the area are informed of the radiological status and potential hazard, provided with the appropriate protective clothing and equipment (PPE), properly trained and authorized to enter the area and perform work. Control of egress from contaminated areas ensures that radioactive material is not inadvertently removed from the area. Contaminated areas shall be limited in both number and size in order to minimize the need for protective clothing, restricted access, and the generation of radioactive waste.

4.4.3 Individuals exiting contaminated areas shall perform a whole body frisk using either portable or automated devices (alternative methods need to be considered for nuclides which cannot be reliably detected with hand-held or automated equipment). Required personnel surveys must be detailed in the task work authorization or RWP.

4.4.4 The instruments and techniques used for contamination monitoring must be appropriate for the types, levels, and energies of the radiations encountered and for the existing environmental conditions. The rationale for the use of specific techniques must be provided or referenced in the RPP, and instrumentation should be documented in supporting technical basis documents. Particular attention should be given to hard-to-detect nuclides. The instruments used for frisking must be capable of detecting contamination at or below the total surface contamination control values. Individuals shall be trained in proper frisking techniques, including detector speed and distance, and proper techniques should be enforced through frequent line management observation.

4.4.5 Work in contaminated and airborne radioactivity areas shall be conducted in a manner that minimizes the spread of contamination to adjacent surfaces, individuals in the area, and the workplace atmosphere. Stop-work authority shall be used as necessary to correct work practices which lead to increased contamination risk.

4.4.6 Two types of personnel contaminations can occur: skin (or personal clothing) contamination and wound contamination. If applicable, the task- or site-specific RPP shall contain or reference site-specific written instructions to be followed when a worker becomes contaminated, including management of medical attention (medical treatment of injuries takes precedence over radiological considerations and emergency medical care should be administered immediately), personnel decontamination, area and equipment decontamination, notifications to regulators, and personnel dose assessments. Trigger levels for dose assessments must be developed and documented in task- or site-specific RPP or project documents.

4.5 Contamination Monitoring

Contamination monitoring shall be performed in and around areas determined to be contaminated. Contamination monitoring instruments must be properly calibrated and appropriate operational tests shall be performed. The lower detection limits should be established in a technical basis document.

4.5.1 Federal regulations specify the levels at which contaminated areas/radioactive material areas must be posted/labelled. An established contamination monitoring program shall include monitoring methods that are sufficient to identify the location of surfaces having contamination at project control limits. Contamination levels on surfaces outside of contaminated areas shall be maintained below the project control or regulatory limits, whichever is more restrictive.

4.5.2 Individual and area monitoring must be performed to demonstrate compliance with the regulations, document radiological conditions in the workplace, detect changes in radiological conditions, detect the gradual build-up of radioactive materials in the workplace, verify the effectiveness of engineering and process controls in containing radioactive materials, and identify and control potential sources of individual exposure to radiation and/or radioactive material. Monitoring frequencies should be based on potential and actual radiological conditions, probability of change in conditions, and area occupancy factors.

4.5.3 The release of material and equipment from contaminated areas must be addressed in the task- or site-specific RPP. See CMS-710-07-PR-04011, *Radiological Survey and Monitoring* and CMS-710-07-PR-04011, *Performing and Documenting Radiological Surveys,* for additional detail. Site-specific program documents shall address precisely what is meant by unrestricted or free release. If applicable, the program document must address the release of potentially contaminated liquids. The analyses performed on these substances must be capable of accounting for the degree of radiation attenuation by the liquid itself. The development of volumetric release criteria must be site-specific to address the radionuclides present. These site-specific limits must be developed and documented in the RPP or a technical basis reviewed and approved by the DRS.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-PR-04011	Radiological Survey and Monitoring
CMS-710-07-WI-04011	Performing and Documenting Radiological Surveys
CMS-710-07-PR-04014	Radiological Labelling, Posting and Access Control
Title 10 Code of Federal Regulations, Part 20	Standards for Protection Against Radiation
Title 10 Code of Federal Regulations, Part 835	Occupational Radiation Protection
U.S. Department Of Energy (DOE)	Radiation Protection Programs Guide, DOE G441.1-1C. Washington, D.C.
U.S. Department Of Energy (DOE),	Radiation Protection of the Public and the Environment, DOE Order 458.1. Washington, D.C.

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low as Reasonably Achievable
ARA	Airborne Radioactive Area
CA	Contamination Area
DRS	Director, Radiation Safety
HCA	High Contamination Area
HEPA	High Efficiency Particulate Activity
PPE	Personal Protective Equipment
PRSO	Project Radiation Safety Officer
RMA	Radioactive Material Area
RPP	Radiation Projection Plan
RWP	Radiological Work Permit

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	**Radiation Detection Instrumentation**	**CMS Number:**	**CMS-710-07-PR-04013**
Procedure Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

RADIATION DETECTION RADIATION DETECTION INSTRUMENTATION

1	Previously CMS-710-01-GL-04014. Procedure revised to align with radiation safety document content and update CMS references.	MOS	10 Nov 2014
0	Issued for Use	PO	09 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure provides the minimum requirements of the CB&I *Radiation Safety Program* (CMS-710-07-PR-04000) element "Radiation Detection Instrumentation". The principles, concepts, and requirements in this program document are to be used, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation that are governed by regulation.

2.0 SCOPE

The procedure is to be followed when developing a task- or site- specific Radiation Protection Plan (RPP) intended to support sites involving the potential for exposure to sources of occupational ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities in this procedure:

- Project/Program Radiation Safety Officer (PRSO)
- Director, Radiation Safety (DRS)

4.0 PROCEDURE

In accordance with CB&I *Radiation Safety Program* (CMS-710-07-PR-04000) the RPP shall document which radiation detection instruments are suitable for the required survey measurements. The PRSO shall develop and document a technical basis for verifying that the instruments used are appropriate for the radionuclides of concern and have sufficient sensitivity for the required measurements and monitoring for review and approval by the DRS. The information may be included or referenced in the task- or site-specific RPP.

Operating instructions and calibration and quality assurance procedures shall be maintained for each instrument and should be consistent with ANSI N323A. These requirements apply to both portable and fixed instruments.

4.1 Responsibilities

4.1.1 Project/Program Radiation Safety Officer (PRSO):

4.1.1.1 Periodically reviews the site procedure(s) for applicability and efficacy at least annually or when changing radiological conditions, instruments, project objectives, quality assurance/quality control (QA/QC) requirements, license, or regulatory changes warrant.

4.1.1.2 Establishes project and/or site-specific requirements for radiological survey and fixed instruments including the selection of parameters to be measured and specific instrumentation to be used.

4.1.1.3 Ensures that instrument surveys performed for the demonstration of compliance conform to the requirements of the RPP and applicable regulations.

4.1.1.4 Maintains an adequate inventory of functional, calibrated instruments including support equipment e.g., planchets, tools, and check sources.

4.1.1.5 Controls the use, storage and operation of all portable and fixed instruments.

4.1.1.6 Ensures that the calibration and operational checks of portable and fixed instruments are properly documented and conform to the requirements of this procedure.

4.1.2 Director, Radiation Safety (DRS)

The DRS shall review and approve technical basis decisions addressing instrument sensitivity to detect the nuclides present at a fraction of the control levels.

4.2 Prerequisites

- Only personnel with appropriate, documented training shall issue or use radiation protection instruments. Training and documentation shall comply with 10 CFR 20.19 for NRC licensees and 10 CFR 835.103 and DOE G 441.1-1C for DOE Projects. Activities conducted under agreement state regulation shall have training compliant with those regulations. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites shall have training programs equivalent to those required by the appropriate regulatory group.
- Instruments and detectors shall be inspected for mechanical damage and shall be response tested prior to use.
- Instruments with mechanical damage or that do not pass the response test shall be removed from service and immediately tagged with a *Do Not Use* tag.
- Labels denoting current calibration shall be affixed to instruments in use.

4.3 Precautions and Limitation

- As Low as Reasonably Achievable (ALARA) practices shall be observed to minimize personnel exposure and the spread of contamination when using radiation protection instrumentation.
- Instruments removed from service for calibration, repair, or failure of a response test shall be physically segregated as practical from those instruments available for issue and shall be tagged or labelled to indicate their status.
- Portable survey instruments are susceptible to damage from physical and environmental stresses. Project procedures shall specify the environmental limits (e.g., temperature, humidity, etc.) for each instrument as specified by the manufacturer, if restrictive.
- Instruments will have been surveyed for contamination and decontaminated as necessary, prior to returning to the issue location.
- QA/QC requirements shall be established to include applicable calibration, daily response, and general operations acceptance criteria.
- Inspections, establishing acceptable ranges and daily performance checks shall only be performed by individuals trained and successfully tested on these tasks.

4.4 Characteristics, Accountability, Maintenance, and Calibration of Radiation Detection Instrumentation

4.4.1 Operating Characteristics

The PRSO shall ensure instrumentation is appropriate for the detection of the radionuclides of interest, including energy response, and that the expected Minimal Detectable Activity (MDA's) will meet project requirements. Operational characteristics should be verified with source testing once the instrumentation has been received and the results documented in a technical basis document. Any environmental limitations or special use conditions should be specified along with the required actions if those conditions are exceeded.

4.4.2 Receipt of Radiation Protection Instrumentation

Site-specific instrument procedure(s) shall define the requirements for placing radiation protection instruments in service in accordance with recommendations in Section 9.2.1 of ANSI N323A-1997 (ANSI, 1997).

The instrument may be used for 'information only', until:

- The required procedures have been written, reviewed, and approved.
- The calibration requirements have been satisfied.
- Successful passing of the general operations and source test in accordance with ANSI N323A-1997 (ANSI, 1997).

4.4.3 Performance Testing for Portable and Fixed Instruments

Site-specific instrument procedure(s) shall address the performance testing requirements before initial use, after maintenance that could affect performance, and periodically over the life of the Project to verify that they continue to meet the Project and or Site Measurement Quality Objectives. The site-specific instrument procedure(s) shall define the requirements for the testing and calibration of instruments. The testing and calibration of instruments should be performed under a group of controlled conditions called standard test conditions as described in Table 1 and Section 3.3 of ANSI N323A-1997 (ANSI, 1997).

4.4.4 Instrument Control and Accountability for Portable and Fixed Instruments

Site-specific instrument procedure(s) shall address the instrument accountability requirements including short-term and long-term use as appropriate, physical inventories by serial number, documentation and record keeping, and record disposition. Instrument issue and use should be limited to qualified personnel within the specified use parameters, including proper pre- and post-use checks, and required recordkeeping.

4.4.5 Maintenance for Portable and Fixed Instruments

Maintenance should be performed in accordance with the manufacturer's recommendations and preferably by the manufacturer. Recalibration shall be required following maintenance.

4.4.6 Pre-Calibration for Portable and Fixed Instruments

Instruments must be properly set-up, either at the work site or by the calibration service, in accordance with the instruction manuals prior to calibration. Set-up includes proper adjustment of high voltage, window settings, response time, battery checks, instrument zero, counting gas flow rate, and recording "as found" readings for the instrument. If the meter and detector are maintained as a set, ensure the proper detector is paired with the meter and that the cable is of the proper length. Check instruments for contamination and physical damage as well.

4.4.7 Calibration for Portable and Fixed Instruments

The PRSO shall ensure that the calibration frequency has been established for all instruments. Calibrations shall be performed using NIST traceable sources of the appropriate energy, source strength, and size for the intended use of the instrument. Source jigs shall be used to establish reproducible calibration geometries. Instrument scales to be calibrated shall be specified including whether at the low end, midpoint, or high end of the scale and the acceptance criteria. Specify the calibration data that must be recorded including as left conditions and alarm set points as appropriate. MDAs should be determined following calibration in accordance with NUREG-1507 (NRC, 1999).

4.4.8 Recordkeeping for Portable and Fixed Instruments

Accurate and complete records of instrument inventories, calibrations, repair history, and performance checks must be maintained. Information required on calibration labels must be specified.

4.4.9 Fixed Counting System General Requirements

The requirements for fixed counting systems are the same as described above and include the following requirements as well:

- Physical inspections.
- Counting gas requirements if appropriate.
- System set-up parameters.
- Range for background.
- Operational parameters.
- Performance testing and acceptable testing criteria.
- Appropriate response when instrument response is out of range.
- Sample counting operations, establishing required MDAs or Minimum Detectable Contamination (MDC's).
- Safety precautions.
- Record keeping requirements including data package and data verification and validation.

5.0 REFERENCES

ANSI N323A-1997	American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments. American National Standards Institute. Published by the Institute of Electrical and Electronics Engineers, Inc. New York, New York.
CMS-710-07-PR-04000	Radiation Safety Program
DOE	Occupational Radiation Protection. U.S. Department of Energy, Title 10 Code of Federal Regulations, Part 835, Subpart E, 835.401 – 835.405, Subpart F, 835.501 - 835.502, Subpart G, 835.601 – 835.606, Subpart L, 835.1101 – 835.1102, and Appendix E. Washington, D.C.
DOE	Radiation Protection Programs Guide. DOE G 441.1-1C. U.S. Department of Energy, Washington, D.C.
NRC	Standards for Protection Against Radiation. U.S. Nuclear Regulatory Commission, Title 10 Code of Federal Regulations, Part 20, 1004, and Subpart F, 20.1501 – 20.1502
Technical Report	Abelquist, E. W., W. S. Brown, G. F. Powers, A. M. Huffert. 1998. Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. U.S. Nuclear Regulatory Commission NUREG-1507. Washington, D.C.
Technical Report	Manufacturer's Instrument Technical and Users Manuals and Technical Reports

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOE	Department of Energy
DRS	Director, Radiation Safety
MDA	Minimal Detectable Activity
MDC	Minimum Detectable Contamination
NIST	National Institute of Standards and Technology, the national organization for establishing the quality standards for radiation sources used for instrument calibration.
PRSO	Project Radiation Safety Officer
QA/QC	Quality Assurance/Quality Control
RPP	Radiation Protection Plan

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

PROCEDURE

Procedure Title:	**Radiological Labeling, Posting and Access Control**	**CMS Number:**	**CMS-710-07-PR-04014**
Procedure Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

RADIOLOGICAL LABELING, POSTING AND ACCESS CONTROL

1	Previously CMS-710-01-WI-04115. Revised to align with radiation safety documents and reference updated CMS documents.	MOS	10 Nov 2014
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1.0 PURPOSE

This procedure describes the CB&I *Radiation Safety Program*, CMS-710-07-PR-04000, requirement for labelling radioactive material and equipment, posting Radiologically-Controlled/Restricted Areas, and providing access control. The principles, concepts, and procedures are to be utilized, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation.

2.0 SCOPE

This procedure will be implemented, as appropriate, to support sites involving the potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities in this procedure:

- Project Radiation Safety Officer (PRSO)
- Director, Radiation Safety (DRS)
- CB&I Workers

4.0 PROCEDURE

Each task- or site-specific radiation protection plan (RPP) shall include provisions to identify, post and control access to radiologically-controlled/restricted areas. For sites licensed by the NRC, the agreement state, or other agencies that require equivalency to 10 CFR 20, posting of radiological areas shall be completed in accordance with the requirements of 10 CFR 20.1902. For DOE sites, the posting requirements are similar to the NRC requirements and are contained in 10 CFR 835.603, 604. For all other sites, posting shall be per applicable regulatory requirements.

4.1 Signs

4.1.1 Radiological warning signs shall be clearly worded, and may include additional radiological protection instructions or information regarding current radiological conditions in the area. Inserts (on signs containing insert slots) may be changed, as appropriate, giving current radiological conditions. Radiological postings must be securely affixed and located such that signs can be expected to remain in place when subjected to typical adverse conditions and environments. If more than one radiological condition (i.e., contamination, radiation, or airborne radioactivity) exists in the same area, each radiological condition must be identified and appropriately posted.

4.1.2 If a radiological area or radioactive materials area (RMA) cannot be posted immediately upon identification, a qualified radiological control technician may control the area until the posting is installed. Additional postings may be used to identify special site considerations including hot spots, low dose areas, etc.

4.1.3 Permanent or long-term area signs should be mounted on chains, posts, walls, doors, fences, or other permanent structures. Radiological warning signs used for permanent posting should be durable. Radiological warning signs must be constructed of materials that can endure environmental conditions without significant deterioration of color, legibility, strength, or other physical characteristics. Radiological warning signs for temporary areas should be mounted on or near the physical barrier or on posts, walls, or doors.

4.1.4 Signs providing information that do not communicate a radiological hazard (e.g., job aids, instructions for removing protective clothing, etc.) must not use the radiological color scheme. For example, signs that provide instruction to not discharge or use radioactive materials (e.g., “DO NOT DISPOSE OF RADIOACTIVE LIQUIDS IN THIS SINK” OR “UNFILTERED VENTILATION – DO NOT USE RADIOACTIVE MATERIALS IN HOOD”) should not use the radiological color scheme.

4.2 Access Control

4.2.1 Personnel entrances and exits to radiological areas shall be clearly and conspicuously posted with the appropriate radiological warning signs. Posting on doors or access gates must remain visible when the doors and gates are open or closed

4.2.2 Posted areas must be as small as practicable in order to control personnel and radioactive material. In fulfilling this requirement do not create areas that are so small that they restrict safe or convenient activities within the area.

4.3 Posting

A summary of NRC and DOE posting requirements is provided in Attachment 8.1. The following sections outline the area designations and required postings.

4.3.1 Radiologically-Controlled Area

A radiologically-controlled area is the area outside of a Restricted Area, but inside the site boundary, access to which can be limited by the licensee or DOE for any reason.

4.3.2 Restricted Area

Restricted Area is an area to which access is limited by the licensee (or DOE) 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.

4.3.3 Radioactive Material Area (RMA)

A Radioactive Material Area is an area or room within a controlled area, accessible to individuals, in which items or containers of radioactive material exist and the total activity of radioactive material exceeds the applicable values provided in appendix E of 10 CFR 835 or 10 times the quantity of such material specified in Appendix C of 10 CFR 20. Each RMA shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

4.3.4 Radiation Area

4.3.4.1 Each area within a radiologically-controlled area where an individual can receive a deep dose equivalent greater than 5 millirem (mrem; 50 microSieverts) but less than or equal to 100 mrem (1 milliSievert [mSv]) in one hour at a distance of 30 centimeters (cm) from the radiation source itself, or from any surface through which the radiation penetrates, shall be posted as a Radiation Area (RA). Each RA shall be posted with a conspicuous radiological warning sign or signs bearing the radiation symbol and the words “CAUTION, RADIATION AREA.” The boundary of the area should be identified by use of a boundary identifier or a physical barrier and sufficient radiological warning signs.

4.3.4.2 Boundary identifiers and physical barriers must be clearly visible to prevent unintentional access to areas (i.e., the barriers cannot be readily walked over or under, except at identified access points). For example, rope barriers should be approximately 24 to 40 inches (60 to 100 cm) in height. These barriers shall be set up such that they do not impede the intended use of emergency exits or evacuation routes. Existing physical barriers, such as fences or walls, may be used as boundary identifiers if the posting is adequate to prevent inadvertent access to the radiological area.

4.3.4.3 It is not necessary to erect physical barriers to identify the boundaries of radiological areas that are not accessible to personnel (e.g., underground

radioactive material areas, buried radiological piping, etc.). Appropriate signs must be placed along area boundaries.

4.3.5 High Radiation Area

Any area where an individual can, at any time during normal operations, receive a deep dose equivalent of greater than 100 mrem (1 mSv) at 30 cm from the source or any surface through which the radiation penetrates but less than or equal to an absorbed dose of 500 rads (5 grays) in 1 hour at 100 cm from the radiation source, or from any surface through which the radiation penetrates, shall be posted as a High Radiation Area (HRA). Each HRA shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words “CAUTION, HIGH RADIATION AREA” or “DANGER, HIGH RADIATION AREA.” The words “Personnel Dosimeter, Supplemental Dosimeter, and RWP Required for Entry” shall be included secondary to the “HIGH RADIATION AREA” on the posted radiological warning sign or posted in conjunction with the sign. The posting must be in addition to a physical barrier. High Radiation Areas should be located within Radiation Areas, if practical. The boundaries of permanent HRAs must be the physical barriers (e.g., walls or fences) that prevent access to the area except at designated access points. Refer to 10 CFR 20.1601 and 1602, 835.502 or applicable regulation for the specific control measures required.

4.3.6 Very High Radiation Area

Any area where an individual can at any time during normal operations receive a deep dose equivalent of greater than 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface through which the radiation penetrates shall be posted as a Very High Radiation Area. Each Very High Radiation Area shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words “GRAVE DANGER, VERY HIGH RADIATION AREA.” The words “Personnel Dosimeter, Supplemental Dosimeter, and RWP Required for Entry” shall be included secondary to the “VERY HIGH RADIATION AREA” on the posted radiological warning sign or posted in conjunction with the sign. The posting should be in addition to a physical barrier. Very High Radiation Areas should be located within Radiation Areas, if practical. The boundaries of permanent, Very High Radiation Areas should be the physical barriers (e.g., walls or fences) that prevent access to the area except at designated access points.

4.3.7 Airborne Radioactivity Area

Each Airborne Radioactivity Area (ARA) (as described in Exhibit A – Radiological Posting Requirements) shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words “CAUTION, AIRBORNE RADIOACTIVITY AREA” or “DANGER, AIRBORNE RADIOACTIVITY AREA.”

4.3.8 Contamination Areas

4.3.8.1 For sites supporting the DOE, any area where contamination levels are greater than the values specified in Appendix D of 10 CFR 835, but less than or equal to 100 times those levels, shall be posted as a Contamination Area in accordance with 10 CFR 835.603(e). The sign shall include the radiation symbol and the words “CAUTION, CONTAMINATION AREA.”

4.3.8.2 For sites supporting the DOE, any area where contamination levels are greater than 100 times the values specified in Appendix D of 10 CFR 835 shall be posted as a High Contamination Area in accordance with 10 CFR 835.603(f). The sign shall include the radiation symbol and the words “DANGER, HIGH CONTAMINATION AREA.” The wording “RWP REQUIRED FOR ENTRY” should be included on the sign.

4.3.8.3 For non-DOE sites, the Radiation Protection Program should establish the limits for contamination and the requirements for posting contaminated areas.

4.4 Radiological Postings Design

4.4.1 The background color of radiological warning signs shall be yellow; the foreground color shall be either black or magenta. Magenta is the preferred color. The color scheme used for radiological control postings should be reserved for radiological hazards communication only. For example, entry or exit requirements for radiological areas should use the radiological hazards communication color scheme (e.g., signs stating that “DOSIMETRY REQUIRED FOR ENTRY, “PERSONAL PROTECTIVE CLOTHING REQUIRED FOR ENTRY,” “REMOVE PERSONAL PROTECTIVE CLOTHING PRIOR TO EXIT,” etc., should have a foreground of black or magenta and a background of yellow).

4.4.2 Rope, tape, chains, or similar materials used as boundary identifiers for radiological areas should be yellow and magenta in color. Existing physical barriers used to identify area boundaries do not require color-coding.

4.4.3 The lettering and radiation symbol used for posting should be proportional to the size of the radiological warning sign. Lettering shall not be superimposed on the radiation symbol (ANSI, 1989). The size of lettering used on radiological warning signs should not detract from the clarity of the radiation symbol. Unless circumstances do not permit, the radiation symbol should be oriented with one blade downward and centered on the vertical axis. The size of the primary hazard communication of the sign (e.g., “CAUTION – RADIATION AREA”) should be larger than any other secondary hazard information included on the same sign. When a blank space is provided on a radiological sign or label for indicating a radiological condition, the space should be large enough to adequately display the hazard information. The shape, proportion, and use of the radiation symbol shall conform to the requirements in ANSI N2.1

4.5 Exceptions

4.5.1 An agreement state, NRC licensee, or sites governed by agencies that require adherence to 10 CFR 20, are not required to post radiological warning and caution signs in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions is met:

4.5.1.1 The materials are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure of individuals to radiation or radioactive materials in excess of project ALARA goals.

4.5.1.2 The area or room is subject to project control.

4.5.2 Posting is also not required if a sealed source is present and the radiation level at 30 cm from the surface of the source container or housing does not exceed 5 mrem (0.05 mSv) per hour.

4.5.3 Exceptions to DOE posting requirements defined in 10 CFR 835.603 may be permitted if the exceptions to posting requirements are completed in accordance with 10 CFR 835.604.

4.5.4 Areas may be excepted from the posting requirements of 10 CFR 835.603 for periods of less than eight continuous hours when placed under the continuous observation and control of an individual knowledgeable of, and empowered to implement, required access and exposure control measures.

4.5.5 Areas may be excepted from the RMA posting requirements of 10 CFR 835.603(g) when any of the following are true:

4.5.5.1 The area is posted in accordance with 10 CFR 835.603(a) through (g).

4.5.5.2 Each item or container of radioactive material is labeled according to 10 CFR 835.605 such that individuals entering the area are made aware of the hazard.

4.5.5.3 The radioactive material of concern consists solely of structures or installed components, which have been activated.

5.0 REFERENCES

American National Standards Institute (ANSI) 1989	Radiation Symbol, ANSI N2.1-1971 (R1989), New York, New York
CMS-710-07-PR-04000	Radiation Safety Program
Code of Federal Regulations (CFR), Title 10, Part 20, Subparts 1902 and 1903	Standards for Protection Against Radiation, U.S. Nuclear Regulatory Commission (NRC), 2003, U.S. Government Printing Office, Washington, D.C., (September 2012).
CFR, Title 10, Part 835, Subparts 601, 602, 603, 604	Occupational Radiation Protection, U.S. Department of Energy (DOE), 2003, U.S. Government Printing Office, Washington, D.C., (September 2012).
DOE, 2011	Radiation Protection Programs Guide, DOE G 441.1-1C, Washington, D.C.

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
ARA	Airborne Radioactivity Area
CFR	Code of Federal Regulations
DOE	Department of Energy
DRS	Director, Radiation Safety
HRA	High Radiation Area
NRC	Nuclear Regulatory Commission
PRSO	Project Radiation Safety Officer
RA	Radiation Area
rem	The **roentgen equivalent** in **man** (rem) is a unit of equivalent dose, effective dose, and committed dose. The international system (SI) unit for dose equivalent is the sievert (Sv). One rem is equivalent to 0.01 Sv 1 mrem = 1000 millirem (mrem).
RMA	Radioactive Materials Area
RPP	Radiation Protection Plan
RWP	Radiation Work Permit
Sievert (Sv)	The international system (SI) unit for dose equivalent equal to 1 Joule/kilogram. The Sievert has replaced the unit rem. One Sievert is equivalent to 100 rem. 1 Sv = 1000 millisievert (mSv).

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

Attachment 8.1 Radiological Posting Requirements

Attachment 8.1 Radiological Posting Requirements

Posting Requirement	U.S. Nuclear Regulatory Commission (NRC)	U.S. Department of Energy (DOE)
Radiation Area	In accordance with the requirements of 10 Code of Federal Regulation (CFR) 20.1902. Each area within a Radiological Area where an individual can receive a deep dose equivalent greater than 5 millirem (mrem; 50 microSieverts) but less than or equal to 100 mrem (1 milliSievert [mSv]) in one hour at a distance of 30 centimeters (cm) from the radiation source itself, or from any surface through which the radiation penetrates, shall be posted as a radiation area. Each Radiation Area shall be posted with a conspicuous radiological warning sign or signs bearing the radiation symbol and the words “CAUTION, RADIATION AREA.”	In accordance with DOE 10 CFR 835.603(a) (Same as NRC)
High Radiation Area	In accordance with the requirements of 10 CFR 20.1902. Any area where an individual can at any time during normal operations receive a deep dose equivalent of greater than 100 mrem (1 mSv) at 30 cm from the source or any surface through which the radiation penetrates but less than or equal to an absorbed dose of 500 rads (5 grays) in 1 hour at 100 cm from the radiation source, or from any surface through which the radiation penetrates, shall be posted as a High Radiation Area. Each High Radiation Area shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words “CAUTION, HIGH RADIATION AREA” or “DANGER, HIGH RADIATION AREA.” The words “Personnel Dosimeter, Supplemental Dosimeter, and RWP Required for Entry” shall be included secondary to the “HIGH RADIATION AREA.”	In accordance with DOE 10 CFR 835.603(b) (Same as NRC)
Very High Radiation Area	In accordance with the requirements of 10 CFR 20.1902. Any area where an individual can at any time during normal operations receive a deep dose equivalent of greater than 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface through which the radiation penetrates shall be posted as a Very High Radiation Area. Each Very High Radiation Area shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words “GRAVE DANGER, VERY HIGH RADIATION AREA.” The words “Personnel Dosimeter, Supplemental Dosimeter, and RWP Required for Entry” shall be included secondary to the “VERY HIGH RADIATION AREA” on the posted radiological warning sign or posted in conjunction with the sign.	In accordance with DOE 10 CFR 835.603(c) (Same as NRC)

Posting Requirement	NRC	DOE
Airborne Radioactivity Area	In accordance with the requirements of 10 CFR 20.1902(d). Any room, area or enclosure must be posted as an airborne radioactivity area if (1) radioactive airborne concentration are in excess of the DAC specified in Appendix B, to §§ 20.1001-20.2401 or (2) a worker in an area would be exposed to more than 12 DAC hours in a week.	In accordance with DOE 10 CFR 835.603(d) Concentration greater than 10% DAC
Radioactive Material Area	In accordance with the requirements of 10 CFR 20.1902(e). Post each area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C to part 20 with a conspicuous sign or signs bearing the radiation symbol and the words “CAUTION, RADIOACTIVE MATERIAL(S)” or “DANGER, RADIOACTIVE MATERIAL(S).”	In accordance with the requirements of 10 CFR 835.601-604.
Contamination Area		Any area where contamination levels are greater than the values specified in Appendix D of 10 CFR 835, but less than or equal to 100 times those levels, shall be posted as a Contamination Area in accordance with 10 CFR 835.603(e). The sign shall include the radiation symbol and the words “CAUTION, CONTAMINATION AREA.”
High Contamination Area		Any area where contamination levels are greater than 100 times the values specified in Appendix D of 10 CFR 835 shall be posted as a High Contamination Area in accordance with 10 CFR 835.603(f). The sign shall include the radiation symbol and the words “DANGER, HIGH CONTAMINATION AREA.” The wording “RWP REQUIRED FOR ENTRY” should be included on the sign.

PROCEDURE

Procedure Title:	**Radiation Safety Staff Credentials**	**CMS Number:**	**CMS-710-07-PR-04015**
Procedure Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

RADIATION SAFETY STAFF CREDENTIALS

1	Previously CMS-710-01-WI-04117. Procedure has been revised to align with radiation safety documents and updated to include responsibilities and minimum requirements.	MOS	08 Jan 2015
0	Issued for Use	JPO	11 Dec 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure describes the CB&I Radiation Safety Program minimum requirements credentialing radiation safety staff. This procedure provides the required qualifications, through training and experience, for individuals who have responsibilities for radiation protection and/or nuclear safety at CB&I radiological sites. The qualifications, responsibilities, and successful completion of training of personnel shall be reviewed and evaluated prior to personnel beginning radiological operations. The form, CMS-710-07-FM-04015, *Radiological Training Evaluation Form*, or equivalent, shall be used to document training and qualifications.

Before using licensed material, authorized users will receive the training described in Appendix H of NUREG-1156, Vol, 18, *Consolidated Guidance About Materials Licenses: Program-Specific Guidance about Service Provide Licenses,* dated November 2000.

2.0 SCOPE

This procedure will be implemented, as appropriate, to support projects and work involving the potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following people have responsibilities outlined in this guideline:

- Director, Radiation Safety (DRS)
- Project/Responsible Manager (PM/RM)
- Project/ Program Radiation Safety Officers (PRSO)
- License Radiation Safety Officer (License RSO)

4.0 PROCEDURE

Each Radiation Protection Plan (RPP) shall include a procedure for a documented review of the qualifications of the radiation safety staff. Refer to CMS-710-07-PR-04000, *Radiation Safety Program* for additional information. Depending on project/agency-specific requirements and terminology, these individuals may include program/project managers, health and safety managers, radiation protection managers, radiation safety officers, radiological control supervisors, and senior technicians and other supervisory personnel. The qualifications of the individuals named for some of these positions, particularly the Project/Program Radiation Safety Officer (PRSO), may require review and approval by the cognizant regulatory agency or client. The qualifications of the PRSO also must be reviewed and approved by the Project/Responsible Manager (PM/RM) and the Director, Radiation Safety (DRS).

4.1 Regulatory Agency Requirements

Table 1 below summarizes, by agency, example regulations and associated guidance that collectively define and provide information on the necessary qualifications of project/site personnel with responsibility for radiation protection. Project/site Quality Assurance Program Plans (QAPP) (or similar documents) must provide the supplemental Quality Assurance (QA)/Quality Control (QC) protocols necessary to verify and validate that the qualifications of personnel have been properly evaluated and documented, and that all personnel with responsibility for radiation protection are qualified for assigned positions in accordance with the applicable agency and associated client requirements and/or license conditions.

TABLE 1 Qualifications of Personnel with Responsibility for Radiation Protection

DOE	NRC	USACE	NAVAL REACTORS
• 10 CFR 835.103, "Occupational Radiation Protection – Education , Training and Skills" • DOE O 462.2 , "Personnel Selection, Training, Qualification and Certification Requirements for DOE Nuclear Facilities" • ANSI/ANS N3.1-1993, "Selection, Qualification and Training of Personnel for Nuclear Power Plants"	• Regulatory Guide 1.8, "Training and Qualification of Personnel at Nuclear Power Plants", or • ANSI/ANS N3.1-1993, "Selection, Qualification and Training of Personnel for Nuclear Power Plants" • Based on site Technical Specifications	• ER 385-1-80, "Ionizing Radiation Protection," Section 6 (Authorized User and Qualifications) • EM 385-1-80, Radiation Protection Manual, Chapt.2, "Personnel Responsibilities and Qualifications" • Memorandum of Understanding (MOU) between USACE and the Nuclear Regulatory Commission (NRC) defers to 10 CFR 20 and CERCLA • EM 385-1-1; "Safety and Health Requirements Manual", 06.E.02 (Qualified Personnel)	• Article 106, "Radiological Control Training Requirements" • Article 107, "Radiation Worker Training Standard" • Article 108, "Radiological Controls Technician Training Standard" • Article 112, Training Standard for Engineers of Radiological Work" • Site/Project specific contract "Technical Specification"

4.2 Change in Required Qualifications

Project/site staff must possess a combination of training and experience which allows them to ensure worker and public safety when dealing with radioactive materials and activities conducted under at specific project/site or under a license. As projects become more complex, and/or quantities of radioactive material and/or radiation levels increase, the duties and responsibilities of personnel with radiation protection responsibilities increase in a commensurate fashion. Accordingly, the appropriate levels and degree of training and experience required for successful radiation safety program development and implementation must be considered and re-evaluated on a regular basis as project/site conditions and requirements change.

4.3 Radiation Staff Qualifications and Approvals

4.3.1 The License Radiation Safety Officer (License RSO) or PRSO shall perform a review of the training and qualification records for each candidate. Only qualified candidates shall be permitted to work.

4.3.2 If the candidate meets the qualifications and project-specific selection criteria, he/she is considered qualified to staff the project without further approval. Successful completion of annual radiation safety training is also required prior to beginning work with licensed radioactive material.

4.3.3 A file shall be kept for each successful candidate. This file shall contain the resume, qualification certificates, if appropriate, and any testing or evaluation results.

4.4 Project Radiation Safety Officer (PRSO)

The PRSO shall be qualified by training and experience in radiation protection and be available for advice and assistance on radiological safety matters. The PRSO's training and experience shall include the uses of licensed material identified on the license so that the PRSO is able to oversee the radiation safety program during normal and emergency conditions. The PRSO must have at least five years of documented direct, hands-on radiological controls experience.

4.5 Authorized Users

Authorized Users shall have adequate training and experience to use, possess, or provide services involving licensed materials. Duration of training and experience shall be commensurate with the expected hazards personnel may encounter during routine and emergency conditions and shall be successfully completed annually. Before using licensed material, authorized users will receive the training described in Appendix H of NUREG-1156, Vol, 18, *Consolidated Guidance About Materials Licenses: Program-Specific Guidance about Service Provide Licenses,* dated November 2000.

4.5.1 Criteria for acceptable training and experience shall include classroom training in the form of lecture, videotape, or self-study that emphasizes practical subject matter important to the safe handling of licensed materials. The duration and technical level of training shall be commensurate with the expected hazards encountered during routine and emergency conditions.

4.5.2 Training shall be required prior to the authorized user assuming duties with or in the vicinity of radioactive materials and whenever there is a significant change in duties, regulations, or terms and conditions of the license. Annual refresher training shall also be required.

4.5.3 Past experience should include similar radionuclides and quantities as the current assignment.

4.6 Radiological Controls Technicians

4.6.1 A Radiological Controls Technician (RCT) must have at least 12 months of documented direct, hands-on radiological controls experience. In addition to the minimum experience and education requirements, nationally recognized training and qualification requirements, such as DOE Radiological Controls Technician, U.S. Navy Article 108, Radiological Control Monitor, or other client-mandated training requirements, may be imposed on a project-specific basis.

4.6.2 All RCT candidates shall be considered qualified if they meet the requirements of one or more of the following categories:

- Verifiable evidence of training, experience, or a combination of training and experience consistent with the requirements of American National Standards Institute/American Nuclear Society, Standard N3.1 - 1993, American National Standard for Selection, Qualification and Training of Personnel for Nuclear Power Plants (reaffirmed 1999), for Senior Health Physics Technicians.
- National Certification with the National Registry of Radiation Protection Technologists.
- Certification as a DOE Radiological Controls Technician consistent with the requirements of Title 10 CFR, Part 835, Section 835.103.
- Evidence of NAVSHIPS 389-0288, Radiological Controls for Shipyards or NAVSEA 389-0153, Radiological Controls, Article 108, Qualification.
- Two-year technical degree in health physics or related field.

4.6.3 The candidate shall supply training and qualification records for review. Copies of these records shall be maintained as part of the project record. All RCTs must also successfully complete annual radiation safety training.

4.7 Radiation Workers

All project personnel designated as Radiation Workers shall be qualified or trained as radiation workers prior to beginning work in Restricted Areas. Those personnel qualified as radiation workers shall re-qualify on a yearly basis. Training and/or qualification shall be conducted in accordance with the one or more of the following training standards:

- Training as required by CFR, Title 10, Part 19, Section 19.12
- Training as required by CFR, Title 29, Part 1910.1096
- Any project-specific training that is determined by the License RSO to meet the requirements of the applicable standards noted above.

4.8 Radiation Safety Instructors

A qualified individual, such as a person who meets the qualifications of the RSO or authorized user on the license (or other knowledgeable radiation protection staff person approved by the PRSO) and is familiar with the program, shall conduct the training. Instructors shall have adequate training and experience and possess a thorough understanding of the licensee operations.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-FM-04015	Radiological Training Evaluation Form
American National Standards Institute (ANSI)/American Nuclear Society (ANS), 1993, Standard N3.1	American National Standard for Selection, Qualification and Training of Personnel for Nuclear Power Plants (reaffirmed 1999), for Senior Health Physics Technicians
Code of Federal Regulations (CFR), Title 10, Part 20	Standards for Protection Against Radiation, U.S. Government Printing Office, Washington, D.C.
CFR, Title 10, Part 835.103	Occupational Radiation Protection – Education , Training and Skills, U.S. Government Printing Office, Washington, D.C.
CFR, Title 10, Part 19, Section 19.12	Instructions to Workers
CFR, Title 29, Part 1910.1096	Ionizing Radiation
NUREG-1556, Vol. 18, 2000	Consolidated Guidance About Materials License
U.S. Army Corps of Engineers (USACE), 1997, Engineer Manual (EM) 385-1-80	Radiation Project Manual, Department of the Army, Washington, D.C., May 30
USACE, 2008, EM 385-1-1	Safety and Health Requirements Manual, U.S. Department of the Army, Washington, D.C., September 15
USACE, 2010, Engineer Regulation (ER) 385-1-80	Ionizing Radiation Protection, U.S. Department of the Army, Washington, D.C., June 30
U.S. Department of Energy (DOE), 2011	Personnel Selection, Training, Qualification, and Certification for DOE Nuclear Facilities, DOE O 426.2, National Nuclear Security Administration
U.S. Naval Sea Systems Command (NAVSEA), 389-0153	Radiological Controls
U.S. Naval Ship Systems Command (NAVSHIPS) 389-0288	Radiological Controls for Shipyards

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOE	Department of Energy
DRS	Director, Radiation Safety
MOU	Memorandum of Understanding
NRC	Nuclear Regulatory Commission
PM/RM	Project Manager/Responsible Manager
PRSO	Project/Program Radiation Safety Officer

Term (Acronym)	***Definition***
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
RCT	Radiological Controls Technician
RPP	Radiation Protection Plan
USACE	U.S. Army Corps of Engineers

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None.

Procedure Title:	Procurement, Receipt, Transfer and Inventory of Radioactive Sources	CMS Number:	CMS-710-07-PR-04016
Procedure Owner:	Federal Services HSE	Issuing Authority:	CFS HSE&Q Director

PROCUREMENT, RECEIPT, TRANSFER AND INVENTORY OF RADIOACTIVE SOURCES

1	Previously CMS-710-01-GL-04018. Revised to align with radiation safety documents and include responsibilities and minimum requirements.	MOS	08 Jan 2015
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Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure describes the CB&I Radiation Safety Program element Procurement, Receipt, Transfer, Inventory of Radioactive Sources. The principles, concepts, and guidance in this procedure are to be utilized, at work sites that receive, possess, use, transfer, or dispose of radioactive materials or and radiation-producing devices (devices) which are governed by regulation.

2.0 SCOPE

This procedure is for use when developing a task- or site-specific Radiation Protection Plan (RPP) intended to support sites involving the potential for occupational exposure to sources of ionizing radiation.

3.0 RESPONSIBILITIES

The following personnel have responsibilities outlined in this procedure:

- Project/Program Radiation Safety Officer (PRSO)

4.0 PROCEDURE

Each RPP shall include or reference a task or site-specific procedure for maintaining an inventory of radioactive material and devices under its control. As appropriate, the procedure shall include provisions for procuring, receiving, and checking-in shipments of radioactive material and devices in accordance with the requirements of the controlling documents. Transfers of radiation sources to others must be documented in accordance with the requirements of the controlling documents.

4.1 Introduction

NRC regulations (10 CFR Parts 20, 30, 33 and 34) require licensees to develop, implement and maintain written procedures for:

- Purchasing and receipt of radioactive material and devices;
- Safely receiving and opening packages; and
- Ensuring control and accountability of licensed material.

DOE G 441.1-1C provides guidance on controlling and maintaining radioactive sources, and specifies requirements for receipt, inventory, storage, transfer, disposal, and integrity testing (sealed sources only). NUREG-1556, Vol. 18, Appendix K provides guidance on material ordering and package receipt and opening.

4.2 Material Receipt and Accountability

The PRSO shall approve or place all orders of radioactive material to ensure that the requested material, quantities, manufacturer, quality documentation, and model are necessary (i.e., can't be met with the use of existing sources), authorized by the license and that the possession limits are not exceeded.

4.2.1 Administrative controls and provisions must be established as part of a site-specific radiation protection program to assure safe operations including procedures to ensure the control of procurement and use of radioactive material. Administrative procedures must ensure that only authorized individuals receive radioactive materials and those individuals receive only the types and quantities of radioactive material and devices that they are authorized to receive.

4.2.2 Centralized approval of all orders of radioactive material and devices by the PRSO is required to ensure that the requested material, quantities, devices, manufacturer, and model are authorized by the license and that the possession limits are not exceeded.

4.2.3 Instructions must be given to carriers regarding where to deliver packages of radioactive material during both normal and off-duty hours. During normal working

hours, carriers should be instructed to deliver radioactive packages directly to a designated receiving area. During off-duty hours, security or other designated trained personnel should accept delivery of radioactive packages. Radioactive packages received during off-duty hours shall be signed for by the designated individual, taken immediately to the designated receiving area, and locked inside a designated secured storage area.

4.2.4 During normal working hours, immediately upon receipt of any package of licensed material, each package must be visually inspected for any signs of shipping damage, such as crushed or punctured containers or signs of dampness. Any obvious damage must be reported to the PRSO immediately. Any package suspected of leaking shall not be touched. The person delivering the package is to remain with the damaged package until monitoring can be performed by the PRSO.

4.2.5 Packages received outside of normal working hours shall be placed in a secured storage area and monitored as soon as practical. They should not be allowed to remain in the receiving area any longer than necessary to prevent excessive exposure to receiving personnel.

4.2.6 DOE G 441.1-1C provides guidance on controlling and maintaining sealed radioactive sources, and specifies requirements for receipt, inventory, storage, transfer, disposal, and integrity testing. Unsealed sources shall be controlled and maintained in a similar manner except for integrity testing.

4.3 Receiving and Opening of Packages of Radioactive Material

Licensees are required to develop, implement and maintain written procedures for safely receiving and opening packages of radioactive material in accordance with 10 CFR 20.1906. Procedures must be in place for receiving packages during normal working hours and outside of normal working hours (e.g., nights, weekends, and holidays).

4.3.1 In general, each package must be inspected for any signs of damage, such as crushed or punctured containers or signs of dampness. Any obvious damage must be reported to the PRSO or radiation safety staff immediately. The procedure should include provisions for:

- Wearing appropriate PPE (gloves) while opening the package;
- Visual inspection of the package;
- Checking the package labelling for activity of contents, so the shipment does not exceed license possession limits;
- Monitoring the external surfaces of labelled packages;
- Opening the outer package and verifying the contents;
- Checking the integrity of the final source container;
- Surveying the packing material for contamination and obliterating labels prior to disposal;
- Maintaining records of receipt, package survey, and wipe test results; and
- Notifying the final carrier and regulator if the surface contamination or external radiation levels exceed applicable limits (10 CFR 71.87(I) and 10 CFR 71.47, respectively).

4.4 Inventory

4.4.1 Licensees are required to establish appropriate administrative controls and provisions relating to material control and accounting that are necessary to ensure safe operations. Various methods such as computer programs, manual ledgers, logbooks, etc may be used to account for receipt, use, transfer, disposal, and radioactive decay of unsealed licensed material. These methods help ensure that licensee and individual authorized user possession limits are not exceeded. The inventory must be assessed on a frequency that ensures that license limits are not exceeded. This frequency may

be live-time, daily, weekly, monthly, or longer depending on the needs of the program. Frequency of inventory assessment may also be dictated by license conditions.

4.4.2 Licensees who possess sealed sources are required to perform periodic inventory assessments of radioactive sources and, depending on the type and quantity, periodic leak tests. The frequency of these inventories is normally established by license conditions as every 6 months; however, regulations may specify a different inventory frequency (e.g., sealed sources used for medical therapy are required to be inventoried every 3 months).

4.4.3 Licensed material is considered to be part of the licensee's inventory at the time it is received, be it during normal working hours or after hours when delivered by the carrier in accordance with procedures established by the licensee.

4.5 Records

Licensees must maintain records of receipt, use, transfer, and disposal of all licensed material and devices. In general, records must be maintained as follows:

- Receipt records must be maintained for as long as the material is possessed until three years after transfer or disposal;
- Transfer records must be maintained for three years after transfer;
- Disposal records must be maintained until the NRC terminates the license; and
- Records important to decommissioning must be maintained until the site is released for unrestricted use.

Records important to decommissioning include information about locations where licensed material is used or stored.

4.6 Transfers

4.6.1 Internal Transfers

Licensed radioactive materials and devices may be transferred from one internal department, laboratory or authorized user to another. The transferee must be an authorized user and must be authorized to possess the type and quantity of radioactive material or device being transferred. Internal procedures or license conditions may require prior approval from the PRSO or radiation safety department for internal transfers.

Internal or on-site transfers over non-public thoroughfares or between facilities on the same site must be performed in accordance with written procedures utilizing pre-approved routes. The procedures must include requirements to ensure appropriate monitoring and control of the radioactive material, including packaging, monitoring, labelling, and inventory assessment.

4.6.2 External Transfers

External transfers of licensed radioactive material or devices must be approved by the PRSO. External transfers must be packaged, surveyed, labelled in accordance with applicable regulations (DOT, NRC, or U.S. Postal Service). Refer to CMS-710-07-PR-04017 Shipping and Transportation of Radioactive Materials, for specific guidance regarding shipment of radioactive material.

4.7 Generally Licensed Material

4.7.1 Generally licensed materials are distributed by manufacturers authorized by the NRC to distribute materials directly to the persons who use them under a general license. Examples include Ni-63 sources in gas chromatographs and tritium gas in self-luminous EXIT signs. The site-specific procedure should address how generally licensed sources will be accounted for.

4.7.2 Generally licensed material may be received when a general license transfers a generally licensed item to a specific license that is authorized to possess the material. When received by the specific licensee, the item must now be considered as specifically licensed and should be tracked with other specifically licensed material.

5.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
US Nuclear Regulatory Commission Regulatory Guide (NUREG) 1556 Volume 18, Appendix K	Consolidated Guidance about Materials Licenses, Material Ordering and Package Receipt and Opening

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
CFR	Code of Federal Regulations
CMS	CB&I Management System
DOE	Department of Energy
NRC	Nuclear Regulatory Commission
NUREG	US Nuclear Regulatory Commission Regulatory Guide
PPE	Personal Protective Equipment
PRSO	Project/Program Radiation Safety Officer
RPP	Radiation Protection Plan

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

8.0 ATTACHMENTS

None.

Attachment 5
CB&I Management System Work Instructions

Work Instruction Title:	**SELF-ASSESSMENTS OF THE RADIATION PROTECTION PLAN**	**CMS Number:**	**CMS-710-07-WI-04000**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

SELF ASSESSMENTS OF THE RADIATION PROTECTION PLAN

1	Revised to align with Radiation Safety Program document remapping. Revised position titles and added responsibilities. Clarified documentation and reporting requirements. Previously numbered CMS-710-01-WI-04201.	MOS	30 Oct 2014
0	Issued for Use	JPO	02 Jan 2014
Rev	**Changes**	**Approved**	**Date**

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SELF-ASSESSMENTS OF THE RADIATION PROTECTION PLAN

CMS Number:	Revision:	Approval Date:
CMS-710-07-WI-04000	1	30 Oct 2014

1.0 PURPOSE

This Work Instruction (WI) describes the CB&I Radiation Safety Program requirement for self-assessments. The principles, concepts, and guidance in this instruction are to be utilized, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation.

2.0 APPLICATION

This Work Instruction will be implemented, as appropriate, to support sites involving the potential for exposure to sources of ionizing radiation.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and sufficient skills to perform Radiation Protection Plan (RPP) self-assessments

4.0 REFERENCES

CMS-710-07-PR-04000	Radiation Safety Program
CMS-710-07-PR-04020	Incident Notifications and Improvement Reports
U.S. Army Corps of Engineers, 2008	Safety and Health Requirements Manual, Safety, EM 385-1-1, November 15, Washington, D.C. (July 2012).
National Council on Radiation Protection and Measurements (NCRP)	Self- Assessment of Radiation-Safety Programs, NCRP Report No. 162, NCRP Publications, Bethesda, Maryland.

5.0 WORK INSTRUCTION

5.1 The following personnel have responsibilities in this work instruction:

- Director, Radiation Safety (DRS)
- Project/Program Radiation Safety Officer (PRSO)
- Project Manager (PM)/Responsible Manager (RM)

5.2 Responsibilities

5.2.1 The Director, Radiation Safety shall, in conjunction with the project radiation safety officer (PRSO), direct periodic reviews of radiation protection plan content and implementation. Deficiencies and corrective actions shall be identified. Improvement items shall be tracked, trended, and reported to CB&I management.

5.2.2 The PRSO shall frequently evaluate the radiation protection plan, documenting items for improvement and identifying good practices. The PRSO shall frequently evaluate plan implementation as a means of meeting as low as reasonably achievable (ALARA) goals. For long duration projects, the PRSO should direct that at least two self-assessments are performed each calendar quarter.

5.2.3 The project manager, along with project and site personnel, shall support and cooperate with the performance of self-assessments and shall assist in the development and implementation of any corrective action plan

5.3 Periodic self-assessments shall be conducted in accordance with applicable regulations and the radiation protection plan (RPP) requirements as established by the DRS. Periodic self-assessments shall assist in meeting ALARA goals. These self-assessments shall evaluate the radiological safety of operations, the effectiveness of the radiation protection plan, and the status of compliance with radiological safety regulations

5.3.1 Individual self-assessments of the radiation protection plan shall be conducted separately, and more frequently, than management-level reviews. A self-assessment

program shall manage the scheduling, frequency, and performance of individual self-assessments. The frequency of the reviews shall reflect the radiological risks, and regulatory and client requirements. The self-assessment program shall track, follow-up on corrective actions, and provide lessons learned

5.3.2 The self-assessments will allow operations-level managers to assess performance, measure program effectiveness, and identify program elements that present opportunities for improvement. The self-assessment should utilize interviews with personnel, checklists, review of documents and records, evaluation of performance measures and the observation of activities and processes. The PRSO, or other radiation protection program staff, conducting the self-assessment should:

- Assess compliance with the radiation protection plan and procedures
- Evaluate the effectiveness of the radiation protection plan, with the use of performance measures and indicators
- Assess compliance with the regulatory provisions
- Assess overall radiological safety of operations
- Evaluate effectiveness of ALARA efforts
- Review records and reports for errors and completeness
- Evaluate radiation safety training records
- Identify radiation protection plan deficiencies and prepare corrective actions
- Follow-up on the implementation of corrective measures
- Prepare a report on findings and recommendations

5.3.3 Self-Assessment Methods

A self-assessment is a deliberate examination of certain aspects of the site-specific radiation protection plan to determine its effectiveness. Self-assessments shall be performed by the PRSO, operations manager, or other persons within the radiation safety organization. The major advantage of the self-assessment is that problems can be identified and promptly corrected, internally, within the radiation protection program organization. Problems and deficiencies identified by self-assessments shall be corrected in a timely manner and lessons learned should be examined for applicability to other parts of the radiation safety program. The self-assessments shall be customized to suit the needs of the facility. All project and on-site personnel shall support and cooperate with any self-assessment efforts.

5.3.4 Frequency of Self-Assessments

Self-assessment schedules shall be based on the risk of radiation protection plan activities and use or recent changes to the plan. Frequency of self-assessments should be increased when the facility experiences significant changes in operating procedures, sudden and substantial growth in operations, inadequate staffing, high personnel turnover, previous significant negative audit or regulatory inspection results, or financial instability. The frequency shall be established by the PRSO to be no less than once per quarterly. Established frequencies shall be included in the task- or site-specific RPP. For projects with durations less than a quarter, at least one self-assessment must be performed and documented. Corrective Actions

5.3.5 Corrective actions to fix deficiencies shall be performed in a timely manner. If major deficiencies are noted, immediate action will be required (refer to CMS-710-07-PR-04020, Incident Notification and Improvement Reports). The safety significance of each deficiency shall be evaluated so that priorities may be set and resources may be identified to correct deficiencies. The PRSO and PM/RM shall develop and implement a corrective action plan with specifically assigned tasks and a schedule for completion. (Corrective action plans may be subject to review by the radiation safety director and radiation safety committee.) The self-assessment program seeks to maintain a low significance threshold for reporting. The idea being that discovering and correcting minor issues prevents the likelihood of occurrence of more significant issues. Radiation protection plan elements seen as needing improvement should be identified,

documented, and tracked to resolution in an effort to maintain continuous improvement.

5.3.5 Each site shall establish a corrective action process in accordance with CMS quality requirements. The process should document items for correction, assign a responsible party for the corrective action, establish a due date for completion of the action, and provide closeout once the action is complete. Regulators stress that self-identification of potential issues and the timely correction of them are a key element of a healthy radiation protection program. Unplanned exposures, procedure violations, personnel skin contamination, internal uptake, or a finding resulting from such an event, shall be tracked as radiological occurrence or Radiological Improvement Reports (See CMS-710-07-PR-04022, Incident Notification and Improvement Reports).

5.3.6 Deficiencies should be corrected immediately, if possible, and in a manner that ensures prompt, long-term, and effective corrective action. Follow-up should be built into the self-assessment program to ensure that corrective measures have been taken and that they have been effective in preventing a recurrence. It is necessary that follow-up activities are performed to verify the effectiveness of corrective actions.

5.3.7 Reporting

After the performance of a self-assessment of the radiation protection plan, a report of the findings and the proposed corrective actions shall be prepared. The report should provide an overview of the reviewed tasks, processes, and practices; plan strengths and weaknesses; identification of deficiencies and causes; and the suggested corrective actions and recommendations for improvements. A report, listing the findings and recommendations for radiation protection plan improvements, shall be issued and forwarded to the DRS for concurrence and approval.

5.3.8 Tracking and Trending of Results

Self-assessment reports shall be forwarded to the DRS who shall track and trend findings within the self-assessment program.

5.4 Definitions

5.4.1 Deficiency (National Council on Radiation Protection NCRP-162) — An audit finding, or any condition or action that deviates from an applicable regulation, standard, or procedure or adversely impacts the quality or reliability of any aspect of the radiation safety program.

5.4.2 Self-Assessment Program — A program element of the radiation protection program that schedules, manages, tracks, and monitors trends of the results of individual self-assessments of radiation protection plans.

5.4.3 Radiological Improvement Reports — Documented assessment reports of either positive or negative findings with respect to the implementation of the radiation protection program. See CMS-710-07-PR-04022, Incident Notification and Improvement Reports.

6.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

Work Instruction Title:	**RADIOLOGICAL WORK PERMITS**	**CMS Number:**	**CMS-710-07-WI-04008**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

RADIOLOGICAL WORK PERMITS

0	Initial submittal.	MOS	06 Nov 2014
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This work instruction (WI) outlines the criteria and identifies methods and responsibilities for developing, reviewing, and approving Radiological Work Permits (RWP). This work instruction also provides information relating to As Low as Reasonably Achievable (ALARA) reviews associated with the development of an RWP.

This WI prescribes the processes to ensure that radiological work is planned, evaluated, conducted, and documented in compliance with the requirements of the Code of Federal Regulations (CFR), Title 10, Part 835 and Part 20, Standards for Protection Against Radiation and incorporated by reference into applicable State Regulations.

2.0 APPLICATION

This WI is applicable for all radiological activities requiring the use of an RWP at project sites. This work instruction has been established to ensure ALARA principles are employed throughout the planning and control of radiological activities. An RWP is established prior to beginning authorized radiological work and is used to define and document the work scope and associated radiological work controls.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

3.1 The following personnel have responsibilities in this WI:

- Project/Program Radiation Safety Officer (PRSO)
- Project Manager (PM)/Responsible Manager (RM)
- Radiation Workers
- Director, Radiation Safety (DRS)

3.2 Responsibilities

3.2.1 The PRSO implements this procedure and approves all radiological protective measures incorporated into each RWP. Specifically, the PRSO, or designee shall:

- Review the planned work and associated hazards
- Ensure an ALARA review has been performed and documented, as appropriate
- Formally approve the RWP and any subsequent revisions

3.2.2 The PM/RM ensures personnel under his/her direction have successfully completed required training and comply with the requirements of the applicable RWP. The PM must inform the PRSO, or designee, of any changes in work scope described in the RWP.

3.2.3 All radiation workers must review the applicable RWP and accurately and legibly complete required information on the RWP Access Register (CMS-710-07-FM-40082, *RWP Access Register Form – Example* and CMS-710-07-FM-40083, RWP *Access Register and Dose Tracking Form – Example)* acknowledging that they understand the work scope and requirements detailed in the RWP. All radiation workers must comply with oral and written radiological control instructions and procedures, including instructions on RWPs, observe radiological postings, and maintain an awareness of radiological conditions in the work area.

3.2.4 The DRS is responsible for ensuring workers are qualified to perform assignments, to review and approval ALARA reviews and higher hazard, Class III RWPs.

4.0 REFERENCES

CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

CMS-710-07-FM-40081, *Class I RWP Sign-In – Example*

CMS-710-07-FM-40082, *RWP Access Register – Example*

CMS-710-07-FM-40083, *RWP Access Register and Dose Tracking Form – Example*

CMS-710-07-FM-40084, *RWP Form – Example*

CMS-710-07-FM-40085, *ALARA Review Record – Example*

Code of Federal Regulations (CFR), Title 10, Part 20, Standards for Protection Against Radiation (Ref. 19.3.1)

NRC Regulatory Guide 1.86, Table 1.1

5.0 WORK INSTRUCTION

The RWP is an administrative tool used by project radiation safety personnel to establish radiological controls for work activities. The RWP document is used to inform workers of area radiological conditions and applicable entry/access controls. It also provides a mechanism to relate worker exposure to specific work evolutions.

5.1 Prerequisites

The RWP must be based on a thorough understanding of the work to be performed and the current, and/or anticipated radiological conditions. During the pre-job planning process, the radiation exposure control methods, as defined by the PRSO, must be incorporated into the appropriate work control system (e.g., work package, procedures) directly or by reference. If a formal ALARA review is required, the PRSO must ensure that the completed ALARA review record is attached to the RWP.

5.1.1 Radiological Work Permit Required

An RWP is required for performance of all tasks requiring entries into restricted areas, radioactive materials areas, contamination areas, high contamination, radiation areas, high radiation areas, airborne radioactivity areas, or as specified by the PRSO.

NOTE: An RWP is not required for emergency response activities.

5.1.2 Standing Radiological Work Permits

Standing RWPs may be used to control routine or recurring activities, such as tours and inspection, or specified activities previously demonstrated to have acceptable ALARA exposures in areas with well-characterized and stable radiological conditions. Standing RWPs may not remain active for longer than a calendar year. If a standing RWP is required for longer than a calendar year, it shall be closed and a new standing RWP issued.

5.1.3 Job-Specific Radiological Work Permits

Job-specific RWPs shall be prepared to control non-routine operations, rarely-performed tasks, complex activities, or work in areas with changing radiological conditions. A job-specific RWP may remain in effect only for the duration of the controlled activities and are considered ‘short-term.

5.2 Training

Radiation safety group personnel and PM’s responsible for planning and performing radiological work shall ensure that personnel performing activities per this work instruction are trained to perform the assigned tasks. Indoctrination in RWP fundamentals and protective equipment requirements shall be given to all workers receiving radiological worker training.

5.3 Approval and Concurrence

Approval of the RWP is required by the PRSO (or qualified designee). All work details must be reviewed and understood and appropriate ALARA reviews conducted and documented per requirements of this work instruction prior to approving the RWP.

Concurrence with the work scope and details provided in the RWP is required by the project manager or designee.

5.4 Radiological Work Permit Implementation

NOTE: Prior to authorization as a radiation worker, all personnel performing work under an RWP must satisfy training and medical requirements as specified in the site safety and health plans and training requirements as established in the Radiation Protection Plan and detailed on the RWP (CMS-710-07-FM-40084, *RWP – Example*).

5.4.1 Radiological Work Permit Document

Throughout the authorized work activities, the original RWP document must be maintained at the work location RWPs authorizing routine work activities throughout the site must be maintained in the project radiation safety group files. Program self-assessment must include routine review of the RWP scope and requirements as well as compliance reviews of work activities. Any findings of noncompliance must be documented and immediately reported to the PRSO.

5.4.2 Radiological Work Permit Compliance

The radiation safety staff shall verify that personal protective equipment (PPE), instruments, and other safety-related equipment necessary to support the requirements of the RWP are available for use at the access control point or work site entry point. Prior to work, the assigned RCT must document in the Access Control Log Book (or equivalent) that this equipment verification has been completed.

All personnel shall read and verify that they understand and agree to comply with the terms of the RWP by signing in on the appropriate log-in form. Examples of forms include: Class I RWP Sign-in (CMS-710-07-FM-40081), Class II Access Register Form (CMS-710-07-FM-40082), and Class III Access Register Form – Dose Tracking (CMS-710-07-FM-40083). As required by the radiological posting and hazard class of the RWP, personnel shall sign in/out on the RWP Access Register for each entry into and egress from an area including when exiting the area for short break periods and when transferring to work on a different RWP.

5.4.3 Pre-Job Briefing

All RWP radiation workers will be provided a pre-job briefing on the RWP by the PRSO or qualified designee. The briefing will address all radiological conditions, requirements, necessary equipment, special precautions, and other requirements to ensure that each RWP requirement is fully understood by the workers.

These pre-job briefings shall be held upon initial entry to work areas authorized by the RWP and upon initial entry following revision of the RWP.

5.4.4 Stop Work Authority

All workers have stop work authority for all phases of work under an RWP. Stop work authority can be implemented if personnel or environmental safety is jeopardized when:

- A change in the radiological (or other hazard) environment occurs, requiring additional controls and/or precautions
- Poor work practices are observed
- RWP, ALARA, or procedural controls and/or precautions are violated
- Other actions or activities in the work area create an unsafe condition

All stop work incidents shall be promptly reported to the License RSO and Director, Radiation Safety.

5.5 Revisions

5.5.1 Required Radiological Work Permit Revision

An RWP revision is required when the radiological controls, applicable procedure, or work plans are modified significantly, or the radiological conditions dictate a change or an extension of the RWP beyond the original expiration date. A revision to the RWP requires completion of a new permit, with the same RWP number, and a new revision number. Radiation workers must sign the revised RWP to acknowledge that they understand the revision. Make necessary revisions to an existing RWP to reflect the following:

- Changes in the radiological work scope
- Required changes in the work process/procedure
- Significant changes in radiological conditions in the work area and/or changes in work area postings
- Changes in protective clothing or PPE requirements
- Changes in required engineering controls
- Changes in personnel monitoring requirements

5.5.2 Pen and Ink Changes

Pen and ink changes to an existing RWP may be made by the PRSO, or designee, to correct grammar or for clarification purposes provided the change does not alter the original intent of the RWP or reduce the level of radiological controls imposed by the RWP. All pen and ink changes must be one-line strike-outs, initialed, and dated.

5.6 Terminations

5.6.1 Authorization to Close/Terminate an Radiological Work Permit

An RWP is closed when the work is completed, or if the RWP expiration date is reached and no extension/renewal is requested. If a noncompliance with the RWP requirement is identified, the RWP may be terminated by the PM/RM, PRSO, or DRS. Termination of an RWP for failure to comply with RWP requirements requires concurrence from the PRSO and immediate notification of the PM/RM and DRS, as appropriate.

An activity that cannot be accomplished safely within the scope and control limits of the RWP must be stopped and put in a safe condition. The work must be reviewed by the PRSO and PM/RM, or designee, and modification of controls or work scope is required prior to reinstating the RWP. All stop work incidents shall be reported to the License RSO.

5.6.2 Radiological Work Permit Termination

Upon RWP termination, the RCS or assigned RCT shall ensure the following:

- Work areas are secure, areas are de-posted appropriately, and instrumentation and/or radiological equipment are properly stored.
- All radiological monitoring devices have been returned to the project radiation safety group.
- All work areas are properly posted or de-posted to reflect current radiological conditions.
- Upon completion of the above, note the date of termination on the RWP in the status box and initial.

- The RWP field copy, RWP sign-in sheets and the ALARA Review Record (CMS-710-07-FM-40084), as applicable, are returned to the project radiation safety group.

5.7 Records

Completed ALARA Checklists and Reviews, RWP forms (originals), and RWP Sign-in and Access Registers are quality records. Electronic copies of the records generated by this work instruction are maintained on site for the duration of project activities. Original records are periodically transmitted to the appropriate CB&I office for storage in the central file system.

5.8 Radiological Work Permit Preparation

Refer to the RWP form provided as CMS-710-07-FM-40085. The following numbers correspond to the section of the RWP form to be completed.

(1) Location

The building and/or area for the job or other appropriate identifier for location of the job must be listed.

(2) Work Description

The project manager provides the description of the activity to be accomplished under this RWP to the PRSO. The work scope and details associated with the work must be fully understood to provide meaningful and appropriate radiological controls. As needed, detailed work descriptions are provided as an attachment to the RWP. Include references to any work plan or other planning document prepared for the activity.

(3) Radiological Work Permit Tracking

- RWP No: Assign per RWP log for appropriate work location. The RWP number is comprised of the following:
  - Year – four digits
  - Bldg/Area – three digits or **ALL**
  - Type – **JS** job-specific or **ST** standing RWP
  - Sequence – 01, 02, etc.

  Example: 2014-033-JS-01-0 (year 2014 original job-specific RWP for Area 033)
- Revision No: The first RWP issued is Revision No. 0, the next Revision No. 1, etc. Revisions may become necessary if the expiration date is reached prior to completing all authorized work or if the scope of the work changes. All authorized RWP Radiation Workers and assigned radiation safety technicians must review and sign the revised RWP. The hard copy of the previous revision of the RWP is maintained in the project radiation safety group files and electronic copies may be stored on designated server.
- Effective Date: The PM/RM, or designee, and PRSO must sign and date indicating approval of the RWP. The effective date may not be earlier than the dates on the approvals. The effective date is typically the date of the last approval.
- Expiration Date: The expiration date is agreed upon by the PM/RM and PRSO. For a standing RWP covering routine work, the date may be up to one year from the date of issue. The expiration date for a job-specific RWP is typically a week after the job is expected to be completed.
- Termination Date: Upon completion of the job, the RWP is closed to preclude further work using the same RWP. The RWP may also be terminated if the RWP is no longer valid, for example, because work

conditions are encountered that are outside the RWP work scope. The RCS or PRSO shall indicate the date the RWP is terminated or closed and initial next to the date.

(4) Principal Radionuclides

List the principal radionuclides of concern, if known.

(5) Workplace Radiological Conditions

List the actual workplace radiological conditions. The conditions must be based on information from pre-work scoping surveys, current radiological information, calculations, or historical records review. Include the survey number(s) as reference. In some instances, an RWP may be necessary for the RCT to perform a scoping survey to obtain information concerning the radiological conditions of the workplace.

The hazard classification of the RWP is determined based upon the following workplace radiological conditions, area postings, and work scope. Refer to the ALARA Trigger Levels provided in Attachment 2 for thresholds. The hazard classification may be increased to a higher hazard class by the PRSO; the hazard classification shall not be lowered.

	Class I	Class II	Class III
RWP Work Type	Standing, routine No direct handling, except instrument check sources Known radiological hazards – radionuclides and ~activity	Standing or job-specific Direct handling Known or uncharacterized radiological hazards	Job-specific Direct handling Known or uncharacterized radiological hazards
Radiological Hazards	Less than ALARA trigger levels. RWP is the ALARA review.	Above the trigger levels documented ALARA review required.	Above the trigger levels documented ALARA review and DRS approval required.
Area Radiological Posting (Typical)	Controlled Area Restricted Area Radioactive Material Area	Contamination Area Radiation Area	High Contamination Area High Radiation Area Airborne Radioactivity Area

Check the appropriate RWP Hazard Class.

ALARA Review: If ALARA triggers are exceeded a formal ALARA review by the project ALARA Committee must be conducted and documented prior to beginning work. Check the appropriate box and enter the date the ALARA review was completed. The PRSO shall develop the ALARA reviewand provide it to the DRS/License RSO for Project ALARA Committee review And approval.

Class I RWPs do not require formal ALARA reviews. Completion of the RWP and the associated pre-job briefing are work planning tools for maintaining doses ALARA. The Class I RWP (with any attachments) and the pre-job briefing document serve as ALARA review records for work in areas with radiological conditions below the ALARA trigger levels.

The PRSO shall ensure that the recommended ALARA measures are addressed in the RWP and appropriately implemented. ALARA review documentation and supporting documentation shall be maintained with the RWP.

(6) Control Levels

Dose rate, total dose, and/or contamination limits are established as the point at which work must stop for evaluation. Work under the RWP may resume following a review by the PRSO to determine if there must be additional job planning or other increased precautions to perform the job safely. If the ALARA review trigger levels are likely to be met or exceeded, a higher level ALARA review is required (by the ALARA committee). Radiological safety personnel must stop the work if conditions change significantly from the provisions of the RWP or if workers are not following the RWP, procedures or work plans.

- Dose Rate and Contamination Limits: Provide dose rate and contamination levels at which work must stop for evaluation.
- Individual and Collective Dose Estimate: Provide the individual and collective dose estimate for the job from the ALARA Review Record (CMS-710-07-FM-40085).

(7) Personal Protective Equipment

Check the appropriate boxes and note the number of layers of clothing on the line adjacent to the type of clothing. Specify shoe cover type, as needed.

Put additional protective clothing, such as apron or gauntlet, on the last line and check the box or specify in the Special Instructions/Hold Points. Attachment 3, “Selection of Protective Clothing – Guideline,” provides guidelines for selection of protective clothing. If the ALARA review determined that respiratory protection is required, check the box and note the type of respirator (e.g., full-face/particulate). As appropriate, list the specific cartridge required for respirators.

(8) Dosimetry

Check the appropriate boxes for the dosimetry required. Select the correct dosimetry that is required to be worn by all radiation workers and radiation safety technician performing work in a posted radiologically-controlled area at project sites. A self-reading dosimeter or alarming dosimeter shall be used during all work in a posted radiation area. If an alarming dosimeter is to be used, provide the alarm settings for dose rate and integrated dose. Bioassay (or equivalent) is required if respiratory protection is prescribed for radiological control purposes. If bioassay is required, note the frequency. Note that baseline bioassays are required prior to beginning work that may require special bioassays.

(9) Training

Check the box next to the required worker radiation training. If additional PPE practical training or respirator use/handling training is required for some workers, check the third and/or fourth box.

(10) Air Monitoring

List the required air monitoring, specifying the type. Air monitoring is required for work in high contamination and airborne radioactivity areas.

(11) Surveys

List the required pre-job and post-job surveys and note the location of required surveys. Personnel frisks do not require survey documentation unless contamination is detected on personal clothing or skin. All other radiological surveys require documentation per requirements of WI-02, Radiological Surveys. Check the required RCT coverage for the work, as appropriate.

(12) Special Instructions/Hold Points

Provide special requirements or hold points that must be used to complete the job. Indicate any special engineering controls identified, including those specified in the ALARA Review Record (CMS-710-07-FM-40081).

This section is used to communicate important information not provided elsewhere on the form. If additional space is required, attach additional sheets, reference the RWP, and number all pages sequentially.

Examples include the following:

- Additional information concerning radiological surveys to be performed
- Additional PPE
- Clarification of scope of work
- Effects of weather conditions on work
- Qualifications and training for specific workers in addition to stated entry requirements
- Special engineering controls
- Other required approvals and permits, such as a confined space permit.

(13) Approval and Concurrence

The author of the RWP, or qualified designee, must approve the completed RWP document and submit the document to the PRSO for review and approval. The PM/RM responsible for the work to be performed shall acknowledge concurrence with the specified work scope and associated radiological controls by completing the appropriate section of the RWP form (CMS-710-07-FM-40084).

5.9 As Low As Reasonably Achievable Review

The ALARA Review Record (CMS-710-07-FM-40085) is a tool used to assure that any radiological activity will be designed to keep exposures ALARA. The report and checklist are used to assist in the generation of an RWP.

5.9.1 Formal As Low As Reasonable Achievable Review Requirements

The ALARA reviews are generally required for all new or revised Class II level work and for all Class III level RWPs. The trigger levels for formal ALARA reviews are provided as CMS-710-07-FM-40085. The radiological conditions for Class III RWP work requiring Project ALARA Committee oversight and approval of the ALARA review are provided as Attachment 6.1. Following completion of the ALARA review, the PRSO shall ensure that all provisions are incorporated in the associated RWP and implemented prior to beginning work.

An ALARA review should consider the following:

- Including radiological control hold points in the RWP
- Eliminating or reducing radioactivity through decontamination
- Using work processes and special tools to reduce the time in the work
- Using engineered controls to minimize spread of contamination and generation of airborne radioactivity
- Specifying special radiological training or monitoring requirements
- Using mock-ups for high exposure or complex tasks
- Using engineering, design, and temporary shielding to reduce radiation levels
- Performing a walk-down or dry run of the activity using applicable procedures
- Staging and preparing necessary materials and special tools
- Reviewing abnormal and emergency procedures and plans
- Identifying points where approvals and second party or independent verifications are required
- Establishing completion criteria, with contingency plans to anticipate difficulties
- Developing a pre-job estimate of collective dose to be incurred for the job

5.10 Forms

- CMS-710-07-FM-40081, Class I RWP Sign-In – Example
- CMS-710-07-FM-40082, RWP Access Register (II) – Example
- CMS-710-07-FM-40083, RWP Access Register and Dose Tracking (III) – Example
- CMS-710-07-FM-40084, RWP– Example
- CMS-710-07-FM-40085, ALARA Review Record – Example

5.11 Definitions

Term (Acronym)	***Definition***
Airborne Radioactivity Area	A room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations at 10 percent of the Derived Air Concentration or higher.
As Low As Reasonably Achievable (ALARA)	An approach to radiation protection designed to manage and control individual and collective radiation doses to the worker and the general public, and ensure that exposure is kept to the lowest level reasonably achievable. The ALARA approach considers aspects of social, technical, economic, practical, and public impacts.
ALARA Committee	Committee appointed by the license radiation safety officer (License RSO) to establish performance goals and monitor requirements.
ALARA Trigger Level	The radiological conditions associated with a specific task or work evolution that 'trigger' further review and approval by the ALARA Committee or Project ALARA review prior to beginning work.
Contamination Area (CA)	An area, accessible to individuals, in which surface contamination levels on equipment or solid surface materials are equal to or exceed the values provided in NRC Regulatory Guide 1.86, Table 1.1, but do not exceed 100 times those values . See Attachment 1, "Surface Contamination Limits – Posted Contamination Areas."
Control Limits	Radiological conditions or limits beyond which the radiological controls specified by the Radiological Work Permit (RWP) may not be adequate to protect workers from unintended exposure to radiation or radioactivity. If a control limit is exceeded the work associated with the RWP must be stopped temporarily to evaluate the need for additional radiological controls and modification of the RWP.
Project ALARA Review	Completion of required pre-job ALARA review record (CMS-710-07-FM-40081) by assigned radiation safety staff and concurrence by the PRSO of all technical and administrative documentation associated with planned work prior to commencement of that work.
High Contamination Area (HCA)	An area, accessible to individuals, in which surface contamination levels on equipment or solid surface materials exceed 100 times the values provided in NRC Regulatory Guide 1.86, Table 1.1. See Attachment 1,"Surface Contamination Limits – Posted Contamination Areas."

Term (Acronym)	*Definition*
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 (1 milliSievert) in 1 hour at 30 centimeters from the radiation source or any surface that the radiation penetrates.
Hold Point	A point at which work is halted until a predetermined condition(s) is satisfied. These conditions can occur at the beginning of the work or may be conditions that must be met during the work before the next step can occur.
Radiation Area (RA)	An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 milliSievert) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
Radioactive Materials Area (RMA)	Any area or room where quantities of radioactive materials in excess of 10 times the 10 CFR 20, Appendix C (Ref. 19.3.1) quantities are used or stored, or any area designated by the PRSO.
RWP	An authorization to conduct work involving exposure to radiation or radioactive material that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals. Job-Specific RWP: A permit applying to a specific operation or project. A job-specific RWP specifies the issue and expiration dates and is terminated when the operation for which it was issued is canceled or completed or when the expiration date has lapsed. A job-specific RWP may also be terminated if changes in radiological conditions require the issue of a new RWP to complete the job. Standing RWP: A general permit effective for one year from the issue date. A standing RWP is used for operations and work tasks where radiological hazards and controls remain relatively constant.
RWP Class	The hazard classification of the RWP. Low hazard (Class I), moderate hazard (Class II), and high hazard (Class III).
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. A restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be designated as a restricted area.

6.0 ATTACHMENTS

Attachment 6.1	Surface Contamination Limits – Posted Contamination Areas
Attachment 6.2	Project ALARA Committee Trigger Levels
Attachment 6.3	Selection of Protective Clothing - Guideline

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

CMS Number:	Revision:	Approval Date:
CMS-710-07-WI-04008	0	06 Nov 2014

Attachment 6.1 Surface Contamination Limits – Posted Contamination Areas

Reg. Guide 1.86 (1974), Table 1, Acceptable Surface Contamination Levels.

NUCLIDE[a]	Disintegrations/minute/100-square-centimeters (dpm/100 cm^2)		
	AVERAGE[b c f]	MAXIMUM[b d f]	REMOVABLE[b e]
U-nat, ^{235}U, ^{238}U & associated decay products	5,000 (α)	15,000 (α)	1,000 (α)
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100	200	20
Th-nat, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000	3,000	200
β-γ emitters (nuclides with decay modes other than α-emissions of SF) except ^{90}Sr and others noted above.	5,000 (β-γ)	15,000 (β-γ)	1,000 (β-γ)

Notes:

[a]Where surface contamination by both 5,000 α- and β-γ-emitting nuclides exists, the limits established for α- and β-γ-emitting nuclides should apply independently. [The values apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item.]

[b]As used in this table, dpm means the rate of emission by radioactive material as determined by correcting the counts per minute observed b the appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contamination should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such objective.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent material, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. [The use of dry material may not be appropriate for tritium.] When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire area should be wiped. [Except for transuranics and ^{226}Ra, ^{227}Ac, ^{230}Th, ^{228}Th, ^{231}Pa, and α-emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination (i.e., removable and fixed) are within the limits for removable contamination.]

[[f]The average and maximum radiation levels associated with surface contamination resulting from β-γ-emitting nuclides should not exceed 0.2 mrad/hr @ 1 cm and 1.0 mrad/hr @ 1 cm, respectively, measured

Attachment 6.2 Project ALARA Committee Trigger Levels

Project ALARA COMMITTEE REVIEW TRIGGERS – CLASS III RWP

The project-specific radiological work conditions that require both a pre-job ALARA and an ALARA Committee review and DRS approval are any one of the following:

1. Estimated individual/whole body dose of greater than 500 mrem
2. Estimated collective whole body dose of greater than 1 rem
3. Estimated individual extremity dose of greater than 1 rem
4. Estimated collective extremity dose of greater than 10 rem
5. Work in areas with dose rates ≥ 100 mR/hr @ 30 cm where workers must by routinely exposed to the unshielded radiation as part of normal work (high radiation areas)
6. Predicted or estimated airborne radioactivity concentrations that could result in 40 derived Air Concentration (DAC) – hours of inhalation exposure or exposure to 12 DAC-hours within a 40-hour period
7. Work involving known or estimated general area removable contamination levels greater than or equal to 200,000 dpm/100 cm^2 beta gamma or 20,000 dpm/100 cm^2 alpha, where the potential exists for airborne re-suspension and/or dispersion due to the planned work evolutions (high contamination area)

Attachment 6.3 Selection of Protective Clothing – Guideline

Selection of protective clothing should be based on the contamination level in the work area, the anticipated work activity, worker health considerations, and considerations of non-radiological hazards that may be present. The table below provides general guidelines.

Guidelines for Selecting Protective Clothing (PC)

Work Activity	Removable Contamination Levels		
	LOW (1- 10 times Contamination Area threshold values)	**MODERATE (10 - 100 times Contamination Area threshold values)**	**HIGH (>100 times Contamination Area threshold values)**
Routine	Full set of PC	Full Set of PC	Full set of PC, double gloves, double shoe covers
Heavy work	Full set of PC, work gloves	Double set of PC, work gloves	Double set of PC, work gloves

Full Set of PC	Double Set of PC
Coveralls	Two pairs of coveralls (with the inner being cotton)
Cotton glove liners (optional and use should be based on worker comfort)	Cotton glove liners (optional and use should be based on worker comfort)
Gloves	Two pairs of gloves
Shoe covers, rubber overshoes, or rubber boots	Two pairs of shoe covers
Hood	Rubber overshoes or rubber boots
	Hood

Workers may wear cotton glove liners inside standard gloves for comfort, but glove liners should not be worn alone or considered as a layer of protection.

Shoe covers and gloves should be sufficiently durable for the intended use. When work activities require additional strength or abrasion resistance, workers should wear leather or canvas work gloves in place of or in addition to standard gloves.

Use of hard hats in Contamination, High Contamination, and Airborne Radioactivity Areas should be controlled by the radiological work permit. Hard hats must ***not*** be removed from such areas without being properly surveyed for contamination.

When necessary to prevent contamination, workers should secure or tape shoe covers at the coverall legs and gloves at the sleeves. Tape should be tabbed to permit easy removal.

WORK INSTRUCTION

Work Instruction Title:	**Proper Handling of Dosimetry Data**	**CMS Number:**	**CMS-710-07-WI-04009**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

PROPER HANDLING OF DOSIMETRY DATA

0	Previously CMS-710-01-WI-04501. Revised to align with radiation safety documents, replaced ‘shall’ with ‘must’, updated references.	M. Somerville	7/22/15
Rev	**Changes**	**Approved**	**Date**

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Proper Handling of Dosimetry Data

CMS Number:	Revision:	Approval Date:
CMS-710-07-WI-04009	0	22 Jul 2015

1.0 PURPOSE

The purpose of this Work Instruction (WI) is to establish controls to properly handle dosimetry data generated in the course of performing radiological work for CB&I.

2.0 APPLICATION

This WI applies to all personnel responsible for administering and managing the monitoring of occupational radiation exposure data in accordance with CMS-710-07-PR-04009, *External Exposure Control and Monitoring*, and CMS-710-07-PR-04010, *Internal Exposure Control and Monitoring.*

3.0 REQUIREMENTS

None

4.0 REFERENCES

CMS-710-01-PR-03500	Medical and Exposure Records
CMS-710-07-PR-04009	External Exposure Control and Monitoring
CMS-710-07-PR-04010	Internal Exposure Control and Monitoring
10 CFR 19	Notices, Instructions and Reports to Workers: Inspection and Investigations
10 CFR 20	Standards For Protection Against Radiation

5.0 WORK INSTRUCTION

5.1 Handling Personal Data

5.1.1 Personally Identifiable Information (PII)

PII is identified as Name and any of the following:

- SSN
- Driver's license number.
- ID card number.
- Address and Date of Birth (DOB).

PII must be disclosed only to employees who are designated to have access and to third parties as detailed in CMS-710-01-PR-03500*, Medical and Exposure Records*. To meet these requirements, this procedure provides methods to avoid providing PII to the dosimetry processor.

Handling PII requires:

- Restricted–access storage (locked).
- Use of password controlled and encrypted computers.
- Password protected and encrypted email files.

5.1.2 Dosimetry Results

The dose results provided by the dosimetry processor and the dose results calculated by the project (for air sampling and bioassay) are personal and confidential and must not be disclosed to those without a business need to know.

5.1.3 HIPAA-protected Information

Medical data are protected by the Health Information Portability and Accountability Act if 1996 (HIPAA) and are subject to the CB&I's HIPAA-specific policies and procedures.

5.2 External Dosimetry Data

External dosimetry data must be identified by name and employee number (not SSN or DOB). This will prevent the use of PII associated with these data.

5.2.1 Badge Request to Dosimetry Processor

The request sent to the processor must include the employee name and the employee number for each monitored individual. No PII must be included in the dosimetry request.

5.2.2 Determination of Prior Occupational Exposure

10 CFR 20.2104 requires for those individuals that must by regulation be monitored, CB&I must determine the occupational radiation dose received during the current year.

This information is often obtained by a signed statement or NRC Form 4 from the monitored individual. The NRC Form 4 requests the SSN as an identifier. If this field is completed, the document becomes PII and must be handled accordingly. The project may ask the individual to leave this field blank or use their employee number.

Until prior occupational dose information is obtained for an individual, a low administrative dose limit will be set for that individual and the individual must not participate in a Planned Special Exposure.

5.2.3 Dosimetry Processor Report

The dosimetry processor report must not contain any PII. The dosimetry results are private and confidential, and must not be shared with those without a need to know. Results must not be posted on a site bulletin board or public location. Individual results should be shared with project personnel, but they must not view others' results. Radiological Safety personnel will have a need to know all dosimetry results to properly administer the radiation safety program and must have access to these reports.

5.2.4 Project Dosimetry Report

Any additional dosimetry reports must not contain PII and any reports that contain dosimetry data associated with names must be controlled to prevent distribution to those without a need to know.

5.3 Internal Dosimetry Data

5.3.1 Air Sampling Data

Air sampling data generally do not contain PII or private and confidential information. If the air sampling data are analyzed to determine dose to personnel, this becomes personal and confidential data and must be protected from general distribution. If the dose results are to be assigned to individuals, the results must be maintained in project records. The employee number should be included with the name to verify the individual to which the dose is assigned.

5.3.2 Internal Dosimetry Data

Bioassay sample collection or in vivo counting (whole body or lung counting) may generate documents that contain PII.

5.3.2.1 The project personnel that arrange internal dosimetry sampling or counting must request that PII not be generated. The employee number may be used as an additional identifier.

5.3.2.2 The results of the laboratory analysis of bioassay samples or in vivo counting and the dose estimates derived from these results are private and confidential and must be treated accordingly.

5.3.3 Dosimetry Reports to Third Parties

Dosimetry reports provided to third parties such as clients or regulators must not contain PII.

5.3.3.1 If private and confidential data are requested by third parties, CB&I personnel must negotiate with the third party to determine if a "sanitized" version, in which the names have been removed or replaced with job titles (for example), is exhibits acceptable. If personal and confidential data are requested, the request must be authorized by the Director, Radiation Safety.

6.0 EXHIBITS

Exhibit 6.1 CMS-720-01-FM-00020 – Business Glossary

Exhibit 6.2 CMS-720-01-FM-00021 – Technical Glossary

7.0 ATTACHMENTS

None

WORK INSTRUCTION

Work Instruction Title:	**PERFORMING AND DOCUMENTING RADIATION AND CONTAMINATION SURVEY**	**CMS Number:**	**CMS-710-07-WI-40111**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

PERFORMING AND DOCUMENTING RADIATION AND CONTAMINATION SURVEY

0	Initial submittal.	MOS	28 Jan 2015
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This Work Instruction (WI) provides direction to radiological control personnel for the performance and documentation of radiological surveys to detect, quantify, and document the following:

- Total/removable alpha and/or beta-gamma emitting radioactive contamination on work surfaces, work areas, vehicles, equipment, and personnel
- Exposure and dose rates from beta and gamma for posting requirements and control of radiation exposure to workers
- Gamma static measurement for potential elevated activities

Radiological surveys are conducted for routine work area monitoring and for those activities associated with job-specific tasks authorized by the radiological work permit (RWP) process or as described in the applicable Radiation Protection Plan (RPP).

Radiological Control personnel conduct surveys to:

- Demonstrate compliance with the requirements of applicable Code of Federal Regulations or applicable requirements
- Detect changes in radiological conditions
- Determine the location of radioactive material and/or radiation fields in the workplace
- Determine the effectiveness of engineering and process controls
- Document unrestricted release of work surfaces, work areas, vehicles, and equipment

2.0 APPLICATION

This WI provides the requirements for determining and documenting routine survey frequencies, defines the steps required to detect, quantify, and document radiation exposure and dose rates, total contamination, and removable contamination. This work instruction also specifies the measurements that must be made for:

- Routine surveys
- Posting verification surveys
- Unrestricted release surveys
- Sealed sources leak tests
- Air monitoring surveys
- Personnel frisking

This work instruction does not address the performance and documentation of gamma walk-over surveys or U.S. Department of Transportation surveys. Refer to the applicable work instruction for specific instructions relating to these types of radiological surveys.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

3.1 The following personnel have responsibilities in this WI:

- Project/Program Radiation Safety Officer (PRSO)
- Radiological Control Supervisor (RCS)
- Lead Radiological Control Technician
- Radiological Control Technician

3.2 Responsibilities

3.2.1 The PRSO is responsible for the maintenance, management, and revision of this work instruction. The PRSO is also responsible for ensuring workers comply with the requirements of this WI.

3.2.2 The RCS is responsible for the field oversight of the radiological control technician (RCT) performing tasks detailed in this WI.

3.2.3 The lead RCT may be assigned responsibility by the PRSO or RCS for the field oversight at a specific work site of RCTs performing tasks detailed in this WI.

3.2.4 The RCT is responsible for compliance with this work instruction and for addressing any issues or suggested modifications with the RCS or PRSO.

4.0 REFERENCES

CMS-710-07-PR-04000, *Radiation Safety Program*

CMS-710-07-PR-04005, *Radiation Safety Training*

CMS-710-07-PR-04011, *Radiological Surveys and Monitoring*

CMS-710-07-PR-04013, *Radiation Safety Instrumentation*

CMS-710-07-WI-04008, *Radiological Work Permits*

CMS-710-07-FM-40111, *Radiological Survey Forms*

CFR, Title 10, Part 20, Standards for Protection against Radiation, U.S. Government Printing Office, Washington, D.C., January 1, 2011, available online at 10CFR20 (December 2011).

U.S. Nuclear Regulatory Commission (NRC), Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, Table 1.1.

NRC, 1998, *Minimum Detectable Concentrations with Typical Radiation Instruments for Various Contaminants and Field Conditions*, NUREG-1507, available online at http://www.orau.gov/ddsc/instrument/NUREG-1507.pdf, June.

5.0 WORK INSTRUCTION

5.1 Prerequisites

Staff performing this procedure must be trained and qualified per CMS-710-07-PR-04005, *Radiation Safety Training*.

In collaboration with the RCS or lead RCT, choose the most appropriate instrument based on the radiation environment to be surveying

Gather appropriate information and supplies, such as the following:

- Historical survey data, recent survey information, if available, and any other information that would be useful to perform a proper survey.
- General survey report form (or equivalent), Sealed Source Leak Test report form (or equivalent), map of the area to be surveyed, gloves, appropriate smears and instruments, plastic bags and labels (as needed), and a marker or pen.

Required personal protective equipment must be in accordance with the RPP, RWP (if required), and Job Safety Analysis document covering the specific work or area.

Check instruments for operability, such as battery check and high voltage check. Verify that the instrument calibration is current.

Review and sign applicable RWP(s) for the specific work area, task, or job.

Comply with general industrial safety standards, including those found in the Job Safety Analysis while conducting surveys. For example, never place your body in harm's way when performing surveys on suspended loads. Use long handled meters to reach under the load.

Never place your body beneath suspended loads exceeding 50 pounds. Do not perform surveys near exposed wiring, pressurized lines, cryogen lines, or dewars, unless they have been proven to be safely de-energized per CMS-710-02-PR-01500, *Control of Hazardous Energy*.

5.2 Survey Frequency

Surveying work areas provides the basis for posting and labeling, developing RWPs and other work authorizations, implementing as low as reasonably achievable measures, issuing individual monitoring devices, and verifying the efficacy of design measures and engineering controls.

Survey frequencies are based on potential and actual radiological conditions, probability of change in conditions, and area occupancy factors.

Table 1 provides guidelines for establishing routine and job-specific survey frequencies. Survey locations, frequencies, and additional requirements are documented in the RPP or appropriate RWP, as required.

Table 1
Guidelines for Establishing Survey Frequency

Activity	Guideline Frequency
Survey Type – Routine – No Active Work	
Exposure rates and surface contamination of select items and equipment stored in posted Contamination Area.	Monthly
Exposure rates and surface contamination in uncontrolled areas directly adjacent to Radioactive Material Storage Areas.	Monthly
Exposure rates and/or surface contamination of other uncontrolled areas such as office spaces, work vehicles, etc.	Monthly
Exposure/dose rate surveys of posted Restricted Area and posted Radiation Area boundaries.	Weekly
Survey Type – Active Work	
Exposure rates and surface contamination of uncontrolled areas such as office spaces, work vehicles, etc.	Monthly
Exposure rates and surface contamination in posted Restricted and Radiological Areas (contamination area, high contamination area, radiation area) when work activities are performed	Daily
Leak test of sealed sources – all	Quarterly

5.3 Exposure/Dose Rate Surveys

Exposure/dose rate surveys are conducted to determine the potential dose rates to personnel entering or working in general areas, verify current radiological postings, characterize sources of radiation, and determine public dose rates.

Survey documentation shall include dose rates in the units reported on the instrument (e.g., microroentgens per hour [µR/h], milliRoentgens per hour [mR/h]). However, for beta-gamma radiation, 1 R ≈ 1 rem ≈ 1 rad, therefore, it is acceptable to use values measured in R or rad (or fractions thereof) to verify posting requirements stated in rem or rad.

The instruments will be pre-operationally inspected and response checked prior to use.

The following steps outline the process for completing an exposure or dose rate survey:

Step	Action
1	Take and record on survey report a background measurement in an area representative of the area to be surveyed, but unlikely to be impacted by radiation sources or contamination in the area of interest.

Step	Action
2	Take general area exposure rate measurements at waist-level (approximately 1 meter height), unless otherwise specified. • Move the detector around to verify that it is exposed to all sources of radiation without your body providing inadvertent shielding, allowing sufficient time for stable instrument response (Refer to the instrument manual for the instrument response time). • Record actual dose rates (e.g., µR/h, mR/h, milli rad/hour). *Note: If a source or radiation-emitting surface is located in overhead areas or near the ground, then also measure and record the dose rate at the nearest part of the body (e.g., head, feet).* *Survey points other than waist level (approximately 1 meter height) must be clearly denoted on the survey documentation. Record dose rates in the units reported on the instrument (e.g., µR/h, mR/h).*
3	Take exposure rate measurements at a distance of 30 centimeters from known sources of radiation or surfaces of interest to evaluate potential whole-body exposures and posting requirements. *Note: Measurement distance (e.g., 30 centimeters from source, equipment, etc.) must be clearly denoted on the survey documentation.*
4	Take dose rate measurements on contact with potential sources of radiation if direct source handling is anticipated. Contact readings should be taken approximately 0.5 inch from the surface. *Note: Measurement distance must be clearly denoted on the survey documentation (i.e., "contact").* CAUTION: The size of the source to be surveyed can greatly affect survey results. If concerns or questions arise, contact the RCS or PRSO.
5	For mixed beta/gamma radiation fields use an Ion Chamber with a beta window: • Take a measurement with the window open to determine the combined beta and gamma contribution. The window must be directed toward the source. • Take a measurement with the window closed to determine the gamma-only contribution. *Note: Survey documentation must clearly identify that window open and window closed measurements were made and state the survey distance.* CAUTION: If the open window reading is greater than double the closed window reading it may be necessary to apply an energy-dependent beta correction factor – contact the RCS or PRSO for further instruction. The instrument's correction factor is located in the instrument manual unless a project specific correction factor has been provided.

5.4 Direct Contamination Surveys

Direct surveys are conducted with portable instruments to detect and quantify total alpha and beta contamination on surfaces of equipment, material, and items.

The following steps outline the process for completing a direct contamination survey:

Step	Action
1	Survey for direct contamination prior to surveying for removable contamination so that the direct measurement includes the amount of removable contamination, that is, the total of both fixed and removable.
2	Take and record a minimum of a 1-minute background measurement in an area representative of the area to be surveyed, but unlikely to be impacted by radiation sources or contamination in the area of interest.

Step	Action
3	Use the predetermined scan speed as determined in project specific work plans or procedures. Move the probe over the surface as close as possible (approximately 3 millimeters) to the surface without touching the surface. • For large items (greater than 1 square meter [m^2]), conduct separate scans for each 1 m^2 of surface area. • While performing the scan, observe the count rate audibly and visibly (optional). • If an audible or visual increase above background is observed, consider the location as a potential area of elevated activity, but continue the scan until complete. • Record the results (counts per minute [cpm]) for each 1 m^2 area. Each scan result represents the "average" total residual surface contamination. *Note: Higher scanning speeds may be appropriate in certain situations, such as surveys in areas of known contamination.* *Surfaces prone to static electricity (i.e., Herculite™, plastic hard hats, and polyvinyl chloride pipe) can cause unattached radon daughter products to congregate, resulting in elevated direct readings. A smear survey should be conducted to verify radon daughter products as described in Section 5.6.*
4	Perform a stationary, "static", survey for a minimum of 1 minute or for required count time to meet minimum detectable activity (MDA) at each "hot spot" identified during the scan to determine the count rate. • Record the reading (cpm) for all "hot spots". The 1-minute survey of each "hot spot" represents the "maximum" total residual surface contamination. *Note: The assessment of radiological conditions must include a sufficient number of survey points to characterize the radiological conditions present, verify boundaries, and confirm radiological posting.*
5	Take a background survey at the completion of the area/equipment survey to confirm that the meter is free of contamination and functioning properly. *Note: If these readings differ significantly (e.g., twice pre-survey background reading) notify the lead RCT or RCS.*

5.5 Removable Contamination Surveys

Removable contamination levels are determined via the use of smear surveys to determine the removable or loose contamination on an item, equipment, or an area. Smears are counted on site using a Ludlum Model 3030, or equivalent, or counted on or off site using a liquid scintillation counter (LSC) as necessary based on the radionuclides of concern.

The survey procedure for smear surveys is provided in Section 5.6, the survey procedure for a large area smear (LAS) is outlined in Section 5.7, and the procedure for performance of sealed source leak tests is detailed in Section 5.8.

5.6 Removable Contamination Surveys – Smear Surveys

The following steps outline the process for completing a removable contamination survey using smears:

Step	Action
1	Prepare for the survey by collecting the following: • A survey map of the area of interest or graphical representation of the area or item to be monitored. • Appropriate smear sample media and smear envelopes, baggies, or vials. Prior to use, write on the envelope, baggie, vial, or directly on the smears to identify sampling location. Smears with individual "fold-over" covers do not require

Step	Action
	separate envelopes. Mark locations of smears on a map, drawing, or picture. *Note: Take care not to cross contaminate the smear samples.* • Gloves, appropriate anti-contamination clothing, and other personal protective equipment as required by the RPP or associated RWP. • Survey Report forms, as appropriate. • 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.
2	Determinations of removable contamination must be based on 100 cm^2 taken in the following manner: • Locations of smears must be identifiable – prior to use, write on the holder, envelope, vial, or directly on the smears to identify sampling location. Mark locations on a map, drawing, or picture. • Evaluate removable surface contamination in areas by smearing, in an S-shaped pattern approximately sixteen inches in length or an area four inch by four inch square, an area of 100 cm^2, using a circular filter paper, manufactured disc smear, or other appropriate smear media. • Take the swipe using moderate pressure. Apply enough pressure to be representative of personnel spreading contamination by brushing past the surface. • Confirm that wet smears are dry before counting. *Note: For items less than 100 cm^2, smear the entire surface and note item was less than 100 cm^2.*
3	Field check the smears taken in contamination and high contamination areas with a direct survey instrument prior to counting. CAUTION: To avoid contaminating the instrument DO NOT place smears with count rates greater than 500 cpm alpha or 2,000 cpm beta in the Ludlum 3030 (not applicable to smear being counted via LCS). Surfaces prone to static electricity can cause unattached radon daughter products to congregate, resulting in elevated direct readings. If smears are found to be greater than these levels, count the high activity smear using an appropriate portable direct survey instrument and indicate as such on the survey report. *Note: Results of field counts are not required to be recorded on the survey documentation, unless field counts are required due to high smear activity.*
4	Complete the Chain of Custody (COC) form if necessary. Secondarily contain the smears for transport to the counting station or package appropriately for off-site transport.
5	Count smears individually, for 1 minute each [or for required count time to meet minimum detectable activity (MDA)]. At the completion of the count, record the gross count result (cpm). Bag and label any smears with unexpected high readings for potential radionuclide analysis. Notify the RCS or lead RCT. *Note: Surfaces prone to static electricity can cause unattached radon daughter products to congregate and be available for smear sampling. When suspected, recount smears after some period of time as determined by the PRSO (typically overnight). Record results of the "recount" on the survey documentation to discriminate radon daughters from "long-lived" contamination.*
6	Prepare survey documentation as detailed in Section 5.10.

5.7 Removable Contamination Surveys – Large Area Smear

The LAS surveys are qualitative evaluations, designed to quickly indicate the presence of contamination. The LAS surveys cannot be used for posting determinations or release decisions. Quantitative determination of removable contamination must be based on 100 cm^2 smears taken as specified in Section 5.6.

The following steps outline the process for completing a removable contamination survey using large area smears:

Step	Action
1	To perform an evaluation of gross activity for a large area use a large area media (e.g., 9 inch by 4 inch filter paper, Masslin, disc smear greater than100 cm^2) or "sticky roller" survey prior to performing disc smears of 100 cm^2 areas.
2	Each LAS area to be surveyed must be less than 2 m^2.
3	Count LAS smears using the appropriate portable direct counting instrument and record LAS results in the field activity daily log. *Note: Do not include results of LAS surveys on the final survey documentation. LAS smears cannot be used to release work surfaces, work areas, vehicles, and equipment due to the insufficient MDA of the field instrumentation.*
4	If the survey requires determination of removable contamination levels, LAS surveys must be followed by a sufficient number of 100 cm^2 smears to characterize the area of interest as instructed in Section 5.6.

5.8 Removable Contamination Surveys – Sealed Source Leak Tests

Techniques and equipment used for leak tests shall be capable of detecting the leakage of activity from sealed sources at a value equal to or exceeding 0.005 millicuries (11,000 disintegrations per minute **[**dpm]) as required by 10 CFR 20. This is a minimum acceptable detection limit and is not intended to be a decision basis for whether a source is leaking. The leakage criteria is the applicable removable contamination equal to or greater to the free release limits in Table 1.1 of Regulatory Guide 1.86 for the size of the source smeared, typically 10 cm^2.

The following steps outline the process for completing a removable contamination survey for a sealed source leak test:

Step	Action
1	Review the sealed source inventory record for the source to be surveyed and dose rate information, if available. Confirm that the sealed source being surveyed matches the description in the inventory record and that the source and container are properly labeled.
2	Wear gloves while performing the leak test of the source.
3	Mark each smear paper with an identifying number or character and smear the sealed source. • For encapsulated sources, smear the entire surface of the source • For electroplated or deposited/covered sources, smear the source container and smear around the perimeter of the source *Note: Do not smear the active surface of an electroplated or deposited source as it may cause damage and subsequent leakage.*
4	Take an initial contamination measurement of each smear using an approved portable contamination monitor as required by the RPP.
5	If no removable activity is detected, fold the smear or place the smear in an envelope and proceed to Step 6. If removable activity is detected, then: • Immediately suspend further surveys of the source or others in the location • Survey the area and self to determine the extent of any contamination

Step	Action
	• Secure the area and contact the RSC or PRSO
6	Measure activity of the smear with the low-level counting system, typically Ludlum 3030, 2929, or LSC. Compare the results to the II leak test criterion (applicable Regulatory Guide 1.86, Table 1 value).
7	If the leak test criterion is not satisfied, the source is considered leaking and must be removed from service. • Notify the RSC or PRSO immediately • Secondarily contain the sealed source for proper disposal as radioactive waste • Document that the source has been removed from service • Perform an area survey and decontaminate, as necessary
8	If the leak test criterion is satisfied complete the sealed source survey documentation per instruction provided in Section 5.11.

5.9 Air Monitoring Survey

5.9.1 Lo-Vol/Hi-Vol Sampling

Step	Action
1	Refer to the RPP or RWP, if required, for sampler type and location placement.
2	Take the following actions: • Verify that sample counting instruments and airborne sampling pumps/rotometers are currently calibrated and are functioning properly • Verify that required daily instrument checks have been completed on the air sampling counting equipment (Ludlum 3030 or equivalent) • Determine work site air flow directions by mechanical means such as a meteorological station or windsock to identify upwind and downwind sample locations
3	Obtain the following equipment and supplies: • Air samplers (area), per the RWP requirements • Gloves and tweezers • Particulate filters, sized to fit the air sampler. Air sampling media must be appropriate for the type of radiation • Timing device • Battery unit or other power source
4	Position the collection head to collect air samples that are representative of air breathed by worker (s), per the placement specified in the RWP or at the direction of the PRSO.
5	Start the air sampler and adjust the flow rate to the optimal flow rate listed in Table 1 or as provided by the RCS or PRSO. **Note:** Run the sampler sufficiently long to achieve a minimum sensitivity of 10% of the DAC for a radionuclide of concern (e.g., 3E-11 µCi/ml for ^{226}Ra). Consult with the PRSO for minimum sample run times
6	Record the following on the air filter envelope. Transcribe to the survey form (CMS-710-07-FM-40111): • Physical location and if up/down wind (also indicate on survey form/map) • Purpose (definition of work performed; reference the job-specific RWP) • Sampler serial number (instrument model and associated information will populate the other fields) • Sample start date/time • Initial flow rate • RCT name starting the sampler

Step	Action
7	Periodically throughout sampling, check the following: • Sampler operating properly (e.g., filter head connection, power, flow) • Filter dust loading • Wind direction; if change is noted, consult PRSO for sampler movement
8	When air sampling is complete and the minimum volume collected to achieve the required MDC, observe the flow rate and turn the sampler off.
9	Record the following on the air filter envelope. Transcribe to the survey form (CMS-710-07-FM-40111): • Final flow rate • Sample stop date/time • Total run time (if available) • RCT name terminating the sample **Note:** If the final flow rate has diminished from the initial flow rate, then the average flow rate for the sampling will be used to calculate the air concentration of the radionuclide of concern
10	Take the following actions: • Using gloves hands, remove and/or replace the collection head and filter using caution to prevent cross-contamination • Using tweezers, remove the filter disc from the collection head and place the removed filter in the sample envelope • Field check air filters using the appropriate portable instrument before removing from posted Restricted Area **Note:** Samples above 500 cpm alpha or 2,000 cpm beta will not be counted in the Ludlum 3030, or equivalent. Immediately contact the RCS and/or PRSO for direction
11	Transfer samples with the appropriate COC documentation to counting lab or assigned sample counting technician

5.9.2 Breathing Zone Air Sampling

Step	Action
1	Perform breathing zone (BZ) air sampling per requirements of the RWP.
2	Take the following actions: • Verify that sample counting instruments and airborne sampling pumps/rotometers are currently calibrated and are functioning properly • Verify that required daily instrument checks have been completed on the air sampling counting equipment (Ludlum 3030 or equivalent)
3	Obtain the following equipment and supplies: • New air sample cartridge with hose and a sample pump • Gloves and tweezers • Timing device • Fully charged battery unit
4	Clip the air sample filter cartridge to the front of the worker's personal protective clothing or equipment so that the front face of the filter is within 12 inches of the worker's nose and mouth. **Note:** BZ is typically defined as the 1 ft^3 area in front of the nose and mouth.
5	Connect the short length of tubing to the sample cartridge head and the other end to the air sample pump on the worker's belt or other location that will not interfere with the work activity to be performed.
6	Record the following on the survey form (CMS-710-07-FM-40111): • Assigned worker's name next to sampler name • Purpose (definition of work performed; reference the job-specific RWP) • Select sampler model - serial number and calibration due date will populate the

Step	Action
	form • Sample start date/time • Initial flow rate, final flow rate
7	When BZ sampling is complete detach from the worker. **Note:** Unless otherwise authorized by the PRSO, BZ sampling should be suspended/restarted during the workday to facilitate break periods when no one is in the work area. Accurate volume tracking is crucial during these periods of non-operation.
8	Record the following on the air filter envelope. Transcribe to the survey form (CMS-710-07-FM-40111): • Final flow rate • Sample stop date/time • Total run time (if available) • RCT name terminating the sample **Note:** If the final flow rate has diminished from the initial flow rate, then the average flow rate for the sampling will be used to calculate the air concentration of the radionuclide of concern
9	Take the following actions: • Using gloves hands, remove and/or replace the collection head and filter using caution to prevent cross-contamination • Using tweezers, remove the filter disc from the collection head and place the removed filter in the sample envelope • Field check air filters using the appropriate portable instrument before removing from posted Restricted Area **Note:** Samples above 500 cpm alpha or 2,000 cpm beta will not be counted in the Ludlum 3030, or equivalent. Immediately contact the RCS and/or PRSO for direction
10	Transfer samples with any required appropriate COC documentation to counting lab or assigned sample counting technician
11	Complete the Airborne Survey Form (CMS-710-07-FM-40111) or equivalent, including: • Assigned worker's name next to sampler name • Purpose (definition of work performed; reference the job-specific RWP) • Sampler model - serial number and calibration due date will populate the form • Sample start date/time • Initial flow rate, final flow rate

Table 2 - Air Sample Flow Rates

Sampler Type	Flow Rate Range (lpm)	Optimal Flow Rate (lpm)
Lapel (BZ)	2 - 13	5
Low Volume	10 - 100	50
High Volume	80 - 250	100

5.10 Personnel Surveys

Perform whole body frisk surveys of individuals exiting a contamination area per PRR or RWP, as required, or as requested by the RCS or lead RCT. Surveys of hands and feet *only* may be required upon exit from a Restricted Area.

The following steps outline the process for completing a personnel survey:

Step	Action
1	Hold the probe over the person's outer clothing as close as possible (approximately 3 millimeters) without touching the surface area being surveyed and move at the predetermined scan rate per project. *Note: A project specific scan speed may be established dependent on the radioisotope of concern*
2	Survey the individual starting at their head and carefully survey around nose, mouth, eyes, and ears. Carefully survey the entire body, front and back, paying particular attention to the cuffs of pants, soles of shoes, and wrist and ankle area. *Note: completion of whole body frisk should take approximately 4 minutes.*
3	If the worker is found to be contaminated, notify the RCS or PRSO immediately. *Note: Survey documentation is not required unless skin or personal clothing contamination is identified.*

5.11 Survey Documentation Requirements

All required survey results must be documented on the electronic survey form, CMS-710-07-FM-40111, or equivalent. All applicable data fields must be accurately completed and legibly recorded. If survey reports are written upon, use black or blue permanent ink. All changes must be struck (one-line), initialed, and dated.

5.11.1 General

All blank blocks require an "NA", a line thru or the box darkened. Complete survey documentation within 2 days of performance of the survey, unless unexpected conditions occur, such as absence due to illness. When supplemental information is required, such as additional analytical analysis, submission may be delayed until the necessary information is available. Revise and resubmit surveys returned for revisions within 1 day.

Survey report assembly:

- Survey report
- Continuation sheet(s), as applicable
- Maps/drawings
- Analytical results, as applicable

5.11.2 Survey Report

The survey report should contain the following information (suggested):

1. Survey number: All survey numbers will start with RS (Radiological Survey) and will be typed on each page of the survey.

   The format is RS-MMDDYYYY-AREA-CODE-SEQ, example: RS-12112011-233-RSW-1

   Where:

   MM: Two digit month

   DD: Two digit day

   YYYY: Four digit year

   AREA: work area designation (if applicable)

CODE:

SUR – Requested Survey

RSD – Routine Survey Daily

RSW – Routine Survey Weekly

RSM – Routine Survey Monthly

RSQ – Routine Survey Quarterly

RTS – Routine Trash/Building Survey

JSS – Job Specific Survey (RWP)

URS – Unrestricted Release Survey

DOT – On-Site and Off-Site Transportation Survey

911 – Incident Response

SEQ: Enter the next sequential number obtained from the work area survey log.

2. Survey description: A summary description of the survey, including the type of survey, must be written in a manner that clearly defines the purpose of the survey and the work supported.
3. Instrument block: All information must be provided for each instrument used for the survey. All backgrounds for the instruments will be the backgrounds established during the initial set-up of the instrument.
4. Surveyor, date, and time: Enter the date the survey was performed and enter the start and end time of the survey. If the survey extends to the next day, include the different end date. Include printed name and signature of individual performing and documenting the survey and the date survey paperwork was completed by surveyor.
5. Survey location: Enter the location of the sample, smear, or where the exposure rate reading was performed in the form of a number corresponding to a map location or a brief description (e.g., front left tire, auger handle, etc.).
6. Removable contamination (as applicable): Record the observed counts (counts per minute) for alpha and beta/gamma for smears counted on the sample counter. Calculate the activity (dpm/100 cm^2) and record, or use an automated survey template to perform the calculation. If counting smears on an LSC or other smear counter with automatic reports, attach the report with observed counts and activity to the survey.
7. Direct (total contamination, as applicable): Record the observed counts for beta/gamma and alpha for each static contamination measurement. Calculate the activity (dpm/100 cm^2) and record, or use an automated survey template to perform the calculation.
8. Gamma static (as applicable): Record the observed counts for gamma static measurement.
9. Exposure rates (as applicable): Record the observed instrument reading and select the appropriate distance the detector is from the surface or object being surveyed. Indicate the appropriate units.
10. Additional comments: Enter additional information specific to each sample location. Other relevant information may include a surface or depth of sample or additional readings.
11. Approval: Upon completion of the survey report and supplemental information, provide the packet to the designated individual, typically the RCS, for review and approval. The approver will review the document for accuracy and approve.

5.11.3 Continuation Sheet

The survey report continuation sheet information shall include the information noted on the cover sheet or enter 'see page 1' for any information that is identical

5.11.4 Maps and Drawings

Include the same information as listed on the Survey Report form. Form CMS-710-07-FM-40111, "Radiological Survey Forms – Example," or equivalent, shall be used to include maps, drawings, or photographs of the item, equipment, area, or other.

5.12 Leak Test Documentation Requirements

All required leak test results must be documented on the Sealed Source Leak Test Survey form (CMS-710-07-FM-40111) or equivalent. All applicable data fields must be accurately completed and legibly recorded. If survey reports are written upon, use black or blue permanent ink. All changes must be struck (one-line), initialed, and dated.

5.12.1 General

All blank blocks require an "NA", a line thru or the box darkened prior to printing. Complete survey documentation within 2 days of performance of the survey, unless unexpected conditions occur, such as, absence due to illness. When supplemental information is required, such as additional analytical analysis, submission may be delayed until the necessary information is available. Revise and resubmit surveys returned for revisions within 1 day.

Survey report assembly:

- Survey report
- Continuation sheet(s), as applicable
- Maps/drawings, as applicable
- Analytical results, as applicable

Electronic copies of final survey records are maintained on site for the duration of project activities. Original final survey records are periodically transmitted to the CB&I Concord, California office for storage in the central file system. Pending transfer to the Concord office, all original survey documents shall be filed by the work area designation in the radiological control department central files.

5.12.2 Leak Test Report

The leak test survey report should contain the following information (suggested):

1. Survey number: All survey numbers will start with RS (Radiological Survey) and will be typed on each page of the survey.

   The format is RS-MMDDYYYY-AREA-CODE-SEQ,

   example: RS-12112011-570-SSS-1

   Where:

   - MM: Two digit month
   - DD: Two digit day
   - YYYY: Four digit year
   - AREA: work area designation
   - CODE: SSS – Sealed Source Survey
   - SEQ: Enter the next sequential number obtained from the work area survey log

2. Survey description: A summary description of the survey, including the type of survey, must be written in a manner clearly defines the purpose of the survey and the work supported.
3. Instrument block: All information must be provided for each instrument used for the survey. Select the appropriate instrument from the 'pull-down' list provided. All backgrounds for the instruments will be the backgrounds established during the initial set-up of the instrument.
4. Surveyor, date, and time: Enter the date the survey was performed, by entering the start and end time of the survey. If survey extends to next day, make sure to include the different end date. Include printed name and signature of individual performing and documenting the survey and the date survey paperwork was completed by surveyor.
5. Source ID #: List the source identification number for each source.
6. Nuclide: Enter the sealed source radionuclide.
7. Activity: List the current source activity level (microcuries)
8. Removable contamination: Record the observed counts for alpha and beta/gamma for smears counted on the sample counter (typically Ludlum Model 3030 or 2929). Calculate the activity (dpm/100 cm^2) and record, or use an automated survey template to perform the calculation. If counting smears on an LSC or other smear counter with automatic reports, attach the report with observed counts and activity to the survey.
9. Less than 5 nanoCuries: If results are less than 11,000 dpm/smear, enter "Yes" in the column. If not, enter "No." Also, note if the activity exceeds the leak test criteria (Regulatory Guide 1.86) and the actions taken in the comments column.
10. Exposure rates: Record the observed instrument reading and select the appropriate distance the detector is from the surface or object being surveyed. Indicate the appropriate units.
11. Additional comments: Enter additional information specific to each sample location. Other relevant information may include a surface or depth of sample or additional readings.
12. Approval: Upon completion of the survey report and supplemental information, provide the packet to the designated individual, typically the RCS, for review and approval. The approver will review the document for accuracy, approve, and ensure that the final survey is saved as an electronic.

5.13 Air Monitoring Survey Documentation Requirements

All required air monitoring survey results must be documented on Air Monitoring Survey form (CMS-710-07-FM-40111) or equivalent. All applicable data fields must be accurately completed and legibly recorded. If survey reports are written upon, use black or blue permanent ink. All changes must be struck (one-line), initialed, and dated.

5.12.1 General

All blank blocks require an "NA", a line thru or the box darkened prior to printing. Complete survey documentation within 2 days of performance of the survey, unless unexpected conditions occur, such as, absence due to illness. When supplemental information is required, such as additional analytical analysis, submission may be delayed until the necessary information is available. Revise and resubmit surveys returned for revisions within 1 day.

Survey report assembly:

- Survey report

- Maps/drawings
- Analytical results, as applicable

5.12.2 Air Monitoring Survey Report

The air monitoring survey report should contain the following information (suggested):

1. Survey number: All survey numbers will start with RS (Radiological Survey) and will be typed on each page of the survey.

   The format is RS-MMDDYYYY-AREA-CODE-SEQ,

   example: RS-12112011-233-AIR-1

   Where:

   - MM: Two digit month
   - DD: Two digit day
   - YYYY: Four digit year
   - AREA: work area designation (if applicable)
   - CODE: AIR – Air Monitoring Survey
   - SEQ: Enter the next sequential number obtained from the work area survey log.
2. Survey description: A summary description of the survey, including the type of survey, must be written in a manner that clearly defines the purpose of the survey and the work supported.
3. Instrument block: All information must be provided for each instrument used for the survey. Select the appropriate instrument from the 'pull-down' list provided. All backgrounds for the instruments will be the backgrounds established during the initial set-up of the instrument.
4. Surveyor and date: Enter the date and start and end time the air sampling was performed. Include printed name and signature of individual performing and documenting the survey and the date survey paperwork was completed by surveyor.
5. Air sampling location: Enter the locations where the air sampling was performed in the form of a number corresponding to a map location or a brief description.
6. Air sampling data: Enter the initial and final air flow rate, average flow rate, total run time, and total run volume.
7. Alpha and beta/gamma counts: Record the observed counts (counts per minute) for alpha and beta/gamma for air filters counted on the sample counter (typically Ludlum Model 3030or Ludlum 2929). These results may be provided via the COC form. The Electronic Survey Report and the data will be used to populate the activity column (µCi/ml) using the appropriate instrument efficiency or the activity will be provided directly, via the COC form.
8. Additional comments: Enter additional information specific to each sample location. Other relevant information may include a surface or depth of sample or additional readings.
9. Approval: Upon completion of the survey report and supplemental information, provide the packet to the designated individual, typically the RCS, for review and approval. The approver will review the document for accuracy, approve, and ensure that the final survey is saved as an electronic copy on an external hard drive or equivalent.

5.12.3 Maps and Drawings

Include the same information as listed on the Survey Report form. Form CMS-710-07-FM-40111, "Radiological Survey Forms – Example," or equivalent, shall be used to include maps, drawings, or photographs of the item, equipment, area, or other.

5.12.4 Radioactive Particulate Air Concentration

The airborne radioactive particulates (activity) and the Minimum Detectable Concentration (MDC) are calculated using the following equations:

$$Activity(\mu Ci/ml) = \frac{(Sample\ cpm - Bkg\ cpm)}{(2.22E6\ dpm/\mu Ci)(Vol)(E)(F_a)};$$

$$MDC = \frac{3 + 4.65\sqrt{(Bkg\ cpm)(T_b)}}{(2.22E6\ dpm/\mu Ci)(Vol)(E)(F_a)(T_s)}$$

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 ($\bar{f}$) = (initial flow rate + final flow rate)/2
Volume (ml) = (Runtime in min) ($\bar{f}$ in lpm) (1000 ml/l)
E = Detection efficiency of counting equipment
F_a = Filter absorption, 0.8 for α
2.22E6 dpm/ µCi = Conversion from dpm to microcuries.
T_b = Background count time in min
T_s = Sample count time in min

The PRSO shall routinely review the airborne radioactivity sample log to note any trends of increasing airborne activity at various work locations.

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.

$$Activity\ \left(\frac{\mu Ci}{ml}\right) = \left(Activity\ in \frac{\mu Ci}{ml}\right)(Filter\ Ratio)$$

Where:

$$Filter\ Ratio = \frac{Size\ of\ counted\ filter}{Size\ of\ original\ filter}$$

5.13 Forms

- CMS-710-07-FM-40111, Radiological Survey Forms - Example

5.14 Definitions

TERM (ACRONYM)	DEFINITION
Contamination Survey	The use of smears or direct portable instrument surveys to identify and/or quantify radioactive material on personnel, on equipment, or in an area.
Contamination Area (CA)	An area, accessible to individuals, in which surface contamination levels on equipment or solid surface materials are equal to or exceed the values provided in NRC Regulatory Guide 1.86, Table 1.1, but do not exceed 100 times those values.
General Area (GA)	Radiological reading collected at a height of approximately 1 meter from ground surface (approximately waist level) to determine an area's general radiation levels.
High Contamination Area (HCA)	An area, accessible to individuals, in which surface contamination levels on equipment or solid surface materials exceed 100 times the values provided in NRC Regulatory Guide 1.86, Table 1.1.
High Radiation Area (HRA)	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 (1 milliSievert) in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.
Job Safety Analysis (JSA)	A Job Safety Analysis identifies hazards associated with job-specific tasks and provides appropriate safety controls for the identified hazards.
Radiation Area (RA)	An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 milliSievert) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
Radioactive Materials Area (RMA)	Any area or room where quantities of radioactive materials in excess of 10 times the 10 CFR 20, Appendix C quantities are used or stored, or any area designated by the project radiation safety officer.
Radiological Work Permit (RWP)	A document prepared by radiological control personnel to inform workers of the radiological conditions, which exist in the work area and the radiation safety precautions and requirements for the job.
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.
Routine Survey	Surveys conducted on a scheduled basis to monitor or detect changes in radiological conditions, confirm postings, determine the location of radioactive material and/or fields in the work area, and verify effectiveness of engineering and process controls.
Unrestricted Release	The release of work surfaces, work areas, vehicles, and equipment once the radiological activity levels are below the limits established in U.S. Nuclear Regulatory Commission (NRC), Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, Table 1.1.

TERM (ACRONYM)	DEFINITION
Airborne Radioactive Material	Radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.
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 (0.05 Sv) or a committed dose equivalent of 50 rems (0.5 Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in table 1, columns 1 and 2, of appendix B to §§20.1001–20.2401).
Breathing Zone (BZ)	A uniform description of the volume of air around the worker's upper body and head which may be drawn into the lungs during the course of breathing.
Derived Air Concentration (DAC)	The concentration of a given radioactive nuclide in air which, if breathed by the reference man for a working year of 2000 hours under conditions of light work (1.2 m^3 of air per hour), would result in an intake of one (1) ALI. The DAC for adium-226 (^{226}Ra is 3.7 E-10 µCi/ml)
DAC-hour (DAC-hr)	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).
Monitoring	(Radiation monitoring, radiation protection monitoring) means 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
Representative	Sampling in such a manner that the sample closely approximates both the amount of activity and the physical and chemical properties of the material (e.g., particle size and solubility in the case of aerosol to which workers are exposed). Air sampling performed within the Breathing Zone (BZ) is considered representative of the airborne radioactive material concentration inhaled by the worker.

WORK INSTRUCTION

Work Instruction Title:	**GAMMA WALKOVER SURVEY USING A GLOBAL POSITIONING SYSTEM**	**CMS Number:**	**CMS-710-07-WI-40112**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

GAMMA WALKOVER SURVEY USING A GLOBAL POSITIONING SYSTEM

0	Initial submittal.	MOS	28 Jan 2015
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

The purpose of this Work Instruction (WI) is to provide step by step directions on collecting radiological field data and correlating it to Global Positioning System (GPS) data using a Ludlum Model 2221 (or equivalent) ratemeter/scaler coupled with a Ludlum Model 44-10 sodium-iodide (NaI) detector or a Ludlum Model 44-20 NaI (or equivalent) detector with the Trimble Geo XH (or equivalent) system.

2.0 APPLICATION

This WI provides directions for the user to set up the GPS, create files, perform a Gamma Walkover Survey (GWS), save data, process the data file created by the GWS and create the final survey document and save to the project files.

Additional information for the operation of the Trimble Geo XH (GPS) can be found in the Tremble Geo XH Operating Manuals. Operation and use of the Ludlum instruments are detailed in the Ludlum Instrument Operating Manuals. The instruments selected for each project will be appropriate to detect gamma radiation. This will be documented in the project-specific Instrumentation Technical Basis Document (TBD). Data collected in accordance with this WI are only intended to determine the potential presence of radioactive contamination above the investigation levels and are not suitable to make unconditional release determinations or waste determinations for land areas or excavated soil. Coordinates systems may change from one project to another.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

3.1 The following personnel have responsibilities in this WI:

- Project or Program Radiation Safety Officer (PRSO)
- Radiological Control Supervisor (RCS)
- Radiological Control Technicians (RCT)

3.2 Responsibilities

3.2.1 The PRSO is responsible for the maintenance, management, and revision of this work instruction. The PRSO is also responsible for ensuring workers comply with the requirements of this WI.

3.2.2 The RCS will be responsible for the field oversight of RCT performing tasks detailed in this WI.

3.2.3 The RCT will be responsible for compliance with this work instruction and for addressing any issues or suggested modifications with the RCS or PRSO.

4.0 REFERENCES

CMS-710-07-PR-04000, Gamma Walkover Survey Using Global Positioning System

CMS-710-07-PR-04005, *Radiation Safety Training*

CMS-710-07-PR-04011, *Radiological Surveys and Monitoring*

CMS-710-07-PR-04013, *Radiation Safety Instrumentation*

CMS-710-07-WI-04008, *Radiological Work Permits*

Ludlum Instrument Operating Manuals

Trimble Geo XH Operating Manuals

5.0 WORK INSTRUCTION

5.1 Prerequisites

Staff performing this procedure must be trained and qualified per CMS-710-07-PR-04005, *Radiation Safety Training*.

In collaboration with the RCS or lead RCT, choose the most appropriate instrument based on the radiation environment to be surveying

Gather appropriate information and supplies, such as the following:

- Historical survey data, recent survey information, if available, and any other information that would be useful to perform a proper survey.
- General survey report form, map of the area to be surveyed, required PPE, appropriate instruments, sampling equipment as necessary, marking paint or flags, and a marker or pen.

Required personal protective equipment must be in accordance with the Job Safety Analysis document covering the specific work or area or the RWP, as applicable.

Check instruments for operability in accordance with project-specific procedures, such as battery check and high voltage check. Verify that the instrument calibration is current.

Review and sign RWP(s), if required, for the specific work area, task, or job.

Comply with general industrial safety standards, including those found in the Job Safety Analysis while conducting surveys. For example, never place your body in harm's way when performing surveys on suspended loads. Use long handled meters to reach under the load. Never place your body beneath suspended loads exceeding 50 pounds. Do not perform surveys near exposed wiring, pressurized lines, cryogen lines, or dewars, unless they have been proven to be safely de-energized.

5.2 Set up

Surveying work areas provides the basis for posting and labeling, developing RWPs and other work authorizations, implementing as low as reasonably achievable measures, issuing individual monitoring devices, and verifying the efficacy of design measures and engineering controls. As well as characterization surveys and use of historical data in order to identify reference areas (as applicable) for elevated activity identification which will provide the instrument specific investigation levels which will vary from project to project. (Refer to project specific procedures, TBDs, and work plans for more information.)

Survey frequencies are based on potential and actual radiological conditions, probability of change in conditions, and area occupancy factors.

5.2.1 Survey Methods: Handheld or Cart-Mounted

The handheld method is widely used for the GWS. The GWS requires meeting scan minimum detectable concentration (MDC) calculations when moved at a specific rate of speed, as shall be defined in each project-specific Instrumentation TBD. The width between the survey paths shall be constant and will also be defined in the project-specific Instrumentation TBD. The height that has been modeled is 10 cm (~4 inches) perpendicular from the bottom of the probe to the ground. When swinging the probe during the GWS for more scanning coverage, ensure that the probe stays parallel with the ground, no pendulum swings.

For surfaces that are even or have minimal obstructions, for example, blacktop, excavation footprints that have been graded, yards, etc., a cart may be used. The cart must be able to carry the survey ratemeter/scaler, NaI detector and the Trimble GPS, which may require modifications. The cart will support the NaI detector 10 cm above ground surface. Whether performing GWS with handheld or using cart, surveyor will have to maintain the height 10 cm from the ground to the probe regardless of the terrain, pre-determined scan speed, and pre-determined width between paths.

5.3 Start up Using the Ludlum 2221

Note: The directions throughout this procedure are based on the use of the Ludlum 2221 and Trimble Geo XH GPS. Equivalent equipment may be used; however the directions for use may differ. Refer to the user's manuals for the equipment for more information.

1. The Ludlum 2221 (or equivalent) needs to be set up in accordance with the operating manual and site-specific procedures. Example parameters for a Ludlum 2221 are shown below:
    a. Window = Out
    b. Digital Ratemeter Mode
    c. Battery Voltage = 5.0 or higher
    d. Current calibration
2. If a cart is used, secure the 2221, NaI detector (or equivalent), and GPS to the cart and proceed outdoors into an open area free of overhead obstructions.
3. Connect the GPS handheld to the 2221, via the thin RS232 coaxial cable.
4. Plug in the external antenna to the GPS. Note that the GPS is equipped with an internal antenna. If there are no overhead obstructions such as trench sidewalls and building, the external antenna may not be needed.
5. Power on the 2221. This must happen prior to powering on the GPS to prevent false readings or spiking from the 2221.
6. Power on the GPS.
7. After the GPS has completed system start-up, use the stylus and click the word "GPS" located in the lower right corner of the screen. Note: this may take some time to load. As the TerraSync software opens, there will be a brief audible tone. If the tone is not heard, click the speaker icon in the upper right hand corner of the screen and set volume to the maximum setting so that it is easily heard over work area ambient noise. The opening screen will be "Skyplot" and displays the current available satellites.
8. In the upper left hand corner of the screen there is a main drop-down menu, below the main menu and throughout the screen there could be one to several sub-menus. From the main menu click "Setup," then See Attachment 6.1 for the initial settings for the 2221.
9. After configuring the GPS unit with the initial settings, the GPS should now be ready to communicate with the 2221.

    Note: Not all projects will use the same settings.
10. Go to the starting point of the GWS. From the main menu, click "Data."
11. A file format should be established in advance, for example;
    Site_Location_MMDDYYYY

    Under the "File Name" box, type a new file name in the pre-established format.

    Then click "Create."
12. Click the "OK" box on the pop up after clicking "Create."
13. Select "Line Generic" feature name, then click "Create."
14. The GPS will start beeping indicating the GPS has acquired enough satellites and is recording data (coordinates and 2221 count rates). If there are fewer than 5 satellites, there will be no beeping and the survey cannot be performed. See "Troubleshooting" Section 5.8. Reasons for too few satellites may be satellites positioned too close to the horizon or nearby overhead obstructions such as excavation walls, buildings, trees, etc. It is possible that there are 5 or more satellites but the configuration is not optimum

resulting in a position dilution of precision (PDOP) value that is too high. If this occurs, contact the RCS for further instructions. If the beeps are audible, wait 5 seconds and click "Pause."

15. From the main menu, click "Status." From the left sub-menu, click "Sensor."
16. Data is updated for "Count Within Feature, Total Count, and Last String." The first two are the total number of records stored (these are GPS/2221 readings recorded every second), and "Last String" is the count rate in counts per minute (cpm) sent from the 2221. If numbers are visible, the GPS is communicating with the 2221.
17. Routinely monitor the "Sensor" screen and check that there are at least 5 satellites. Total satellites acquired are indicated by a number next to a satellite symbol at the top of all screens. If the sensor data is not continuously counting and changing on the sensor screen or there are less than 5 satellites, then GPS and 2221 data is not being recorded.
18. From the main menu, click "Map" so walkover progress may be observed. At the bottom of the screen there is a circle with a + or – in it. These are the zoom buttons and it is at the discretion of the user to determine how far or how close to zoom to view the progress. Generally, clicking the + icon 7 times (a scale of approximately 3 meters) is a good starting point. Under the "Options" sub-menu, "Auto Pan To GPS Position" may be selected. This automatically pans the map to view the current GPS location. The entire area surveyed can be viewed by clicking the = symbol at the bottom of the screen. The surveyor can periodically review the map screen to ensure no unacceptable spaces exist between transects.
19. Press "Play ▶ " the GWS is now ready to start.

    Note: Some GPS units may differ so refer to the owner's manual for specific information.

5.4 Scanning

1. Walkover scan speed shall be determined for the project in advance and defined in the project-specific Instrumentation TBD (e.g., ½ meter per second).
2. To achieve 100% coverage of the survey area each pass should overlap the previous pass by 1 foot. Note: Not all projects will require the same coverage; refer to project specific work plans and TBDs for additional information.
3. If the GPS is placed in pause mode with a file open, do not move the unit or coordinates will continue to be recorded without data from the scaler/ratemeter instrument.
4. During operation an audible response on the scaler/ratemeter can be used to identify areas of elevated activity. Headphones or an earpiece are recommended if background noise is too loud.
5. If during the walkover an area of elevated activity is identified and the count rate exceeds the investigative level for the instrument, mark the location.
6. Upon completion of the GWS, return to any marked locations for further investigation. Any additional hotspots will be identified on the post processed GWS figure and will also be investigated. The process for elevated activity identification and investigation may vary from project to project; refer to project specific procedures and work plans for more information.

5.5 Closing a File

1. After completion of the survey, select "Data" from the main menu, then click the OK button to stop data recording. Then select "Close" to close the file, then "Yes" on pop up screen. Data will automatically be saved. To exit and turn off the GPS, select the "X" button in upper right side of screen. Select "Yes" to exit TerraSync.

Turn off the GPS unit.

5.6 Opening an Existing TerraSync File

If it is necessary to stop the GWS and continue at another time, the user has two options. The existing file can be reopened to continue data collection or a new file can be created. If the user chooses to create a new file, simply follow the same steps in 5.3. The user can name the file with the same name as the existing file but needs to add something that differentiates it from the original: Example; Site_Location_MMDDYYYY_Revision. If the user only wants to create one file for the entire survey area, the following steps are taken to open an existing file:

1. Follow Steps 1-10, Section 5.3.
2. Go to the new starting point of GWS.
3. After clicking “Data” from the main menu, click “Existing File” on the sub-menu.
4. Select the file to be opened. Click “Open.”
5. On the left sub-menu, change “Update Features” to “Collect Features”. If “Update Features” is selected, ALL EXISTING DATA WILL BE ERASED and replaced with the new data.
6. Select “Line Generic” feature name, then click “Create.” This will create a new feature in which to store GWS data.
7. Continue Steps 15-19, Section 5.3.

5.7 Post Processing of Saved Data on GPS

1. Plug the micro USB cable into the GPS, and connect the cable to a computer installed with Microsoft ActiveSync (ActiveSync) or Windows Mobile and GPS Pathfinder Office (Pathfinder) software. If not already done, turn on the computer.
2. Turn on the GPS. The computer should automatically connect to the GPS using ActiveSync or Windows Mobile. A pop-up box will appear on the computer Ensure connectivity but do not synchronize or set up a partnership between the computer and GPS. The ActiveSync or Windows Mobile box should already have appear. You can click “X” to close the box; it will continue running and move to the system tray.
3. From the computer “Start” menu, navigate to “Programs - Trimble - GPS Pathfinder Office.” Then click “GPS Pathfinder Office” at the top.
4. When Pathfinder opens, a pop-up box labelled “Select Project” will appear. For “Project Name” select previously created project file name. If unavailable, click “New” and setup a folder for files to be transferred into under the project name. For example: c:\DocumentsandSettings\John.Doe\ MyDocuments\Project name
5. When finished, click “OK.”
6. Next, click “Utilities” at the top and select “Data Transfer.” In the “Data Transfer” box, ensure the green check button is selected and the picture indicates a GPS and computer connection. If not, then click the green check button to connect.
7. With the “Receive” tab selected, click “Add” and select “Data File.” This will prompt a screen showing all the files on the GPS. Choose the file(s) that need(s) to be processed and click “Open.” The selected file(s) will now appear in the “Files to Receive” queue. Click “Transfer All”. When complete, the “Transfer Completed” box will appear. Click “Close.” Close the “Data Transfer” box.
8. Click “Utilities” at the top and select “Export.” The “Export” pop-up box will appear with the file name(s) just transferred in the “Selected Files” queue. The “Output Folder” is where the file will be exported to. It is the user’s discretion on the location to put the file. Under “Choose an Export Setup,” “Sample ESRI Shapefile Setup” should be selected from the drop down menu. After choosing your output folder, click “OK.” A

pop–up box stating ”No ESRI projection file has been found. Do you wish to continue with the export?” Click “Yes.” An “Export Completed” box will appear with the details of the file being exported. Click “Close” and close Pathfinder.

9. An .ssf file has now been created and is saved in the Output Folder selected. Now post process the data file with Geographical Information System (GIS)/ArcMap, other software, or have a Geospatial Analyst process the file(s). Maintain these files as required by the project-specific procedures and per CMS-710-07-PR-04000, Gamma Walkover Survey Using Global Positioning System, Section 4.2.19 Radiation Protection Records .
10. Choose a Geospatial Analyst or equivalent GIS/ArcMap expert and send them the .ssf file. The expert will process the data file and send the appropriate maps, statistics, scatter plot maps, and cumulative frequency plots.
11. The user and the Geospatial Analyst or equivalent should communicate on keeping these completed files in an organized electronic file or by hard copy and keep a cumulative list of reference areas, static surveys and GWS. This will allow structured communication between the user and the analyst. If an instrument is sent off or returned for calibration and is returned to the project site with the same probe it is important that a distinction is made from the original. For example if the user’s original instrument has a serial number of 268650, when it comes back from the calibration or repair the instrument now needs to be number 268650A. This allows the user and the Geospatial Analyst or equivalent to differentiate between the two because after leaving the site the instrument will have to be re-set up and this will create new backgrounds, investigation levels, etc. The new instrument should be thought of as a separate instrument and added to the cumulative list with the new serial number.

5.8 Troubleshooting

1. There are not enough satellites (<5) to start or continue the survey

Satellites are not being picked up or have been lost due to the spacing of the satellites or due to an obstruction (building, tree, structure, etc). The GPS settings can be adjusted to get more satellites. The Skyplot screen is the section where this takes place. To get to the Skyplot screen from another section or during a survey, select “Status” from the main menu and then “Skyplot” on the sub-menu. At the bottom of screen there will be a slider bar with “Productivity ….Precision.” To get more satellites move the slider bar towards “Productivity.” This allows the receiver to log data from more satellites; however, precision may be lost. Only move the bar one click at a time checking to see if it has enough satellites to continue after each click. The default position is the middle. If possible change back to default after getting around obstruction. If this doesn’t work after sliding bar to last click then satellites are most likely below the horizon mask or are spaced too close together. The survey will have to be continued at another time or contact the RCS for direction.

If gamma surveys need to be completed and GPS datalogging is not possible, an option to conduct scanning and static gamma measurements will be completed per direction of RCS. For example, the area may be laid out in 1 meter grids and scanning of the entire area by hand at height of 10 cm above ground surface with the detector may be performed. Readings in gross counts may be monitored and the range of lowest to highest reading may be documented on the survey for the grid. At the highest two readings within the grid, a one minute static count may be documented on the survey form. Any readings exceeding the investigation level will be further investigated.

2. The screen has turned white or it has frozen and no choices can be made.

The unit has become over heated and needs to be cooled off immediately. Take the unit to a cool place. After 30 minutes check to see if it will start back up or turn it off. If not then let it cool until it functions.

3. The GPS is not receiving data from the Ratemeter.

While monitoring the “Status – Sensor” screen, if the “Last String” line either shows no count rate or the count rate is not updating every 1 or 2 seconds, then pause or stop the GWS. Check the RS-232 cable connections. Replace the cable if necessary. Resume recording Log ▶ and observe that the “Last String” line is correctly displaying the count rate sent by the digital output of the Ratemeter. Monitor the “Sensor” screen to ensure this problem does not recur.

5.9 GWS Documentation Requirements

All required GWS results must be documented on the electronic GWS survey form, CMS-710-07-FM-40112 or equivalent. All applicable data fields must be accurately completed and legibly recorded. If survey reports are written upon, use black or blue permanent ink. All changes must be struck (one-line), initialed, and dated.

5.9.1 General

All blank blocks require an “NA”, a line thru or the box darkened prior to printing. Complete survey documentation within 2 days of performance of the survey, unless unexpected conditions occur, such as absence due to illness. When supplemental information is required, such as additional analytical analysis, submission may be delayed until the necessary information is available. Revise and resubmit surveys returned for revisions within 1 day.

Survey report assembly:

- Survey report
- Map and drawing(s), as applicable
- Statistical information, as applicable

5.9.2 GWS Report

A report should be prepared for the GWS. The following outlines an example GWS Report using CMS-710-07-FM-40112:

1. Survey number: All survey numbers will start with RS (Radiological Survey) and will be typed on each page of the survey.

   The format is MMDDYYYY-AREA-CODE-SEQ,

   example: RS-12112011-012-GWS-1

   Where:

   - MM: Two digit month
   - DD: Two digit day
   - YYYY: Four digit year
   - AREA: work area designation
   - CODE: GWS – Gamma Walkover Survey
   - SEQ: Enter the next sequential number obtained from the work area survey log

2. Survey description: A summary description of the survey, including the type of survey, must be written in a manner clearly defines the purpose of the survey and the work supported.
3. Instrument block: All information must be provided for each instrument used for the survey. All backgrounds or Investigation Levels (IL) for the instruments will be the backgrounds or IL established during the initial set-up of the instrument, or as applicable to project specific documentation.

4. Surveyor, date, and time: Enter the date the survey was performed, by entering the start and end time of the survey. If survey extends to next day, make sure to include the different end date. Include printed name and signature of individual performing and documenting the survey and the date survey paperwork was completed by surveyor.
5. The final survey Geographical Information System (GIS) map showing the location of survey points and corresponding radiation survey range results and information on the investigation level for the instrument used will be saved electronically and saved to project files. Also the statistical information will be saved electronically and saved to project files. The examples are provided in CMS-710-07-FM-40112.
6. The file name shall include the location of the GWS and the date the GWS was performed. The GWS map should include the same file name. The copy should be in color or in a format so it is clear which range corresponds to the marks on the map.
7. In cases where the GPS was not used to collect gamma survey data, a radiological survey form will be completed and the survey scans and static measurement data will be documented per CMS-710-07-FM-40112, or equivalent form. A map showing the location of the grids surveyed and the location of the highest readings found in each grid will be included on the survey map.
8. Approval: Upon completion of the survey report and supplemental information, provide the packet to the designated individual, typically the RCS or designee, for review and approval. The approver will review the document for accuracy and approve.

5.10 Forms

- CMS-710-07-FM-40112, Gamma Walkover Survey Forms - Example

5.11 Definitions

TERM (ACRONYM)	DEFINITION
GIS	Geographical Information System
GPS	Global Positioning System
GWS	Gamma Walkover Survey
NaI	Sodium Iodide
PRSO	Project Radiation Safety Officer
RCS	Radiological Control Supervisor
RCT	Radiological Control Technician
RWP	Radiological Work Permit

6.0 ATTACHMENTS

Attachment 6.1	Ludlum Model 2221/2241 Trimble GeoXH Initial Settings
Attachment 6.2	Example of GIS Survey Maps (Image)
Attachment 6.3	Example of GIS Survey Maps (Statistics)

Attachment 6.1
Example of Ludlum Model 2221/2241 Trimble GeoXH Initial Settings

Logging Settings

Accuracy Settings:	Horizontal - in the field
Point/Vertex Auto-pause Count:	None
Antenna Height:	0.914 m
Log Carrier Data:	Auto
Log Velocity Data:	No
Allow Position Update:	Confirm
Confirm End Feature:	No
Filename Prefix:	R
Waypoint Filename Prefix:	W
Between Feature Logging - Style:	Time
Interval:	Off

Real-Time Settings

Choice 1:	Use Uncorrected GPS

External Sensors

Choose Sensor 1 and select Properties

Name:	Ludlum 2221or 2241
Communications Port:	COM1
Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None
Data Identification - Prefix String:	R
Suffix String:	\0d\0a
Max Bytes:	(blank)
Time Out:	0.25s
Receive Mode:	Unsolicited
Logging Intervals - Point Feature:	All
Line/Area Feature:	All
Not in Feature:	All
Data Destination:	Uninterpreted

GPS Settings (Treasure Island)

GPS Receiver Port:	COM3
DOP Type:	PDOP
Max PDOP:	6.0
Min SNR:	39.0
Min. Elevation:	15°
Velocity Filter:	Off
NMEA Output:	Off
Use GLONASS:	Auto

Coordinate System (Treasure Island)

Select By:	Coordinate System and Zone
System:	US State Plane 1983
Zone:	California Zone 3 0403
Datum:	NAD 1983 (Conus)
Altitude Reference:	Mean Sea Level (MSL)
Altitude Units:	US Survey Feet
Display USNG:	Off
Geoid Model:	Other
Geoid:	DMA 10x10 (Global)
Coordinate Units:	US Survey Feet
Coordinate Order:	North/East

Units

Distance Units:	Meters
Area Units:	Square Meters
Velocity Units:	Meters per Second
Angle Units:	Degrees
Lat/Long Format:	DD°MM'SS.ss"
Offset Format:	Horizontal/Vertical
North Reference:	TRUE
Magnetic Declination:	Auto(14.3°E)

Work Instruction Title:	**SAMPLE COLLECTION FOR RADIOLOGICAL ANALYSIS**	**CMS Number:**	**CMS-710-07-WI-40113**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

SAMPLE COLLECTION FOR RADIOLOGICAL ANALYSIS

0	Initial submittal.	MOS	28 Jan 2015
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This Work Instruction (WI) provides methods, procedures, and documentation requirements for the following:

- Identifying soil (or other media) sampling locations and sample collection
- Establishing areas for decontaminating soil (or other media) sampling equipment
- Performing decontamination of sampling equipment

Soil (or other media for radiological analysis) samples are collected in support of the scoping, background, characterization, remedial actions, and final status survey activities.

2.0 APPLICATION

This WI provides the steps required for identifying soil sample locations, collecting soil samples, and establishing areas for cleaning equipment and how to decontaminate sampling equipment. This WI is applicable to scoping, background, characterization, remedial action, and final status soil sampling activities. Additionally, this procedure may be used to collect solid samples such as asphalt, concrete, or building materials.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

3.1 The following personnel have responsibilities in this WI:

- Project or Program Radiation Safety Officer (PRSO)
- Project Manager (PM)/Responsible Manager (RM)
- Radiation Workers
- Director, Radiation Safety (DRS)

3.2 Responsibilities

3.2.1 The PRSO implements this procedure and approves all radiological protective measures incorporated into any applicable Radiological Work Permit (RWP). Specifically, the PRSO, or designee shall:

- Review the planned work and associated hazards
- Ensure an ALARA review has been performed and documented, as appropriate
- Formally approve the RWP, as applicable, and any subsequent revisions
- Ensure radiation workers comply with the requirements of the applicable RWP
- Ensure workers are qualified to perform assignments

3.2.2 The PM/RM ensures personnel under his/her direction have successfully completed required training. The PM must inform the PRSO, or designee, of any changes in work scope described in the RWP.

3.2.3 All radiation workers must review the applicable RWP and accurately and legibly complete required information on the RWP Access Register (CMS-710-07-FM-40082, *RWP Access Register Form – Example* and CMS-710-07-FM-40083, *RWP Access Register and Dose Tracking Form – Example)* acknowledging that they understand the work scope and requirements detailed in the RWP. All radiation workers must comply with oral and written radiological control instructions and procedures, including instructions on RWPs, observe radiological postings, and maintain an awareness of radiological conditions in the work area.

3.2.4 The DRS is responsible for ensuring workers are qualified to perform assignments, to review and approval ALARA reviews and higher hazard, Class III RWPs.

4.0 REFERENCES

CMS-710-07-PR-04000, *Radiation Safety Program*

CMS-710-07-WI-04008, *Radiological Work Permits*

CMS-710-07-WI-40111, *Performing and Documenting Radiation and Contamination Survey*

CMS-710-07-FM-40115, *Radiological Sample Collection Forms - Example*

Code of Federal Regulations (CFR), Title 10, Part 20, Standards for Protection Against Radiation

NRC Regulatory Guide 1.86, Table 1.1

5.0 WORK INSTRUCTION

Soil sampling will not occur where conditions are deemed unsafe, for example, near exposed utility lines. Suspect conditions must be reviewed and approved for work by the PRSO in consultation with the site safety and health officer.

The PRSO may authorize to omit gamma surveys described below if absence of gamma emitters is known. It requires special considerations if radionuclides of concern for sampling are low-energy beta emitters (e.g., Tritium, Carbon-14). The PRSO should discuss with the project certified health physicist for the procedure.

5.1 Prerequisites

The following prerequisites shall be met prior to conducting soil sampling:

- Gamma walk-over surveys (GWS) and static surveys of the area of interest have been conducted. The GWS and static survey count rate data has been analyzed to define the soil sample locations supporting scoping, background, characterization, remedial action activities, or biased sampling during final status survey. Final status survey sample coordinates have been calculated based on a random start location and a systematic sampling grid. A map has been provided by the geospatial analyst, or equivalent, identifying the soil sample coordinates and the 0.0 Northing and 0.0 Easting origins and the map is available to the field samplers. **Note:** The PRSO may authorize soil sampling at locations where a GWS has not been performed, for example, to support background studies.
- Determine the sampling depth in advance (typically 6 inch sampling depth).
- Determine gamma static and exposure rate measurements locations (height and/or depth) on each sampling location in advance.
- A Radiological Work Permit (RWP) has been prepared and approved for soil sampling and equipment cleaning or decontamination within any radiologically controlled area.
- Required personal protective equipment and dosimetry in accordance with the RWP, as applicable, and a job safety analysis document are available for use.
- Radiological control technicians performing field sampling activities have been trained to this WI, met the training requirements, and have read and understood the RWP and/or site-specific procedures for the specific work.
- Use only clean or new equipment.
- All required soil sampling, cleaning, and decontaminating of supplies and materials are available for use on site, for example:
  - Hand auger T-bar with auger bits
  - Shovel and/or spade
  - Scoops, knives, spoons, spatulas, and bowl
  - Nonphosphate detergent (Liquinox or equivalent)

- Plastic sheeting and bags, appropriate waste bags
- Scrub brushes
- Ziploc® bags
- Clear tape
- Custody tape
- Sample labels and sample documentation
- Paper towels or alcohol wipes
- Nitrile gloves
- Sample cooler
- Five gallon buckets (three)
- Sample containers for laboratory analysis
- Tap water

Note: New equivalents made of nylon, Teflon®, or similar materials do not require decontamination prior to use and are discarded after one use.

5.2 Reference Background Area Soil Sampling

To sample reference background area soil (or other media) for radiological analysis, perform the following steps, in order:

Step	Reference Background Area Sampling – Action
1	Obtain the map of the sampling locations and locate the starting point (0.0 Northing, 0.0 Easting) of the survey grid using global positioning system (GPS) or hand measurements. An example sampling location map is provided as Attachment 6.1, "Example Map of Soil Sample Locations." **Note:** Operation of the GPS is addressed in CMS-710-07-WI-40112 and the GPS manufacturer's operation manual.
2	Set a wooden stake or other semi-permanent marker to establish starting point location.
3	Locate the sample locations and set a pin flag or other semi-permanent marker to denote the sample location or sample number. Determine the sampling depth in advance. **Note:** Soil sample locations may be defined based on GWS or static survey results, or based on locations established per appropriate work plan, sampling and analysis plan, or survey plan.
4	Collect static gamma measurements, if applicable, at each sample location at pre-determined height above the sampling locations and depth in the hole using a Ludlum Model 2221 with a Ludlum Detector 44-10 or Ludlum Detector 44-20 (or equivalent). The depth of the hole may vary based on the media being sampled, and it should be denoted on the survey form. **Note:** Clearly denote the height of survey on the survey documentation on CMS-710-07-FM-40115, "Radiological Sample Collection Survey" or equivalent.
5	Collect exposure rate measurement, if applicable, at pre-determined height above the soil sample location using a Ludlum Model 19. Document the exposure rate measurements in accordance with CMS-710-07-WI-40111. **Note:** Record exposure rates in the units reported on the Ludlum Model 19 (e.g., microroentgens per hour [µR/h], milliroentgens per hour [mR/h]) on CMS-710-07-FM-40115.
6	Remove any surface debris (e.g., vegetation, rocks, twigs) from the soil sample location.

Step	Reference Background Area Sampling – Action
7	Place plastic sheeting around the targeted soil sample location if needed to stage sampled material. Cut an access hole for collecting the soil sample.
8	Place the bucket of the hand auger on the ground with the teeth down and while holding the T-handle, rotate it in a clockwise direction while pushing straight downward until the bucket is full. If a hand auger is not sufficient, then an equivalent powered auger, or drill bit may be used. **Note:** A shovel, trowel, or scoop may also be used to collect the sample.
9	Collect a soil sample at pre-determined depth below ground surface using a hand auger or applicable sampling tool. It may be necessary to adjust sampling depth to prevent mixing different materials. If this is the case, denote actual depth and media type in the survey. **Note**: Multiple samples may be cored from the sample location until the desired depth is reached and to support total volume of soil material needed for laboratory analysis. Soil sample depths may vary with project scope.
10	Measure the depth of the sample bottom with a measuring stick or tape measure and make note of the resulting depth when writing the survey.
11	Place soil sample into bowl or bag and remove any rocks or other debris materials.
12	Mix the soil in the bowl or bag with a spoon or spatula or equivalent tool to homogenize the collected soil sample.
13	Transfer the soil sample into the container specified in the project-specific SAP, receiving laboratory, or PRSO. If a split sample is required, evenly divide sample between containers ensuring enough soil is collected to fill each of the containers.
14	Cap sample containers, label, complete documentation, and place into a sample cooler. Complete form CMS-710-07-FM-40115 “Sample Shipment Checklist” or equivalent.
15	Place any excess soil back into hole at sample location.
16	Clean non-disposable sampling equipment per Section 5.4 of this WI before repeating the above steps, or gather disposable equipment for proper disposal.

5.3 Soil Sampling within Radiologically Controlled Areas

To sample soil for radiological analysis, perform the following steps in order:

Step	Sampling – Action
1	Obtain the map of the sampling locations and locate the starting point (0.0 Northing, 0.0 Easting) of the survey grid using GPS or hand measurements. An example sampling location map is provided as Attachment 1. **Note:** Operation of the GPS is addressed in CMS-710-07-WI-40112 or the GPS manufacturer’s operation manual.
2	Set a wooden stake or other semi-permanent marker to establish starting point location.
3	Locate the soil sample locations and set a pin flag or other semi-permanent marker to denote the sample location or sample number. **Note:** Soil sample locations are defined in accordance with the survey map, which is based on locations established per appropriate work plan, sampling and analysis plan, or survey plan.
4	Protect all sampling containers and paperwork from contamination by staging items on plastic sheeting or similar.
5	Don a pair of clean gloves and change out gloves after each sample location and as

Step	Sampling – Action
	needed. Dispose of used gloves in designated radioactive waste bag.
6	Take and record a background measurement with all survey instruments being used in an area representative of the area to be surveyed, but unlikely to be impacted by radiation sources or contamination in the area of interest. Data will be recorded into CMS-710-07-FM-40115, "Radiological Sample Collection Survey" (or equivalent), but for field purposes use of notebook or Field Activity Daily Log (FADL) is suitable to maintain collection data until proper documentation is completed.
7	Collect static gamma measurements, if applicable, at each sample location at pre-determined height above the sampling locations and depth in the hole using a Ludlum Model 2221 with a Ludlum Detector 44-10 or Ludlum Detector 44-20 (or equivalent). The depth of the hole may vary based on the media being sampled, and it should be denoted on the survey form. **Note:** Clearly denote the height of survey point on the survey documentation on CMS-710-07-FM-40115, "Radiological Sample Collection Survey."
8	Collect exposure rate measurement, if applicable, at pre-determined height above the soil sample location using a Ludlum Model 19. Document the exposure rate measurements. **Note:** Record exposure rates in the units reported on the Ludlum Model 19 (e.g., µR/h, mR/h) on CMS-710-07-FM-40115, "Radiological Sample Collection Survey."
9	Remove any surface debris (e.g., vegetation, rocks, twigs) from the soil sample location.
10	Place plastic sheeting around the targeted soil sample location, if needed, to stage sampled material. Cut an access hole for collecting the soil sample, if required by site-specific procedures.
11	Place the bucket of the hand auger on the ground with the teeth down and while holding the T-handle, rotate it in a clockwise direction while pushing straight downward until the bucket is full. If a hand auger is not sufficient, than an equivalent powered auger, or drill bit may be used. **Note:** A shovel, trowel, or scoop may also be used to collect the sample.
12	Collect a soil sample at pre-determined depth below ground surface using hand auger or other sampling tool. . It may be necessary to adjust sampling depth to prevent mixing different materials. If this is the case, denote actual depth and media type in the survey. **Note**: Multiple samples may be collected from the sample location until the desired depth is reached and to support total volume of soil material needed for laboratory analysis. Soil sample depths may vary with project scope.
13	Measure the depth of the sample bottom with a measure stick or tape measure and make note of the resulting depth when writing the survey.
14	Collect a static gamma reading, if applicable, with Ludlum Model 2221 with a Ludlum Detector 44-10 or Ludlum Detector 44-20 (or equivalent) in the hole at the pre-determined depth. The depth of the hole may vary based on the media being sampled, if the hole is not pre-determined depth, it should be denoted on the survey form. Document the static reading in accordance with CMS-710-07-WI-40111, on form CMS-710-07-FM-40115, "Radiological Sample Collection Survey" or equivalent.
15	Place soil sample into bowl or bag and remove any rocks or other debris materials.
16	Mix the soil in the bowl or bag with a spoon or spatula or equivalent tool to homogenize the collected soil sample.
17	Transfer the soil sample into the container specified in the project-specific SAP, receiving laboratory, or PRSO. If a split sample is required, evenly divide sample between containers ensuring enough soil is collected to fill each of the containers.

Step	Sampling – Action
18	Cap sample containers, label, complete documentation, and place into a sample cooler. Complete CMS-710-07-FM-40115, "Sample Shipment Checklist" or equivalent.
19	Place any excess soil back into hole at sample location.
20	Clean the non-disposable sampling equipment per Section 5.4 of this work instruction before repeating the above steps, or gather disposable equipment for proper disposal.
21	Document survey of decontaminated equipment along with release of sample containers, on form CMS-710-07-FM-40115, "Radiological Sample Collection Survey" or equivalent. Wrap equipment with plastic or other clean disposal material for storage.
22	Dispose single use (disposable) scoops, spoons, and other trash generated into low-level radioactive waste bag.

5.4 Cleaning and Decontamination of Soil Sampling Equipment

Areas for cleaning soil sampling equipment shall be established in a location that is central to the sampling locations, within the radiologically controlled areas. Equipment used for soil sampling for background areas may be cleaned in an area outside a posted radiologically controlled area. The area shall be easily accessed to support soil sample collection and multiple locations may be established as necessary to support the sampling process. The following steps are only required if radiological decontamination is necessary. Dirty tools do not constitute the need for a new waste stream and wet decontamination in a radiologically controlled area should only be done as necessary.

Step	Cleaning Sampling Equipment – Action
1	Place plastic sheeting on the area to provide a barrier over the soil in the sampling area and to provide a clean work surface to stage buckets and tools for cleaning and decontamination.
2	Prepare three 5-gallon buckets for cleaning equipment; two buckets will contain tap water and one will contain tap water with soap. If dry decontamination is adequate then decontaminate using available dry media, and skip to step 8. **Note:** Have a scrub brush or similar available for each bucket. Separate scrub brushes (cleaning tool) shall be used for each bucket.
3	Remove visible particulate matter from sampler with disposable spatula or other equivalent tool.
4	Immerse sampler into bucket (1) of tap water and scrub with brush.
5	Immerse sampler into bucket (2) of tap water with soap and scrub with brush.
6	Immerse sampler into bucket (3) of tap water for final rinse.
7	Dry sampler with paper towel. Dispose of paper towel in designated radioactive waste bag.
8	Survey the sampler surfaces (scan) with a Ludlum Model 2360 with a Ludlum Detector 43-93 (or equivalent) and collect a smear sample in accordance with CMS-710-07-WI-40111, Section 5.6. If surface area of tool being surveyed is less than 100cm^2, a note of this shall be made in the release survey. **Note**: If contamination is found on the sampler in excess of the release criteria specified in Attachment 6.1 of CMS-710-07-WI-04008, repeat the decontamination process until sampler is found to be less than the applicable release criteria. Release criteria are applicable unrestricted release values in Regulatory Guide 1.86, Table 1.

Step	Cleaning Sampling Equipment – Action
9	Continue sampling if total and removable surface radioactivity is less than the appropriate limit in Attachment 6.1 of CMS-710-07-WI-04008. Where possible use a different clean sampler for each sample location.
10	If the decontaminated sampler is not being reused immediately, place it in a clean plastic bag and seal the bag to prevent possible contamination.
11	Document the decontamination verification surveys and smear samples in accordance with CMS-710-07-WI-40111. Document the equipment decontamination on the Field Activity Daily Log (or equivalent) and on form CMS-710-07-FM-40115, "Radiological Sample Collection Survey" or equivalent.
13	Collect all water used to clean the sampling equipment and consolidate in the drums (typically 55-gallon) as directed by the construction manager. **Note**: Water will be sampled and properly disposed per requirements of applicable sampling and analysis plan.

5.5 Sampling Documentation Requirements

All required survey results must be documented on the electronic survey form, CMS-710-07-FM-40113, or equivalent. All applicable data fields must be accurately completed and legibly recorded. If survey reports are written upon, use black or blue permanent ink. All changes must be struck (one-line), initialed, and dated.

5.5.1 General

All blank blocks require an "NA", a line thru or the box darkened. Complete survey documentation within 2 days of performance of the survey, unless unexpected conditions occur, such as absence due to illness. When supplemental information is required, such as additional analytical analysis, submission may be delayed until the necessary information is available. Revise and resubmit surveys returned for revisions within 1 day.

Survey report assembly:

- Survey report
- Continuation sheet(s), as applicable
- Maps/drawings

Analytical results, as applicable

5.5.2 Survey Report

All required radiological survey and smear results should be documented on CMS-710-07-FM-40115, or equivalent. All applicable data fields must be accurately completed and legibly recorded.

Below is an example of the data recorded for sample collection:

- Survey Description: Provide information on the purpose of the survey-sampling, sampling matrix, and the location where the samples are collected.
- Reference to Previous Survey: Provide previous survey number of GWS or gamma static survey
- Sampling Map: Attach map that shows all of the sampling locations. **Note:** Also document soil sample location activities in a Field Activity Daily Log, or equivalent.

- Depth of Sampling: Enter the depth and units of sampling.
- Sample Containers: Enter the type and size of sample containers
- Weather Conditions: Enter the type of sun exposure, temperature, and wind speed.
- Chain of Custody No: Enter the custody number provided by the project chemist or designee.
- Offsite Analysis Requested: Enter the analysis requested and turn-around time.
- Survey-Sample Location No. and Time of Sample: Enter location number and time sample was collected.
- Sample ID No. (established in advance per site-specific plans)

The format is Site- Location-CODE-SEQ. Example: TI-B233-FSS-001

Where:

Site = Site Identifier

Location = the general sampling area

CODE = Purpose of survey

- BA = Baseline
- BG = Background
- BI = Biased
- FSS = Final Status Sampling
- WC = Waste Characterization
- WS = Waste Soil

SEQ = Enter the next sequential number

- Sample Description: Enter information on the moisture, color, and texture of the sample.

5.5.3 Chain of Custody (COC)

Chain of custody information must be documented in CMS-710-07-FM-40115, “Chain of Custody,” or equivalent. An example of the information recorded on a COC is as follows:

- Reference Number: COC number issued and tracked by the project chemist or designee.
- Project Number, Project Name/Location: As stated.
- Analysis Requested: List the required radionuclide analysis for the collected soil samples.
- Exposure Rate (μR/hr): Enter the exposure rate collected on the sample container.
- Shipment Date and Waybill Number: Enter the date the shipment was sent to the analytical laboratory and the shipment tracking number from the shipper’s waybill.
- Project Manager: Enter the project manager of the project number list in box 2.
- Send Report To: Shaded fields will be completed by the project chemist or designee.

- Lab Destination: Shaded fields will be completed by the project chemist or designee.
- Sample ID Number: All Sample ID numbers will start with the location.

  The format is Location-CODE-SEQ. Example: B233-FSS-001

Where:

Location = the general sampling area

CODE = Purpose of Survey

- BA = Baseline
- BG = Background
- BG = Background
- FSS= Final Status Sampling
- WC = Waste Characterization
- WS = Waste Soil

SEQ = Enter the next sequential number

- Sample Location: Enter information on the where the sample was collected (i.e., Excavation Area 5, sample location #1).
- Date and Time: Date and time (military) the sample was collected.
- Method: Refer to method codes. The majority of soil samples will be collected using the grab method (G).
- Matrix: Refer to matrix codes on the form.

Where:

S = Soil

ASP = Asphalt

CO = Concrete

WO = Wood

- # of Containers: Enter total number of containers for this sample ID number.
- Beginning Depth/Ending Depth: Starting and ending depth of soil sample.
- Turnaround time: Select or enter the laboratory turnaround time for analysis results.
- Level of QC Required: Select QC level and any project specific requirements.
- Relinquished/Received: Track the custody and transfer of samples from collection to analysis or placement in a designated secure area within the testing facility.

5.6 Forms

- CMS-710-07-FM-40115, Sampling Survey Form – Example

5.7 Definitions

TERM (ACRONYM)	DEFINITION
µR/h	Microroentgen per hour
COC	Chain of Custody
GPS	Global Positioning System
GWS	Gamma Walk-over Survey
Hand Auger	A sample collection device consisting of metal rods with a T-bar handle and a detachable metal head. The auger is a hollow metal tube with cutting edges at the bottom curved into each other to hold the material pushed up into the tube as the auger is forced deeper.
Homogenized	The use of physical mixing motions to make a uniform sample matrix.
ID	Identification
mR/h	milliroentgen(s) per hour
Mud Auger	A type of auger head with the top several inches open at the sides to allow for reduction of suction during removal from wetted and highly plastic (i.e., high clay content) materials, such as mud and wetland solids.
PRSO	Project Radiation Safety Officer
QC	Quality Control
RCS	Radiological Control Supervisor
Reference Area (Background Area)	"A site radiological reference area (background area) is defined as an area that has similar, physical, chemical and radiological, and biological characteristics as the site area being remediated, but which has not been contaminated by site activities. The distribution and concentration of background radiation in the reference area should be the same as that which would be expected on the site if the site had never been contaminated. More than one reference area may be necessary for valid comparisons if a site exhibits considerable physical, chemical radiological or biological variability."
RWP	Radiological Work Permit
Sample	Portion of material selected from a larger quantity of material, collected, and taken away for testing.
Sampling	Defined procedure whereby a part of the soil is taken for testing.
CB&I	Chicago Bridge & Iron
Soap	A standard brand of phosphate-free laboratory detergent, such as Liquinox®.
Split	A sample that has been homogenized and divided into two or more aliquots for subsequent analysis.
Tap Water	Water obtained from any municipal water treatment system.

6.0 ATTACHMENTS

Attachment 6.1 Example Map of Soil Sample Locations

Attachment 6.1 Example Map of Soil Sample Locations

EXHIBIT 1 - Grid Location Coordinates (meters from 0,0) for Excavation Area at Building 1123

Area of the survey unit (m^2) = 853

$L = (A/0.866 \times n)^{0.5}$ Equation 5.7 in MARSSIM

where

L = length of the spacing of the triangular grid spacing of the sample locations (m)

A = area of the excavation (m^2) = 853

n = 18 = number of samples given a relative shift (DCGLW - LBGR)/standard deviation

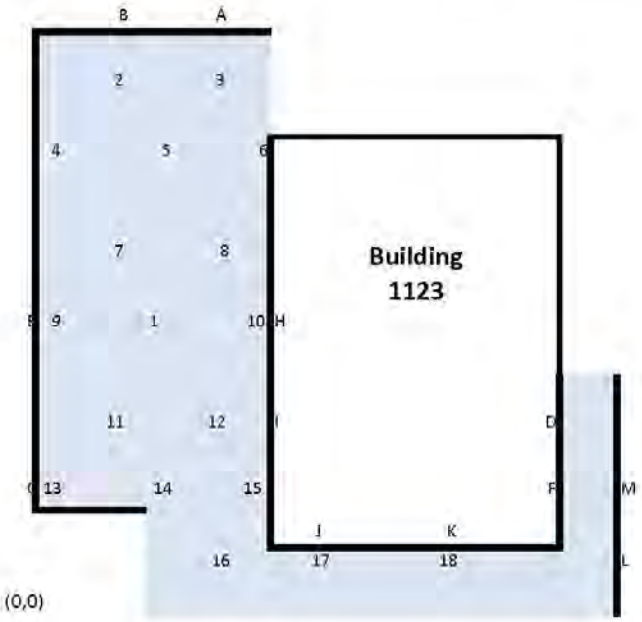
the radium-226 concentration DCGL = 1.7, LBGR = 0.85, $\delta = 0.646$ and $\alpha = \beta = 0.05$

$L = (853/0.866 \times 18)^{0.5}$ (meters) = 7.4

0.866 x L (meters) = 6.4

0.5 x L (meters) = 3.7

A random coordinate location is calculated as a survey pattern starting location, 9.0 meters east, 23 meters north (9E,23N). Beginning at the random starting coordinate, a row of sample locations are identified, parallel to the east-west axis, at intervals equal to L (7.4 m). A second row of points is calculated, at a distance of 0.866 x L (6.4 m). Sampling points along the second row are midway, on the east-west axis, between the points on the first row. This process is repeated to identify the triangular grid sample pattern throughout the excavation area.



= Excavation Area for Building 1123, sidewalls are displayed in bold type, 1 - 18 are floor sample locations, A - M sidewall sample locations.

NOTE: This drawing is not to scale

Appendix B
Waste Management Plan

APPENDIX B

FINAL
WASTE MANAGEMENT PLAN
Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California

Contract Number: N62473-12-D-2005
Contract Task Order: 0008

Document Control Number: CBI-2005-0008-0005

December 2015

Submitted to:

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Approved by: _____ Date: December 8, 2015

John Hackett, PE, CHP, PMP
Project Manager

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Attachment 2 Waste Storage Area Inspection Checklist

Acronyms and Abbreviations

CB&I	CB&I Federal Services LLC
LLMW	low-level mixed waste
LLRW	low-level radiological waste
PPE	personal protective equipment
Navy	U.S. Department of the Navy
NRC	U.S Nuclear Regulatory Commission
T&D	transportation and disposal

1.0 Introduction

This Waste Management Plan was prepared and will be implemented by CB&I Federal Services LLC (CB&I), under Contract No. N62473-12-D-2005, Contract Task Order 0008. This document is submitted as Appendix B of the Work Plan.

This Waste Management Plan describes the categories of waste, and project management and engineering controls that CB&I will use to accumulate, transport, and dispose of wastes generated at the site in a cost-effective, timely, and compliant manner. Section 2.0 includes a summary of the types of wastes expected to be generated during operation of the Radiological Screening Yards, when providing radiological support to contractor performing work in radiologically impacted areas, and when characterizing and disposing of onsite unknown soil/debris piles. It also provides specific waste information and the Transportation and Disposal (T&D) Coordinator's associated responsibilities for each T&D activity.

2.0 Waste Categories and Classification

This section describes the types of waste anticipated to be generated during the Basewide Radiological Support project.

The Site Superintendent will ensure wastes from different sources are additionally segregated by each individual source. The T&D Coordinator will then review available information and determine whether the wastes from different sources can be commingled for both cost and handling efficiency. Table 1 includes information regarding waste accumulation methods and times.

2.1 Solid Wastes

Site activities will consist of radiological support of non-radiological contractors in radiologically controlled or restricted areas; radiological characterization of soil and debris stockpiles of unknown origin; operation of the site portal monitor; and routine radiological compliance and controls activities. Waste generated during these activities will either be radiological or non-radiological in nature (Table 2 and Table 3). There are several waste streams that may be generated as a result of the planned stockpile relocation activities. All practical measures will be implemented to minimize the generation of low-level radiological waste (LLRW; materials that contain radionuclides at greater than Hunters Point action levels) or low-level mixed waste (LLMW; wastes containing both LLRW and levels of chemicals triggering a hazardous waste designation).

LLRW or LLMW that are anticipated may include, but are not limited to, the following:

- Soil
- Construction debris
- Personal protective equipment (PPE)

Non-radiological wastes that are anticipated may include, but are not limited to, the following:

- Soil
- Construction debris
- Vegetation/green waste
- Refuse and debris (i.e., used sampling equipment)
- PPE

2.2 Liquid Waste

Waste liquids may be generated from decontamination water generated from equipment and personnel decontamination. Saturated stockpiled soil is expected to dry within stockpiles or while sitting on radiological screening yard pads.

If liquid waste is generated, it will be stored in drums or tanks, or equivalent and appropriately labeled. When the drums or tanks are full or after 60 days, whichever comes first, the water will be sampled to determine if it meets sewer discharge requirements; if not, water analyses will serve as waste profiling per off-site disposal requirements.

2.3 Concrete, Asphalt, and Miscellaneous Debris

Construction debris present in debris stockpiles may include concrete pavement, rebar, asphalt pavement, and other miscellaneous construction debris. The level of radiological impact for some of these piles may not be known. Concrete rubble and asphalt may be stockpiled at a waste soil/debris staging area within the work site designated for clean materials only to avoid cross-contamination with radiologically-contaminated materials, and may be reused on site, recycled, or disposed as construction debris in a Class III landfill. General construction debris that cannot be reused will be segregated and recycled or disposed at a Class III landfill.

3.0 Transportation and Disposal Activities

The following subsections address specific control and management practices for LLRW and LLMW. Waste characterization activities will include radiological screening of waste debris and

other materials prior to final disposition. Surveys will follow CB&I's U.S Nuclear Regulatory Commission (NRC) and/or California License procedures for free release (Appendix A). If classified as LLRW or LLMW, these wastes may be placed in containers provided by the U.S. Department of the Navy (Navy) LLRW waste broker. The Navy's LLRW waste broker will coordinate closely with Navy's Radiological Affairs Support Office and be responsible for all packaging, shipping, manifesting, and disposal of LLRW and LLMW.

3.1 Waste Classification

Radioactive wastes will be classified as either LLRW or LLMW per NRC guidelines and/or disposal facility requirements. Waste characteristics, including the radionuclides present and their associated specific activity, will be measure using available standardized test methods such as those listed in Table 2.

3.2 Waste Accumulation and Storage

Radiologically impacted soil and/or debris will be placed in covered and lined roll-off containers (or other suitable container) which will be provided by the Navy's LLRW waste broker. The Navy's LLRW waste broker will assign a unique identification number to each individual container and will supervise and manage the tracking and contents of each bin.

Potentially radiologically impacted soil stockpiles and waste storage areas will be stored within radiologically controlled areas which fall under the authority of CB&I's NRC license. These stockpiles will be protected using Gorilla Snot® soil stabilizer or equivalent. Cells will be constructed atop existing hardscape (e.g., pavement) with thick-milled plastic sheeting to prevent mixing of stockpiled soil with base material. Berms will be placed around the perimeter of the stockpiles to prevent transport of materials by stormwater.

Wastewater from the radioactive material decontamination area will be maintained separately from hazardous decontamination and dewatering wastewater. The wastewater will be managed as LLRW wastewater until the chemical and radiological characteristics are known.

Attachment 1 provides the "Waste Inventory Log" that the Project Site Superintendent will use to track project wastes. Attachment 2 provides the "Waste Storage Area Inspection Checklist" that the Project Site Superintendent will use to inspect each waste storage area on a weekly basis.

3.3 Labeling and Posting of Containers Containing Radioactive Waste

Each waste container containing LLRW will be labeled and placed in a designated radioactive material storage area. The waste container will be labeled with a "Caution – Radioactive Material" label. The label will also note the maximum surface radiation level (measured in

mR/hr). The waste inventories will be managed under CB&I's NRC License until it is transferred to the Navy's LLRW waste broker.

3.4 Waste Accumulation Areas

CB&I will implement, at a minimum, the following requirements for radioactive waste stored on site within a designated radiologically impacted area:

- Display an industry standard placard and barrier materials with wording that includes the following, "Caution, Radiologically Controlled Area, Radioactive Materials Area, RWP Required for Entry, Authorized Personnel Only" (written in English and Spanish), at each radiological storage area every 50 feet (or 15 meters). The signs will be legible.
- Aisle space will be maintained to allow for the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency.
- The areas will be secured to prevent unauthorized access to the material.
- 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 will be available.
- Portable fire extinguishers, fire control equipment, spill control equipment, and decontamination equipment will be available.

Filled containers generated during performance of this Work Plan will be stored at the site where they were generated until the contained material can be characterized for packaging and disposal by the waste broker.

3.5 Waste Minimization

To minimize the volume of all waste streams generated during the project, the following general guidelines will be followed:

- Waste material will not be cross-contaminated unnecessarily.
- Work will be planned ahead.
- Material 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.
- When decontaminating radioactively contaminated material, every effort should be made to minimize the generation of mixed waste.
- Drop cloths or other absorbent material will be used to contain small spills or leaks.
- Contaminated material will not be placed with clean material.
- Wooden pallets inside the exclusion zone will be covered with plastic.
- Material 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.

3.6 Inspections

While all waste accumulation areas will be informally inspected on a daily basis, formal inspections of all radiological controlled areas under CB&I NRC license will be inspected weekly. The PRSO or designee will conduct inspections. Inspections will be logged in a dedicated field notebook, and a weekly inspection checklist will be completed. The radiologically controlled areas will be inspected to ensure the following:

- The containers will be checked for good condition. If a container is not in good condition the waste broker will be informed.
- The containers will be checked to ensure that they remain closed and secured at all times, except when adding or removing waste.
- The soil stockpiles will be checked to see they are properly identified/labeled and that their identification number is legible.
- The fencelines and gates will be checked for signs of break-ins or vandalism.

3.7 Waste Disposal

Wastes generated under this project, which will require off-site disposal by the Navy's basewide disposal contractors, include the following:

- Debris, PPE, and soil classified as unsuitable for reuse as backfill, based on radiological analysis, will be directly loaded into bins and transferred to the Navy's LLRW waste broker for disposal. Bins will be provided by the Navy's LLRW waste broker.

- Debris, PPE, and soil not classified as radiologically impacted will be moved outside the radiologically controlled area following approval from Radiological Affairs Support Office. The basewide T&D contractor will direct placement, characterization, and disposal of the releases debris, PPE, and/or soil.
- Wastewater will be characterized and profiled for appropriate off-site treatment and/or disposal.

4.0 References

California Code of Regulation, Title 22, Social Security, Division 4.5, "Environmental Health Standards for the Management of Hazardous Waste," Chapter 12, "Standards Applicable to Generators of Hazardous Waste," current.

Code of Federal Regulations, Title 40, Part 300, *National Oil and Hazardous Substances Pollution Contingency Plan*, U.S. Government Printing Office, Washington, D.C.

Tables

Table 1
Waste Accumulation Methods and Times

Waste	Accumulation Method	Maximum Accumulation Times
LLRW (from soil and building screening)	Temporary waste pile; roll-off container	Not applicable for nonhazardous; 90 days maximum for hazardous according to 22 CCR Section 66262.34
PPE and Visqueen®	Roll-off container; plastic bag	Not applicable for nonhazardous; 90 days maximum for hazardous according to 22 CCR Section 66262.34
Wastewater (from equipment decon activities and/or dewatering of excavations)	Temporary storage tank	Not applicable for nonhazardous; 90 days maximum for hazardous according to 22 CCR Section 66262.34

Notes:

California Code of Regulation (CCR), Title 22, Social Security; Division 4.5, Environmental Health Standards for the Management of Hazardous Waste; Chapter 12, Standards Applicable to Generators of Hazardous Waste; current through April 10, 2009.

LLRW *low-level radiological waste*
PPE *personal protective equipment*

Table 2
Waste Sample Types and Analyses

Waste	Sample Type	Analytical Methods
LLRW (from soil and debris screening)	Representative	Surface contamination and gamma scanning surveys Gamma spectroscopy for radium-226 and cesium-137 (EPA Method 901.1) Other radionuclide-specific analyses as required
PPE and Visqueen®	Not necessary since will infer from analytical data representing the soils	Will infer from analytical data representing the soils
Wastewater (from equipment decon activities and/or dewatering of excavations)	Representative	Radium-226/228 (EPA Methods 903/904) Other radionuclide-specific analyses as required.

Notes:

California Code of Regulation (CCR), Title 22, Social Security; Division 4.5, Environmental Health Standards for the Management of Hazardous Waste; Chapter 12, Standards Applicable to Generators of Hazardous Waste; current through April 10, 2009.

EPA *U.S. Environmental Protection Agency*
LLRW *low-level radiological waste*
PPE *personal protective equipment*

Table 3
Preliminary Characterization and Classification

Waste Stream	EPA/DTSC Characterization	DOT Classification
LLRW or LLMW (from soil and building screening)	Class A LLRW	Class 7 or not regulated
PPE and Visqueen®	Nonhazardous	Not applicable
Wastewater	Nonhazardous	Not applicable

Notes:

DOT	*U.S. Department of Transportation.*
DTSC	*California Department of Toxic Substances Control*
EPA	*U.S. Environmental Protection Agency*
LLMW	*low-level mixed waste*
LLRW	*low-level radiological waste*
PPE	*personal protective equipment*

Attachment 1
Waste Inventory Log

WASTE INVENTORY LOG

CB&I Federal Services LLC
N62473-12-D-2005 | CTO 0008
Hunters Point Naval Shipyard
San Francisco, California

Date of Inventory Inspection: _____ Inspected by: _____

Manifest Number	Container Number	Container Type	Container Volume	Generation Date	Waste Description/ Originating Site	Date Removed from site

Attachment 2
Waste Storage Area Inspection Checklist

Waste Storage Area
Inspection Checklist

Inspected by: _____ Date: _____ Time: _____

	Yes	No	Corrective Action		Date Corrected
Area posted with appropriate hazard and cautionary signs	☐	☐	_____		_____
Area free of spills?	☐	☐	_____		_____
All liquids stored in proper secondary containment?	☐	☐	_____		_____
Secondary containment basins free of liquids, snow and debris?	☐	☐	_____		_____
Containers compatible with waste being stored?	☐	☐	_____		_____
Containers properly sealed (lids on, rings in place, bins covered, etc.)?	☐	☐	_____		_____
All containers properly labeled?	☐	☐	_____		_____
Labels easily visible for inspection?	☐	☐	_____		_____
Accumulation start dates present on labels?	☐	☐	_____		_____
Accumulation start dates with storage time limit (e.g., 90 days)?	☐	☐	_____		_____
Information on all labels legible not faded and all required information is present?	☐	☐	_____		_____
Adequate aisle space for drums (minimum 22 inches)?	☐	☐	_____		_____
Aisles and doorways free of obstructions?	☐	☐	_____		_____
Containers free of leaks, dents or deterioration including structural defects and rusting?	☐	☐	_____		_____
Adequate separation of incompatible materials?	☐	☐	_____		_____
Tops of containers free of standing water?	☐	☐	_____		_____
Stockpiles adequately covered?	☐	☐	_____		_____

Notes: _____

_____

Appendix C
Abbreviated Sampling and Analysis Plan

SAP Worksheet #1: Title and Approval Page

Final
ABBREVIATED SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)

December 2015

Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California

Prepared for:
Base Realignment and Closure
Program Management Office West
Naval Facilities Engineering Command Southwest
33000 Nixie Way, Building 50
San Diego, California 92147

Prepared by:
CB&I Federal Services LLC
4005 Port Chicago Highway, Suite 200
Concord, California 94520-1120
925.288.9898

Prepared under:
Contract Number: N62473-12-D-2005
Contract Task Order: 0008
Document Control Number: CBI-2005-0008-0005

EXECUTIVE SUMMARY

This Abbreviated Sampling and Analysis Plan has been prepared by CB&I Federal Services LLC to support sampling and analytical tasks associated with the Basewide Radiological Support at Hunters Point Naval Shipyard. Project work includes the performing radiological support activities for non-radiological contractor, including soil and water sampling; operation of the site portal monitor; and characterization of waste soil and debris piles consistent with the requirements for a Class 1 survey per the *Multi-Agency Radiation Survey and Site Investigation Manual* (U.S. Nuclear Regulatory Commission et al, 2000).

Sampling activities will include radiological soil sampling for waste characterization. These activities will be performed in accordance with the project Work Plan, State of California Radioactive Materials License Number 7889-07 and U.S. Nuclear Regulatory Commission License 20-31340-01 issued to CB&I Federal Services LLC, and the Sitewide Radiation Protection Plan (Appendix A of the Work Plan). No chemical sampling is anticipated for this project.

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Figure 1 Radiological Areas Under Contract

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List of Acronyms

°C	degree Celsius
^{137}Cs	cesium-137
^{226}Ra	radium-226
^{90}Sr	strontium-90
CB&I	CB&I Federal Services LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chain-of-custody
DoD	U.S. Department of Defense
DQA	data quality assessment
DQO	data quality objective
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
H&S	health and safety
HPNS	Hunters Point Naval Shipyard
ID	identification
LCS	laboratory control sample
LOD	limit of detection
LOQ	limit of quantitation
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
MS	matrix spike
MSD	matrix spike duplicate
NAVFAC SW	Naval Facilities Engineering Command Southwest
Navy	U.S. Department of the Navy
NRC	U.S. Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PM	project manager
POC	point of contact
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QSM	*Quality Systems Manual for Environmental Laboratories*
RASO	Radiological Affairs Support Office
RPD	relative percent difference
RPM	Remedial Project Manager
RSY	radiological screening yard
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
UFP-QAPP	*Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data*

SAP Worksheet #2: SAP Identifying Information

Site Name/Number:	**Basewide Radiological Support at Hunters Point Naval Shipyard (HPNS)**
Contractor Name:	**CB&I Federal Services LLC (CB&I)**
Contract Number:	**N62473-12-D-2005**
Contract Title:	**EMAC III**
Work Assignment Number (optional):	**Contract Task Order 0008**

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs* (UFP-QAPP; U.S. Environmental Protection Agency [EPA], 2005) and *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5*, Office of Environmental Information (EPA, 2001). With additional guidance from the following publications:

   - *Quality Systems Manual for Environmental Laboratories, Version 5.0* (QSM; U.S. Department of Defense [DoD], 2013)
   - *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006)
   - *Environmental Work Instruction 3EN2.1—Chemical Data Validation* (Naval Facilities Engineering Command Southwest [NAVFAC SW], 2001)
   - *Environmental Work Instruction EVR.2—Review, Approval, Revision, and Amendment of Sampling and Analysis Plans* (NAVFAC SW, 2011)
   - *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: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

3. This is a project-specific SAP and abbreviated to include only specifics about radiological analyses.

4. List dates of scoping sessions that were held: September 22, 2015 (Project Kick-Off Meeting)

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
No relevant documents available	

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

Oversight by the California Department of Toxic Substances Control
Oversight by the California Department of Public Health, Division of Drinking Water and Environmental Management
Oversight by the California Regional Water Quality Control Board

7. Lead organization

U.S. Department of the Navy (Navy)
Oversight by the Radiological Affairs Support Office (RASO)

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:

This is an abbreviated SAP for basewide radiological support services and does not require regulatory or Navy Quality Assurance Officer (QAO) review. The following worksheet is not applicable and has been omitted: 24

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	
2	Table of Contents; SAP Identifying Information	
3	Distribution List	
4	Project Personnel Sign-Off Sheet	
Project Organization		
5	Project Organizational Chart	
6	Communication Pathways	
7	Personnel Responsibilities and Qualifications Table	
8	Special Personnel Training Requirements Table	
Project Planning/Problem Definition		
9	Project Planning Session Documentation (Including Data Needs Tables); Project Scoping Session Participants Sheet	
10	Problem Definition, Site History, and Background Site Maps (Historical and Present)	
11	Site-Specific Project Quality Objectives	
12	Measurement Performance Criteria Table	
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	
14	Summary of Project Tasks	
15	Reference Limits and Evaluation Table	
16	Project Schedule/Timeline Table	
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	
19	Analytical Methods/SOP Requirements Table	
20	Field Quality Control (QC) Sample Summary Table	
21	Project Sampling SOP References Table Sampling SOPs	
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
Analytical Tasks		
23	Analytical SOPs Analytical SOP References Table	
24	Analytical Instrument Calibration Table	
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain of Custody (COC) Form and Seal	
QC Samples		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	
Data Management Tasks		
29	Project Documents and Records Table	
30	Analytical Services Table Analytical and Data Management SOPs	
C. Assessment Oversight		
31	Planned Project Assessments Table Audit Checklists	
32	Assessment Findings and Corrective Action Responses Table	
33	Quality Assurance (QA) Management Reports Table	
D. Data Review		
34	Verification (Step I) Process Table	
35	Validation (Steps IIa and IIb) Process Table	
36	Validation (Steps IIa and IIb) Summary Table	
37	Usability Assessment	

Notes:

Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs (EPA, 2005)

SAP Worksheet #3: Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	Email Address or Mailing Address
Leslie Howard	Remedial Project Manager (RPM)	NAVFAC SW	619.524.5903	leslie.howard.ctr@navy.mil Base Realignment and Closure Program Management Office West 33000 Nixie Way, Bldg 50 San Diego, California 92147
Matthew Slack	Environmental Protection Manager	RASO; Naval Sea System Command Detachment	757.887.4212	matthew.slack@navy.mil Building 1959 NWS P.O. Drawer 260 Yorktown, Virginia 23691-0260
Ulrika Messer	Program Manager	CB&I	619.446.4529	ulrika.messer@cbifederalservices.com 1230 Columbia Street, Suite 1200 San Diego, California 92101
John Hackett	Project Manager (PM)	CB&I	303.486.2512	john.hackett@cbifederalservices.com 6380 South Fiddler's Green Circle Greenwood Village, Colorado 80111
Jamie Egan	Assistant PM	CB&I	415.636.4036	jamie.egan@cbifederalservices.com 101 Montgomery Street, Suite 750 San Francisco, California 94104
Rose Condit	Program Chemist	CB&I	925.288.2151	rose.condit@cbifederalservices.com 4005 Port Chicago Highway Concord, California 94520
Steve Massey	Program QC Manager	CB&I	619.446.4522	Stephen.massey@cbifederalservices.com 1230 Columbia Street, Suite 1200 San Diego, California 92101
Raymond Schul	Radiological Operations Manager	CB&I	518.496.5533	raymond.schul@cbifederalservices.com 950 Avenue M, Building 570 San Francisco, California 94130

SAP Worksheet #3: Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	Email Address or Mailing Address
Takeshi Ibuki	Project Radiation Safety Officer/License Authorized User	CB&I	415.398.6547 x235	takeshi.ibuki@cbifederalservices.com 950 Avenue M, Building 570 San Francisco, California 94130
Minh Chi	Project Radiation Safety Officer Representative	CB&I	415.741.8299	minhsec.chi@cbifederalservices.com 950 Avenue M, Building 570 San Francisco, California 94130
Mark Vennemeyer	Project QC Manager	CB&I	925.288.2383	mark.vennemeyer@cbifederalservices.com 4005 Port Chicago Highway Concord, California 94520
Erika Gish	Laboratory PM	Test America, St. Louis Laboratory	925.513.1270 314.298.8566	erika.gish @testamericainc.com 13715 Rider Trail North Earth City, Missouri 63045

SAP Worksheet #4: Project Personnel Sign-Off Sheet

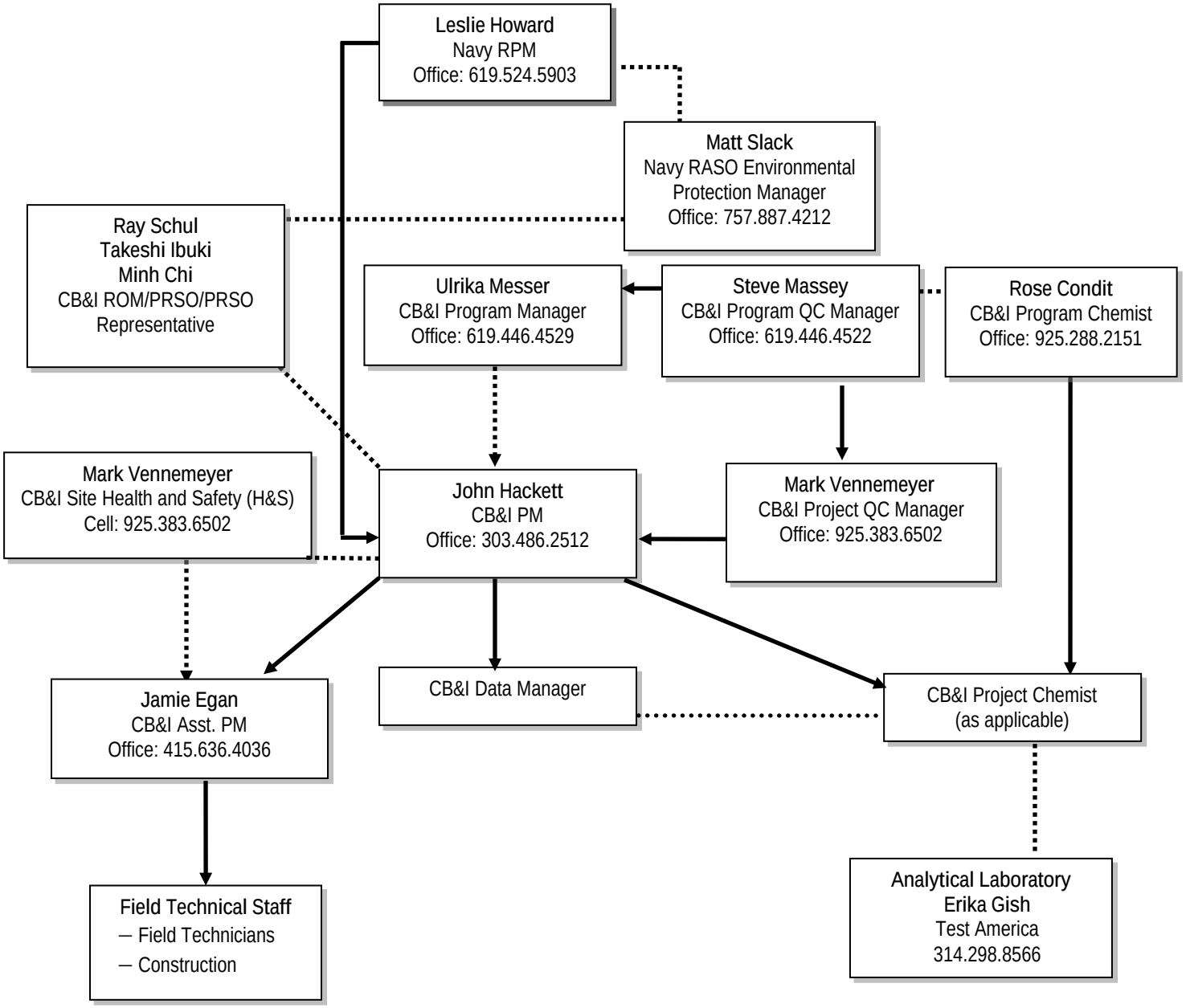
Name	Organization/Title/Role	Signature/Email Receipt	SAP Section Reviewed	Date SAP Read
John Hackett	CB&I PM			
Rose Condit	CB&I Program Chemist			
Mark Vennemeyer	CB&I Project QC Manager			
Erika Gish	Test America PM			

Note:

The signed SAP Worksheet #4 will be stored in the on-site project files, and then will be transferred to the CB&I Concord, California home office file storage at completion of fieldwork.

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 the Navy RPM and RASO	PM Asst. PM	John Hackett Jamie Egan	303.486.2512 415.636.4036	All materials and information about the project will be forwarded to the RPM by the PM or Asst. PM.
SAP Changes in the Field	Project Chemist or Program Chemist	Rose Condit Project Chemist	925.288.2151 TBD	The Project Chemist is responsible for documenting field changes related to sampling. The Project Chemist or Program 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 project management issues in writing. 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.
Sampling Quality Issues	Project or Program QC Manager Project or Program Chemist	Mark Vennemeyer or Steve Massey Project Chemist or Rose Condit	925.383.6502 619.446.4522 925.288.2151	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, Project Site Superintendent, Technical Lead, etc.), then the issue will be elevated to the Program Chemist or Program QC Manager). The Program Chemist or designee 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 issues in writing.

SAP Worksheet #6: Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or Email	Procedure
Sample Collection Issues	Project Chemist or Program Chemist	Project Chemist or Rose Condit	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 and other staff), then the issue will be elevated to the Program Chemist (Rose Condit) 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 issues 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	Program Chemist/ Data Manager	Rose Condit	925.288.2151	The Project Chemist is the POC for laboratory issues. The project Data Manager is the POC for electronic data deliverables (EDD). If laboratory issues are not resolved with the Project Chemist or Data Manager, then the issue will be elevated to the Program Chemist. If significant problems are identified from the laboratory that will impact the usability of the data, the Project Chemist should inform the PM, Navy RPM, and other parties as applicable within 24 hours of discovery or by the next business day. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the laboratory issue in writing.

SAP Worksheet #6: Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or Email	Procedure
Notification of Non-Usable Analytical Data	Program Chemist	Rose Condit	925.288.2151	If significant problems are identified by the laboratory or the project team that impact the usability of the data (i.e., the data is rejected or the data quality objectives are not met), the Program Chemist will notify the NAVFAC SW RPM and the NAVFAC SW QAO within 24 hours or the next business day.
Field Activity Issues	PM Assistant PM	John Hackett Jamie Egan	303.486.2512 415.636.4036	The PM is the POC for all project site activities such as scheduling, staffing, subcontractors, fieldwork, etc. The Assistant PM, in consultation with the PM and Navy RPM, if necessary, will resolve project site issues. Upon resolution, the PM or Assistant PM oversees the documentation, notification, and corrective actions associated with site issues in writing. The PM or Assistant PM is to be notified of site issues within 24 hours.
H&S Issues	Site Safety and Health Officer (SSHO)	Mark Vennemeyer	925.383.6502	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, Project Site Superintendent, 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
Stop Work Issues (H&S)	SSHO CB&I Employees	Mark Vennemeyer	925.383.6502	All employees have the right and duty to stop work when conditions are unsafe, or when established safety procedures are being disregarded. Whenever an employee determines that workplace conditions present an immediate uncontrolled risk of injury or illness, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the employee is authorized and required to issue a Stop Work Order in accordance with CB&I Procedure CMS-710-05-PR-00400, "Stop Work Authority" (2015). The specific activity or operation in question shall be discontinued until the issue is resolved.

SAP Worksheet #7: Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibility
Leslie Howard	Navy RPM	Navy	• Manages governmental oversight of the project. • Manages project funding and scope. • Coordinates project documents review. • Primary contact and liaison with regulatory agencies. • Responsible for technical oversight of the project.
John Hackett	PM	CB&I	• Manages oversight of the project for CB&I. • POC for communication with the Navy RPM and Navy contracts. • Ensures that all requirements of project contract are attained in a manner consistent with project plans. • Oversees planning, execution, and conclusion of all project activities. • Manages project budgets and schedules. • Develops work plans to address project scope of work. • Prepares work plan variances, if necessary. • Manages technical project elements.
Jamie Egan	Assistant PM	CB&I	• Performs activities as delegated by the PM, including coordination of field activities
Rose Condit	Program Chemist	CB&I	• Reviews and approves this SAP; Guides the selection of subcontract analytical laboratories. • Conducts field and laboratory audits; Serves as a POC for the Navy QAO. • Develops corrective action as required; Serves as a technical advisor to the project.

SAP Worksheet #7: Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibility
TBD	Project Chemist	CB&I	• Develops the project data quality objectives (DQO) and prepares this SAP. • Selects qualified subcontract laboratories. • Implements chemical data QC procedures and audits field performance. • Reviews laboratory data prior to use. • Oversees third-party validation of laboratory data. • Reviews data validation report. • Prepares the appropriate sections of the report summarizing the project sampling activities.
Raymond Schul	Project Radiation Safety Officer	CB&I	• Oversees overall radiological operations and documentation for the project. • Acts as the Technical Lead for radiological data collection. • Ensures that the Project Radiological Control Technicians have adequate training in sample collection. • Receives and reviews QA laboratory sample data to ensure DQOs are met.
Mark Vennemeyer	Project QC Manager	CB&I	• Develops the project QC objectives and prepares the QC Plan. • Administers the QC Plan. • Manages QC documentation and QC deliverables. • Lists definable features of work. • Conducts inspections (preparatory, initial, follow-up, completions).
Mark Vennemeyer	SSHO	CB&I	• Develops and administers the Site Safety and Health Plan. • Manages personnel and environmental monitoring. • Coordinates preparation of job safety analyses. • Selects appropriate personal protective equipment and facilitates daily safety meetings. • Reviews essential H&S requirements with on-site personnel.

SAP Worksheet #7: Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibility
CB&I Field Technician	Field Technician (sampling)	CB&I	• Performs all sampling in accordance with approved SAP. • Ensures that field QC samples are collected as specified in the SAP. • Completes field documentation and implements field corrective actions as required. • Must have Occupational Safety and Health Administration (OSHA) 40-hour Certification and 8-hour OSHA Refresher Certification as appropriate.
Erica Gish	Laboratory PM	Test America	• Oversees proper analysis and reporting of project samples according to approved SAP. • Manages communication between laboratory and CB&I Project Chemist. • Ensures proper QA/QC procedures are followed during laboratory analysis.

SAP Worksheet #8: Special Personnel Training Requirements Table

All field personnel will be required to have completed the OSHA 40-hour Hazardous Waste Operations and Emergency Response Standard Protection training, continued 8-hour Hazardous Waste Operations and Emergency Response, and submit to annual medical surveillance, as required by OSHA. The CB&I 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
All On-Site Project Personnel	Title 49 Transportation Subpart H Function-specific Training	Radiological Controls Supervisor	Prior to start of fieldwork	All On-Site Project Personnel	Radiological Controls Supervisor	CB&I Project Files
	Radiation Worker Training (see Sitewide Radiation Protection Plan [Appendix A of the Work Plan])	CB&I Project Radiation Safety Officer or designee	Prior to start of fieldwork	All On-Site Project Personnel	CB&I SSHO	CB&I Project Files
Radiological Monitoring Personnel	Site-Specific Qualification	Radiological Controls Supervisor	Prior to start of fieldwork	Junior and Senior Radiological Controls Technicians	Radiological Controls Supervisor	CB&I Project Files

SAP Worksheet #9: Project Scoping Session Participants Sheet

Project Name: Removal and Final Status Survey	Project Name: Basewide Radiological Support at Hunters Point Naval Shipyard
Projected Date(s) of Sampling: 2015-2016	
PM: John Hackett	Site Location: Hunters Point Naval Shipyard, San Francisco CA
Date of Session: July 30, 2015	
Scoping Session Purpose: Project kick-off meeting	

Name	Title	Affiliation	Phone #	Email Address	Project Role
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Comments/Decisions:	Project kick-off meeting
Action Items/ Decisions:	None

SAP Worksheet #10: Problem Definition

The project scope includes providing radiological support to HPNS contractors performing non-radiological work in radiologically impacted areas. In addition, various stockpiles of soil and debris are to be released from radiologically controlled areas, which will require soil sampling.

10.1 SITE HISTORY AND DESCRIPTION

The *Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard* (Navy, 2004) provides information on the historical use of radioactive materials at HPNS.

SAP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements

Step 1	Define the Problem that Necessitates the Study

Radiologically screen and sample soil, water, debris, and/or stockpiles as applicable under the project scope of work.

Step 2	Identify the Goal of the Study

The goals of the sampling activities are as follows:

- Collect radiological soil concentration data
- Where soil screening criteria are exceeded, collect sufficient data to delineate elevated areas and/or demonstrate successful removal of elevated soil

The study question is as follows:

- Do the sampling results support a conclusion that concentrations of project radionuclides of concern meet HPNS criteria for radiological release?

Step 3	Identify Information Inputs

The radiological surveys will include the following:

- Gamma scan data and gamma measurements at (biased) locations identified from scan data analysis
- Systematic surface soil samples
- Biased soil samples located to characterize the highest gamma scan results

Soil samples will be analyzed primarily by gamma spectroscopy (EPA Method 901.1 or equivalent) for cesium-137 (^{137}Cs), radium-226 (^{226}Ra) and daughters, and other gamma emitting radionuclides. Other radionuclide-specific analyses will be performed as noted in subsequent worksheets.

Step 4	Define the Boundaries of the Study

Soil and debris will be screened using established radiological screening yard (RSY) pads so that materials are surveyed in a standard layout, with a maximum size of 1,000 square meters and depth of 6 to 9 inches.

Step 5	*Develop the Analytic Approach*

Decision rules are described as follows:

Radiological soil sampling will be performed as specified in the Work Plan. The sampling frequency is designed to provide a high degree of confidence that the project areas are adequately characterized.

- If the results of the survey meet HPNS criteria for radiological release, then the data will be used to support a conclusion that the screened material meets the conditions for unrestricted radiological release.
- If the results of the survey exceed HPNS criteria, then remediation will be performed, and additional biased samples will be collected to verify that as-left soil conditions meet HPNS criteria.

SAP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements (continued)

Step 6	*Specify Performance or Acceptance Criteria*

To limit uncertainty in the obtained environmental data, criteria for the precision, accuracy, representativeness, completeness, and comparability parameters and limit of detection (LOD) for the contaminants of concern have been developed. Measurement errors will be controlled by using appropriate sampling and analytical methods, and the laboratory errors will controlled by adhering to the DoD QSM (2013), following established SOPs, and having the Project Chemist performing data review to verify laboratory processes. The field crews will review the SAP before sample collection to limit sample collection errors. The subcontract analytical laboratory will have a copy of this SAP and will adhere to DoD QSM (2013) guidance to limit measurement errors.

The *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (U.S. Nuclear Regulatory Commission [NRC] et al., 2000) guidelines will be used and a 95 percent confidence level for detecting radioactivity above the release criterion will be assumed with Type I and II errors limited to 2.5 and 5 percent, respectively.

Step 7	*Plan the Design for Obtaining Data*

The radiological survey design for this project is based on MARSSIM guidelines (NRC et al., 2000). 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.

SAP Worksheet #12: Measurement Performance Criteria Table—Field Quality Control Samples (Soil—Backfill Material Only)

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Matrix Spikes (MS)	Not applicable				
Rinse Blanks	Not applicable				
Field Duplicates	None	Due to known heterogeneity of contaminant distribution in soil matrix, field duplicates for soil will not be collected for this project	Not Applicable	Not Applicable	S&A
Temperature Blanks	Radiochemical Analysis	Every cooler shipped to the laboratory	Representative-ness	0 – 6 degrees Celsius (°C)	S

SAP 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
Existing site radiological data	*Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard*	Navy, 2004	Site characterization	None

SAP Worksheet #14: Summary of Project Tasks

14.1 SCOPE OF WORK

The scope of work of sampling activities for this project includes the following:

- Maintaining HPNS radiological controls and postings
- Performance of radiological surveys and sampling and providing radiological support to other contractors
- Performance of incoming and outgoing radiological surveys as needed
- Operation of the HPNS portal monitor
- Provide dosimetry to non-radiological contractor personnel
- Release of stockpiled soil and debris from radiologically controlled areas

14.2 SAMPLE COLLECTION METHODS AND PROCEDURES

The following subsections describe the sampling methods and procedures that will be used to collect samples for this project.

14.2.1 Shallow Soil Sampling—Radiological Screening Yard Pads

To facilitate the sampling to radiologically clear stockpiled soil for disposal, the soil will be spread in RSY pads approximately 6 to 9 inches deep or less and up to 1,000 square meters in surface area. Excavated soil will be cycled through the RSY pads for radiological screening and sampling. As necessary, the soil will be allowed to air-dry before radiological surveys are performed (see the Work Plan for details regarding radiological walk-over surveys).

Samples for off-site radiological analysis will be collected from the RSY pads using the general sampling technique described as follows:

1. Obtain a new (unused) disposable sampling scoop (or other nondisposable decontaminated sampling equipment).
2. Put on a new (unused) pair of sampling gloves and other appropriate personal protective equipment.
3. Establish the systematic triangle grid pattern throughout the RSY pad using a randomly selected starting point (see Work Plan, Section 2.1.1).
4. Collect the soil samples for radiological analysis into the appropriate sample containers using a disposable sampling scoop.
5. Submit soil samples for gamma spectroscopy analysis.
6. Label, package, and prepare the samples for shipment to the laboratory.

7. Radiologically release sample containers from the radiological areas prior to shipment to the laboratory.

14.2.2 Wastewater Sampling

Wastewater samples from on-site storage tanks, if needed, will be collected using a grab sampling technique (disposable bailer, Coliwasa, or equivalent). Samples will be collected using the following procedure:

1. Obtain an unused sampler for each sample event.
2. Put on a new, clean, and chemical-resistant pair of disposable gloves.
3. Lower the sampler into the containment area to the desired depth. Allow sufficient time for the bailer to fill with water.
4. Retrieve the sampler and fill appropriate bottle(s) for analyses being requested.
5. If the storage container is equipped with sampling taps, samples may be collected at these locations.
6. Cap the bottle(s) and wipe any moisture from the outside of the bottle(s).
7. Label, package, and prepare the samples for shipment to the laboratory. Transfer the samples to cold storage after collection.

14.2.3 Equipment Decontamination

Sampling equipment decontamination is not anticipated for this project since disposable equipment will be used as much as possible. However, if decontamination is necessary, the following procedures will be used. Decontamination of nondisposable sampling equipment that comes in contact with samples (i.e., sleeve rings and the split-spoon sampling device) will be performed to prevent the introduction of extraneous material into samples, and to prevent cross-contamination between samples. If required, sampling equipment will be decontaminated by steam cleaning, or by washing with a nonphosphate detergent such as Liquinox™ or equivalent. Decontamination water will be collected in 55-gallon U.S. Department of Transportation-approved drums or a poly-tank.

The following procedures will be used for decontamination of nondisposable sampling equipment:

1. If mud or soil is adhering to the sampling equipment, first rinse with potable water. This step will decrease the gross contamination and reduce the frequency at which the nonphosphate detergent and water solution need to be changed.

2. Wash with the nonphosphate detergent and water solution. This step will remove remaining contamination from the equipment. Dilute the nonphosphate detergent as directed by the manufacturer.

3. Rinse with potable water. Change the water frequently.

4. Rinse with deionized water. This step will rinse any detergent solution and potable water residues. Rinsing will be done by applying the deionized water from a clean squeeze bottle (or equivalent) while holding equipment over a bucket.

14.3 ANALYTICAL REQUIREMENTS

All analytical methods will be performed according to the applicable EPA and DoD QSM (2013) QC requirements (e.g., initial calibrations, continuing calibrations, tuning, reagent blanks, surrogates, replicates, and laboratory control sample [LCS]) as described in Worksheets #24 and #28.

14.4 QUALITY CONTROL TASKS

Samples will have appropriate associated QC samples, analyzed as blanks, LCS, MS and matrix spike duplicates (MSD), as described in Worksheets 12, 20, and 28.

14.5 DATA RECORDING AND TRANSFER

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

14.5.1 Hard Copy Deliverables

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 CB&I 30 days before disposal of any relevant laboratory records.

The hardcopy data deliverable requirements for this project are as follows:

- Radiological characterization samples—90 percent Level III and 10 percent Level IV
- Wastewater—100 percent Level II

14.5.2 Electronic Deliverables

The laboratory EDD will be in EnviroData format (CB&I database format). The analytical laboratory will follow the requirements stated in the Laboratory Interface Document for the Analytical Laboratory EDD.

The laboratory will certify that the EDD and the hard copy reports are identical. Both the EDD and the hard copy will present results to two or three significant figures. Field information (e.g., date and time collected, sample identification) will be entered directly into the main database from the COC record or uploaded from electronic files generated in the field.

14.6 DATA MANAGEMENT

This section describes the data management procedures for data review, verification, reporting, and validation.

14.6.1 Data Reduction, Verification, and Reporting

All analytical data generated by the laboratory projects will be reviewed prior to reporting to ensure 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.

14.6.2 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 CB&I to make alternative arrangements.

14.6.3 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. Laboratory 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 DoD QSM (2013). This review, at a minimum, will 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 LCS are within appropriate QC limits.
- Special sample preparation and analytical requirements have been met.

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

Level 2. Laboratory 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 findings of the Level 1 data review:

- 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 the analytical results from at least 10 percent 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 percent 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 have been checked. All errors and corrections noted will be documented.

Level 3. Laboratory Administrative Quality Assurance Data Review

The laboratory QA Manager will review 10 percent 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.

14.7 DATA VALIDATION

No additional data validation will be performed for this project.

SAP Worksheet #15.1: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Gamma Isotopes)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Americium-241 (^{241}Am)	86954-36-1	pCi/g	NA	NA	NA	NA	NA	NA
Bismuth-212 (^{212}Bi)	14913-49-6	pCi/g	NA	NA	NA	NA	NA	NA
Bismuth-214(^{214}Bi)	14733-03-0	pCi/g	NA	NA	NA	NA	NA	NA
Cesium-137 (^{137}Cs)	10045-97-3	pCi/g	0.113	Release Criteria	0.07	0.07[2]	NA	NA
Cobalt-60 (^{60}Co)	10198-40-0	pCi/g	NA	NA	NA	NA	NA	NA
Europium-152 (^{152}Eu)	14683-23-9	pCi/g	NA	NA	NA	NA	NA	NA
Europium-154 (^{154}Eu)	15585-10-1	pCi/g	NA	NA	NA	NA	NA	NA
Lead-212 (^{212}Pb)	15092-94-1	pCi/g	NA	NA	NA	NA	NA	NA
Lead-214 (^{214}Pb)	15067-28-4	pCi/g	NA	NA	NA	NA	NA	NA
Potassium-40 (^{40}K)	13966-00-2	pCi/g	NA	NA	NA	NA	NA	NA
Protactinium-234 (^{234}Pa)	15100-28-4	pCi/g	NA	NA	NA	NA	NA	NA
Radium-226 (^{226}Ra)	13982-63-3	pCi/g	1.0 above background[1]	Release Criteria	0.2	0.2[2]	NA	NA
Thallium-208 (^{208}Tl)	14913-50-9	pCi/g	NA	NA	NA	NA	NA	NA
Thorium-232 (^{232}Th)	7440-29-1	pCi/g	NA	NA	NA	NA	NA	NA
Thorium-234 (^{234Th})	15065-10-8	pCi/g	NA	NA	NA	NA	NA	NA
Uranium-235 (^{235}U)	15117-96-1	pCi/g	NA	NA	NA	NA	NA	NA

Notes:

[1] ^{226}Ra background for definitive data is 0.625 pCi/g for this project.

[2] A minimum detected concentration at or less than the value listed must be achieved for ^{137}*Cs and* ^{226}*Ra for all samples for this project. Minimum detected concentrations for other radionuclides analyzed by gamma spectroscopy are not required to be achieved unless specifically requested on the applicable COC.*

LOQ	*limit of quantitation*
NA	*not applicable*
pCi/g	*picocurie per gram*

SAP Worksheet #15.2: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Strontium-90)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Total Strontium	7440-24-6	pCi/g	0.331	Release Criteria	0.16	0.16	NA	NA
Strontium-90 (^{90}Sr)	10098-97-2	pCi/g	0.331	Release Criteria	0.16	0.16	NA	NA

Notes:

Total strontium analysis will be performed first by the laboratory since all strontium isotopes (not including ^{90}Sr) have decays away since activities involving radioactive material ceased at HPNS. If the total strontium result is less than the release criterion, a ^{90}Sr specific analysis is not required. If the total strontium result is above the release criterion, then a ^{90}Sr specific analysis will be performed.

LOQ	*limit of quantitation*
NA	*not applicable*
pCi/g	*picocurie per gram*

SAP Worksheet #15.3: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Alpha Isotopes)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Plutonium-239/240 ($^{239/240}$Pu)	10-12-8	pCi/g	2.59	Release Criteria	0.10	0.10	NA	NA

Notes:

LOQ	*limit of quantitation*
NA	*not applicable*
pCi/g	*picocurie per gram*

SAP Worksheet #15.4: Reference Limits and Evaluation Table—Site Contaminants (Soil Matrix—Tritium)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Tritium (Hydrogen-3)	10028-17-8	pCi/g	2.28	Release Criteria	1	1	NA	NA

Notes:

LOQ *limit of quantitation*

NA *not applicable*

pCi/g *picocurie per gram*

SAP Worksheet #15.5: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Americium-241 (^{241}Am)	86954-36-1	pCi/L	NA	NA	NA	NA	NA	NA
Bismuth-212 (^{212}Bi)	14913-49-6	pCi/L	NA	NA	NA	NA	NA	NA
Bismuth-214(^{214}Bi)	14733-03-0	pCi/L	NA	NA	NA	NA	NA	NA
Cesium-137 (^{137}Cs)	10045-97-3	pCi/L	119	Release Criteria	55	55[1]	NA	NA
Cobalt-60 (^{60}Co)	10198-40-0	pCi/L	NA	NA	NA	NA	NA	NA
Europium-152 (^{152}Eu)	14683-23-9	pCi/L	NA	NA	NA	NA	NA	NA
Europium-154 (^{154}Eu)	15585-10-1	pCi/L	NA	NA	NA	NA	NA	NA
Lead-212 (^{212}Pb)	15092-94-1	pCi/L	NA	NA	NA	NA	NA	NA
Lead-214 (^{214}Pb)	15067-28-4	pCi/L	NA	NA	NA	NA	NA	NA
Potassium-40 (^{40}K)	13966-00-2	pCi/L	NA	NA	NA	NA	NA	NA
Protactinium-234 (^{234}Pa)	15100-28-4	pCi/L	NA	NA	NA	NA	NA	NA
Radium-226 (^{226}Ra)	13982-63-3	pCi/L	5	Release Criteria	2.5	2.5[1]	NA	NA
Thallium-208 (^{208}Tl)	14913-50-9	pCi/L	NA	NA	NA	NA	NA	NA
Thorium-232 (^{232}Th)	7440-29-1	pCi/L	NA	NA	NA	NA	NA	NA
Thorium-234 (^{234Th})	15065-10-8	pCi/L	NA	NA	NA	NA	NA	NA
Uranium-235 (^{235}U)	15117-96-1	pCi/L	NA	NA	NA	NA	NA	NA

Notes:

[1] A minimum detected concentration at or less than the value listed must be achieved for ^{137}Cs and ^{226}Ra for all samples for this project. Minimum detected concentrations for other radionuclides analyzed by gamma spectroscopy are not required to be achieved unless specifically requested on the applicable COC.

LOQ *limit of quantitation*
NA *not applicable*
pCi/L *picocurie per liter*

SAP Worksheet #15.6: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Strontium-90)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Total Strontium	7440-24-6	pCi/L	8	Release Criteria	4	0.16	NA	NA
Strontium-90 (^{90}Sr)	10098-97-2	pCi/L	8	Release Criteria	4	4	NA	NA

Notes:

Total strontium analysis will be performed first by the laboratory since all strontium isotopes (not including ^{90}Sr) have decays away since activities involving radioactive material ceased at HPNS. If the total strontium result is less than the release criterion, a ^{90}Sr specific analysis is not required. If the total strontium result is above the release criterion, then a ^{90}Sr specific analysis will be performed.

LOQ	*limit of quantitation*
NA	*not applicable*
pCi/L	*picocurie per liter*

SAP Worksheet #15.7: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Alpha Isotopes)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Plutonium-239/240 ($^{239/240}$Pu)	10-12-8	pCi/L	15	Release Criteria	7.5	7.5	NA	NA

Notes:

LOQ	*limit of quantitation*
NA	*not applicable*
pCi/L	*picocurie per liter*

SAP Worksheet #15.8: Reference Limits and Evaluation Table—Site Contaminants (Water Matrix—Tritium)

Analyte	CAS Number	Units	Project Action Limit	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						LOQ	LOD	DL
Tritium (Hydrogen-3)	10028-17-8	pCi/L	20,000	Release Criteria	1	1	NA	NA

Notes:

LOQ *limit of quantitation*

NA *not applicable*

pCi/L *picocurie per liter*

SAP Worksheet #15.9: Reference Limits and Evaluation Table—Site Contaminants (Swipe Matrix—Gross Alpha/Gross Beta)

Analyte	CAS Number	Units	Removable Surface Contamination Limit	Removal Surface Contamination Limit Reference	Removable Surface Contamination MDC	Laboratory-Specific		
						LOQ	LOD	DL
Gross Alpha	12587-46-1	dpm/ 100cm^2	20	Regulatory Guide 1.86	14	NA	NA	NA
Gross Beta	12587-47-2	dpm/ 100cm^2	200	Regulatory Guide 1.86	84	NA	NA	NA

Notes:

Gamma isotopes associated with ^{226}Ra or other naturally occurring radioactive material (potassium-40 and uranium-235) are reported at the request of RASO even though the release criteria has not been established.

MDCs are being used in place of limits of quantitation, limits of detection, and detection limits for radiochemistry analyses. MDCs are calculated on a per sample, per-analysis basis and take into account instrument background, sample size, and count time. Therefore, any MDC value listed in this worksheet for the radiological analyses is the minimum MDC value that the laboratory will achieve. However, laboratory reports will list the actual MDC value calculated for each isotope.

LOQ	*limit of quantitation*
MDC	*minimum detected concentration*
NA	*not applicable*
dpm/100cm^2	*disintegrations per minute per 100 square centimeters*

SAP Worksheet #16: Project Schedule/Timeline Table

ID	Task Mode	Task Name	Duration	Start	Finish
1		X020 Award	1 day	Tue 9/8/15	Tue 9/8/15
2		Project Management	255 days	Wed 9/9/15	Fri 9/9/16
3		**Project Meetings**	**255 days**	**Tue 8/4/15**	**Thu 8/4/16**
4		Kick-Off Meeting	1 day	Tue 9/22/15	Tue 9/22/15
5		Contractor Integration Meetings	255 days	Wed 9/9/15	Fri 9/9/16
6		Coordination Meetings	255 days	Wed 9/9/15	Fri 9/9/16
7		**Planning Documents**	**52 days**	**Wed 9/9/15**	**Thu 11/19/15**
8		Preparation of Work Plans	22 days	Wed 9/9/15	Thu 10/8/15
9		Internal Draft Review	22 days	Fri 10/9/15	Mon 11/9/15
10		Respond to Internal Draft Comments	5 days	Tue 11/10/15	Mon 11/16/15
11		Issue Final	3 days	Tue 11/17/15	Thu 11/19/15
12		**Field Work**	**201 days**	**Fri 11/20/15**	**Wed 9/7/16**
13		Radiological Controls and Postings	201 days	Fri 11/20/15	Wed 9/7/16
14		Radiological Surveys	201 days	Fri 11/20/15	Wed 9/7/16
15		Radiological Support to Other Contractors	201 days	Fri 11/20/15	Wed 9/7/16
16		Incoming and Outgoing Surveys	201 days	Fri 11/20/15	Wed 9/7/16
17		Portal Monitor	201 days	Fri 11/20/15	Wed 9/7/16
18		Personal Dosimetry	201 days	Fri 11/20/15	Wed 9/7/16
19		Work Instructions	201 days	Fri 11/20/15	Wed 9/7/16

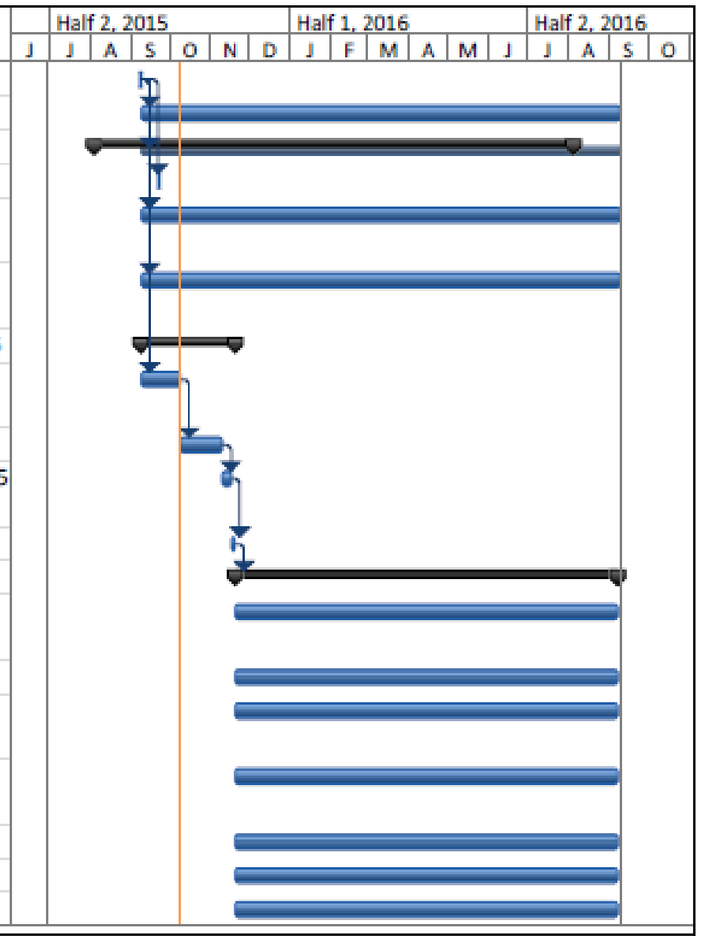

Figure 3
Project: D2005 CTO008 HPNS Sch
Date: Thu 10/8/15

Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Deadline
External Tasks	Duration-only	Progress

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SAP Worksheet #17: Sampling Design and Rationale

Radiological investigation sampling will be based on guidance in the MARSSIM (NRC et al., 2000) using a systematic sampling approach as described in the following subsections and in the Work Plan.

17.1 RADIOLOGICAL SURVEY SAMPLING—RSY PADS

Soil/debris stockpiles will be transported to RSY pads for radiological survey activities. Thickness of soil on the pad will be a maximum of9 inches if the RS-700 gamma scanning system is used; otherwise, RSY pad thickness will be a maximum of 6 inches. Each RSY pad will have a maximum 1,000 square meters of surface area. Soil from stockpiles of unknown origin will be radiologically screened on RSY pads prior to radiological release for reuse as backfill material or disposal off site.

Gamma scan surveys will be performed on the RSY pad, and soil samples will be collected at the rate of 20 samples per 1,000 square meters and will be analyzed by gamma spectroscopy for ^{137}Cs and ^{226}Ra.

The soil sample locations will be positioned throughout the RSY pad by first randomly selecting a starting point and establishing a systematic pattern. A triangular grid is selected for the RSY pads because it is generally more efficient for locating small areas of elevated activity. Grid coordinates are laid out using the hand-held global positioning system (or equivalent). RSY samples will be collected following the procedure described in the Work Plan. Following collection, the samples will be shipped to the off-site laboratory for analysis.

For the RSY pads, gamma spectroscopy results will be reported after a 7-day ingrowth period. If the gamma spectroscopy results of the soil indicate the ^{226}Ra concentration in the soil equals, or exceeds the screening criterion of one 1 picocurie per gram above average background, the soil will either be placed in a bin for disposal as low level radioactive waste or may be additionally remediated and sampled to minimize low level radioactive waste.

17.2 WASTE SOIL AND WASTEWATER SAMPLING

Waste characterization sampling for chemical constituents will not be performed as part of this task order.

Waste characterization samples for soil and water will be collected at a frequency based on professional judgment, project scope of work, and in consultation with RASO. At a minimum, the analysis will include the isotopes of concern for the site from which the waste was generated. The established radiological release criteria is listed in the “Release Criteria Table.” The “Building/Area Assessment, Classification, and Associated Isotopes of Concern Table” lists the

isotopes of concern for buildings, sites, ore areas at HPNS that have not achieved free release as of October 30, 2015.

Release Criteria Table

Radionuclide	Total Surface Contamination		Soil[d]		Water [e]
	Equipment or Waste (dpm/100cm^2)[a]	Structures (dpm/100cm2)[b]	Outdoor Worker (pCi/g)[c]	Residential (pCi/g)[c]	(pCi/L)
Americium-241	100	100	5.67	1.36	15
Cesium-137	5,000	5,000	0.113	0.113	119
Cobalt-60	5,000	5,000	0.0602	0.0361	100
Europium-152	5,000	5,000	0.13[f]	0.13[f]	60
Europium-154	5,000	5,000	0.23[f]	0.23[f]	200
Plutonium-239	100	100	14.0	2.59	15
Radium-226	100	100	1.0[g]	1.0[g]	5[h]
Strontium-90	1,000	1,000	10.8	0.331	8
Thorium-232	1,000	36.5	2.7	1.69	15
Tritium	5,000	5,000	4.23	2.28	20,000
Uranium-235	5,000	488	0.398	0.195	30

Source:

Final Basewide Radiological Removal Action, Action Memorandum—Revision 2006, Hunters Point Shipyard, San Francisco, California (Navy, 2006)

Notes:

[a] These limits are based on AEC "Regulatory Guide 1.86" (AEC 1974). Limits for removable surface activity are 20 percent of these values.

[b] These limits are based on 25 mrem/yr, using RESRAD-Building Version 3.3 or "Regulatory Guide 1.86" (AEC 1974), whichever is lower.

c The laboratory will ensure that the MDC meets the listed release criteria by increasing sample size or counting time as necessary. The MDC is defined as the lowest net response level, in counts, that can be seen with a fixed level of certainty, customarily 95 percent. The MDC is calculated per sample by considering background counts, amount of sample used, and counting time.

[d] EPA PRGs for two future-use scenarios.

[e] 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.

[f] Based on EPA-decay-corrected PRGs for commercial reuse and a previous action memorandum (Tetra Tech EM, Inc., 2000 and 2001).

[g] Limit is 1 pCi/g above background, per agreement with EPA.

[h] Limit is for total radium concentration.

AEC	*Atomic Energy Commission*
cm^2	*square centimeters*
dpm	*disintegrations per minute*
MDC	*minimum detectable concentration*
mrem/yr	*millirem per year*
pCi/g	*picocuries per gram*
pCi/L	*picocuries per liter*
PRG	*preliminary remediation goal*

Building/Area Assessment, Classification, and Associated Isotopes of Concern Table

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Action	Isotopes of Concern
	Known-Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System		
Parcel B																					
IR-07*				√		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
IR-18*				√		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Drydock 5				√		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Drydock 6				√		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Drydock 7				√		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Parcel C																					
205 and Discharge Channel				√		N	N	N	N	N	L	L	N	N	N	N	N	L	L	Scoping Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
211		√				N	N	N	N	N	M	L	N	N	N	N	N	L	L	Remediation and Final Status Survey	^{137}Cs, ^{226}Ra, and ^{232}Th
224			√			N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, and ^{90}Sr
253		√				N	N	N	N	N	H	H	N	N	N	N	N	M	M	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr, and ^{232}Th
Drydock 2			√			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Drydock 3			√			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Drydock 4			√			N	N	N	N	N	M	L	N	N	N	N	N	L	L	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr

Building/Area Assessment, Classification, and Associated Isotopes of Concern Table (continued)

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Action	Isotopes of Concern
	Known-Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System		
Parcel D																					
383				√		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Review Final Status Survey Report	Tritium ^{226}Ra, and ^{90}Sr
Gun Mole Pier			√			L	L	N	N	N	L	N	L	L	N	N	N	L	N	Review Characterization Report	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Mahan Street - NRDL			√			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Parcel E																					
500 Building Series			√			M	H	N	N	N	N	H	L	M	N	N	N	N	H	Scoping Survey	^{241}Am, ^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
510 Site			√			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
510A Site			√			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Scoping Survey	^{137}Cs, ^{90}Sr
517 Site			√			L	L	N	N	N	N	M	L	L	N	N	N	N	L	Characterization Survey	^{60}Co, ^{137}Cs, ^{90}Sr
520 Site		√				M	M	N	N	N	N	M	M	M	N	N	N	N	L	Characterization Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr
707/Kennels		√				L	L	N	N	N	L	M	L	L	N	N	N	L	M	Characterization Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
707 B Site				√		L	L	N	N	N	N	N	N	L	N	N	N	N	L	Characterization Survey (as part of 707 Triangle Area)	^{137}Cs, ^{226}Ra, and ^{90}Sr
707 C Site				√		L	L	N	N	N	N	N	L	L	N	N	N	N	N	Characterization Survey (as part of 707 Triangle Area)	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
707 Triangle Area		√				L	H	N	N	N	N	H	L	M	N	N	N	N	M	Characterization Survey	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr, and ^{235}U
708				√		L	N	N	N	N	L	N	L	N	N	N	N	N	N	Review Final Status Survey Report	^{137}Cs, ^{90}Sr
719 Site				√		L	L	N	N	N	N	N	L	N	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr

Building/Area Assessment, Classification, and Associated Isotopes of Concern Table (continued)

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Action	Isotopes of Concern
	Known-Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System		
Shack 79 Site			√			M	L	N	N	N	N	N	L	L	N	N	N	N	N	Final Status Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr
Shack 80 Site		√				H	M	N	N	N	N	N	M	L	N	N	N	N	N	Remediation and Final Status Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr
Experimental Shielding Range			√			M	L	N	N	N	N	N	L	L	N	N	N	N	N	Review Final Status Survey Report	^{60}Co, ^{137}Cs, ^{226}Ra
IR-01/21, Industrial Landfill		√				H	H	N	N	N	N	N	M	M	N	N	N	N	N	Review Characterization Survey Report, Remediation, and Final Status Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr
IR-02, Bay Fill		√				H	H	N	L	N	N	N	M	M	N	L	N	N	N	Characterization Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr
IR-03			√			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr
Former Salvage Yard			√			M	M	N	N	N	N	N	L	L	N	N	N	N	N	Scoping Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr
Shoreline		√				H	M	L	N	N	N	N	M	M	L	N	N	N	N	Characterization Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr
Basewide																					
Storm Drain Lines		√				N	L	N	N	N	L	H	N	L	N	N	N	L	M	Scoping/Characterization Surveys of systems associated with NRDL sites or sites associated with radium use	^{137}Cs, ^{226}Ra, and ^{90}Sr
Sanitary Lines		√				N	L	N	N	N	L	H	N	L	N	N	N	L	M	Scoping/Characterization Surveys of systems associated with NRDL sites or sites associated with radium use	^{137}Cs, ^{226}Ra, and ^{90}Sr

Building/Area Assessment, Classification, and Associated Isotopes of Concern Table (continued)

Building No. or Area	Contamination Potential					Contaminated Media							Potential Migration Pathways							Recommended Action	Isotopes of Concern
	Known-Restricted Access	Known-Continued Access	Likely	Unlikely	Unknown	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System	Surface Soil	Subsurface Soil	Surface Water	Groundwater	Air	Structures	Drainage System		
Septic Systems		√				N	M	N	N	N	N	H	N	L	N	N	N	N	M	Scoping/Characterization Surveys of systems associated with NRDL sites or sites associated with radium use	^{137}Cs, ^{226}Ra, and ^{90}Sr
Parcel F																					
Underwater Areas			√			N	L	N	N	N	N	N	L	N	N	N	N	N	N	Scoping Surveys in areas of Operation CROSSROADS decontamination activities and site outfall discharges	^{137}Cs, ^{239}Pu, ^{226}Ra, ^{90}Sr, and ^{235}U
All Ship Berths				√		L	L	N	N	N	L	N	N	L	N	N	N	L	N	Review Final Status Survey Report for completed berths; Scoping Survey on remainder	^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr
Off-Site Facility																					
ICW 418				√		N	N	N	N	N	L	N	N	N	N	N	N	L	N	Scoping Survey	^{137}Cs, ^{226}Ra, and ^{90}Sr

Source:

Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard (Navy, 2004)

Notes:

** Received restricted release from the State of California*

H High	*Evidence of contamination in the media or migration pathway has been identified.*
L Low	*The potential for contamination in the type of media or migration pathway is remote.*
M Moderate	*The potential for contamination in the media or migration pathway exists, although the extent has not been fully assessed.*
N None	*Evidence of contamination in the specific media or migration pathway has not been found, or known contamination has been removed, and surveys indicate that the media or migration pathway meets today's release criteria.*

SAP Worksheet #18: Sampling Locations and Methods/Standard Operating Procedures Requirements Table

The sample numbers shown in this worksheet represent the number of samples based on the initial estimated excavation size. Additional samples will be documented on COC Forms and in the field logbook. In addition, all sample locations will be either surveyed using a licensed land surveying company, or using hand-held global positioning system units.

Sampling Location	Purpose	Sample ID Number	Matrix	Depth (feet below ground surface)	Analytical Group	Number of Samples	Sampling SOP Reference
Stockpiled soil screening pads/ RSY pads	Radiological screening for release to allow for reuse or disposal	Pad # - Cycle # - 001 through Pad # - Cycle # - XXX	Soil	Surface (0 to 6 inches)	Gamma Isotopes, Sr-90, Alpha Isotopes, and/or Tritium	175 (estimated) *Estimated 7 pad cycles and up to 25 samples per pad*	Worksheet #14
Waste Soil	Waste characterization	CH-1 Through CH-## (sequential as needed)	Soil	Not applicable	Gamma Isotopes, Sr-90, Alpha Isotopes, and/or Tritium	As needed, up to 25 samples	Worksheet #14
Wastewater	Radiological characterization of investigation-derived waste water prior to discharge	WW-001 (sequential as needed)	Water	Not applicable	Gamma Isotopes, Sr-90, Alpha Isotopes, and/or Tritium	As needed, up to 25 samples	Worksheet #14

SAP Worksheet #19: Analytical Standard Operating Procedures Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/ Reference	Sample Volume	Container	Preservation Requirements	Maximum Holding Time
Soil	Gamma Isotopes	EPA 901.1MOD	250 – 400 grams	One 250-mL poly/glass or tuna can	None	180 days
Soil	Total Strontium/ ^{90}Sr	EPA 905.0/ Sr-02	250 – 400 grams	One 250-mL poly/glass or tuna can	None	180 days
Soil	Alphas Isotopes	HASL A-01-R	250 – 400 grams	One 250-mL poly/glass or tuna can	None	180 days
Soil	Tritium	EPA 906.0	250 – 400 grams	One 250-mL poly/glass or tuna can	None	180 days
Waste water	Gamma Isotopes (^{226}Ra only)	EPA Methods 903 and 904	1 L	One 1 L, poly/glass	Nitric Acid pH <2	180 days
Waste water	Gamma Isotopes (remainder of list besides ^{226}Ra)	EPA 901.1MOD/DOE HASL 300 Ga-01-R	1 L	One 1 L, poly/glass	Nitric Acid pH<2	180 days
Waste water	Total Strontium/ ^{90}Sr	EPA 905.0/ DOES HASL 300 Sr-02	1 L	One 1 L, poly/glass	Nitric Acid pH<2	180 days
Waste water	Alpha Isotopes	HASL A-01-R	1 L	One 1 L, poly/glass	Nitric Acid pH<2	180 days
Waste water	Tritium	EPA 906.0	1 L	One 1 L, poly/glass	Nitric Acid pH<2	180 days

Notes:

< *less than*

L *liter*

mL *milliliter*

SAP Worksheet #20: Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Primary Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equipment Rinse Blanks	No. of Trip Blanks	Total No. of Samples to Laboratory
Soil (RSY pads)	Gamma Isotopes Total Strontium Alpha by LSC	175 (estimated) Up to 25 per pad cycle	None	Not Applicable	None (disposable sampling equipment used)	None (disposable sampling equipment used)	Not Applicable	175 (estimated)
Wastewater	$^{226}Ra/^{228}Ra$ Gamma Isotopes Total Strontium	1 (collect as necessary)	None	None	None	None	None	25 (estimated)

Notes:

^{228}Ra	*radium-228*
LSC	*liquid scintillation counting*

SAP Worksheet #21: Project Sampling Standard Operating Procedures References Table

Reference Number	Title	Date, Revision and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
Worksheet #14	Surface Soil Sampling	NA	CB&I	Disposable Scoops	N	
Worksheet #14	Wastewater Sampling	NA	CB&I	Disposable bailer	N	

Notes:

NA *not applicable*

SAP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
No field instruments for chemical screening will be used for this project.						
Radiological controls portable instrument procedures are described in detail in the Sitewide Radiation Protection Plan (Appendix A of the Work Plan) and work instructions					Project Radiation Safety Officer or designee	Appendix A

SAP Worksheet #23: Analytical Standard Operating Procedures References Table

Laboratory SOP Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
ST-RD-0102	Gamma Vision Analysis Rev. 13 6/22/15	Definitive	Soil/Water Gamma Isotopes Water	Gamma Spectrometer	TestAmerica	N
Receipts-RD-0403	Low Background Gas Flow Proportional Counting System Analysis Revision 14, 09/12/13	Definitive	Soil/Water Sr-90 and Ra-226 (water)	Gas Flow Proportional Counter	TestAmerica	N
ST-RD-0210	Alpha Spectroscopy Analysis Revision 11, 8/21/13	Definitive	Soil/Water Alpha Isotopes	Alpha Spectrometer	TestAmerica	N
ST-RD-0302	Liquid Scintillation Counter Analysis Revision 14, 05/08/13	Definitive	Soil/Water Tritium	Liquid Scintillation Counter	TestAmerica	N
Add others upon receipt						

Notes:

[1]Portable document format copies of analytical SOPs will be provided in the Final SAP (Attachment 2).

SAP 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
Gamma Spectroscopy	Efficiency check	Continuing calibration verification count	Multipoint	Daily	±3 standard deviations	Recount	Analyst/ Department Manager	ST-RD-0102
Gamma Spectrometer	1. Clean cave; fill dewar with nitrogen gas 2. QA check	1. Physical check 2. Background and source check	1. Physical check 2. Check deviation	1. Weekly 2. Daily	1. Acceptable background 2. Within 2 sigma of measured population	Recalibrate Instrument maintenance Consult with Technical Director	Analyst/ Department Manager	ST-RD-0102

Notes:

± *plus or minus*

SAP Worksheet #26: Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): CB&I—Field Technician
Sample Packaging (Personnel/Organization): CB&I—Field Technician
Coordination of Shipment (Personnel/Organization): CB&I—Field Technician
Type of Shipment/Carrier: Laboratory Courier—UPS or FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): TestAmerica (Sample Receiving)
Sample Custody and Storage (Personnel/Organization): TestAmerica (Sample Receiving)
Sample Preparation (Personnel/Organization): Subcontract Laboratory—TestAmerica Analytical Chemist
Sample Determinative Analysis (Personnel/Organization): Subcontract Laboratory— TestAmerica Analytical Chemist
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Shipped to laboratory the same day as collection if possible, if not possible to ship the same day; storage on site in refrigerator or ice-packed cooler in locked building
Laboratory Sample Storage (No. of days from sample collection): Minimum three months TestAmerica
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 30 days—TestAmerica
Biological Sample Storage (No. of days from sample collection): Not applicable to this project
SAMPLE DISPOSAL
Personnel/Organization: TestAmerica
Number of Days from Analysis: Three months

SAP 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. The sample identifications (IDs) will include the following information:

RSY Pad Sample ID: Pad #-Cycle # -001
RSY Pad ID Number
Cycle Number
-001—Sequential sample number within RSY pad

Each sample container will be labeled with the following, at a minimum:

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

27.3 CHAIN OF CUSTODY

An example COC Form is shown in Attachment 1. 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 for inclusion in the project files
- 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 Form 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. A temperature blank will be placed in every cooler with samples.

All sample containers from radiological areas will be screened in the field prior to shipping to the laboratory following Work Instruction WI-40113 of the Sitewide Radiation Protection Plan (Appendix A of the Work Plan). The field exposure rate collected on the sample container is entered on the COC. Samples to be shipped by commercial carrier will be 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 air bill 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 air bill 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 ensure 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 Form and properly labeled and sealed shipping container(s).

27.5 FIELD LOGBOOKS

A permanently bound field logbook with consecutively numbered pages will be assigned to this project. A sample collection log work sheet is provided in Attachment 1. All entries will be recorded in indelible ink. Corrections will be made following the procedure described in Section 27.6. 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)
- 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.
- List of QC activities.

- Verbal or written instructions from the Navy and CB&I 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.

SAP Worksheet #28: Laboratory Quality Control Samples Table (Gamma Isotopes and other Radiological Analyses)

Matrix: Soil/Water

Gamma Radionuclides and other Radionuclides

EPA 901.1M/SOP GL-RAD-A-013/ Other SOPs

QC Check	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	One per analytical batch Batch = 20 samples or less	Result < RL	Narrate/Recount/reanalyze batch	Laboratory Manager/Analyst	A means of assessing the existence and magnitude of contamination introduced via the analytical process	Result < RL
LCS/LCSD	One per analytical batch Batch = 20 samples or less	75 to 125%	Recount/reanalyze batch	Laboratory Manager/Analyst	Accuracy	75 to 125%
Sample Duplicate	One per analytical batch Batch = 20 samples or less	Act < 5*MDC, then relative percent difference (RPD) is 100% or less. If act > 5*MDC, then RPD is 20% or less or relative error ratio /=3	Recount/reanalyze batch	Laboratory Manager/Analyst	Precision	Act < 5*MDC, then RPD is 100% or less. If act > 5*MDC, then RPD is 20% or less or relative error ratio </=3

Notes:

%	*percent*
<	*less than*
>	*greater than*
MDC	*minimum detectable concentration*
RL	*reporting limit*

SAP Worksheet #29: Project Documents and Records Table

Document	Where Maintained
Final Work Plan and SAP	CB&I project file (CB&I Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Field notes/logbook	CB&I project file(CB&I Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
COC Forms	CB&I project file (CB&I Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Laboratory raw data package	CB&I project file (CB&I Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Audit/assessment checklists/reports	CB&I project file(CB&I Concord, California office) and laboratory NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Corrective action forms/reports	CB&I project file (CB&I Concord, California office) and laboratory
Laboratory equipment calibration logs	CB&I project file (CB&I Concord, California office) and laboratory
Sample preparation logs	CB&I project file (CB&I Concord, California office) and laboratory
Run logs	CB&I project file (CB&I Concord, California office) and laboratory
Sample disposal records	CB&I project file (CB&I Concord, California office) and laboratory
Data validation reports and validated data	CB&I project file (CB&I Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites

SAP Worksheet #30: Analytical Services Table

Matrix	Analytical Group	Sample Locations/ ID Numbers	Analytical Method	Data Package Turnaround Time	Laboratory/Organization[1] (Name, Address, Contact, and Telephone No.)	Backup Laboratory (Name, Address, Contact, and Telephone No.)
Soil	All	All radiological samples shown in Worksheets #18 and 19	All	7 to 28 calendar days	Test America St. Louis Laboratory Contact: Erika Gish 13715 Rider Trail North Earth City, Missouri 63045 314.298.8566	Curtis & Tompkins 2323 5th Street Berkeley, California 94710 510.486.0900
Water	All	All radiological samples shown in Worksheets #18 and 19	All	7 to 28 calendar days	Test America St. Louis Laboratory Contact: Erika Gish 13715 Rider Trail North Earth City, Missouri 63045 314.298.8566	Curtis & Tompkins 2323 5th Street Berkeley, California 94710 510.486.0900

Notes:

[1] All analytical laboratories performing analyses will be State of California and DoD Environmental Laboratory Accreditation Program-accredited laboratories.

SAP 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 Corrective Actions
Laboratory Technical Systems Audit	If deemed necessary prior to start of sampling activities	External	CB&I	CB&I Project or Program Chemist	Laboratory QA Officer	Laboratory QA Officer	Laboratory QA Officer and CB&I Project Chemist
Initial Inspection/Preparatory Meeting	Prior to the start of sampling activities	Internal	CB&I	CB&I 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	Internal	CB&I and/or Navy QA Officer	CB&I Project or Program Chemist	Project Chemist or Program Chemist	Project Chemist or Program Chemist	Project Chemist or Program Chemist
Field documentation review	At least once at the beginning of sampling activities and then as needed as the project progresses	Internal	CB&I	CB&I Program Chemist or Field QA Manager	CB&I PM; Field Sampling Technician or Project Chemist	CB&I PM; Field Sampling Technician or Project Chemist	CB&I Program Chemist or Field QA Manager

SAP 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 Systems Audit	Written Audit Report	Project PM	48 hours after audit	Email or letter	Field Technician, CB&I Project Chemist, CB&I Program Chemist	24 hours after notification
Off-Site Laboratory Audit (if performed for project)	Written Audit Report	Laboratory QA Manager, Laboratory PM (TestAmerica St. Louis)	5 days after audit	Corrective Action Plan	Field Technician, CB&I Project Chemist, CB&I Program Chemist	10 business days after receiving report
Laboratory Data Review Findings	Memorandum	Laboratory QA Manager, Laboratory PM (TestAmerica St. Louis)	48 hours after audit	Email or letter	Field Technician, CB&I Project Chemist, CB&I Program Chemist	3 days after notification

SAP 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 Technical System Audit Report	At least once at the beginning of sampling activities and then as needed as the project progresses	Within 24 hours of field sampling audit	CB&I I QA Manager or CB&I Project Chemist	CB&I PM
Off-Site Laboratory Technical System Audit Report (if performed)	Prior to sample receipt at laboratory	Within 48 hours of on-site audit	CB&I Project Chemist or CB&I Program Chemist	Laboratory QA Manager, Laboratory PM
Data Review Report	After all waste sample data reviewed by Project Chemist	As received from laboratory	CB&I Project Chemist or CB&I Program Chemist	CB&I PM
Final Project Report (if needed)	After completion of all field work	Project document delivery schedule is provided in the Work Plan	CB&I PM	Navy RPM and regulatory agencies (see distribution list)

SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table

Data Review Input	Description	Responsible for Verification	Step I/IIa/IIb[1]	Internal/External
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 Form should be initialed by the reviewer, a copy of the COC Form retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	Field sampling team leader (CB&I) or Project Chemist	Step I	Internal
Sample receipt	The sample cooler will be checked for compliance with preservative, temperature and packaging requirements. Sample containers will be reviewed against the COC for agreement. Sample receipt will be documented by the laboratory on a login sheet and sample information will be entered into the Laboratory Information Management System.	Laboratory sample receiving and PM	Step I	External
Field notes/logbook	Field notes will be reviewed internally and placed in the project file upon project completion.	CB&I Project Chemist and Field QC Manager	Step I	Internal
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.	CB&I PM	Step I	Internal
Laboratory data packages	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 CB&I Chemist and a third-party reviewer according to the data validation procedures specified in this SAP.	Laboratory PM and CB&I Project Chemist	Step I	Internal/External

SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Data Review Input	Description	Responsible for Verification	Step I/IIa/IIb[1]	Internal/External
EDD	All EDDs will be verified internally by the subcontract laboratory for completeness and technical accuracy prior to submittal to CB&I. All received EDDs will be verified CB&I and/or the validation company against the hardcopy laboratory reports.	Laboratory, CB&I Chemist and a third-party data validation company	Step I	Internal/External
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.	CB&I Project Chemist and Field QC Manager	Step IIa	Internal
Holding times	Ensure the samples were analyzed within the EPA holding times. If holding times were not met, verify that deviations were documented and proper notifications were made.	Laboratory PM	Step IIa	External
Analytes and project LOQs met	Ensure that the required list of analytes and that project-specific LOQs specified in this SAP are met and reported per project requirements.	Laboratory PM and Project Chemist	Step IIa	Internal/External
Hard copy data packages	Review data package for compliance with EPA Method requirements (1996, 2008) and DoD QSM (2013) requirements, and approved SAP.	Not applicable		
Documentation of all EPA Method QC sample results; 90 percent Level III data review	Determine if all EPA Method required QC samples were analyzed and met required control limits per SAP and DoD QSM (2013) requirements when applicable.	Not applicable		
10 percent Level IV Raw Data Review	Recalculation of laboratory raw data to confirm laboratory calculation of final results.	Not applicable		
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 (2013) requirements when applicable.	Not applicable		

SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Data Review Input	Description	Responsible for Verification	Step I/IIa/IIb[1]	Internal/External
Sampling Plan	Determine whether the SAP was executed as specified (number, location, type of field samples collected).	CB&I Project QC Manager or Project Chemist	Step IIb	Internal
Gamma spec	In accordance with validation company SOPs, EPA Method requirements and EPA Level III and IV guidance (Worksheet #14) (1996, 2008).	Not applicable		

Notes:

[1] IIa = compliance with methods, procedures, and contracts (see Table 10, page 117, Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs [EPA, 2005]).

IIb = comparison with measurement performance criteria in the SAP (see Table 11, page 118, Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs [EPA, 2005]).

LOQ limit of quantitation

SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

VALIDATION OF LABORATORY DATA

Data validation is a systematic, independent process of reviewing a body of data to determine the analytical limitations of that data based on specific QC criteria. A third-party data validation company will validate definitive-level project laboratory data described as follows:

- Radiological characterization samples and import fill samples—90 percent EPA Level 3 and 10 percent EPA Level 4
- Waste samples—100 percent EPA Level 2

The CB&I Project Chemist will specify the sample and sample groups using a random selection process for the 10 percent Level 4 reporting and validation. Wastewater and waste soil samples will not be validated by a third-party validation company, but will be reviewed by the CB&I Project Chemist.

Data review and validation will be in accordance with the QA requirements and control limits specified in this project-specific Quality Assurance Project Plan and the following guidance, as appropriate to the analytical methods used:

- DoD QSM (2013)
- *National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2014a)
- *National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2014b)

The Chemist or reviewer's professional judgment will be used to evaluate data quality when called for in the National Functional Guidelines. Professional judgment will also be used where no clear policy exists, or when there is conflicting guidance on how data should be qualified.

Level III and Level IV Data Validation Criteria and Checklist

For a Level III data validation effort, the data values for routine and QC samples are generally assumed to be correctly reported by the laboratory. Data quality is assessed by comparing the parameters listed below to the appropriate criteria (or limits) as specified in the project SAP, DoD QSM (2013), or by EPA Method-specific requirements. If calculations for quantitation are verified, it is done on a limited basis requires raw data (Level 4) in addition to the standard data forms normally present in a data package.

Data review/validation may include the following QC elements shown in the following example validation checklist (depending on the analysis being reviewed):

Pass/Fail QC Criteria	Review/Validation Criteria (Level 3 and Level 4)
	Sample Receipt and Preservation
	Sample Holding Times
	Laboratory MBs/Calibration Blanks/Instrument Blanks
	Surrogate Recoveries
	LCS/LCSD Recoveries
	MS/MSD Sample Recoveries
	RPD Evaluation
	Sample Duplicate Evaluation
	Breakdown check standards (Pesticides/SVOCs)
	Initial calibrations
	Continuing calibration verification
	Second Column Confirmation
	Retention Time Evaluation (Gas Chromatograph Methods)
	Interference Check Standards (Metals)
	Serial Dilutions and Post-Digestion Spikes (Metals)
	Field Blanks
	Field Duplicate RPD
	Internal standard recoveries—Level 4 Validation only
	Review of manual integrations (if performed)—Level 4 Validation only
	Instrument tuning and system performance (Gas Chromatograph/Mass Spectrometer)—Level 4 Validation only
	Analyte identification (e.g., spectra and chromatograms)—Level 4 Validation only
	Analyte quantitation (calculation check)—Level 4 Validation only

Level II data review for remediation parameters and waste sample data will include the following:

Pass/Fail QC Criteria	Review/Validation Criteria (Level 2)
	Sample Receipt and Preservation
	Sample Holding Times
	Laboratory MBs/Calibration Blanks/Instrument Blanks
	Surrogate Recoveries

Pass/Fail QC Criteria	Review/Validation Criteria (Level 2)
	LCS/LCSD Recoveries
	MS/MSD Sample Recoveries
	RPD Evaluation
	Sample Duplicate Evaluation

SAP Worksheet #37: Usability Assessment

37.1 DATA QUALITY ASSESSMENT REPORT

Based on data validation/review, the Project Chemist will determine if the project DQOs have been met, and will calculate data completeness. To reconcile the collected data with project DQOs and to establish and document data usability, the data will be reviewed against data quality indicators (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 final project report.

37.2 DATA QUALITY INDICATORS

This section defines the data quality indicators 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 the RPD to assess a method's precision:

$$\textit{Precision as RPD} = \frac{2 \times |\textit{Result} - \textit{Duplicate Result}| \times 100\%}{\textit{Result} + \textit{Duplicate Result}}$$

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 laboratory control sample/duplicate 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. The laboratory control sample/duplicate 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 use DoD QSM acceptability limits for RPDs if available (2013). If DoD limits are not available, then the laboratory will establish statistically based acceptability limits for RPDs 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.

The analytical laboratory will use DoD QSM (2013) control limits if available; otherwise, the 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.

Due to the heterogeneous nature of site soil, field duplicates cannot be used to assess sampling precision; therefore, 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 percent 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:

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

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.

The laboratory will use DoD QSM (2013) control limits for accuracy if available. For analytes not specified in the QSM, the laboratory may use 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 approved site-specific SAP. Errors in sample collection, packaging, preservation, or COC procedures may result in samples being judged nonrepresentative 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 and standardized report formats; follow the calculations as referenced in the 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:

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

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

37.3 PROJECT-REQUIRED REPORTING LIMITS

The laboratory will determine the detection limits, limits of quantitation (LOQs), and LODs for each method, instrument, analyte, and matrix by using the procedure described DoD QSM (2013). The laboratory LOD and LOQ will be below the project reporting limit goals (Worksheet #15). The LOD is the smallest amount of a substance that must be present in a sample in order to be detected at a 99 percent confidence level. The LOQ is the lowest concentration of a substance that produces a quantitative result within specific limits of precision and bias. The laboratory will perform quarterly LOD verifications to verify method sensitivity, and quarterly LOQ verifications to determine precision and bias at the LOQ. The LOQ is greater than LOD and must be within the calibration range prior to sample analysis.

References

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EPA, 2014b, *National Functional Guidelines for Inorganic Superfund Data Review*, EPA 540-R-013-001, OSWER 9355.0-131, August.

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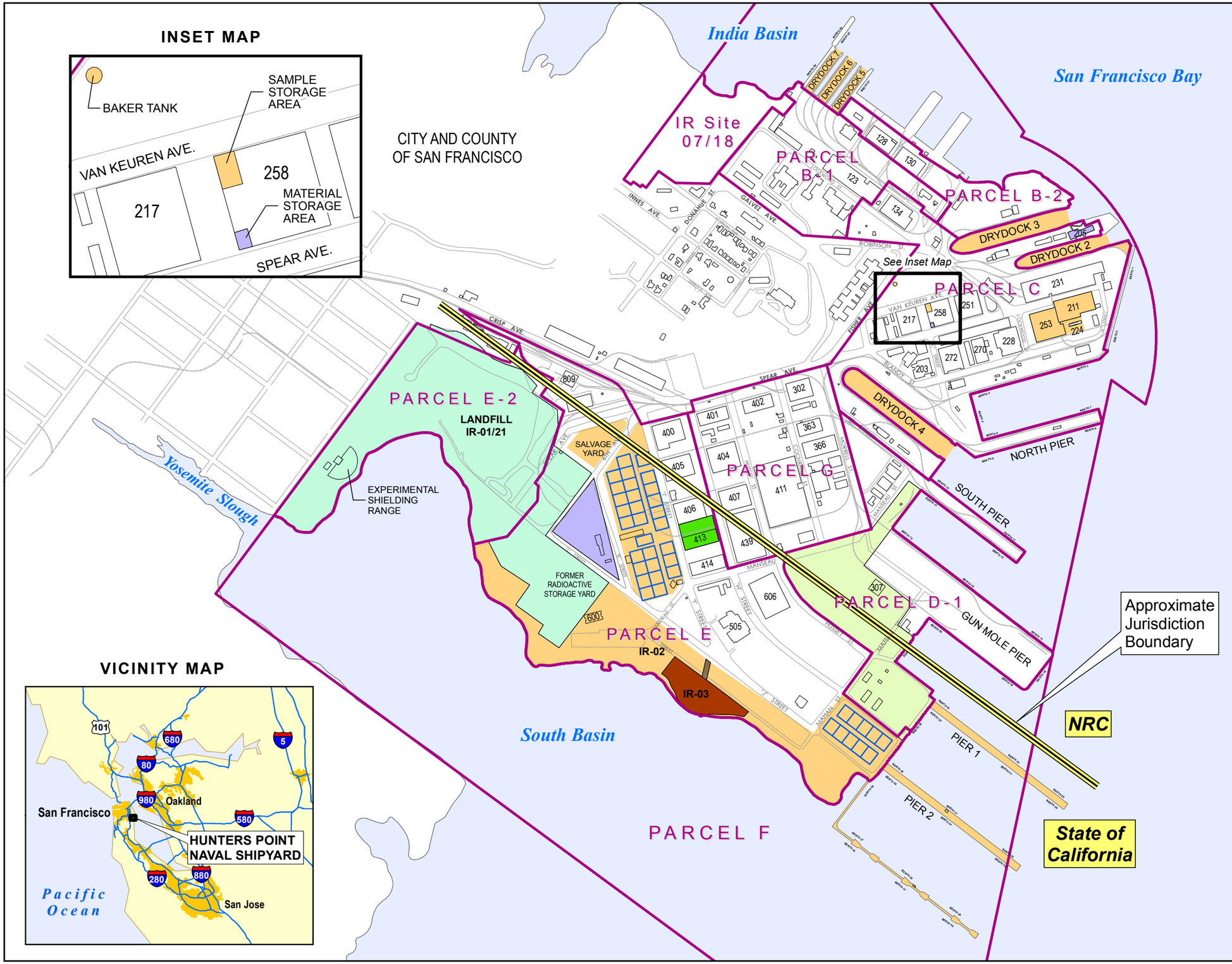
FIGURES

INSET MAP

VICINITY MAP



Legend

- Approximate Jurisdiction Boundary
- Parcel Boundary
- Impacted Buildings or Sites - CB&I Basewide Support
- U.S. Army Joint Munitions Command Radiological Waste Broker Bin Storage
- CIJV IR-03
- Land Bridge for Unrestricted Access to IR-03
- TTEC Parcel C Phase III
- Gilbane Parcel D-1
- Gilbane Parcel E/E-2
- RSY Pad

NOTES:

1. Parcel F is controlled under the CB&I basewide support contract.

2. Radiological areas under contract as of November 20, 2015.

N

0 800 1,600 Feet

U.S. Department of the Navy
BRAC PMO West
San Diego, California

FIGURE 1
RADIOLOGICAL AREAS UNDER CONTRACT

BASEWIDE RADIOLOGICAL SUPPORT
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

C:\GIS\HUNTERS_PT\GIS_Documents\Project_Maps\Basewide\HPNS_001_Contract_Areas.mxd 11/19/2015

ATTACHMENT 1
FIELD FORMS

CHAIN OF CUSTODY

Ref. Document # _____

Page 1 of 1

CB&I

Federal Services Division

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 500523

Project Name / Location: HPNS Basewide Radiological Support

Purchase Order #:

Project Manager: *John Hackett - 303-486-2512* (Name & phone #)

Shipment Date:

Waybill Number:

Lab Destination:

Lab Contact Name / ph. #:

Send Report To: *Rose Condit*
Phone/Fax Number: *925-288-2037*
Address: *4005 Port Chicago Hwy*
City: *Concord, CA, 94520*

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Lead (EPA 6010B)	PCBs (EPA8082)	PAHs (EPA 8270-SIM)	Dioxin (EPA 8290)	Gamma Scan (EPA 901.0M)			MS/MSD	Cooler Temperature	Dose Rate µR/Hr
							Preservative (water)										
							Preservative (soil)	N/A	N/A	N/A	N/A	N/A					
							Container Type	4oz Glass Jar	8oz Glass Jar	8oz Glass Jar	8oz Glass Jar	16oz HDPE					

Special Instructions:

☐ 24-hr ☐ 48-hr

Standard TAT ☐ ☐ 3-day ☐ 7-day

Level Of QC Required: I II III Project Specific:

Relinquished By:	Date:	Received By:	Date:
	Time:		Time:
Relinquished By:	Date:	Received By:	Date:
	Time:		Time:

Method Codes

C = Composite G = Grab

Matrix Codes

DW = Drinking Water SO =Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples
A = Air ABS=Asbestos, PO=Pipe Openning

CB&I Federal Services LLC

DATE			
TIME		:	
PAGE		OF	
PROJECT NO.	**500523**		

SAMPLE COLLECTION LOG

PROJECT NAME **HPNS Basewide Radiological Support**

SAMPLE NO. _____

SAMPLE LOCATION _____

SAMPLE TYPE ☐ Soil ☐ Water ☐ Air ☐ Other (give description)

COMPOSITE ☐ YES ☐ NO

COMPOSITE TYPE _____

DEPTH OF SAMPLE _____

WEATHER _____

MAP ON PAGE ☐

ANALYSES		CONTAINER AND AMOUNT COLLECTED
☐ PCBs	☐ PAHs	☐ 8 - OZ JARS
☐ Metals	☐ Sr90	☐ 4 - OZ JARS
☐ TPH	☐ Dioxin	☐ Encore
☐ Gamma Spec		☐ 16 - OZ JARS

COMMENTS:

PREPARED BY:_____

ATTACHMENT 2
CONTROL LIMITS, CERTIFICATIONS, ANALYTICAL STANDARD OPERATING PROCEDURES

Appendix C: Laboratory Control Sample (LCS) Control Limits and Requirements

1.0 Introduction

The DoD Environmental Data Quality Workgroup (EDQW) determined that both DoD and DOE would benefit from updating the existing Laboratory Control Sample (LCS) control limits that were established as a result of a study conducted in 1999 and reported in the 2004 LCS study. The initial study in 2004 was based on a limited data set and did not include all the laboratories and methods that are now a part of DoD ELAP and DOECAP. The objective of the new study was to develop updated LCS limits and provide values for an expanded scope of methods.

The new LCS study, conducted in the summer of 2012, incorporated the contributions from approximately 50 DoD ELAP and DOECAP accredited/approved laboratories. In all, 6.5 million records were analyzed, and LCS limits were set for 23 methods and approximately 1,280 matrix-method-analyte combinations. Based on the laboratory LCS sample data, control limits were calculated for all matrix-method-analyte combinations that met the criteria (a minimum of 100 records) for having sufficient data. Control limits were calculated as the sample mean $\pm$ 3 sample standard deviations.

2.0 LCS Limit Tables

Table 1. Method 1668 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
2051-60-7	PCB 1	148	91.7	14.6	48	136
56558-16-8	PCB 104	152	99.4	6.2	81	118
32598-14-4	PCB 105	179	105.6	7.2	84	127
74472-37-0	PCB 114	177	105.4	6.2	87	124
31508-00-6	PCB 118	180	107.7	9.6	79	137
65510-44-3	PCB 123	188	107.2	8.8	81	134
57465-28-8	PCB 126	181	100.8	7.3	79	123
2050-68-2	PCB 15	151	106	13.9	64	148
33979-03-2	PCB 155	153	98.7	7.5	76	121
38380-08-4	PCB 156	176	104.5	6.9	84	125

Table 1. Method 1668 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
52663-72-6	PCB 167	181	106.8	8.3	82	132
32774-16-6	PCB 169	181	98.8	7.3	77	121
74487-85-7	PCB 188	150	97.5	6.4	78	117
39635-31-9	PCB 189	176	102.2	5.7	85	119
38444-73-4	PCB 19	151	99.5	8.6	74	125
2136-99-4	PCB 202	150	97.1	7.1	76	118
74472-53-0	PCB 205	150	100	9.4	72	128
40186-72-9	PCB 206	183	97.5	7.8	74	121
52663-77-1	PCB 208	150	100.2	6.6	80	120
2051-24-3	PCB 209	181	107.6	8.4	83	133
2051-62-9	PCB 3	126	97.4	13.2	58	137
38444-90-5	PCB 37	152	104.3	14.4	61	148
13029-08-8	PCB 4	144	98	13.8	57	140
15968-05-5	PCB 54	150	95.9	9.5	67	124
32598-13-3	PCB 77	152	96.5	7	75	118
70362-50-4	PCB 81	150	100.6	7.7	78	124

Table 2. Method 1668 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
2051-60-7	PCB 1	206	86.7	9.4	58	115
37680-73-2	PCB 101	107	103.8	9.5	75	132
56558-16-8	PCB 104	206	99.4	6.9	79	120
32598-14-4	PCB 105	258	104.7	9.3	77	133
74472-37-0	PCB 114	246	106.5	8.7	81	133
31508-00-6	PCB 118	212	104.9	7.7	82	128

Table 2. Method 1668 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
65510-44-3	PCB 123	252	106.8	10.2	76	138
57465-28-8	PCB 126	242	98.4	6.8	78	119
38380-07-3	PCB 128	103	102.3	7.8	79	126
2050-68-2	PCB 15	211	103.5	9.8	74	133
33979-03-2	PCB 155	208	97.4	9.5	69	126
38380-08-4	PCB 156	248	107.6	9.9	78	137
52663-72-6	PCB 167	249	110.4	11	78	143
32774-16-6	PCB 169	247	96.9	8.7	71	123
35065-30-6	PCB 170	108	108	10	78	138
74487-85-7	PCB 188	207	95.7	6.5	76	115
39635-31-9	PCB 189	248	102.4	7.2	81	124
38444-73-4	PCB 19	196	98.7	6.5	79	118
2136-99-4	PCB 202	205	95.5	6.2	77	114
74472-53-0	PCB 205	208	95.5	8.8	69	122
40186-72-9	PCB 206	210	93.6	6.6	74	113
52663-77-1	PCB 208	210	98.6	6.4	79	118
2051-24-3	PCB 209	212	103.7	8	80	128
2051-62-9	PCB 3	208	93.6	9.8	64	123
38444-90-5	PCB 37	206	97	12.3	60	134
13029-08-8	PCB 4	207	95	10.9	62	128
15968-05-5	PCB 54	204	95	9.4	67	123
32598-13-3	PCB 77	208	94.1	6.2	75	113
70362-50-4	PCB 81	208	100.6	8	77	125

Table 3. Method 6010 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7429-90-5	Aluminum	6258	96.7	7.5	74	119
7440-36-0	Antimony	5997	96.4	5.7	79	114
7440-38-2	Arsenic	9530	96.2	4.9	82	111
7440-39-3	Barium	9236	98.3	5	83	113
7440-41-7	Beryllium	6799	97.8	5.1	83	113
7440-42-8	Boron	2312	93	7.1	72	114
7440-43-9	Cadmium	9466	97.5	5.3	82	113
7440-70-2	Calcium	6347	98.1	5.8	81	116
7440-47-3	Chromium	9598	98.9	4.6	85	113
7440-48-4	Cobalt	6725	98.7	4.5	85	112
7440-50-8	Copper	7839	99.1	6	81	117
7439-89-6	Iron	5746	99.7	6.1	81	118
7439-92-1	Lead	10160	96.8	5.1	81	112
7439-93-2	Lithium	551	98.8	4.5	85	112
7439-95-4	Magnesium	6283	96.1	6.1	78	115
7439-96-5	Manganese	6732	99.1	4.9	84	114
7439-98-7	Molybdenum	4424	98.7	5.7	82	116
7440-02-0	Nickel	7412	98.1	4.9	83	113
7723-14-0	Phosphorus	189	103.1	3.8	92	114
7440-09-7	Potassium	6574	98.3	5.8	81	116
7782-49-2	Selenium	8862	94.5	5.6	78	111
7440-22-4	Silver	9105	97.3	5	82	112
7440-23-5	Sodium	5825	100.1	5.8	83	118
7440-24-6	Strontium	2573	98.5	5	83	114
7440-28-0	Thallium	6416	96.8	4.6	83	111

Table 3. Method 6010 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7440-31-5	Tin	2780	100.1	6.6	80	120
7440-32-6	Titanium	2107	98.2	5.2	83	114
7440-61-1	Uranium	109	97.4	5.2	82	113
7440-62-2	Vanadium	6934	98.3	5.4	82	114
7440-66-6	Zinc	7882	97.4	5	82	113

Table 4. Method 6010 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7429-90-5	Aluminum	11532	100	4.8	86	115
7440-36-0	Antimony	10737	100.2	4.2	88	113
7440-38-2	Arsenic	14123	99.9	4.3	87	113
7440-39-3	Barium	14476	100.3	4.1	88	113
7440-41-7	Beryllium	11552	100.4	4	89	112
7440-69-9	Bismuth	147	95.8	3.2	86	105
7440-42-8	Boron	3871	98.8	4.8	85	113
7440-43-9	Cadmium	13922	100.8	4.1	88	113
7440-70-2	Calcium	11382	100	4.2	87	113
7440-47-3	Chromium	15027	101.1	3.9	90	113
7440-48-4	Cobalt	11824	101.2	4.2	89	114
7440-50-8	Copper	12910	100.2	4.6	86	114
7439-89-6	Iron	13797	100.7	4.7	87	115
7439-92-1	Lead	14391	99.3	4.4	86	113
7439-93-2	Lithium	938	100.7	5.3	85	117
7439-95-4	Magnesium	11423	98.8	4.8	85	113
7439-96-5	Manganese	12767	101.9	4.1	90	114

Table 4. Method 6010 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7439-98-7	Molybdenum	8251	101.1	4	89	113
7440-02-0	Nickel	12699	100.5	4.1	88	113
7440-05-3	Palladium	492	99.8	4	88	112
7723-14-0	Phosphorus	203	100.5	4.2	88	113
7440-09-7	Potassium	11006	99.9	4.7	86	114
7782-49-2	Selenium	13264	98.5	5.2	83	114
7440-21-3	Silicon	1525	100.6	6.1	82	119
7440-22-4	Silver	13770	99.1	5.1	84	115
7440-23-5	Sodium	10893	100.9	4.7	87	115
7440-24-6	Strontium	3782	101.3	3.8	90	113
7704-34-9	Sulfur	145	100.7	3.9	89	112
7440-28-0	Thallium	10063	99.5	4.7	85	114
7440-31-5	Tin	4502	101.3	4.4	88	115
7440-32-6	Titanium	5625	101.1	3.4	91	111
7440-61-1	Uranium	223	101.3	5.8	84	119
7440-62-2	Vanadium	12032	100.2	3.6	90	111
7440-66-6	Zinc	13549	100.6	4.6	87	115

Table 5. Method 6020 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7429-90-5	Aluminum	919	101	7.7	78	124
7440-36-0	Antimony	1911	98.2	8.7	72	124
7440-38-2	Arsenic	3686	99.8	6	82	118
7440-39-3	Barium	2598	100.6	5	86	116
7440-41-7	Beryllium	2457	100.3	6.6	80	120

Table 5. Method 6020 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7440-42-8	Boron	581	101.1	9	74	128
7440-43-9	Cadmium	2893	99.6	5.4	84	116
7440-70-2	Calcium	835	102.2	5.4	86	118
7440-47-3	Chromium	2420	100.8	6	83	119
7440-48-4	Cobalt	2005	99.7	5.1	84	115
7440-50-8	Copper	2548	101.3	5.8	84	119
7439-89-6	Iron	1131	102.7	7.1	81	124
7439-92-1	Lead	3228	101	5.7	84	118
7439-93-2	Lithium	162	97.8	7.5	75	120
7439-95-4	Magnesium	868	101.6	7.1	80	123
7439-96-5	Manganese	1830	100.3	5.1	85	116
7439-97-6	Mercury	226	99.9	8.8	74	126
7439-98-7	Molybdenum	1188	98.1	5.1	83	114
7440-02-0	Nickel	2617	101.4	5.8	84	119
7440-09-7	Potassium	803	102.3	5.7	85	119
7782-49-2	Selenium	3104	99.2	6.6	80	119
7440-22-4	Silver	2488	100.1	5.9	83	118
7440-23-5	Sodium	818	102.2	7.7	79	125
7440-24-6	Strontium	676	101.7	8.9	75	129
7440-28-0	Thallium	2589	100.1	5.9	83	118
7440-29-1	Thorium	341	98.4	5.7	81	116
7440-31-5	Tin	886	101.3	6.6	82	121
7440-32-6	Titanium	512	100.2	5.7	83	117
7440-61-1	Uranium	833	101.1	6.1	83	120
7440-62-2	Vanadium	1677	99.1	5.7	82	116
7440-66-6	Zinc	2352	100.1	6.2	82	119

Table 6. Method 6020 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7429-90-5	Aluminum	3145	100.6	5.4	84	117
7440-36-0	Antimony	5172	100.9	5.3	85	117
7440-38-2	Arsenic	6404	100.1	5.3	84	116
7440-39-3	Barium	4452	99.9	4.8	86	114
7440-41-7	Beryllium	4297	102	6.3	83	121
7440-42-8	Boron	1460	101.5	9.6	73	130
7440-43-9	Cadmium	5699	100.8	4.7	87	115
7440-70-2	Calcium	2085	102.3	5.2	87	118
7440-47-3	Chromium	5569	100.6	5.1	85	116
7440-48-4	Cobalt	3885	100.7	4.7	86	115
7440-50-8	Copper	5092	101.4	5.4	85	118
7439-89-6	Iron	3135	102.4	5.2	87	118
7439-92-1	Lead	6868	101.7	4.5	88	115
7439-93-2	Lithium	461	102.3	8	78	126
7439-95-4	Magnesium	2399	100.4	5.9	83	118
7439-96-5	Manganese	4330	101.1	4.7	87	115
7439-97-6	Mercury	328	97.2	9	70	124
7439-98-7	Molybdenum	2908	99.3	5.4	83	115
7440-02-0	Nickel	5095	100.8	5.3	85	117
7440-09-7	Potassium	2154	101.2	4.7	87	115
7782-49-2	Selenium	5797	100.1	6.7	80	120
7440-22-4	Silver	4956	100.8	5.1	85	116
7440-23-5	Sodium	2313	100.7	5.3	85	117
7440-24-6	Strontium	1170	99.9	5.9	82	118
7440-28-0	Thallium	5352	99.3	5.6	82	116

Table 6. Method 6020 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7440-29-1	Thorium	313	103.7	5.7	87	121
7440-31-5	Tin	1509	100.6	4.8	86	115
7440-32-6	Titanium	1538	98.6	5.3	83	115
7440-33-7	Tungsten	130	103.5	6.2	85	122
7440-61-1	Uranium	1860	103.3	5.4	87	120
7440-62-2	Vanadium	3375	100.5	5	86	115
7440-66-6	Zinc	4253	101	6	83	119

Table 7. Method 6850 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
14797-73-0	Perchlorate	575	102.5	6.1	84	121

Table 8. Method 6850 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
14797-73-0	Perchlorate	790	101.6	5.8	84	119

Table 9. Method 7196 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
18540-29-9	Hexavalent Chromium [Cr (VI)]	2688	96.7	4.3	84	110

Table 10. Method 7196 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
18540-29-9	Hexavalent Chromium [Cr (VI)]	1576	100.5	3.6	90	111

Table 11. Method 7470 - 7471 series Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7439-97-6	Mercury	6471	102	7.5	80	124

Table 12. Method 7470 - 7471 series Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
7439-97-6	Mercury	10530	100.5	6.3	82	119

Table 13. Method 8015 (MOD) Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
460-00-4	4-Bromofluorobenzene	1263	100.7	11.1	67	134
303-04	Diesel Range Organics (DRO)	2184	85.2	15.7	38	132
307-27	Gasoline Range Organics (GRO)	1134	100.3	7.2	79	122
307-51	Motor Oil	658	72.2	11.2	39	106
84-15-1	o-Terphenyl	314	87.4	14.1	45	130

Table 14. Method 8015 (MOD) Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
460-00-4	4-Bromofluorobenzene	756	101	10.8	69	133
303-04	Diesel Range Organics (DRO)	1757	83.7	16	36	132
307-27	Gasoline Range Organics (GRO)	971	99.9	7.3	78	122
307-51	Motor Oil	573	76.9	12.1	41	113
84-15-1	o-Terphenyl	299	90.5	11.4	56	125
630-02-4	Octacosane	130	101.1	13.8	60	142

Table 15. Method 8081 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
789-02-6	2,4'-DDT	110	100.1	11.9	64	136
53-19-0	2,4-DDD	111	102.8	9.2	75	130
3424-82-6	2,4-DDE	111	102.2	9.5	74	131
72-54-8	4,4'-DDD	2995	97.7	13.9	56	139
72-55-9	4,4'-DDE	2938	95.3	13	56	134
50-29-3	4,4'-DDT	2470	95.8	15.1	50	141
309-00-2	Aldrin	2985	90.5	15.2	45	136
319-84-6	alpha-BHC	3021	90.9	15.3	45	137
5103-71-9	alpha-Chlordane	2681	93.7	13.2	54	133
319-85-7	beta-BHC	2989	93.1	14.3	50	136
57-74-9	Chlordane	229	95.7	17.7	43	149
319-86-8	delta-BHC	2943	93.3	15.3	47	139
60-57-1	Dieldrin	2987	95.7	13.4	56	136
959-98-8	Endosulfan I	984	92.2	13.2	53	132

Table 15. Method 8081 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
33213-65-9	Endosulfan II	2913	93.1	13.5	53	134
1031-07-8	Endosulfan sulfate	2954	95.9	13.5	55	136
72-20-8	Endrin	3076	98.1	13.9	57	140
7421-93-4	Endrin Aldehyde	3004	86	17	35	137
53494-70-5	Endrin Ketone	2953	95.5	13.5	55	136
58-89-9	gamma-BHC [Lindane]	3153	92.1	14.4	49	135
5103-74-2	gamma-Chlordane	2749	94.3	13.7	53	135
76-44-8	Heptachlor	3144	91.6	14.9	47	136
1024-57-3	Heptachlor Epoxide	3093	93.9	13.9	52	136
118-74-1	Hexachlorobenzene	319	91.6	11.4	57	126
72-43-5	Methoxychlor	3021	97.6	15.2	52	143
2385-85-5	Mirex	303	96.4	10.6	65	128
877-09-8	Tetrachloro-m-xylene	1482	85.3	14.6	42	129
8001-35-2	Toxaphene	532	86.7	17.9	33	141

Table 16. Method 8081 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
72-54-8	4,4'-DDD	3112	99.6	14.4	56	143
72-55-9	4,4'-DDE	3062	96	12.9	57	135
50-29-3	4,4'-DDT	2681	97	15.3	51	143
309-00-2	Aldrin	3021	89.5	14.7	45	134
319-84-6	alpha-BHC	3070	95.8	13.9	54	138
5103-71-9	alpha-Chlordane	2736	94.3	11.6	60	129
319-85-7	beta-BHC	3068	96.3	13.3	56	136
57-74-9	Chlordane	150	101.2	13	62	140

Table 16. Method 8081 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
319-86-8	delta-BHC	3035	97.2	15	52	142
60-57-1	Dieldrin	3078	98	12.6	60	136
959-98-8	Endosulfan I	968	93.8	10.7	62	126
33213-65-9	Endosulfan II	3047	93.4	13.7	52	135
1031-07-8	Endosulfan sulfate	3013	97.2	11.9	62	133
72-20-8	Endrin	3635	98.7	13	60	138
7421-93-4	Endrin aldehyde	3018	91.1	13.5	51	132
53494-70-5	Endrin Ketone	2908	95.9	12.6	58	134
58-89-9	gamma-BHC [Lindane]	3693	96.4	12.5	59	134
5103-74-2	gamma-Chlordane	3008	95.8	13.2	56	136
76-44-8	Heptachlor	3597	91.9	12.8	54	130
1024-57-3	Heptachlor Epoxide	3574	96.9	12.1	61	133
118-74-1	Hexachlorobenzene	134	82.1	18.1	27.8	136.5
72-43-5	Methoxychlor	3569	99	15.2	54	145
2385-85-5	Mirex	340	88.8	12.6	51	127
877-09-8	Tetrachloro-m-xylene	1510	84.1	13.3	44	124
8001-35-2	Toxaphene	421	83.9	16.8	33	134

Table 17. Method 8082 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
12674-11-2	Aroclor 1016	6847	90.1	14.5	47	134
11097-69-1	Aroclor 1254	406	101.2	11.4	67	135
11096-82-5	Aroclor 1260	7975	96.6	14.4	53	140
877-09-8	Tetrachloro-m-xylene	2379	86.7	14.4	44	130

Table 18. Method 8082 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
12674-11-2	Aroclor 1016	3356	87.1	13.8	46	129
11097-69-1	Aroclor 1254	184	80.1	15.4	34	127
11096-82-5	Aroclor 1260	3538	89.4	14.8	45	134

Table 19. Method 8141 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
86-50-0	Azinphos-methyl	325	96.7	19.6	38	156
35400-43-2	Bolstar [Sulprofos]	270	93.5	15.1	48	139
786-19-6	Carbophenothion	237	96.6	12.5	59	134
2921-88-2	Chlorpyrifos	333	93.3	15.5	47	140
56-72-4	Coumaphos	321	98.4	20.5	37	160
8065-48-3	Demeton	254	80.2	12.4	43	117
333-41-5	Diazinon	328	87.9	15.2	42	134
62-73-7	Dichlorvos [DDVP]	322	90.6	17.2	39	142
60-51-5	Dimethoate	264	77.5	20.6	16	139
298-04-4	Disulfoton	332	86	19.5	28	145
2104-64-5	EPN	300	90.6	15.5	44	137
563-12-2	Ethion	160	99.3	13.5	59	140
13194-48-4	Ethoprop	325	87.8	13.5	47	128
52-85-7	Fampphur	192	90.6	14.6	47	134
115-90-2	Fensulfothion	324	87.1	20	27	147
55-38-9	Fenthion	325	88.7	14.9	44	134
121-75-5	Malathion	322	91.2	15.2	46	137
298-00-0	methyl Parathion	330	93.6	14.8	49	138

Table 19. Method 8141 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
126-68-1	O,O,O-Triethyl phosphorothioate	186	79.8	13.3	40	120
56-38-2	Parathion	313	94.3	14.9	50	139
298-02-2	Phorate	330	82.6	19.8	23	142
299-84-3	Ronnel	328	91.6	15.5	45	138
122-34-9	Simazine	120	93	16.3	44	142
22248-79-9	Stirophos [Tetrachlorovinphos, Gardona]	153	91.2	16.3	42	140
3689-24-5	Tetraethyl dithiopyrophosphate [Sulfotep]	238	89	12.2	52	126
297-97-2	Thionazine	192	83.5	13.3	44	124
34643-46-4	Tokuthion [Protothiofos]	320	90.7	15.1	45	136
327-98-0	Trichloronate	326	88.3	17.2	37	140

Table 20. Method 8141 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
1912-24-9	Atrazine	262	82.1	12.5	45	120
86-50-0	Azinphos-methyl	689	88.9	15.4	43	135
35400-43-2	Bolstar [Sulprofos]	561	91.2	14.6	47	135
786-19-6	Carbophenothion	418	94.4	14.1	52	137
2921-88-2	Chlorpyrifos	644	90	14.2	47	133
56-72-4	Coumaphos	684	89.9	15.1	45	135
8065-48-3	Demeton	591	76.2	17.1	25	128
126-75-0	Demeton-S	134	91.4	23.6	21	162
333-41-5	Diazinon	684	86	14.4	43	129

Table 20. Method 8141 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
62-73-7	Dichlorvos [DDVP]	682	88.3	16.4	39	138
60-51-5	Dimethoate	597	75.2	16.5	26	125
298-04-4	Disulfoton	753	85.1	16.3	36	134
2104-64-5	EPN	623	90	14.3	47	133
563-12-2	Ethion	345	93.3	17.1	42	145
13194-48-4	Ethoprop	620	88.8	12.2	52	125
55-38-9	Fenthion	712	89.7	15.8	42	137
121-75-5	Malathion	635	87.8	14.6	44	132
150-50-5	Merphos	704	79.6	17.8	26	133
298-00-0	Methyl parathion	795	91.9	14.2	49	134
126-68-1	O,O,O-Triethyl phosphorothioate	295	94.2	17.5	42	147
56-38-2	Parathion	713	92.9	13.7	52	134
298-02-2	Phorate	675	79.8	19	23	139
139-40-2	Propazine [Milogard]	241	86.7	11.8	51	122
299-84-3	Ronnel	740	87.1	15.1	42	133
22248-79-9	Stirophos [Tetrachlorovinphos, Gardona]	310	94.8	15.8	48	142
3689-24-5	Tetraethyl dithiopyrophosphate [Sulfotep]	584	86.5	13.1	47	126
297-97-2	Thionazine	366	85.1	13.4	45	125
34643-46-4	Tokuthion [Protothiofos]	696	87.8	14.8	43	132
327-98-0	Trichloronate	556	82.8	18.2	28	137

Table 21. Method 8151 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
93-76-5	2,4,5-T	1106	84.6	17.7	31	138
93-72-1	2,4,5-TP [Silvex]	1179	86.1	14.3	43	129
94-75-7	2,4-D	1256	86	19.3	28	144
94-82-6	2,4-DB	1030	88.2	17.9	34	142
19719-28-9	2,4-Dichlorophenylacetic Acid	1041	74	15.9	27	122
100-02-7	4-Nitrophenol	208	76.7	20	17	137
50594-66-6	Acifluorfen	206	79.8	18	26	134
1861-32-1	Dacthal (DCPA)	147	72.5	15.6	26	119
1918-00-9	Dicamba	1070	85.2	15.7	38	132
120-36-5	Dichloroprop	1033	91.4	21	28	155
94-74-6	MCPA	935	81.5	17.8	28	135
93-65-2	MCPP	807	88.7	18	35	143

Table 22. Method 8151 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
93-76-5	2,4,5-T	1758	94.8	17.5	42	147
93-72-1	2,4,5-TP [Silvex]	2289	92.9	13.8	51	134
94-75-7	2,4-D	2396	98.4	17.7	45	152
94-82-6	2,4-DB	1427	94.1	19.7	35	153
19719-28-9	2,4-Dichlorophenylacetic Acid	905	85	17.7	32	138
100-02-7	4-Nitrophenol	245	89.8	17.4	38	142
50594-66-6	Acifluorfen	262	95.5	16.2	47	144
133-90-4	Chloramben	230	79.5	18.5	24	135
1861-32-1	Dacthal (DCPA)	160	76.2	13.6	36	117
75-99-0	Dalapon	1220	79	20	19	139

1918-00-9	Dicamba	1434	95.3	15.2	50	141
120-36-5	Dichloroprop	1404	102	18.8	46	159
94-74-6	MCPA	1284	89.2	18.2	35	144
93-65-2	MCPP	1137	95.2	20.7	33	157
7085-19-0	Mecoprop	126	97.4	21.2	34	161
87-86-5	Pentachlorophenol	1149	97.5	13.8	56	139

Table 23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
630-20-6	1,1,1,2-Tetrachloroethane	11115	101.1	7.8	78	125
71-55-6	1,1,1-Trichloroethane	12156	101.6	9.4	73	130
79-34-5	1,1,2,2-Tetrachloroethane	11670	97	8.9	70	124
79-00-5	1,1,2-Trichloroethane	11772	99.7	7.2	78	121
76-13-1	1,1,2-Trifluoro-1,2,2-trichloroethane [Freon-113]	9760	100.8	11.7	66	136
75-34-3	1,1-Dichloroethane	11856	100.4	8.1	76	125
75-35-4	1,1-Dichloroethene	12352	100.3	10.1	70	131
563-58-6	1,1-Dichloropropene	10793	100.5	8.3	76	125
87-61-6	1,2,3-Trichlorobenzene	10572	97.8	10.6	66	130
96-18-4	1,2,3-Trichloropropane	10925	99.1	8.8	73	125
526-73-8	1,2,3-Trimethylbenzene	1948	99.8	6	82	118
120-82-1	1,2,4-Trichlorobenzene	10980	98	10.4	67	129
95-63-6	1,2,4-Trimethylbenzene	11085	98.7	7.9	75	123
96-12-8	1,2-Dibromo-3-chloropropane	11380	96.6	11.7	61	132
106-93-4	1,2-Dibromoethane	11408	100.1	7.3	78	122
95-50-1	1,2-Dichlorobenzene	11785	99.1	7.2	78	121
107-06-2	1,2-Dichloroethane	12328	100.5	9.2	73	128

Table 23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
17060-07-0	1,2-Dichloroethane-d4	5951	103.1	10.8	71	136
540-59-0	1,2-Dichloroethene	7748	99.9	7.3	78	122
78-87-5	1,2-Dichloropropane	12145	99.5	7.8	76	123
354-23-4	1,2-Dichlorotrifluoroethane [Freon 123a]	1269	97.8	11.3	64	132
108-70-3	1,3,5-Trichlorobenzene	4723	99.4	9.6	71	128
108-67-8	1,3,5-Trimethylbenzene	11080	98.4	8.4	73	124
541-73-1	1,3-Dichlorobenzene	11619	98.9	7.4	77	121
142-28-9	1,3-Dichloropropane	10713	99.1	7.3	77	121
542-75-6	1,3-Dichloropropene	3714	101.6	8.1	77	126
106-46-7	1,4-Dichlorobenzene	11848	97.5	7.6	75	120
105-05-5	1,4-Diethylbenzene	1896	96.6	5.9	79	114
123-91-1	1,4-Dioxane	7698	96.4	13.7	55	138
544-10-5	1-Chlorohexane	2543	100.4	9.8	71	130
594-20-7	2,2-Dichloropropane	10703	99.7	11.1	67	133
78-93-3	2-Butanone [MEK]	11514	99.6	16.3	51	148
126-99-8	2-Chloro-1,3-butadiene	6667	99	11.3	65	133
110-75-8	2-Chloroethyl vinyl ether	6957	96.1	17.6	43	149
95-49-8	2-Chlorotoluene	10838	98.5	7.9	75	122
591-78-6	2-Hexanone	11004	99.1	15.4	53	145
79-46-9	2-Nitropropane	4969	98.3	17.1	47	150
67-63-0	2-Propanol [Isopropyl alcohol]	1696	99.8	13.4	60	140
460-00-4	4-Bromofluorobenzene	6267	98.9	6.8	79	119
106-43-4	4-Chlorotoluene	10785	98.3	8.6	72	124
108-10-1	4-Methyl-2-pentanone [MIBK]	11364	99.6	11.6	65	135
67-64-1	Acetone	11089	99.6	21.4	36	164

Table 23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
75-05-8	Acetonitrile	5697	98.5	14.8	54	143
107-02-8	Acrolein [Propenal]	7528	101.1	18	47	155
107-13-1	Acrylonitrile	8293	99.7	11.4	65	134
107-05-1	Allyl chloride	6908	101.1	11.2	68	135
71-43-2	Benzene	12853	99.2	7.4	77	121
100-44-7	Benzyl chloride	2743	92.1	9.4	64	120
108-86-1	Bromobenzene	10974	99.3	7.3	78	121
74-97-5	Bromochloromethane	11023	101.4	7.8	78	125
75-27-4	Bromodichloromethane	11850	101	8.5	75	127
75-25-2	Bromoform	11890	99.1	10.8	67	132
74-83-9	Bromomethane	11416	98.3	15	53	143
75-15-0	Carbon disulfide	11132	97.9	11.5	63	132
56-23-5	Carbon tetrachloride	12090	102.3	10.7	70	135
108-90-7	Chlorobenzene	12382	99.7	6.9	79	120
124-48-1	Chlorodibromomethane	11852	100.2	8.7	74	126
75-00-3	Chloroethane	11444	98.8	13.3	59	139
67-66-3	Chloroform	12344	100.3	7.6	78	123
74-87-3	Chloromethane	11876	93.3	14.3	50	136
156-59-2	cis-1,2-Dichloroethene	11645	99.9	7.6	77	123
10061-01-5	cis-1,3-Dichloropropene	11805	99.8	8.7	74	126
1476-11-5	cis-1,4-Dichloro-2-butene	977	106	12.4	69	143
110-82-7	Cyclohexane	8827	98.9	10.6	67	131
108-94-1	Cyclohexanone	3764	93.2	20.9	30	156
1868-53-7	Dibromofluoromethane	2142	98.1	6.8	78	119
74-95-3	Dibromomethane	10913	101.1	7.9	78	125
75-71-8	Dichlorodifluoromethane [Freon-12]	11467	88.9	20.1	29	149

Table 23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
75-43-4	Dichlorofluoromethane	717	100.8	18	47	155
60-29-7	Diethyl ether	6283	99.6	9.6	71	129
108-20-3	Diisopropyl ether	8542	98.3	9.7	69	127
64-17-5	Ethanol	3958	102.2	18.9	45	159
141-78-6	Ethyl acetate	4516	95.4	14.5	52	139
97-63-2	Ethyl methacrylate	7075	98.9	9.9	69	129
637-92-3	Ethyl tert-butyl ether	7514	98.9	9.1	72	126
100-41-4	Ethylbenzene	12427	99.1	7.7	76	122
462-06-6	Fluorobenzene	689	97.3	5.4	81	114
142-82-5	Heptane	5420	93.4	14.9	49	138
87-68-3	Hexachlorobutadiene	10264	98.1	12.4	61	135
67-72-1	Hexachloroethane	3265	102.5	10.1	72	133
110-54-3	Hexane	7116	93.6	16.1	45	142
74-88-4	Iodomethane	9457	100.9	10.1	71	131
78-83-1	Isobutyl alcohol	6162	97.5	12.6	60	135
108-21-4	Isopropyl acetate [Acetic acid]	2885	94.2	12.2	58	131
98-82-8	Isopropylbenzene	11596	100.8	11.1	68	134
179601-23-1	m/p-Xylene [3/4-Xylene]	10612	100.4	7.7	77	124
126-98-7	Methacrylonitrile	6736	99.2	11.1	66	132
79-20-9	Methyl acetate	8320	98.7	15.2	53	144
80-62-6	Methyl methacrylate	7050	98.4	11.9	63	134
1634-04-4	Methyl tert-butyl ether [MTBE]	11253	98.9	8.7	73	125
108-87-2	Methylcyclohexane	8565	99.4	11.2	66	133
75-09-2	Methylene chloride	12024	98.9	9.7	70	128
123-86-4	n-Butyl acetate	2981	95.1	11	62	128
71-36-3	n-Butyl alcohol	4800	92.9	12.6	55	131

Table 23. Method 8260 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
104-51-8	n-Butylbenzene	10921	98.7	9.7	70	128
103-65-1	n-Propylbenzene	10947	98.9	8.8	73	125
91-20-3	Naphthalene	10602	95.6	11.2	62	129
95-47-6	o-Xylene	11940	100	7.7	77	123
99-87-6	p-Isopropyltoluene [p-Cymene]	10953	100.3	9	73	127
76-01-7	Pentachloroethane	5957	102	11.1	69	135
107-12-0	Propionitrile [Ethyl cyanide]	6734	101	11.1	68	134
135-98-8	sec-Butylbenzene	10960	99	8.8	73	126
100-42-5	Styrene	11809	100.2	8	76	124
994-05-8	tert-Amyl methyl ether [TAME]	7153	99.8	8.9	73	126
75-65-0	tert-Butyl alcohol	7492	100.5	10.7	68	133
98-06-6	tert-Butylbenzene	10974	98.8	8.6	73	125
127-18-4	Tetrachloroethene	12091	100.5	9.2	73	128
109-99-9	Tetrahydrofuran	8039	98	12.4	61	135
108-88-3	Toluene	12499	99.3	7.3	77	121
2037-26-5	Toluene-d8	6232	100.7	5.2	85	116
156-60-5	trans-1,2-Dichloroethene	11849	99.2	8.6	74	125
10061-02-6	trans-1,3-Dichloropropene	11805	100.9	9.8	71	130
110-57-6	trans-1,4-Dichloro-2-butene	8307	98.6	12.3	62	136
79-01-6	Trichloroethene	12440	100.2	7.6	77	123
75-69-4	Trichlorofluoromethane [Freon-11]	11530	101	13.1	62	140
108-05-4	Vinyl acetate	7260	100.3	16.9	50	151
75-01-4	Vinyl chloride	12129	95.6	13.2	56	135
1330-20-7	Xylenes [total]	8623	100.7	7.7	78	124

Table 24. Method 8260 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
630-20-6	1,1,1,2-Tetrachloroethane	24511	101.1	7.6	78	124
71-55-6	1,1,1-Trichloroethane	28223	102.7	9.6	74	131
79-34-5	1,1,2,2-Tetrachloroethane	27450	96.4	8.3	71	121
79-00-5	1,1,2-Trichloroethane	27338	99.5	6.5	80	119
76-13-1	1,1,2-Trifluoro-1,2,2-trichloroethane [Freon-113]	21122	103	11.1	70	136
75-34-3	1,1-Dichloroethane	28154	101.3	8	77	125
75-35-4	1,1-Dichloroethene	29436	101	10	71	131
563-58-6	1,1-Dichloropropene	23631	102	7.8	79	125
87-61-6	1,2,3-Trichlorobenzene	24271	98.7	10.1	69	129
96-18-4	1,2,3-Trichloropropane	24525	97.5	8	73	122
526-73-8	1,2,3-Trimethylbenzene	2965	100.9	6.2	82	120
120-82-1	1,2,4-Trichlorobenzene	25290	99.8	10.1	69	130
95-63-6	1,2,4-Trimethylbenzene	27917	99.6	8	76	124
96-12-8	1,2-Dibromo-3-chloropropane	24955	94.9	11.1	62	128
106-93-4	1,2-Dibromoethane	29096	99	7.2	77	121
95-50-1	1,2-Dichlorobenzene	27583	99.4	6.5	80	119
107-06-2	1,2-Dichloroethane	32965	100.3	9.2	73	128
17060-07-0	1,2-Dichloroethane-d4	8673	99.5	6.1	81	118
540-59-0	1,2-Dichloroethene	18667	100.2	7.1	79	121
78-87-5	1,2-Dichloropropane	27787	100.1	7.2	78	122
354-23-4	1,2-Dichlorotrifluoroethane [Freon 123a]	3144	103.1	10.9	70	136
108-70-3	1,3,5-Trichlorobenzene	10037	102.1	9.2	75	130
108-67-8	1,3,5-Trimethylbenzene	27820	99.5	8.1	75	124

Table 24. Method 8260 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
106-99-0	1,3-Butadiene	1202	100.6	19.2	43	158
541-73-1	1,3-Dichlorobenzene	26951	99.7	6.5	80	119
142-28-9	1,3-Dichloropropane	23811	99.1	6.5	80	119
542-75-6	1,3-Dichloropropene	9784	99.9	7.6	77	123
106-46-7	1,4-Dichlorobenzene	27715	98.3	6.5	79	118
105-05-5	1,4-Diethylbenzene	1980	98.4	6.4	79	118
123-91-1	1,4-Dioxane	17866	99	13.4	59	139
544-10-5	1-Chlorohexane	5790	99.6	8	76	124
540-84-1	2,2,4-Trimethylpentane [Isooctane]	5432	95.2	12.3	58	132
594-20-7	2,2-Dichloropropane	23775	99.7	13.2	60	139
75-85-4	2-Butanol	4332	92.7	9.1	66	120
78-93-3	2-Butanone [MEK]	26659	99.6	14.6	56	143
126-99-8	2-Chloro-1,3-butadiene	15673	100	11.7	65	135
110-75-8	2-Chloroethyl vinyl ether	18225	94.7	14.7	51	139
95-49-8	2-Chlorotoluene	23750	100	7.2	79	122
591-78-6	2-Hexanone	25368	97.9	13.5	57	139
91-57-6	2-Methylnaphthalene	3754	79.4	20.9	17	142
79-46-9	2-Nitropropane	10213	92.6	14.5	49	136
67-63-0	2-Propanol [Isopropyl alcohol]	2034	98.8	14.4	56	142
624-95-3	3,3-Dimethyl-1-butanol	6491	90.9	13.9	49	133
460-00-4	4-Bromofluorobenzene	9971	99.7	4.9	85	114
106-43-4	4-Chlorotoluene	23616	99.9	7.4	78	122
108-10-1	4-Methyl-2-pentanone [MIBK]	25796	98.5	10.6	67	130
67-64-1	Acetone	25006	99.5	20.1	39	160
75-05-8	Acetonitrile	13308	95.8	15.2	50	142

Table 24. Method 8260 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
107-02-8	Acrolein [Propenal]	16380	96.8	19.3	39	155
107-13-1	Acrylonitrile	20173	99	11.9	63	135
107-05-1	Allyl chloride	15758	99	10.4	68	130
71-43-2	Benzene	34376	99.4	6.9	79	120
100-44-7	Benzyl chloride	10675	90.1	15.9	42	138
108-86-1	Bromobenzene	23762	99.7	6.7	80	120
74-97-5	Bromochloromethane	24356	100.8	7.5	78	123
75-27-4	Bromodichloromethane	26888	101.8	7.8	79	125
75-25-2	Bromoform	27675	97.8	10.8	66	130
74-83-9	Bromomethane	26717	97	14.7	53	141
75-15-0	Carbon disulfide	25719	98.8	11.5	64	133
56-23-5	Carbon tetrachloride	28870	103.8	10.7	72	136
108-90-7	Chlorobenzene	29802	100	6.1	82	118
124-48-1	Chlorodibromomethane	27424	100	8.5	74	126
75-45-6	Chlorodifluoromethane	7197	84.4	14.9	40	129
75-00-3	Chloroethane	27069	99	13	60	138
67-66-3	Chloroform	29373	101.1	7.5	79	124
74-87-3	Chloromethane	27697	94.5	15	50	139
156-59-2	cis-1,2-Dichloroethene	27935	100.1	7.5	78	123
10061-01-5	cis-1,3-Dichloropropene	27197	99.5	8	75	124
1476-11-5	cis-1,4-Dichloro-2-butene	1524	101.5	14.9	57	146
110-82-7	Cyclohexane	20438	100.4	10	71	130
1868-53-7	Dibromofluoromethane	5702	99.1	6.5	80	119
74-95-3	Dibromomethane	24473	101.1	7.3	79	123
75-71-8	Dichlorodifluoromethane [Freon-12]	25410	92	20.1	32	152

Table 24. Method 8260 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
75-43-4	Dichlorofluoromethane	1504	101.5	9.8	72	131
60-29-7	Diethyl ether	17189	98.6	10.2	68	129
108-20-3	Diisopropyl ether	22989	97.5	10.3	67	128
64-17-5	Ethanol	9543	99.2	17.1	48	151
141-78-6	Ethyl acetate	9208	96.8	13.9	55	138
97-63-2	Ethyl methacrylate	16674	98.7	9	72	126
637-92-3	Ethyl tert-butyl ether	19841	98.3	9.4	70	127
100-41-4	Ethylbenzene	33325	99.8	7	79	121
462-06-6	Fluorobenzene	1373	97.9	6.1	80	116
142-82-5	Heptane	11878	94.4	15	49	140
87-68-3	Hexachlorobutadiene	23535	100.1	11.3	66	134
67-72-1	Hexachloroethane	8718	102.9	10.3	72	134
110-54-3	Hexane	15545	95.5	15.9	48	143
74-88-4	Iodomethane	20229	100	10.4	69	131
78-83-1	Isobutyl alcohol	14123	97.7	11.7	63	133
108-21-4	Isopropyl acetate [Acetic acid]	7216	97.8	11.6	63	133
98-82-8	Isopropylbenzene	28636	101.5	9.9	72	131
179601-23-1	m/p-Xylene [3/4-Xylene]	28168	100.5	6.9	80	121
126-98-7	Methacrylonitrile	15982	97.9	11.6	63	133
79-20-9	Methyl acetate	19698	96	13.2	56	136
80-62-6	Methyl methacrylate	16524	97.7	10.2	67	128
1634-04-4	Methyl tert-butyl ether [MTBE]	29660	97.3	8.8	71	124
108-87-2	Methylcyclohexane	20025	101.8	10.1	72	132
75-09-2	Methylene chloride	27659	99.4	8.3	74	124
123-86-4	n-Butyl acetate	7247	96.8	9.4	69	125

Table 24. Method 8260 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
71-36-3	n-Butyl alcohol	10122	95.1	12	59	131
104-51-8	n-Butylbenzene	24088	101.1	8.8	75	128
109-60-4	n-Propyl acetate	602	100.8	8.3	76	126
103-65-1	n-Propylbenzene	24419	101	8.5	76	126
91-20-3	Naphthalene	27847	94.6	11.3	61	128
95-47-6	o-Xylene	31776	100	7.2	78	122
99-87-6	p-Isopropyltoluene [p-Cymene]	24335	102	8.5	77	127
76-01-7	Pentachloroethane	11688	101.1	10.7	69	133
109-66-0	Pentane	3915	74.8	19.7	16	134
107-12-0	Propionitrile [Ethyl cyanide]	15701	99.9	12	64	136
135-98-8	sec-Butylbenzene	24191	101.1	8.1	77	126
100-42-5	Styrene	26985	100.5	7.6	78	123
994-05-8	tert-Amyl methyl ether [TAME]	19726	98.1	10.1	68	128
75-65-0	tert-Butyl alcohol	21112	98.6	10.1	68	129
762-75-4	tert-Butyl formate	6651	98.1	11.1	65	132
98-06-6	tert-Butylbenzene	23919	101	7.7	78	124
127-18-4	Tetrachloroethene	29017	101.3	9.3	74	129
109-99-9	Tetrahydrofuran	18021	95	12.8	57	133
108-88-3	Toluene	33510	100.1	6.8	80	121
2037-26-5	Toluene-d8	9809	100.4	3.8	89	112
156-60-5	trans-1,2-Dichloroethene	27663	99.5	8.2	75	124
10061-02-6	trans-1,3-Dichloropropene	27134	100	8.9	73	127
110-57-6	trans-1,4-Dichloro-2-butene	19320	91.5	16.1	43	140
79-01-6	Trichloroethene	30150	101.1	7.3	79	123
75-69-4	Trichlorofluoromethane	26108	103	12.8	65	141

Table 24. Method 8260 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
	[Freon-11]					
108-05-4	Vinyl acetate	18941	100.2	15.3	54	146
75-01-4	Vinyl chloride	29472	97.4	13.2	58	137
1330-20-7	Xylenes [total]	23426	100.1	7	79	121

Table 25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
92-52-4	1,1-Biphenyl	1645	78.5	13	40	117
95-94-3	1,2,4,5-Tetrachlorobenzene	1810	77.8	13.7	37	119
120-82-1	1,2,4-Trichlorobenzene	3577	75.7	13.9	34	118
95-50-1	1,2-Dichlorobenzene	3352	74.6	14	33	117
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	203	79.4	11.9	44	115
122-66-7	1,2-Diphenylhydrazine [Azobenzene]	2039	83	13.9	41	125
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	154	89.2	10.7	57	121
541-73-1	1,3-Dichlorobenzene	3288	72.6	14.1	30	115
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	598	84.6	14	43	127
106-46-7	1,4-Dichlorobenzene	3793	73.1	13.9	31	115
100-25-4	1,4-Dinitrobenzene	248	84.4	15.7	37	132
130-15-4	1,4-Naphthoquinone	150	81.2	8.8	55	108
90-13-1	1-Chloronaphthalene	119	81.1	11.1	48	115
90-12-0	1-Methylnaphthalene	3004	79.2	13.2	40	119
58-90-2	2,3,4,6-Tetrachlorophenol	1724	84.7	13.6	44	125
935-95-5	2,3,5,6-Tetrachlorophenol	227	75.9	11.9	40	112

Table 25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
608-27-5	2,3-Dichloroaniline	108	82.4	13	44	121
95-95-4	2,4,5-Trichlorophenol	4014	82.6	13.7	41	124
118-79-6	2,4,6-Tribromophenol	2930	85.7	15.4	39	132
88-06-2	2,4,6-Trichlorophenol	4183	82.1	14.5	39	126
120-83-2	2,4-Dichlorophenol	3794	80.9	13.7	40	122
105-67-9	2,4-Dimethylphenol	3886	78.4	16.2	30	127
121-14-2	2,4-Dinitrotoluene	4075	86.8	12.9	48	126
87-65-0	2,6-Dichlorophenol	1364	79.2	12.6	41	117
606-20-2	2,6-Dinitrotoluene	3706	85	13	46	124
53-96-3	2-Acetylaminofluorene	175	94	13.3	54	134
91-58-7	2-Chloronaphthalene	3569	77.5	12.1	41	114
95-57-8	2-Chlorophenol	3977	77.3	14.5	34	121
321-60-8	2-Fluorobiphenyl	3191	79.5	11.8	44	115
367-12-4	2-Fluorophenol	3008	75.2	13.3	35	115
91-57-6	2-Methylnaphthalene	5059	80.1	14	38	122
95-48-7	2-Methylphenol (o-Cresol)	4016	77	14.9	32	122
88-74-4	2-Nitroaniline	3639	85.4	13.8	44	127
119-75-5	2-Nitrodiphenylamine	279	88.1	11.6	53	123
88-75-5	2-Nitrophenol	3804	79.6	14.5	36	123
109-06-8	2-Picoline [2-Methylpyridine]	181	64.5	12.7	27	103
91-94-1	3,3'-Dichlorobenzidine	3521	71.3	16.5	22	121
56-49-5	3-Methylcholanthrene	188	95.1	13	56	134
99-09-2	3-Nitroaniline	3454	75.9	14.3	33	119
65794-96-9	3/4-Methylphenol [m/p-Cresol]	2900	76.5	14.1	34	119
534-52-1	4,6-Dinitro-2-methylphenol	3739	80.7	17.2	29	132
101-55-3	4-Bromophenyl phenyl ether	3708	85.1	13	46	124

Table 25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
59-50-7	4-Chloro-3-methylphenol	3880	83.3	12.9	45	122
106-47-8	4-Chloroaniline [p-Chloroanlinie]	3435	61.3	14.9	17	106
7005-72-3	4-Chlorophenyl phenyl ether	3673	83	12.7	45	121
106-44-5	4-Methylphenol [p-Cresol]	1555	84.1	14.1	42	126
100-02-7	4-Nitrophenol	3976	80.6	17	30	132
99-55-8	5-Nitro-o-toluidine [2-Amino-4-nitrotoluene]	187	69.8	15.8	23	117
57-97-6	7,12-Dimethylbenz(a)-anthracene	338	96.2	15.3	50	142
83-32-9	Acenaphthene	5300	81.3	13.7	40	123
208-96-8	Acenaphthylene	5194	81.8	16.8	32	132
98-86-2	Acetophenone	2101	73.9	13.6	33	115
120-12-7	Anthracene	5250	85.2	12.7	47	123
1912-24-9	Atrazine	1428	87.1	13.4	47	127
103-33-3	Azobenzene	378	82.1	14.2	39	125
56-55-3	Benz(a)anthracene	5385	87.4	12.9	49	126
50-32-8	Benzo(a)pyrene	5500	86.9	13.9	45	129
205-99-2	Benzo(b)fluoranthene	5323	88.3	14.5	45	132
191-24-2	Benzo(g,h,i)perylene	5263	88.5	15.1	43	134
207-08-9	Benzo(k)fluoranthene	5386	89.6	14.2	47	132
100-51-6	Benzyl alcohol	2895	75.7	15.6	29	122
111-91-1	bis(2-Chloroethoxy)methane	3705	78.4	14.2	36	121
111-44-4	Bis(2-chloroethyl) ether	3711	75.4	14.9	31	120
39638-32-9	bis(2-Chloroisopropyl) ether	769	82	16.3	33	131
117-81-7	Bis(2-ethylhexyl) phthalate	4018	91.9	13.7	51	133
103-23-1	bis(2-Ethylhexyl)adipate	156	90.8	10.1	61	121
85-68-7	Butyl benzyl phthalate	3956	90.3	14	48	132

Table 25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
105-60-2	Caprolactam	1203	81.3	11.9	46	117
86-74-8	Carbazole	3095	86.3	12	50	123
510-15-6	Chlorobenzilate	172	99.7	16.9	49	150
218-01-9	Chrysene	5395	87.1	12.2	50	124
84-74-2	Di-n-butyl phthalate	4041	89.4	12.8	51	128
117-84-0	Di-n-octyl phthalate	3985	92.4	16	45	140
2303-16-4	Diallate [cis or trans]	173	93.7	12.7	56	132
53-70-3	Dibenzo(a,h)anthracene	5393	89.5	14.7	45	134
132-64-9	Dibenzofuran	3749	81.5	12.7	44	120
84-66-2	Diethyl phthalate	4012	87.2	12.3	50	124
60-51-5	Dimethoate	137	68	13.3	28	108
131-11-3	Dimethyl phthalate	4023	85.9	12.6	48	124
60-11-7	Dimethylaminoazobenzene	177	98.7	11.6	64	134
88-85-7	Dinoseb	123	67.3	17.1	16	119
101-84-8	Diphenyl ether	114	95.6	6	78	114
122-39-4	Diphenylamine	854	79.5	10.6	48	111
62-50-0	Ethyl methanesulfonate	174	85.1	16.9	34	136
206-44-0	Fluoranthene	5340	88.3	12.9	50	127
86-73-7	Fluorene	5150	84.2	13.8	43	125
118-74-1	Hexachlorobenzene	4138	83.5	13	45	122
87-68-3	Hexachlorobutadiene	4003	77.3	15.3	32	123
67-72-1	Hexachloroethane	4049	72.2	14.9	28	117
1888-71-7	Hexachloropropene	259	81.9	16.7	32	132
95-13-6	Indene	188	85.3	8.9	59	112
193-39-5	Indeno(1,2,3-cd)pyrene	5367	89.3	14.7	45	133
465-73-6	isodrin	167	93.8	12.8	56	132

Table 25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
78-59-1	Isophorone	3787	75.9	15.2	30	122
120-58-1	Isosafrole	174	89.5	15.4	43	136
66-27-3	Methyl methanesulfonate	150	77.9	13.1	38	117
100-75-4	N-Nitorosopiperidine	232	89.4	9.8	60	119
924-16-3	N-Nitrosodi-n-butylamine	236	91.7	10.8	59	124
621-64-7	N-Nitrosodi-n-propylamine	3857	78.2	13.9	36	120
55-18-5	N-nitrosodiethylamine	421	82.1	13.8	41	124
62-75-9	N-Nitrosodimethylamine	3170	71.6	16.2	23	120
86-30-6	N-Nitrosodiphenylamine	2968	82.7	14.8	38	127
10595-95-6	n-Nitrosomethylethylamine	265	78.7	14.9	34	123
59-89-2	n-Nitrosomorpholine	172	91.3	13.8	50	133
930-55-2	n-Nitrosopyrrolidine	326	85.5	13.6	45	126
91-20-3	Naphthalene	5342	78.8	14.7	35	123
98-95-3	Nitrobenzene	4103	77.8	14.7	34	122
4165-60-0	Nitrobenzene-d5	3226	79.3	14.2	37	122
56-57-5	Nitroquinoline-1-oxide	177	91.3	24.5	18	165
126-68-1	O,O,O-Triethyl phosphorothioate	138	91.6	10.8	59	124
593-45-3	Octadecane	113	87.4	14.5	44	131
608-93-5	Pentachlorobenzene	346	89.7	11.8	54	125
76-01-7	Pentachloroethane	131	70.4	10.6	39	102
87-86-5	Pentachlorophenol	4161	78.7	18	25	133
82-68-8	Pentchloronitrobenzene	579	86.1	16	38	134
62-44-2	Phenacetin	185	95	12.5	57	133
85-01-8	Phenanthrene	5259	85.4	12	50	121
108-95-2	Phenol	4029	77.3	14.4	34	121
4165-62-2	Phenol-d5	1016	77.4	14.9	33	122

Table 25. Method 8270 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
23950-58-5	Pronamide	179	93	12.4	56	130
129-00-0	Pyrene	5518	87.2	13.3	47	127
91-22-5	Quinoline	219	90	11.9	54	126
94-59-7	Safrole	176	87.8	13.6	47	129
1718-51-0	Terphenyl-d14	3111	90.5	12.3	54	127
3689-24-5	Tetraethyl dithiopyrophosphate [Sulfotep]	136	94.4	14	52	137
297-97-2	Thionazine	139	94.6	10.7	62	127

Table 26. Method 8270 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
92-52-4	1,1-Biphenyl	2247	82.1	11.1	49	115
95-94-3	1,2,4,5-Tetrachlorobenzene	2326	77.9	14.5	35	121
120-82-1	1,2,4-Trichlorobenzene	4716	72.6	14.5	29	116
95-50-1	1,2-Dichlorobenzene	4442	71.4	13.3	32	111
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	112	83.9	8.3	59	109
122-66-7	1,2-Diphenylhydrazine [Azobenzene]	2244	85.4	12.2	49	122
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	241	89.1	16	41	137
541-73-1	1,3-Dichlorobenzene	4375	68.6	13.6	28	110
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	601	88.2	13.1	49	128
106-46-7	1,4-Dichlorobenzene	5433	70.4	13.9	29	112
90-13-1	1-Chloronaphthalene	211	84.5	8.8	58	111
90-12-0	1-Methylnaphthalene	3742	80	13.1	41	119
134-32-7	1-Naphthylamine	258	73.7	16.6	24	124
58-90-2	2,3,4,6-Tetrachlorophenol	2293	89	13	50	128

Table 26. Method 8270 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
935-95-5	2,3,5,6-Tetrachlorophenol	266	85.6	11.7	50	121
608-27-5	2,3-Dichloroaniline	150	99.2	9.8	70	129
95-95-4	2,4,5-Trichlorophenol	5707	88.1	11.8	53	123
118-79-6	2,4,6-Tribromophenol	2059	91.5	16	43	140
88-06-2	2,4,6-Trichlorophenol	6136	87.2	12.4	50	125
120-83-2	2,4-Dichlorophenol	5330	84	12.2	47	121
105-67-9	2,4-Dimethylphenol	5298	77.5	15.6	31	124
51-28-5	2,4-Dinitrophenol	5127	82.9	20	23	143
121-14-2	2,4-Dinitrotoluene	6032	92.3	11.8	57	128
87-65-0	2,6-Dichlorophenol	1583	84	11.4	50	118
606-20-2	2,6-Dinitrotoluene	5107	90.7	11.2	57	124
53-96-3	2-Acetylaminofluorene	228	98.9	12.9	60	138
91-58-7	2-Chloronaphthalene	5084	78	12.8	40	116
95-57-8	2-Chlorophenol	5571	77.5	13.2	38	117
93951-73-6	2-Chlorophenol-d4	119	79.9	8.7	54	106
321-60-8	2-Fluorobiphenyl	2263	81.2	12.4	44	119
367-12-4	2-Fluorophenol	2022	68.8	16.6	19	119
91-57-6	2-Methylnaphthalene	6330	80.7	13.6	40	121
95-48-7	2-Methylphenol (o-Cresol)	5800	73	14.5	30	117
88-74-4	2-Nitroaniline	4855	90.8	12.1	55	127
119-75-5	2-Nitrodiphenylamine	272	97.3	11.3	64	131
88-75-5	2-Nitrophenol	5097	84.6	12.7	47	123
109-06-8	2-Picoline [2-Methylpyridine]	195	71.6	12.6	34	109
91-94-1	3,3'-Dichlorobenzidine	4815	77.9	16.9	27	129
56-49-5	3-Methylcholanthrene	237	94	12.8	56	133

Table 26. Method 8270 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
99-09-2	3-Nitroaniline	4808	84.4	14.5	41	128
65794-96-9	3/4-Methylphenol [m/p-Cresol]	3472	69.7	13.6	29	110
534-52-1	4,6-Dinitro-2-methylphenol	5097	90.1	15.5	44	137
101-55-3	4-Bromophenyl phenyl ether	5074	89.1	11.5	55	124
59-50-7	4-Chloro-3-methylphenol	5338	85.5	11.3	52	119
106-47-8	4-Chloroaniline [p-Chloroanlinie]	4687	75.3	14	33	117
7005-72-3	4-Chlorophenyl phenyl ether	5071	86.7	11.3	53	121
106-44-5	4-Methylphenol [p-Cresol]	2798	72.5	15.8	25	120
99-55-8	5-Nitro-o-toluidine [2-amino-4-nitrotoluene]	260	82.1	14.6	38	126
57-97-6	7,12-Dimethylbenz(a)-anthracene	373	97.1	11.9	61	133
83-32-9	Acenaphthene	6952	84.5	12.3	47	122
208-96-8	Acenaphthylene	6662	85.3	14.7	41	130
98-86-2	Acetophenone	2877	82.1	12	46	118
120-12-7	Anthracene	6792	89.6	11	57	123
140-57-8	Aramite	100	82.8	16.3	34	132
1912-24-9	Atrazine	2328	92.8	16.4	44	142
103-33-3	Azobenzene	578	88.5	9.3	61	116
56-55-3	Benz(a)anthracene	6867	91.6	11.1	58	125
50-32-8	Benzo(a)pyrene	7045	90.8	12.4	54	128
205-99-2	Benzo(b)fluoranthene	6767	92	12.9	53	131
191-24-2	Benzo(g,h,i)perylene	6624	92	13.9	50	134
207-08-9	Benzo(k)fluoranthene	6803	93.2	12.1	57	129
100-51-6	Benzyl alcohol	3349	71.2	13.5	31	112
111-91-1	bis(2-Chloroethoxy)methane	5094	83.9	11.9	48	120
111-44-4	Bis(2-chloroethyl) ether	5139	80.8	12.6	43	118

Table 26. Method 8270 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
39638-32-9	bis(2-Chloroisopropyl) ether	1140	83.4	15.4	37	130
117-81-7	Bis(2-ethylhexyl) phthalate	5288	95.2	13.3	55	135
85-68-7	Butyl benzyl phthalate	5173	93.3	13.5	53	134
86-74-8	Carbazole	4187	91.1	10.4	60	122
510-15-6	Chlorobenzilate	226	104.3	15.4	58	150
218-01-9	Chrysene	6779	91.3	10.7	59	123
124-18-5	Decane	126	66.9	12.8	29	105
84-74-2	Di-n-butyl phthalate	5329	93	11.4	59	127
117-84-0	Di-n-octyl phthalate	5222	95.5	15	51	140
2303-16-4	Diallate [cis or trans]	249	95.3	9.6	67	124
226-36-8	Dibenz(a,h)acridine	136	104.4	9.7	75	134
53-70-3	Dibenzo(a,h)anthracene	6840	92.7	13.8	51	134
132-64-9	Dibenzofuran	4963	85.3	10.8	53	118
84-66-2	Diethyl phthalate	5207	90.1	11.5	56	125
131-11-3	Dimethyl phthalate	4977	86	13.7	45	127
60-11-7	Dimethylaminoazobenzene	238	97.1	11.6	62	132
88-85-7	Dinoseb	144	93.4	10.8	61	126
101-84-8	Diphenyl ether	142	91.7	7.8	68	115
122-39-4	Diphenylamine	754	83	9.2	55	111
298-04-4	Disulfoton	122	92.5	12.5	55	130
62-50-0	Ethyl methanesulfonate	215	90.1	9.4	62	118
206-44-0	Fluoranthene	6826	92.6	11.9	57	128
86-73-7	Fluorene	6786	88.1	12	52	124
118-74-1	Hexachlorobenzene	6263	88.7	12.1	53	125
87-68-3	Hexachlorobutadiene	5878	73.1	16.9	22	124

Table 26. Method 8270 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
67-72-1	Hexachloroethane	5904	68	15.7	21	115
95-13-6	Indene	253	93.8	13.7	53	135
193-39-5	Indeno(1,2,3-cd)pyrene	6880	92.6	13.6	52	134
465-73-6	isodrin	212	97.6	10	68	128
78-59-1	Isophorone	5190	83.3	13.7	42	124
120-58-1	Isosafrole	230	91.1	11.8	56	126
66-27-3	Methyl methanesulfonate	237	70.1	12.3	33	107
298-00-0	Methyl parathion	121	101.6	19	45	159
100-75-4	N-Nitorosopiperidine	299	88.6	10.8	56	121
924-16-3	N-Nitrosodi-n-butylamine	322	90.4	10.3	60	121
621-64-7	N-Nitrosodi-n-propylamine	5145	84	11.7	49	119
55-18-5	N-nitrosodiethylamine	488	81.8	12.9	43	121
86-30-6	N-Nitrosodiphenylamine	3743	86.8	11.9	51	123
10595-95-6	n-Nitrosomethylethylamine	311	78.7	12.7	41	117
59-89-2	n-Nitrosomorpholine	214	86.2	10.3	55	117
930-55-2	n-Nitrosopyrrolidine	716	80.8	10.8	48	113
91-20-3	Naphthalene	6953	80	13.5	40	121
98-95-3	Nitrobenzene	5955	83	12.8	45	121
4165-60-0	Nitrobenzene-d5	2223	82.1	12.6	44	120
126-68-1	O,O,O-Triethyl phosphorothioate	212	92.6	8.8	66	119
95-53-4	o-Toluidine	296	69.9	13.2	30	110
593-45-3	Octadecane	151	89	13.1	50	128
56-38-2	Parathion	152	102.6	12.3	66	140
608-93-5	Pentachlorobenzene	401	91.1	10.7	59	123
76-01-7	Pentachloroethane	139	60.9	10.4	30	92

Table 26. Method 8270 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
87-86-5	Pentachlorophenol	6083	86.4	17.1	35	138
82-68-8	Pentchloronitrobenzene	618	94.5	13.4	54	135
62-44-2	Phenacetin	241	97.9	8.9	71	124
85-01-8	Phenanthrene	6822	89.6	10.2	59	120
298-02-2	Phorate	126	88.6	16.8	38	139
23950-58-5	Pronamide	249	97	10.5	65	129
129-00-0	Pyrene	7013	91.1	11.5	57	126
91-22-5	Quinoline	249	100.1	10.5	69	132
94-59-7	Safrole	233	90	9.7	61	119
1718-51-0	Terphenyl-d14	1893	91.7	13.9	50	134
3689-24-5	Tetraethyl dithiopyrophosphate [Sulfotep]	200	96.7	11.9	61	133
297-97-2	Thionazine	196	102	10.1	72	132

Table 27. Method 8270 SIM Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
90-12-0	1-Methylnaphthalene	2267	76.6	11.3	43	111
95-95-4	2,4,5-Trichlorophenol	169	79.9	14.9	35	125
91-58-7	2-Chloronaphthalene	615	76.7	10.5	45	108
321-60-8	2-Fluorobiphenyl	1961	80.6	11.6	46	115
91-57-6	2-Methylnaphthalene	2535	76.8	12.5	39	114
83-32-9	Acenaphthene	2813	77.7	11.2	44	111
208-96-8	Acenaphthylene	2761	77.1	12.8	39	116
120-12-7	Anthracene	2812	82.1	10.7	50	114
56-55-3	Benz(a)anthracene	2827	88	11.4	54	122

Table 27. Method 8270 SIM Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
50-32-8	Benzo(a)pyrene	2789	87.3	12.5	50	125
205-99-2	Benzo(b)fluoranthene	2790	90.3	12.6	53	128
191-24-2	Benzo(g,h,i)perylene	2739	87.8	13	49	127
207-08-9	Benzo(k)fluoranthene	2761	89.3	11.2	56	123
111-44-4	Bis(2-chloroethyl) ether	192	65.4	15.8	18	113
117-81-7	Bis(2-ethylhexyl) phthalate	181	108.9	13.9	67	150
85-68-7	Butyl benzyl phthalate	144	103.5	10.6	72	135
86-74-8	Carbazole	183	79.3	14.6	36	123
218-01-9	Chrysene	2812	87.5	10.2	57	118
84-74-2	Di-n-butyl phthalate	150	106.5	12.9	68	145
117-84-0	Di-n-octyl phthalate	144	105.5	16.8	55	156
53-70-3	Dibenzo(a,h)anthracene	2778	89.2	13.2	50	129
132-64-9	Dibenzofuran	282	71.9	12.2	35	108
84-66-2	Diethyl phthalate	147	99.3	10.9	67	132
131-11-3	Dimethyl phthalate	149	99.3	9.3	71	127
206-44-0	Fluoranthene	2782	87.3	10.7	55	119
86-73-7	Fluorene	2795	80.6	11.2	47	114
118-74-1	Hexachlorobenzene	201	81.9	14.2	39	125
193-39-5	Indeno(1,2,3-cd)pyrene	2812	89.6	13.5	49	130
62-75-9	N-Nitrosodimethylamine	117	90.7	10.9	58	124
91-20-3	Naphthalene	2823	74.7	12.2	38	111
4165-60-0	Nitrobenzene-d5	531	84.7	13.6	44	125
87-86-5	Pentachlorophenol	259	82.4	15.5	36	129
85-01-8	Phenanthrene	2792	80.8	10.6	49	113
129-00-0	Pyrene	2792	85.8	10.2	55	117
1718-51-0	Terphenyl-d14	1864	95.3	12.6	58	133

Table 28. Method 8270 SIM Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
92-52-4	1,1-Biphenyl	106	77.3	7.3	56	99
90-12-0	1-Methylnaphthalene	2566	77.9	12.5	41	115
95-95-4	2,4,5-Trichlorophenol	488	84.1	13.4	44	124
118-79-6	2,4,6-Tribromophenol	164	83.7	12.7	46	122
606-20-2	2,6-Dinitrotoluene	118	67.2	15.8	20	115
91-58-7	2-Chloronaphthalene	717	72.4	12.7	34	111
321-60-8	2-Fluorobiphenyl	747	79.2	8.8	53	106
91-57-6	2-Methylnaphthalene	2984	76.5	12.6	39	114
83-32-9	Acenaphthene	3241	80.9	11.1	48	114
208-96-8	Acenaphthylene	3234	77.8	14.4	35	121
120-12-7	Anthracene	3224	85.8	11	53	119
56-55-3	Benz(a)anthracene	3277	89.3	10.1	59	120
50-32-8	Benzo(a)pyrene	3284	86.4	11.2	53	120
205-99-2	Benzo(b)fluoranthene	3248	89.7	12.3	53	126
191-24-2	Benzo(g,h,i)perylene	3178	86	14.1	44	128
207-08-9	Benzo(k)fluoranthene	3167	89.3	11.9	54	125
111-44-4	Bis(2-chloroethyl) ether	775	77.8	12.6	40	116
117-81-7	Bis(2-ethylhexyl) phthalate	275	114.1	19.6	55	173
85-68-7	Butyl benzyl phthalate	159	90.7	17.3	39	143
86-74-8	Carbazole	631	84	13.1	45	123
218-01-9	Chrysene	3215	88.3	10.4	57	120
84-74-2	Di-n-butyl phthalate	153	102.5	14.2	60	145
117-84-0	Di-n-octyl phthalate	157	103.3	19	46	160
53-70-3	Dibenzo(a,h)anthracene	3233	87.2	14.5	44	131
132-64-9	Dibenzofuran	864	77.5	14.1	35	120

Table 28. Method 8270 SIM Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
84-66-2	Diethyl phthalate	142	94.5	13.5	54	135
206-44-0	Fluoranthene	3242	89.1	10.4	58	120
86-73-7	Fluorene	3232	84.1	11.3	50	118
118-74-1	Hexachlorobenzene	947	84.8	13	46	124
87-68-3	Hexachlorobutadiene	187	84.5	14.7	40	129
193-39-5	Indeno(1,2,3-cd)pyrene	3244	88.7	13.7	48	130
62-75-9	N-Nitrosodimethylamine	162	62.5	10	33	92
91-20-3	Naphthalene	3277	78.8	11.9	43	114
4165-60-0	Nitrobenzene-d5	444	83.1	9.2	55	111
87-86-5	Pentachlorophenol	808	88.4	17.6	36	141
85-01-8	Phenanthrene	3240	83.6	10.3	53	115
129-00-0	Pyrene	3252	87.1	11.3	53	121
1718-51-0	Terphenyl-d14	642	95.1	12.4	58	132

Table 29. Method 8290 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
3268-87-9	1,2,3,4,5,6,7,8-Octachlorodibenzo-p-dioxin	824	104.2	10.3	73	135
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	816	104.6	13	66	144
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	813	100.7	8.1	76	125
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	835	103.8	10.2	73	135
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	823	101.1	9.8	72	131
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	830	101.7	9.9	72	131
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	835	103.1	8.9	77	130
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	844	103.7	10	74	134
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	837	103.6	10.3	73	134
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	845	104.8	11.2	71	138
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	895	104.6	10.1	74	135
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	840	99.2	8.6	74	125
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	803	103.7	8.9	77	131
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran	942	103.4	9.7	74	133
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	912	101.4	8.9	75	128
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	871	99	9.7	70	128
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	939	105.2	10.1	75	135

Table 30. Method 8290 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
3268-87-9	1,2,3,4,5,6,7,8-Octachlorodibenzo-p-dioxin	539	107.7	9.1	81	135
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	553	107.9	14.1	66	150
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	537	100.7	7.2	79	122

Table 30. Method 8290 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	574	105.2	8.1	81	130
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	575	102.7	8.4	77	128
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	568	102.9	7.7	80	126
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	579	105	8.4	80	130
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	585	105.7	9.4	78	134
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	578	105.1	8.7	79	131
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	585	106.6	10.1	76	137
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	577	106.7	7.9	83	130
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	579	98.6	7.5	76	121
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	542	105.8	8	82	130
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran	597	105.5	8.1	81	130
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	613	103.1	8.6	77	129
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	635	97.9	9	71	125
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	641	104.9	11.1	72	138

Table 31. Method 8310 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
90-12-0	1-Methylnaphthalene	740	88.3	16.1	40	137
91-57-6	2-Methylnaphthalene	742	87.3	15.7	40	135
83-32-9	Acenaphthene	826	87	13.2	47	127
208-96-8	Acenaphthylene	815	86.5	10.3	56	117
120-12-7	Anthracene	787	88.9	7.9	65	113
56-55-3	Benz(a)anthracene	838	97.3	9.5	69	126
50-32-8	Benzo(a)pyrene	838	91.3	9.6	63	120
205-99-2	Benzo(b)fluoranthene	838	95.8	8.2	71	120

Table 31. Method 8310 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
191-24-2	Benzo(g,h,i)perylene	831	98.6	10	69	129
207-08-9	Benzo(k)fluoranthene	834	95	8.3	70	120
218-01-9	Chrysene	801	95.7	6.5	76	115
53-70-3	Dibenzo(a,h)anthracene	834	94.2	7.9	70	118
206-44-0	Fluoranthene	825	94.6	8.2	70	119
86-73-7	Fluorene	809	89.7	9.6	61	119
193-39-5	Indeno(1,2,3-cd)pyrene	675	98.9	11.6	64	134
91-20-3	Naphthalene	848	85.4	16.6	36	135
85-01-8	Phenanthrene	832	91.3	8.8	65	118
129-00-0	Pyrene	838	93.7	8.3	69	119

Table 32. Method 8310 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
90-12-0	1-Methylnaphthalene	432	73.3	11	40	106
91-57-6	2-Methylnaphthalene	448	73.4	10.7	41	106
83-32-9	Acenaphthene	493	78.5	11.2	45	112
208-96-8	Acenaphthylene	478	80.5	9.1	53	108
120-12-7	Anthracene	453	85.8	9.2	58	113
56-55-3	Benz(a)anthracene	493	89	11.6	54	124
50-32-8	Benzo(a)pyrene	445	89.1	10.3	58	120
205-99-2	Benzo(b)fluoranthene	467	88.7	11.6	54	124
191-24-2	Benzo(g,h,i)perylene	428	88.6	11.3	55	122
207-08-9	Benzo(k)fluoranthene	460	88.4	11.8	53	124
218-01-9	Chrysene	469	90.3	9.6	61	119
53-70-3	Dibenzo(a,h)anthracene	452	87.2	10.5	56	119

Table 32. Method 8310 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
206-44-0	Fluoranthene	485	86.9	10.6	55	119
86-73-7	Fluorene	483	82.2	9.7	53	111
193-39-5	Indeno(1,2,3-cd)pyrene	458	89.4	12.2	53	126
91-20-3	Naphthalene	440	73.3	10.5	42	105
85-01-8	Phenanthrene	489	85.2	9.5	57	114
129-00-0	Pyrene	472	86.3	9.3	58	114

Table 33. Method 8321 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
99-35-4	1,3,5-Trinitrobenzene	228	92.4	7.6	69	115
99-65-0	1,3-Dinitrobenzene	234	102.4	6.5	83	122
118-96-7	2,4,6-Trinitrotoluene	222	99	11.4	65	133
121-14-2	2,4-Dinitrotoluene	229	100.7	6.1	82	119
606-20-2	2,6-Dinitrotoluene	225	99.7	4.6	86	113
35572-78-2	2-Amino-4,6-dinitrotoluene	230	102.2	9.2	75	130
88-72-2	2-Nitrotoluene	232	98.1	8.8	72	125
99-08-1	3-Nitrotoluene	235	96.8	9.5	68	125
19406-51-0	4-Amino-2,6-dinitrotoluene	230	101.2	8.1	77	125
99-99-0	4-Nitrotoluene	231	99.2	9.1	72	127
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	231	100.2	7.6	77	123
98-95-3	Nitrobenzene	221	97.1	7.5	75	120
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	225	89.3	8.1	65	114
78-11-5	PETN	229	102.3	13.6	62	143
479-45-8	Tetryl	214	78	13.9	36	120

Table 34. Method 8321 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
99-35-4	1,3,5-Trinitrobenzene	452	88.6	7.4	66	111
99-65-0	1,3-Dinitrobenzene	460	98	6.5	78	118
118-96-7	2,4,6-Trinitrotoluene	413	98.4	10.1	68	129
121-14-2	2,4-Dinitrotoluene	458	96.4	6.9	76	117
606-20-2	2,6-Dinitrotoluene	447	93.7	4.7	80	108
35572-78-2	2-Amino-4,6-dinitrotoluene	456	97.9	9.6	69	127
88-72-2	2-Nitrotoluene	359	82	10.1	52	112
99-08-1	3-Nitrotoluene	356	83	9.7	54	112
19406-51-0	4-Amino-2,6-dinitrotoluene	459	96.7	9.7	68	126
99-99-0	4-Nitrotoluene	361	85.5	10.6	54	117
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	458	99.6	8.9	73	126
98-95-3	Nitrobenzene	353	84.6	7.7	61	108
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	452	87	8.3	62	112
78-11-5	PETN	354	95	11	62	128
479-45-8	Tetryl	330	86.2	17.1	35	138

Table 35. Method 8330 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	339	105.7	5.7	89	123
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	607	101.9	7	81	123
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	602	104.2	6.7	84	124
118-96-7	2,4,6-Trinitrotoluene	618	100.2	8.4	75	125
121-14-2	2,4-Dinitrotoluene	600	102.3	6.9	82	123

Table 35. Method 8330 Solid Matrix

606-20-2	2,6-Dinitrotoluene	556	102.4	5.4	86	119
35572-78-2	2-Amino-4,6-dinitrotoluene	562	103.8	5.7	87	121
88-72-2	2-Nitrotoluene	591	102	6	84	120
99-08-1	3-Nitrotoluene	614	103.3	8	79	127
19406-51-0	4-Amino-2,6-dinitrotoluene	594	104.2	6.7	84	124
99-99-0	4-Nitrotoluene	595	102.2	6.5	83	122
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	595	103.1	6.9	82	124
98-95-3	Nitrobenzene	598	103.9	7.9	80	128
55-63-0	Nitroglycerin	352	97.2	8.2	73	122
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	581	99.1	7.5	77	122
78-11-5	PETN	326	100.9	7.5	78	123
479-45-8	Tetryl	584	101.8	11.9	66	138

Table 36. Method 8330 - 8330B series Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	978	101.1	6	83	119
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	1578	99	8.5	73	125
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	1572	98.7	7	78	120
118-96-7	2,4,6-Trinitrotoluene	1728	97	8.6	71	123
6629-29-4	2,4-Diamino-6-nitrotoluene	578	95	9.1	68	122
121-14-2	2,4-Dinitrotoluene	1563	98.9	7.1	78	120
59229-75-3	2,6-Diamino-4-nitrotoluene	577	96.6	8.3	72	122
606-20-2	2,6-Dinitrotoluene	1693	102	8.3	77	127
35572-78-2	2-Amino-4,6-dinitrotoluene	1568	99.4	6.8	79	120
88-72-2	2-Nitrotoluene	1630	98.4	9.6	70	127

Table 36. Method 8330 - 8330B series Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
618-87-1	3,5-Dinitroaniline	150	94.3	7.6	71	117
99-08-1	3-Nitrotoluene	1643	98.8	8.8	73	125
19406-51-0	4-Amino-2,6-dinitrotoluene	1586	100.3	8	76	125
99-99-0	4-Nitrotoluene	1654	99.1	9.3	71	127
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	1833	99.1	10.4	68	130
80251-29-2	Hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine (DNX)	109	92.8	8.8	66	119
5755-27-1	Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine (MNX)	249	94.3	12.5	57	132
98-95-3	Nitrobenzene	1743	99.3	11.4	65	134
55-63-0	Nitroglycerin	1076	100.4	8.8	74	127
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	1755	100	11.8	65	135
78-11-5	PETN	1079	100.2	9	73	127
479-45-8	Tetryl	1597	95.8	10.7	64	128

Table 37. Method 8330B Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
528-29-0	1,2-Dinitrobenzene [1,2-DNB]	283	98.9	6.8	78	119
99-35-4	1,3,5-Trinitrobenzene [1,3,5-TNB]	450	98	6.1	80	116
99-65-0	1,3-Dinitrobenzene [1,3-DNB]	461	96.3	7.7	73	119
118-96-7	2,4,6-Trinitrotoluene	443	95.8	8.2	71	120
121-14-2	2,4-Dinitrotoluene	457	98	7.5	75	121
606-20-2	2,6-Dinitrotoluene	430	98	6.3	79	117
35572-78-2	2-Amino-4,6-dinitrotoluene	455	96.5	8.7	71	123

Table 37. Method 8330B Solid Matrix

88-72-2	2-Nitrotoluene	447	96.8	9.1	70	124
618-87-1	3,5-Dinitroaniline	115	101.6	5.3	86	118
99-08-1	3-Nitrotoluene	448	97.7	10.3	67	129
19406-51-0	4-Amino-2,6-dinitrotoluene	434	95.4	10.6	64	127
99-99-0	4-Nitrotoluene	451	97.3	8.9	71	124
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	457	97.9	10.3	67	129
98-95-3	Nitrobenzene	440	97.9	10.4	67	129
55-63-0	Nitroglycerin	386	98.1	8.5	73	124
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	422	99.1	8.2	74	124
78-11-5	PETN	376	100.1	9.4	72	128
479-45-8	Tetryl	377	101.3	11.1	68	135

Table 38. Method 9010 - 9020 Series Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
57-12-5	Cyanide, Total	842	98.2	7.4	76	120

Table 39. Method 9010 - 9020 Series Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
57-12-5	Cyanide, Total	1660	99	5.5	83	116

Table 40. Method 9056 Solid Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
24959-67-9	Bromide	222	101	5.1	86	116
16887-00-6	Chloride	612	100.9	4.7	87	115
16984-48-8	Fluoride	300	100.3	9.1	73	128
14797-55-8	Nitrate	680	99.2	4	87	111
14797-65-0	Nitrite	419	100.3	4.9	86	115
14265-44-2	Phosphate	142	102.4	3.8	91	114
14808-79-8	Sulfate	305	100.9	4.7	87	115

Table 41. Method 9056 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
24959-67-9	Bromide	2199	100.3	3.2	91	110
16887-00-6	Chloride	4948	98.5	4	87	111
16984-48-8	Fluoride	3251	99.7	4	88	112
14797-55-8	Nitrate	3192	99.7	3.9	88	111
14797-65-0	Nitrite	2583	98.9	3.9	87	111
14265-44-2	Phosphate	843	97.8	6.1	80	116
14808-79-8	Sulfate	4155	99.2	4.1	87	112

Table 42. Method RSK-175 Water Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
74-86-2	Acetylene	719	99.6	9.8	70	129
106-97-8	Butane	262	97.3	7.3	75	119
124-38-9	Carbon dioxide	441	100.8	6.9	80	122
74-84-0	Ethane	2240	102.6	9.6	74	131
74-85-1	Ethylene	2284	102.5	10.2	72	133
75-28-5	Isobutane	267	97.6	6.6	78	117
74-82-8	Methane	2459	99.2	8.7	73	125
74-98-6	Propane	900	98.1	8.2	74	123

Table 43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
630-20-6	1,1,1,2-Tetrachloroethane	1344	97.9	10.5	67	129
71-55-6	1,1,1-Trichloroethane	5436	96.7	9.5	68	125
79-34-5	1,1,2,2-Tetrachloroethane	5273	95.9	10.4	65	127
79-00-5	1,1,2-Trichloroethane	5332	95.9	7.7	73	119
76-13-1	1,1,2-Trifluoro-1,2,2-trichloroethane [Freon-113]	5351	96.1	10	66	126
75-34-3	1,1-Dichloroethane	5422	97	9.7	68	126
75-35-4	1,1-Dichloroethene	3503	97.3	11.9	61	133
96-18-4	1,2,3-Trichloropropane	465	99.6	8	76	124
120-82-1	1,2,4-Trichlorobenzene	4545	98.5	14.5	55	142
95-63-6	1,2,4-Trimethylbenzene	4699	99.2	11.1	66	132

Table 43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
106-93-4	1,2-Dibromoethane	4655	98.2	7.9	74	122
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	4572	92.4	9.7	63	121
95-50-1	1,2-Dichlorobenzene	4739	95.7	11	63	129
107-06-2	1,2-Dichloroethane	5467	96.8	10.5	65	128
78-87-5	1,2-Dichloropropane	4729	95.7	8.9	69	123
108-67-8	1,3,5-Trimethylbenzene	4679	98.3	10.4	67	130
106-99-0	1,3-Butadiene	3167	99.8	11.4	66	134
541-73-1	1,3-Dichlorobenzene	4737	97.1	10.9	65	130
142-28-9	1,3-Dichloropropane	165	105.2	14.4	62	148
542-75-6	1,3-Dichloropropene	560	100.7	8.1	77	125
106-46-7	1,4-Dichlorobenzene	4719	95.8	11.8	60	131
123-91-1	1,4-Dioxane	2656	96.5	8.6	71	122
540-84-1	2,2,4-Trimethylpentane [Isooctane]	3008	94.3	8.8	68	121
78-93-3	2-Butanone [MEK]	4635	98.4	10.4	67	130
95-49-8	2-Chlorotoluene	1092	101.9	9.2	74	130
591-78-6	2-Hexanone	4600	95.4	11	62	128
67-63-0	2-Propanol [Isopropyl alcohol]	3069	88.4	12.3	52	125
622-96-8	4-Ethyltoluene	4673	97.9	10.3	67	129
108-10-1	4-Methyl-2-pentanone [MIBK]	4646	98.5	10.5	67	130
67-64-1	Acetone	4600	92.7	11.6	58	128
75-05-8	Acetonitrile	1999	97.3	11.6	63	132
107-02-8	Acrolein [Propenal]	2469	93.8	10.6	62	126
107-13-1	Acrylonitrile	2105	103.7	10.9	71	137
107-05-1	Allyl chloride	2980	101.1	10.1	71	131

Table 43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
98-83-9	alpha-Methylstyrene	1976	97.3	10.2	67	128
71-43-2	Benzene	5436	93.8	8.4	69	119
100-44-7	Benzyl chloride	4419	98.7	16.2	50	147
75-27-4	Bromodichloromethane	4682	99.9	9.3	72	128
75-25-2	Bromoform	4638	102.3	12.1	66	139
74-83-9	Bromomethane	2657	98.6	11.8	63	134
106-97-8	Butane	587	96.2	10.9	64	129
75-15-0	Carbon disulfide	4756	95.6	12.7	57	134
56-23-5	Carbon tetrachloride	4202	99.6	10.7	68	132
108-90-7	Chlorobenzene	4652	94.5	8	70	119
124-48-1	Chlorodibromomethane	4628	99.9	10	70	130
75-45-6	Chlorodifluoromethane	559	102.1	14.3	59	145
75-00-3	Chloroethane	5370	94.7	10.6	63	127
67-66-3	Chloroform	5481	95.3	9.3	68	123
74-87-3	Chloromethane	4540	95.2	12.2	59	132
156-59-2	cis-1,2-Dichloroethene	5320	95.6	8.4	70	121
10061-01-5	cis-1,3-Dichloropropene	4691	98.8	9.7	70	128
110-82-7	Cyclohexane	3178	93.5	7.7	70	117
124-18-5	Decane	1982	93.8	7.9	70	118
75-71-8	Dichlorodifluoromethane [Freon-12]	5307	93.6	11.5	59	128
108-20-3	Diisopropyl ether	2309	93.5	8	70	117
64-17-5	Ethanol	2981	91.8	11.1	59	125
141-78-6	Ethyl acetate	2835	96.4	10.5	65	128
100-41-4	Ethylbenzene	5420	96.8	9	70	124
142-82-5	Heptane	3163	95.7	8.9	69	123

Table 43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
87-68-3	Hexachlorobutadiene	4551	96.7	13.7	56	138
110-54-3	Hexane	3150	91.6	9.5	63	120
98-82-8	Isopropylbenzene	3022	95.6	9.3	68	124
179601-23-1	m/p-Xylene [3/4-Xylene]	5019	97.3	12.3	61	134
80-62-6	Methyl methacrylate	3037	98.9	9.7	70	128
1634-04-4	Methyl tert-butyl ether [MTBE]	4681	95.5	10	66	126
75-09-2	Methylene chloride	5314	88.8	8.9	62	115
71-36-3	n-Butyl alcohol	1981	97.5	11.7	62	133
104-51-8	n-Butylbenzene	2656	97.7	10.6	66	130
112-40-3	n-DoDecane	1932	104.4	14.1	62	147
103-65-1	n-Propylbenzene	2570	95.7	9	69	123
91-20-3	Naphthalene	2439	97.5	13.4	57	138
111-84-2	Nonane	2617	95.4	10.8	63	128
95-47-6	o-Xylene	5334	96.3	9.7	67	125
111-65-9	Octane	2514	95	8.7	69	121
99-87-6	p-Isopropyltoluene [p-Cymene]	2694	98.1	10.5	67	130
109-66-0	Pentane	712	96.7	11.3	63	131
115-07-1	Propene	3193	96.6	13.3	57	136
135-98-8	sec-Butylbenzene	2665	96.4	9.6	68	125
100-42-5	Styrene	4735	100.1	9	73	127
75-65-0	tert-Butyl alcohol	2997	86.8	20.9	24	150
98-06-6	tert-Butylbenzene	2710	94.3	9.8	65	124
127-18-4	Tetrachloroethene	5432	95.2	9.7	66	124
109-99-9	Tetrahydrofuran	3192	93.7	9.8	64	123
108-88-3	Toluene	5406	92.7	8.8	66	119
156-60-5	trans-1,2-Dichloroethene	5411	95.5	9.5	67	124

Table 43. Method TO-15 Gas Matrix

CAS ID	Analyte	N Records	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
10061-02-6	trans-1,3-Dichloropropene	4621	104	9.6	75	133
79-01-6	Trichloroethene	5478	96.7	8.7	71	123
75-69-4	Trichlorofluoromethane [Freon-11]	5376	93.7	10.6	62	126
1120-21-4	Undecane	1976	96.1	9	69	123
108-05-4	Vinyl acetate	4599	97.4	13.7	56	139
593-60-2	Vinyl bromide	1054	98.4	9.2	71	126
75-01-4	Vinyl chloride	5445	95.1	10.4	64	127

LABORATORY ACCREDITATION BUREAU®

Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2305

TestAmerica Laboratories

St. Louis Facility
13715 Rider Trail North
Earth City Missouri 63045

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: January 10, 2016

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 31st of May 2013

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2305

Scope of Accreditation For TestAmerica Laboratories

St. Louis Facility
13715 Rider Trail North
Earth City, Missouri 63045
Marti Ward
314-298-8566

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (LABPR 403 DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V5) based on the TNI Standard - Environmental Laboratory Sector, Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis, Sept 2009 (EL-V1-2009); accreditation is granted to **TestAmerica Laboratories** to perform the following tests:

Accreditation granted through: **January 10, 2016**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Aluminum
ICP-AES	EPA 6010C	Antimony
ICP-AES	EPA 6010C	Arsenic
ICP-AES	EPA 6010C	Barium
ICP-AES	EPA 6010C	Beryllium
ICP-AES	EPA 6010C	Bismuth
ICP-AES	EPA 6010C	Boron
ICP-AES	EPA 6010C	Cadmium
ICP-AES	EPA 6010C	Calcium
ICP-AES	EPA 6010C	Chromium
ICP-AES	EPA 6010C	Cobalt
ICP-AES	EPA 6010C	Copper
ICP-AES	EPA 6010C	Iron
ICP-AES	EPA 6010C	Lead
ICP-AES	EPA 6010C	Lithium
ICP-AES	EPA 6010C	Magnesium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Manganese
ICP-AES	EPA 6010C	Molybdenum
ICP-AES	EPA 6010C	Nickel
ICP-AES	EPA 6010C	Phosphorus
ICP-AES	EPA 6010C	Potassium
ICP-AES	EPA 6010C	Selenium
ICP-AES	EPA 6010C	Silicon
ICP-AES	EPA 6010C	Silver
ICP-AES	EPA 6010C	Sodium
ICP-AES	EPA 6010C	Strontium
ICP-AES	EPA 6010C	Sulfur
ICP-AES	EPA 6010C	Thallium
ICP-AES	EPA 6010C	Thorium
ICP-AES	EPA 6010C	Tin
ICP-AES	EPA 6010C	Titanium
ICP-AES	EPA 6010C	Uranium
ICP-AES	EPA 6010C	Vanadium
ICP-AES	EPA 6010C	Zinc
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	n-Butanol
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Carbon disulfide

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chlorobromomethane
GC/MS	EPA 8260C	2-Chloro-1,3-butadiene
GC/MS	EPA 8260C	Chlorodibromomethane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	Allyl chloride
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	1,1-Dichloropropene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260C	Dimethyl disulfide
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl ether
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Freon 113
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	n-Hexane
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutanol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methyl butyl ketone
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Dichloromethane
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	MTBE
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	Nonanal
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	Tetrachloroethene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	m-Xylene & p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Xylenes (total)
GC/MS	EPA 8260C SIM	1,4-Dioxane
GC/MS	EPA 624	Acetone
GC/MS	EPA 624	Acetonitrile
GC/MS	EPA 624	Acrolein
GC/MS	EPA 624	Acrylonitrile
GC/MS	EPA 624	Benzene
GC/MS	EPA 624	Benzyl chloride
GC/MS	EPA 624	Bromobenzene
GC/MS	EPA 624	Bromochloromethane
GC/MS	EPA 624	Bromodichloromethane
GC/MS	EPA 624	Bromoform
GC/MS	EPA 624	Bromomethane
GC/MS	EPA 624	n-Butanol
GC/MS	EPA 624	2-Butanone
GC/MS	EPA 624	n-Butylbenzene
GC/MS	EPA 624	sec-Butylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	tert-Butylbenzene
GC/MS	EPA 624	Carbon disulfide
GC/MS	EPA 624	Carbon tetrachloride
GC/MS	EPA 624	Chlorobenzene
GC/MS	EPA 624	Chlorobromomethane
GC/MS	EPA 624	2-Chloro-1,3-butadiene
GC/MS	EPA 624	Chlorodibromomethane
GC/MS	EPA 624	Dibromochloromethane
GC/MS	EPA 624	Chloroethane
GC/MS	EPA 624	2-Chloroethyl vinyl ether
GC/MS	EPA 624	Chloroform
GC/MS	EPA 624	Chloromethane
GC/MS	EPA 624	Allyl chloride
GC/MS	EPA 624	2-Chlorotoluene
GC/MS	EPA 624	4-Chlorotoluene
GC/MS	EPA 624	Cyclohexane
GC/MS	EPA 624	Cyclohexanone
GC/MS	EPA 624	1,2-Dibromo-3-chloropropane
GC/MS	EPA 624	1,2-Dibromoethane
GC/MS	EPA 624	Dibromomethane
GC/MS	EPA 624	1,2-Dichlorobenzene
GC/MS	EPA 624	1,3-Dichlorobenzene
GC/MS	EPA 624	1,4-Dichlorobenzene
GC/MS	EPA 624	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624	Dichlorodifluoromethane
GC/MS	EPA 624	1,1-Dichloroethane
GC/MS	EPA 624	1,2-Dichloroethane
GC/MS	EPA 624	cis-1,2-Dichloroethene
GC/MS	EPA 624	trans-1,2-Dichloroethene
GC/MS	EPA 624	1,1-Dichloroethene
GC/MS	EPA 624	1,2-Dichloroethene (total)
GC/MS	EPA 624	1,2-Dichloropropane
GC/MS	EPA 624	1,3-Dichloropropane
GC/MS	EPA 624	2,2-Dichloropropane
GC/MS	EPA 624	cis-1,3-Dichloropropene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	trans-1,3-Dichloropropene
GC/MS	EPA 624	1,1-Dichloropropene
GC/MS	EPA 624	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 624	Dimethyl disulfide
GC/MS	EPA 624	1,4-Dioxane
GC/MS	EPA 624	Ethyl acetate
GC/MS	EPA 624	Ethylbenzene
GC/MS	EPA 624	Ethyl ether
GC/MS	EPA 624	Diethyl ether
GC/MS	EPA 624	Ethyl methacrylate
GC/MS	EPA 624	Freon 113
GC/MS	EPA 624	Hexachlorobutadiene
GC/MS	EPA 624	n-Hexane
GC/MS	EPA 624	2-Hexanone
GC/MS	EPA 624	Iodomethane
GC/MS	EPA 624	Isobutanol
GC/MS	EPA 624	Isopropylbenzene
GC/MS	EPA 624	p-Isopropyltoluene
GC/MS	EPA 624	Methacrylonitrile
GC/MS	EPA 624	Methyl acetate
GC/MS	EPA 624	Methyl butyl ketone
GC/MS	EPA 624	Methylcyclohexane
GC/MS	EPA 624	Dichloromethane
GC/MS	EPA 624	Methylene chloride
GC/MS	EPA 624	Methyl methacrylate
GC/MS	EPA 624	4-Methyl-2-pentanone
GC/MS	EPA 624	MTBE
GC/MS	EPA 624	Naphthalene
GC/MS	EPA 624	2-Nitropropane
GC/MS	EPA 624	Nonanal
GC/MS	EPA 624	Pentachloroethane
GC/MS	EPA 624	Propionitrile
GC/MS	EPA 624	n-Propylbenzene
GC/MS	EPA 624	Styrene
GC/MS	EPA 624	1,1,1,2-Tetrachloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624	Tetrachloroethene
GC/MS	EPA 624	Tetrahydrofuran
GC/MS	EPA 624	Toluene
GC/MS	EPA 624	1,3,5-Trichlorobenzene
GC/MS	EPA 624	1,2,3-Trichlorobenzene
GC/MS	EPA 624	1,2,4-Trichlorobenzene
GC/MS	EPA 624	1,1,1-Trichloroethane
GC/MS	EPA 624	1,1,2-Trichloroethane
GC/MS	EPA 624	Trichloroethene
GC/MS	EPA 624	Trichlorofluoromethane
GC/MS	EPA 624	1,2,3-Trichloropropane
GC/MS	EPA 624	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 624	Trichlorotrifluoroethane
GC/MS	EPA 624	1,2,4-Trimethylbenzene
GC/MS	EPA 624	1,3,5-Trimethylbenzene
GC/MS	EPA 624	Vinyl acetate
GC/MS	EPA 624	Vinyl chloride
GC/MS	EPA 624	m-Xylene & p-Xylene
GC/MS	EPA 624	o-Xylene
GC/MS	EPA 624	Xylenes (total)
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite (total)
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzo(ghi)perylene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	1,1'-Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	n-Butylbenzenesulfonamide
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	p-Chlorobenzilate
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Cresols (total)
GC/MS	EPA 8270D	Cyclohexanol
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dichlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	p-Dimethylaminoazobenzene
GC/MS	EPA 8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	Dimethylformamide
GC/MS	EPA 8270D	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	2-Methylbenzenamine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 8270D	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 8270D	Methylphenols (total)
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	N-Nitrosomethylethylamine
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	5-Nitro-o-toluidine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	p-Phenylene diamine
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 8270D	Thionazin
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	Tris(2-chloroethyl)phosphate
GC/MS	EPA 8270D	1-Methyl naphthalene
GC/MS	EPA 625	Acenaphthene
GC/MS	EPA 625	Acenaphthylene
GC/MS	EPA 625	Acetophenone
GC/MS	EPA 625	2-Acetylaminofluorene
GC/MS	EPA 625	4-Aminobiphenyl
GC/MS	EPA 625	Aniline

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	Anthracene
GC/MS	EPA 625	Aramite (total)
GC/MS	EPA 625	Atrazine
GC/MS	EPA 625	Azobenzene
GC/MS	EPA 625	Benzaldehyde
GC/MS	EPA 625	Benzidine
GC/MS	EPA 625	Benzo(a)anthracene
GC/MS	EPA 625	Benzo(b)fluoranthene
GC/MS	EPA 625	Benzo(k)fluoranthene
GC/MS	EPA 625	Benzoic acid
GC/MS	EPA 625	Benzo(ghi)perylene
GC/MS	EPA 625	Benzo(a)pyrene
GC/MS	EPA 625	Benzyl alcohol
GC/MS	EPA 625	1,1'-Biphenyl
GC/MS	EPA 625	bis(2-Chloroethoxy)methane
GC/MS	EPA 625	bis(2-Chloroethyl) ether
GC/MS	EPA 625	bis(2-Chloroisopropyl) ether
GC/MS	EPA 625	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 625	4-Bromophenyl phenyl ether
GC/MS	EPA 625	n-Butylbenzenesulfonamide
GC/MS	EPA 625	Butyl benzyl phthalate
GC/MS	EPA 625	Caprolactam
GC/MS	EPA 625	Carbazole
GC/MS	EPA 625	4-Chloroaniline
GC/MS	EPA 625	Chlorobenzilate
GC/MS	EPA 625	p-Chlorobenzilate
GC/MS	EPA 625	4-Chloro-3-methylphenol
GC/MS	EPA 625	2-Chloronaphthalene
GC/MS	EPA 625	2-Chlorophenol
GC/MS	EPA 625	4-Chlorophenyl phenyl ether
GC/MS	EPA 625	Chrysene
GC/MS	EPA 625	Cresols (total)
GC/MS	EPA 625	Cyclohexanol
GC/MS	EPA 625	Diallate
GC/MS	EPA 625	Dibenz(a,h)anthracene
GC/MS	EPA 625	Dibenzo(a,h)anthracene
GC/MS	EPA 625	Dibenzofuran
GC/MS	EPA 625	Di-n-butyl phthalate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	1,2-Dichlorobenzene
GC/MS	EPA 625	1,3-Dichlorobenzene
GC/MS	EPA 625	1,4-Dichlorobenzene
GC/MS	EPA 625	3,3'-Dichlorobenzidine
GC/MS	EPA 625	2,4-Dichlorophenol
GC/MS	EPA 625	2,6-Dichlorophenol
GC/MS	EPA 625	Diethyl phthalate
GC/MS	EPA 625	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 625	Dimethoate
GC/MS	EPA 625	p-Dimethylaminoazobenzene
GC/MS	EPA 625	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 625	3,3'-Dimethylbenzidine
GC/MS	EPA 625	Dimethylformamide
GC/MS	EPA 625	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 625	2,4-Dimethylphenol
GC/MS	EPA 625	Dimethyl phthalate
GC/MS	EPA 625	1,3-Dinitrobenzene
GC/MS	EPA 625	1,4-Dinitrobenzene
GC/MS	EPA 625	4,6-Dinitro-2-methylphenol
GC/MS	EPA 625	2,4-Dinitrophenol
GC/MS	EPA 625	2,4-Dinitrotoluene
GC/MS	EPA 625	2,6-Dinitrotoluene
GC/MS	EPA 625	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 625	Dinoseb
GC/MS	EPA 625	Di-n-octyl phthalate
GC/MS	EPA 625	1,4-Dioxane
GC/MS	EPA 625	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 625	Disulfoton
GC/MS	EPA 625	Ethyl methacrylate
GC/MS	EPA 625	Ethyl methanesulfonate
GC/MS	EPA 625	Famphur
GC/MS	EPA 625	Fluoranthene
GC/MS	EPA 625	Fluorene
GC/MS	EPA 625	Hexachlorobenzene
GC/MS	EPA 625	Hexachlorobutadiene
GC/MS	EPA 625	Hexachlorocyclopentadiene
GC/MS	EPA 625	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 625	Hexachloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	Hexachlorophene
GC/MS	EPA 625	Hexachloropropene
GC/MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 625	Isodrin
GC/MS	EPA 625	Isophorone
GC/MS	EPA 625	Isosafrole
GC/MS	EPA 625	Kepone
GC/MS	EPA 625	Methapyrilene
GC/MS	EPA 625	2-Methylbenzenamine
GC/MS	EPA 625	3-Methylcholanthrene
GC/MS	EPA 625	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 625	Methyl methacrylate
GC/MS	EPA 625	Methyl methanesulfonate
GC/MS	EPA 625	2-Methylnaphthalene
GC/MS	EPA 625	Methyl parathion
GC/MS	EPA 625	2-Methylphenol
GC/MS	EPA 625	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 625	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 625	Methylphenols (total)
GC/MS	EPA 625	Naphthalene
GC/MS	EPA 625	1,4-Naphthoquinone
GC/MS	EPA 625	1-Naphthylamine
GC/MS	EPA 625	2-Naphthylamine
GC/MS	EPA 625	2-Nitroaniline
GC/MS	EPA 625	3-Nitroaniline
GC/MS	EPA 625	4-Nitroaniline
GC/MS	EPA 625	Nitrobenzene
GC/MS	EPA 625	2-Nitrophenol
GC/MS	EPA 625	4-Nitrophenol
GC/MS	EPA 625	4-Nitroquinoline-1-oxide
GC/MS	EPA 625	N-Nitrosodi-n-butylamine
GC/MS	EPA 625	N-Nitrosodiethylamine
GC/MS	EPA 625	N-Nitrosodimethylamine
GC/MS	EPA 625	N-Nitrosodiphenylamine
GC/MS	EPA 625	N-Nitrosodi-n-propylamine
GC/MS	EPA 625	N-Nitrosomethylethylamine
GC/MS	EPA 625	N-Nitrosomorpholine
GC/MS	EPA 625	N-Nitrosopiperidine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	N-Nitrosopyrrolidine
GC/MS	EPA 625	5-Nitro-o-toluidine
GC/MS	EPA 625	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 625	Parathion
GC/MS	EPA 625	Pentachlorobenzene
GC/MS	EPA 625	Pentachloroethane
GC/MS	EPA 625	Pentachloronitrobenzene
GC/MS	EPA 625	Pentachlorophenol
GC/MS	EPA 625	Phenacetin
GC/MS	EPA 625	Phenanthrene
GC/MS	EPA 625	Phenol
GC/MS	EPA 625	p-Phenylene diamine
GC/MS	EPA 625	Phorate
GC/MS	EPA 625	2-Picoline
GC/MS	EPA 625	Pronamide
GC/MS	EPA 625	Pyrene
GC/MS	EPA 625	Pyridine
GC/MS	EPA 625	Safrole
GC/MS	EPA 625	Sulfotepp
GC/MS	EPA 625	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 625	Thionazin
GC/MS	EPA 625	o-Toluidine
GC/MS	EPA 625	Tributyl phosphate
GC/MS	EPA 625	1,2,4-Trichlorobenzene
GC/MS	EPA 625	2,4,5-Trichlorophenol
GC/MS	EPA 625	2,4,6-Trichlorophenol
GC/MS	EPA 625	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 625	1,3,5-Trinitrobenzene
GC/MS	EPA 625	Tris(2-chloroethyl)phosphate
GC/MS	EPA 625	1-Methyl naphthalene
GC-ECD	EPA 8081B	Aldrin
GC-ECD	EPA 8081B	alpha-BHC
GC-ECD	EPA 8081B	beta-BHC
GC-ECD	EPA 8081B	delta-BHC
GC-ECD	EPA 8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081B	alpha-Chlordane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8081B	gamma-Chlordane
GC-ECD	EPA 8081B	Chlordane (technical)
GC-ECD	EPA 8081B	4,4'-DDD
GC-ECD	EPA 8081B	2,4'-DDD
GC-ECD	EPA 8081B	4,4'-DDE
GC-ECD	EPA 8081B	2,4'-DDE
GC-ECD	EPA 8081B	4,4'-DDT
GC-ECD	EPA 8081B	2,4'-DDT
GC-ECD	EPA 8081B	Dieldrin
GC-ECD	EPA 8081B	Endosulfan I
GC-ECD	EPA 8081B	Endosulfan II
GC-ECD	EPA 8081B	Endosulfan sulfate
GC-ECD	EPA 8081B	Endrin
GC-ECD	EPA 8081B	Endrin aldehyde
GC-ECD	EPA 8081B	Endrin ketone
GC-ECD	EPA 8081B	Heptachlor
GC-ECD	EPA 8081B	Heptachlor epoxide
GC-ECD	EPA 8081B	Methoxychlor
GC-ECD	EPA 8081B	Toxaphene
GC-ECD	EPA 608	Aldrin
GC-ECD	EPA 608	alpha-BHC
GC-ECD	EPA 608	beta-BHC
GC-ECD	EPA 608	delta-BHC
GC-ECD	EPA 608	gamma-BHC (Lindane)
GC-ECD	EPA 608	alpha-Chlordane
GC-ECD	EPA 608	gamma-Chlordane
GC-ECD	EPA 608	Chlordane (technical)
GC-ECD	EPA 608	4,4'-DDD
GC-ECD	EPA 608	2,4'-DDD
GC-ECD	EPA 608	4,4'-DDE
GC-ECD	EPA 608	2,4'-DDE
GC-ECD	EPA 608	4,4'-DDT
GC-ECD	EPA 608	2,4'-DDT
GC-ECD	EPA 608	Dieldrin
GC-ECD	EPA 608	Endosulfan I
GC-ECD	EPA 608	Endosulfan II

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-ECD	EPA 608	Endosulfan sulfate
GC-ECD	EPA 608	Endrin
GC-ECD	EPA 608	Endrin aldehyde
GC-ECD	EPA 608	Endrin ketone
GC-ECD	EPA 608	Heptachlor
GC-ECD	EPA 608	Heptachlor epoxide
GC-ECD	EPA 608	Methoxychlor
GC-ECD	EPA 608	Toxaphene
GC-ECD	EPA 608	Aroclor 1016
GC-ECD	EPA 608	Aroclor 1221
GC-ECD	EPA 608	Aroclor 1232
GC-ECD	EPA 608	Aroclor 1242
GC-ECD	EPA 608	Aroclor 1248
GC-ECD	EPA 608	Aroclor 1254
GC-ECD	EPA 608	Aroclor 1260
GC-ECD	EPA 608	Aroclor 1262
GC-ECD	EPA 608	Aroclor 1268
GC-ECD	EPA 8082A	Aroclor 1016
GC-ECD	EPA 8082A	Aroclor 1221
GC-ECD	EPA 8082A	Aroclor 1232
GC-ECD	EPA 8082A	Aroclor 1242
GC-ECD	EPA 8082A	Aroclor 1248
GC-ECD	EPA 8082A	Aroclor 1254
GC-ECD	EPA 8082A	Aroclor 1260
GC-ECD	EPA 8082A	Aroclor 1262
GC-ECD	EPA 8082A	Aroclor 1268
GC-ECD	EPA 8151A	2,4-D
GC-ECD	EPA 8151A	Dalapon
GC-ECD	EPA 8151A	2,4-DB
GC-ECD	EPA 8151A	Dicamba
GC-ECD	EPA 8151A	Dichlorprop
GC-ECD	EPA 8151A	Dinoseb
GC-ECD	EPA 8151A	MCPA
GC-ECD	EPA 8151A	MCPP
GC-ECD	EPA 8151A	4-Nitrophenol
GC-ECD	EPA 8151A	Pentachlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8151A	2,4,5-TP (Silvex)
GC-ECD	EPA 8151A	2,4,5-T
LC/MS/MS	EPA 8321A	2,4-D
LC/MS/MS	EPA 8321A	Dalapon
LC/MS/MS	EPA 8321A	2,4-DB
LC/MS/MS	EPA 8321A	Dicamba
LC/MS/MS	EPA 8321A	Dichlorprop
LC/MS/MS	EPA 8321A	Dinoseb
LC/MS/MS	EPA 8321A	MCPA
LC/MS/MS	EPA 8321A	MCPP
LC/MS/MS	EPA 8321A	2,4,5-TP (Silvex)
LC/MS/MS	EPA 8321A	2,4,5-T
GC-FID	RSK-175	Methane
GC-FID	RSK-175	Ethane
GC-FID	RSK-175	Ethene
GC-FID	RSK-175	Acetylene
GC-FID	EPA 8015B	Ethanol
GC-FID	EPA 8015B	Methanol
GC-FID	EPA 8015B	Ethylene glycol
GC-FID	EPA 8015B	Propylene glycol
GC-FID	EPA 8015B	Diesel Range Organics
GC-FID	EPA 8015B	Motor Oil Range Organics
GC-FID	EPA 8015B	TPH (as Diesel)
GC-FID	EPA 8015B	Gasoline Range Organics
LC/MS/MS	EPA 8321A	2-Amino-4,6-dinitrotoluene
LC/MS/MS	EPA 8321A	4-Amino-2,6-dinitrotoluene
LC/MS/MS	EPA 8321A	3,5-Dinitroaniline
LC/MS/MS	EPA 8321A	1,3-Dinitrobenzene
LC/MS/MS	EPA 8321A	2,4-Dinitrotoluene
LC/MS/MS	EPA 8321A	2,6-Dinitrotoluene
LC/MS/MS	EPA 8321A	DNX
LC/MS/MS	EPA 8321A	HMX
LC/MS/MS	EPA 8321A	HNAB
LC/MS/MS	EPA 8321A	HNS
LC/MS/MS	EPA 8321A	MNX
LC/MS/MS	EPA 8321A	Nitrobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 8321A	Nitroglycerin
LC/MS/MS	EPA 8321A	4-Nitrotoluene
LC/MS/MS	EPA 8321A	3-Nitrotoluene
LC/MS/MS	EPA 8321A	2-Nitrotoluene
LC/MS/MS	EPA 8321A	PETN
LC/MS/MS	EPA 8321A	RDX
LC/MS/MS	EPA 8321A	TATB
LC/MS/MS	EPA 8321A	Tetryl
LC/MS/MS	EPA 8321A	TNX
LC/MS/MS	EPA 8321A	1,3,5-Trinitrobenzene
LC/MS/MS	EPA 8321A	2,4,6-Trinitrotoluene
LC/MS/MS	EPA 8321A	Tris (o-cresyl) Phosphate
LC/MS/MS	EPA 8321A	2,4-diamino-6-nitrotoluene
LC/MS/MS	EPA 8321A	2,6-diamino-4-nitrotoluene
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	HNAB
HPLC	EPA 8330B	HNS
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	PETN
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	TATB
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(ghi)perylene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
LC/MS/MS	EPA 6850	Perchlorate
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Bismuth
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Cerium
ICP-MS	EPA 6020A	Cesium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Hafnium
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lanthanum
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Neodymium
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Niobium
ICP-MS	EPA 6020A	Palladium
ICP-MS	EPA 6020A	Phosphorus
ICP-MS	EPA 6020A	Platinum
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Praseodymium
ICP-MS	EPA 6020A	Rhodium
ICP-MS	EPA 6020A	Ruthenium
ICP-MS	EPA 6020A	Samarium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silicon
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Sulfur
ICP-MS	EPA 6020A	Tantalum
ICP-MS	EPA 6020A	Tellurium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Thorium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Uranium 233
ICP-MS	EPA 6020A	Uranium 234
ICP-MS	EPA 6020A	Uranium 235
ICP-MS	EPA 6020A	Uranium 236
ICP-MS	EPA 6020A	Uranium 238
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Yttrium
ICP-MS	EPA 6020A	Zinc

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Zirconium
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Bismuth
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Cerium
ICP-MS	EPA 200.8	Cesium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Hafnium
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lanthanum
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Neodymium
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Niobium
ICP-MS	EPA 200.8	Palladium
ICP-MS	EPA 200.8	Phosphorus
ICP-MS	EPA 200.8	Platinum
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Praseodymium
ICP-MS	EPA 200.8	Rhodium
ICP-MS	EPA 200.8	Ruthenium
ICP-MS	EPA 200.8	Samarium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silicon

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Sulfur
ICP-MS	EPA 200.8	Tantalum
ICP-MS	EPA 200.8	Tellurium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Thorium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Tungsten
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Yttrium
ICP-MS	EPA 200.8	Zinc
ICP-MS	EPA 200.8	Zirconium
ICP-AES	EPA 200.7	Aluminum
ICP-AES	EPA 200.7	Antimony
ICP-AES	EPA 200.7	Arsenic
ICP-AES	EPA 200.7	Barium
ICP-AES	EPA 200.7	Beryllium
ICP-AES	EPA 200.7	Bismuth
ICP-AES	EPA 200.7	Boron
ICP-AES	EPA 200.7	Cadmium
ICP-AES	EPA 200.7	Calcium
ICP-AES	EPA 200.7	Chromium
ICP-AES	EPA 200.7	Cobalt
ICP-AES	EPA 200.7	Copper
ICP-AES	EPA 200.7	Iron
ICP-AES	EPA 200.7	Lead
ICP-AES	EPA 200.7	Lithium
ICP-AES	EPA 200.7	Magnesium
ICP-AES	EPA 200.7	Manganese
ICP-AES	EPA 200.7	Molybdenum
ICP-AES	EPA 200.7	Nickel
ICP-AES	EPA 200.7	Phosphorus

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 200.7	Potassium
ICP-AES	EPA 200.7	Selenium
ICP-AES	EPA 200.7	Silicon
ICP-AES	EPA 200.7	Silver
ICP-AES	EPA 200.7	Sodium
ICP-AES	EPA 200.7	Strontium
ICP-AES	EPA 200.7	Sulfur
ICP-AES	EPA 200.7	Thallium
ICP-AES	EPA 200.7	Thorium
ICP-AES	EPA 200.7	Tin
ICP-AES	EPA 200.7	Titanium
ICP-AES	EPA 200.7	Uranium
ICP-AES	EPA 200.7	Vanadium
ICP-AES	EPA 200.7	Zinc
CVAA	EPA 7470A	Mercury
Colorimetric	EPA 9010C EPA 9012B	Cyanide
Ion Chromatography	EPA 300.0/9056A	Bromide
Ion Chromatography	EPA 300.0/9056A	Chloride
Ion Chromatography	EPA 300.0/9056A	Fluoride
Ion Chromatography	EPA 300.0/9056A	Nitrate
Ion Chromatography	EPA 300.0/9056A	Nitrite
Ion Chromatography	EPA 300.0/9056A	Sulfate
Ion Chromatography	EPA 300.0/9056A	Ortho-phosphate
Ion Chromatography	EPA 300.0/9056A	Iodide
Ion Chromatography	EPA 314.0	Perchlorate
Gravimetric	SM 2540B SM 2540C SM 2540D	Solids
Probe	EPA 9040C EPA 9045D EPA 150.1	pH
Titration	SM 2320B EPA 310.1	Alkalinity
Titration	EPA 9030	Sulfide
Penske-Martin	EPA 1010A	Ignitability

Non-Potable Water		
Technology	**Method**	**Analyte**
Colormetric	EPA 353.1	nitrate/Nitrite
Colormetric	EPA 350.1	Ammonia
Colormetric	EPA 351.2	TKN
TOC Analyzer	EPA 9060A	TOC
Tritrmetric	EPA 9020B	TOX
Colormetric	EPA 7196A	Hex Chromium
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	TPH
Probe	EPA 9050A	Conductivity
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Uranium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	Eichrom Technologies FEW01	Iron-55
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Preparation	**Method**	**Type**
Organic Extraction & Sample Prep	EPA 3500C	Organic Extraction & Sample Prep
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Organic prep/analysis	EPA 8000C	Determinative Chromatographic Separations
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Purge & Trap	EPA 5030C	Purge & Trap for Aqueous Volatile

Non-Potable Water		
Preparation	**Method**	**Type**
Sep Funnel Liquid-Liquid Extraction	EPA 3510C	Sep Funnel Liquid-Liquid Extraction
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Florisil Cleanup	EPA 3620C	Florisil Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup
Acid Clean Up	EPA 3665A	Acid Clean Up for PCBs
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Solid Phase Extraction	EPA 3535A	Solid Phase Extraction

Drinking Water		
Technology	**Method**	**Analyte**
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Aluminum
ICP-AES	EPA 6010C	Antimony
ICP-AES	EPA 6010C	Arsenic
ICP-AES	EPA 6010C	Barium
ICP-AES	EPA 6010C	Beryllium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Bismuth
ICP-AES	EPA 6010C	Boron
ICP-AES	EPA 6010C	Cadmium
ICP-AES	EPA 6010C	Calcium
ICP-AES	EPA 6010C	Chromium
ICP-AES	EPA 6010C	Cobalt
ICP-AES	EPA 6010C	Copper
ICP-AES	EPA 6010C	Iron
ICP-AES	EPA 6010C	Lead
ICP-AES	EPA 6010C	Lithium
ICP-AES	EPA 6010C	Magnesium
ICP-AES	EPA 6010C	Manganese
ICP-AES	EPA 6010C	Molybdenum
ICP-AES	EPA 6010C	Nickel
ICP-AES	EPA 6010C	Phosphorus
ICP-AES	EPA 6010C	Potassium
ICP-AES	EPA 6010C	Selenium
ICP-AES	EPA 6010C	Silicon
ICP-AES	EPA 6010C	Silver
ICP-AES	EPA 6010C	Sodium
ICP-AES	EPA 6010C	Strontium
ICP-AES	EPA 6010C	Sulfur
ICP-AES	EPA 6010C	Thallium
ICP-AES	EPA 6010C	Thorium
ICP-AES	EPA 6010C	Tin
ICP-AES	EPA 6010C	Titanium
ICP-AES	EPA 6010C	Uranium
ICP-AES	EPA 6010C	Vanadium
ICP-AES	EPA 6010C	Zinc
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	n-Butanol
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chlorobromomethane
GC/MS	EPA 8260C	2-Chloro-1,3-butadiene
GC/MS	EPA 8260C	Chlorodibromomethane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	Allyl chloride
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260C	Dimethyl disulfide
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl ether
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Freon 113
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	n-Hexane
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutanol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methyl butyl ketone
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Dichloromethane
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	MTBE
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	2-Nitropropane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Nonanal
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	Tetrachloroethene
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	m-Xylene & p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Xylenes (total)
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite (total)
GC/MS	EPA 8270D	Atrazine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzo(ghi)perylene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	1,1'-Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	n-Butylbenzenesulfonamide
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	p-Chlorobenzilate
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Cresols (total)
GC/MS	EPA 8270D	Cyclohexanol
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	1,2-Dichlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	p-Dimethylaminoazobenzene
GC/MS	EPA 8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	Dimethylformamide
GC/MS	EPA 8270D	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloro-1,3-cyclopentadiene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	2-Methylbenzenamine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 8270D	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 8270D	Methylphenols (total)
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-propylamine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	N-Nitrosomethylethylamine
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	p-Phenylene diamine
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 8270D	Thionazin
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	Tris(2-chloroethyl)phosphate
GC/MS	EPA 8270D	1-Methyl naphthalene
GC-ECD	EPA 8081B	Aldrin

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8081B	alpha-BHC
GC-ECD	EPA 8081B	beta-BHC
GC-ECD	EPA 8081B	delta-BHC
GC-ECD	EPA 8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081B	alpha-Chlordane
GC-ECD	EPA 8081B	gamma-Chlordane
GC-ECD	EPA 8081B	Chlordane (technical)
GC-ECD	EPA 8081B	4,4'-DDD
GC-ECD	EPA 8081B	2,4'-DDD
GC-ECD	EPA 8081B	4,4'-DDE
GC-ECD	EPA 8081B	2,4'-DDE
GC-ECD	EPA 8081B	4,4'-DDT
GC-ECD	EPA 8081B	2,4'-DDT
GC-ECD	EPA 8081B	Dieldrin
GC-ECD	EPA 8081B	Endosulfan I
GC-ECD	EPA 8081B	Endosulfan II
GC-ECD	EPA 8081B	Endosulfan sulfate
GC-ECD	EPA 8081B	Endrin
GC-ECD	EPA 8081B	Endrin aldehyde
GC-ECD	EPA 8081B	Endrin ketone
GC-ECD	EPA 8081B	Heptachlor
GC-ECD	EPA 8081B	Heptachlor epoxide
GC-ECD	EPA 8081B	Methoxychlor
GC-ECD	EPA 8081B	Toxaphene
GC-ECD	EPA 8082A	Aroclor 1016
GC-ECD	EPA 8082A	Aroclor 1221
GC-ECD	EPA 8082A	Aroclor 1232
GC-ECD	EPA 8082A	Aroclor 1242
GC-ECD	EPA 8082A	Aroclor 1248
GC-ECD	EPA 8082A	Aroclor 1254
GC-ECD	EPA 8082A	Aroclor 1260
GC-ECD	EPA 8082A	Aroclor 1262
GC-ECD	EPA 8082A	Aroclor 1268
GC-ECD	EPA 8151A	2,4-D
GC-ECD	EPA 8151A	Dalapon
GC-ECD	EPA 8151A	2,4-DB

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8151A	Dicamba
GC-ECD	EPA 8151A	Dichlorprop
GC-ECD	EPA 8151A	Dinoseb
GC-ECD	EPA 8151A	MCPA
GC-ECD	EPA 8151A	MCPP
GC-ECD	EPA 8151A	4-Nitrophenol
GC-ECD	EPA 8151A	Pentachlorophenol
GC-ECD	EPA 8151A	2,4,5-TP (Silvex)
GC-ECD	EPA 8151A	2,4,5-T
LC/MS/MS	EPA 8321A	2,4-D
LC/MS/MS	EPA 8321A	Dalapon
LC/MS/MS	EPA 8321A	2,4-DB
LC/MS/MS	EPA 8321A	Dicamba
LC/MS/MS	EPA 8321A	Dichlorprop
LC/MS/MS	EPA 8321A	Dinoseb
LC/MS/MS	EPA 8321A	MCPA
LC/MS/MS	EPA 8321A	MCPP
LC/MS/MS	EPA 8321A	2,4,5-TP (Silvex)
LC/MS/MS	EPA 8321A	2,4,5-T
LC/MS/MS	EPA 8321A	2-Amino-4,6-dinitrotoluene
LC/MS/MS	EPA 8321A	4-Amino-2,6-dinitrotoluene
LC/MS/MS	EPA 8321A	3,5-Dinitroaniline
LC/MS/MS	EPA 8321A	1,3-Dinitrobenzene
LC/MS/MS	EPA 8321A	2,4-Dinitrotoluene
LC/MS/MS	EPA 8321A	2,6-Dinitrotoluene
LC/MS/MS	EPA 8321A	DNX
LC/MS/MS	EPA 8321A	HMX
LC/MS/MS	EPA 8321A	HNAB
LC/MS/MS	EPA 8321A	HNS
LC/MS/MS	EPA 8321A	MNX
LC/MS/MS	EPA 8321A	Nitrobenzene
LC/MS/MS	EPA 8321A	Nitroglycerin
LC/MS/MS	EPA 8321A	4-Nitrotoluene
LC/MS/MS	EPA 8321A	3-Nitrotoluene
LC/MS/MS	EPA 8321A	2-Nitrotoluene
LC/MS/MS	EPA 8321A	PETN

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 8321A	RDX
LC/MS/MS	EPA 8321A	TATB
LC/MS/MS	EPA 8321A	Tetryl
LC/MS/MS	EPA 8321A	TNX
LC/MS/MS	EPA 8321A	1,3,5-Trinitrobenzene
LC/MS/MS	EPA 8321A	2,4,6-Trinitrotoluene
LC/MS/MS	EPA 8321A	Tris (o-cresyl) Phosphate
LC/MS/MS	EPA 8321A	2,4-diamino-6-nitrotoluene
LC/MS/MS	EPA 8321A	2,6-diamino-4-nitrotoluene
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	HNAB
HPLC	EPA 8330B	HNS
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	PETN
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	TATB
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(ghi)perylene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
GC/MS	EPA 8260C SIM	1,4- dioxane
GC-FID	EPA 8015B	Diesel Range Organics
GC-FID	EPA 8015B	Motor Oil Range Organics
GC-FID	EPA 8015B	TPH (as Diesel)
GC-FID	EPA 8015B	Gasoline Range Organics
GC-FID	EPA 8015B	Ethanol
GC-FID	EPA 8015B	Methanol
GC-FID	EPA 8015B	Ethylene glycol
GC-FID	EPA 8015B	Propylene glycol
LC/MS/MS	EPA 6850	Perchlorate
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Bismuth
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Cerium
ICP-MS	EPA 6020A	Cesium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Hafnium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lanthanum
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Neodymium
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Niobium
ICP-MS	EPA 6020A	Palladium
ICP-MS	EPA 6020A	Phosphorus
ICP-MS	EPA 6020A	Platinum
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Praseodymium
ICP-MS	EPA 6020A	Rhodium
ICP-MS	EPA 6020A	Ruthenium
ICP-MS	EPA 6020A	Samarium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silicon
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Sulfur
ICP-MS	EPA 6020A	Tantalum
ICP-MS	EPA 6020A	Technetium-99
ICP-MS	EPA 6020A	Tellurium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Thorium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Uranium 233
ICP-MS	EPA 6020A	Uranium 234
ICP-MS	EPA 6020A	Uranium 235

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Uranium 236
ICP-MS	EPA 6020A	Uranium 238
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Yttrium
ICP-MS	EPA 6020A	Zinc
ICP-MS	EPA 6020A	Zirconium
CVAA	EPA 7471B	Mercury
Colormetric	EPA 9010C EPA 9012B	Cyanide
Ion Chromatrography	EPA 300.0 EPA 9056A	Bromide
Ion Chromatrography	EPA 300.0 EPA 9056A	Chloride
Ion Chromatrography	EPA 300.0 EPA 9056A	Fluoride
Ion Chromatrography	EPA 300.0 EPA 9056A	Nitrate
Ion Chromatrography	EPA 300.0 EPA 9056A	Nitrite
Ion Chromatrography	EPA 300.0 EPA 9056A	Sulfate
Ion Chromatrography	EPA 300.0 EPA 9056A	Ortho-phosph
Ion Chromatrography	EPA 300.0 EPA 9056A	Iodide
Ion Chromatrography	EPA 314.0	Perchlorate
Gravimetric	SM 2540B SM 2540C SM 2540D	Solids
Probe	EPA 9040C EPA 9045D EPA 150.1	pH
Titration	SM 2320B EPA 310.1	Alkalinity
Titration	EPA 9030	Sulfide
Penske-Martin	EPA1010A	Ignitability
Colormetric	EPA 353.1	nitrate/Nitrite
Colormetric	EPA 350.1	Ammonia
Colormetric	EPA 351.2	TKN
TOC Analyzer	EPA 9060A	TOC

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Colormetric	EPA 7196A	Hex Chromium
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	TPH
Probe	EPA 9050A	Conductivity
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Uranium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	Eichrom Technologies FEW01	Iron-55
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Preparation	**Method**	**Type**
Organic Extraction & Sample Prep	EPA 3500C	Organic Extraction & Sample Prep
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Organic prep/analysis	EPA 8000C	Determinative Chromatographic Separations
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Acid Digestion (solids)	EPA 3050B	Acid Digestion for Metals of Sedimtent/Soils
Purge & Trap	EPA 5030C	Purge & Trap for Aqueous Volatile Samples
Closed System Purge & Trap and Extraction for Volatiles	EPA 5035A	Closed System Purge & Trap and Extraction for Volatiles
Sep Funnel Liquid-Liquid Extraction	EPA 3510C	Sep Funnel Liquid-Liquid Extraction
Ultrasonic Extraction	EPA 3550C	Ultrasonic Extraction Organic Soils
Solid Phase Extraction	EPA 3535A	Solid Phase Extraction
Acid Clean-up	EPA 3665A	Acid Clean Up for PCBs

Solid and Chemical Materials		
Preparation	**Method**	**Type**
Florisil Cleanup	EPA 3620C	Florisil Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup
Waste Dilution	EPA 3585	Waste Dilution Volatile Organics
Waste Dilution	EPA 3580A	Waste Dilution SemiVolatile Organics
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Alkaline Digestion	EPA 3060A	Alkaline Digestion for Hexavalent Chromium

Notes:

1) This laboratory offers commercial testing service.

Approved by: _____ Date: March 6, 2015

R. Douglas Leonard
Chief Technical Officer

Re-Issued: 5/31/13 Revised: 6/17/13 Revised: 12/5/13 Revised: 12/9/13 Revised: 12/16/13
Revised: 5/23/14 Revised: 1/2/15 Revised: 3/6/15

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YOU MAY APPEAL THIS DECISION

Based on the redaction, this constitutes a partial denial of your request. Because your request has been denied in part, you are advised of your right to appeal this determination in writing.

Please refer to the accompanying correspondence from the FOIA Office for directions and information about the appeal process.

Appendix D
HPNS Basewide Stockpile Inventory
(as of October 2, 2015)

Basewide IR-02/Salvage Yard Stockpile Inventory as of October 2, 2015

Stockpile ID	Date Added to RCA	Location within RCA	Date Removed from RCA	Field Comments
Former ITSI Soil/Debris	9/19/2012	MDR		
520D oily soil/oily debris	4/20/2012	MDR		
UNK-001	unknown, prior to 4-7-15	MDR		
UNK-002	unknown, prior to 4-7-15	MDR		
0000	unknown, prior to 4-7-15	IR-02 adjacent to Building 600		
0001	3/26/2015	IR-02 adjacent to Building 600		
0003	3/26/2015	IR-02 adjacent to Building 600		
0004	3/26/2015	IR-02 adjacent to Building 600		
0006	3/26/2015	IR-02 adjacent to Building 600		
0007	3/26/2015	IR-02 adjacent to Building 600		
0010	3/26/2015	IR-02 adjacent to Building 600		
0013	3/26/2015	IR-02 adjacent to Building 600		
0014	3/26/2015	IR-02 adjacent to Building 600		
B707 C1-D4	10/8/2010	Salvage Yard		
B707 C4-D1	10/8/2010	Salvage Yard		
B707 C4-D2	10/8/2010	Salvage Yard		
B708 D1	10/8/2010	Salvage Yard		
B707 C4-D4	10/8/2010	Salvage Yard		
Asphalt 500 SA, SU3-A1	2/8/2012	Salvage Yard		
Asphalt 500 SA, SU16	2/8/2012	Salvage Yard		
Asphalt 500 SA, SU15	2/8/2012	Salvage Yard		
Asphalt 79&80, SU1 A1	11/17/2011	Salvage Yard		
Asphalt 520 SA, SU5 A1	11/16/2011	Salvage Yard		
Asphalt B707 A6-D1, A5-D5, A7-D7, A6-D4, A5-D2, A6-D2	10/8/2010	Salvage Yard		
618	3/22/2012	MDR		
642	3/29/2012	MDR		
644	3/30/2012	MDR		
645	6/8/2012	MDR		
691	5/21/2012	MDR		
693	5/17/2012	MDR		
SBO-9	unknown, prior to 4-7-15	SB4		
Creosote Wood w/ Soil underneath	unknown, prior to 4-7-15	SB4		
Concrete Grindings	8/17/12-9/20/2012	SB4		
Rebar, wire mesh, concrete debris	4/26/2014	SB4		
Asphalt Grindings	8/21/2014	SB4		
647	8/7/2012	SB4		
648	8/3/2012	SB4		
649	8/6/2012	SB4		
650	8/6/2012	SB4		
651	8/7/2012	SB4		
655	8/2/2012	SB4		
CTO 15 Soil	8/15/14 - 9/24/14	SB4		
Brick Grindings	9/20/2012	SB4		
BART Soil	4/20/2012	SB4		
6" drain rock	9/11/2014	SB4		
1.5" drain rock	8/26/2014	SB4		
1.5" drain rock	8/26/2014	SB4		
8" minus/riprap	prior to 4/7/2015	SB4		
base rock	5/19/2014	SB4		
1" minus/pea gravel	prior to 4/7/2015	SB4		
quarry fines	start 5/1/12	SB4		
rock stockpile	5/19/2014	SB4		
poly/debris	unknown, prior to 4-7-15	IR-02 adjacent to Building 600		
SB-03 Debris	unknown, prior to 4-7-15	IR-02 adjacent to Building 600		
SB0-1	unknown, prior to 4-7-15	IR-02 adjacent to Building 600		
SB-07	unknown, prior to 4-7-15	IR-02 adjacent to Building 600		
SB0-8	unknown, prior to 4-7-15	IR-02 adjacent to Building 600		
Imported MD Soil	5/1/2006	IR-02 adjacent to Building 600		

Notes:

SB4 - stockpile location between J and K Streets within IR-02

MDR - Metal Debris Reef; area located at the south eastern portion of IR-02 just east of the intersection of J and Mahan Streets adjacent to RSY 3

BART soil - import material from expansion of Bay Area Rapid Transit System

MD soil - Pennisula Mills import material

Basewide RSY/IDW Inventory as of October 2, 2015

RSY 4

RSY IDW ID	Date Added to RCA	Location within RCA	Date Removed from RSY4 RCA	Field Comments
Container from SB-07	3/11/2015	RSY 4		located on pad E 20
GFLU001173X2	8/26/2015	RSY 4	9/14/2015	transferred to TES

B-211/253

RSY IDW ID	Date Added to RCA	Location within RCA	Date Removed from B-211/253 RCA	Field Comments
CBI Drum 1	6/22/2015	Well Area	9/23/2015	transferred to CB&I
CBI Drum 2	6/22/2015	Well Area	9/23/2015	transferred to CB&I
CBI Drum 3	6/22/2015	Well Area	9/23/2015	transferred to CB&I
Gilbane Drum 1	10/23/2014	B211	9/23/2015	transferred to Gilbane/Arcadis
Gilbane Drum 2	10/23/2014	B211	9/23/2015	transferred to Gilbane/Arcadis
Tt Pallet Box 1	5/3/2013	6th floor outer Mezzanine		roofing stone, glass, concrete roof tile
Tt Pallet Box 2	5/3/2013	6th floor outer Mezzanine		roofing stone, glass, concrete roof tile
Tt Pallet Box 3	5/3/2013	6th floor outer Mezzanine		roofing stone, glass, ceiling tiles
Tt Pallet Box 4	5/3/2013	6th floor outer Mezzanine		roofing stone, glass, ceiling tiles
Tt Pallet Box 5	5/3/2013	6th floor outer Mezzanine		Wall board
Tt Pallet Box 6	5/3/2013	6th floor outer Mezzanine		Wall board
Tt Pallet Box 7	5/3/2013	6th floor outer Mezzanine		Random Debris, pipe floor sweep
Tt Pallet Box 8	5/3/2013	6th floor outer Mezzanine		Random Debris, floor sweep

Basewide Scrap Yard Non-LLRW Stockpile Inventory as of October 2, 2015

Stockpile ID	Date Added	Date Removed	Field Comments
919	6/26/2015[1/]	9/10/2015	Soil and asphalt/debris returned from Keller Canyon Landfill
920	6/23/2015[1/]	9/10/2015	Soil and asphalt/debris returned from Keller Canyon Landfill
921	6/25/2015[1/]	9/10/2015	Soil and asphalt/debris returned from Keller Canyon Landfill

[1/] radiologically cleared asphalt/debris was added to the respective stockpiles on 7/9/15

Appendix E
Contractor Quality Control Plan

APPENDIX E

FINAL
CONTRACTOR QUALITY CONTROL PLAN
Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California

Contract Number: N62473-12-D-2005
Contract Task Order: 0008

Document Control Number: CBI-2005-0008-0005

December 2015

Submitted to:

Base Realignment and Closure
Program Management Office West Naval Facilities Engineering Command
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San Diego, California 92147

Submitted by:

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Concord, California 94520-1120

APPENDIX E

FINAL
CONTRACTOR QUALITY CONTROL PLAN
Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California

Contract Number: N62473-12-D-2005
Contract Task Order: 0008

Document Control Number: CBI-2005-0008-0005

December 2015

Approved by: _____ Date: December 8, 2015
Stephen Massey
Program Quality Control Manager

Approved by: _____ Date: December 8, 2015
John Hackett, PE, CHP, PMP
Project Manager

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Attachment 2 Project Quality Control Duties and Responsibilities
Attachment 3 Project Quality Control Manager Letter of Designation, Resume, and Construction Quality Management Training Certificate
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Attachment 7 Testing Plan and Log
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Attachment 9 Organization and Personnel Certifications
Attachment 10 Procedures

Acronyms and Abbreviations

APP/SSHP	*Accident Prevention Plan, Basewide Radiological Support, Hunters Point Naval Shipyard, San Francisco, California*
CB&I	CB&I Federal Services LLC
CMS	CB&I Management System
COR	Contracting Officer Representative
CQC	contractor quality control
CTO	contract task order
DFOW	definable feature of work
HPNS	Hunters Point Naval Shipyard
IL	investigation level
KO	Contracting Officer
Navy	U.S. Department of the Navy
PM	project manager
QC	quality control
QCD	quality control directive
RASO	Radiological Affairs Support Office
RCT	radiological control technician
RSY	radiological screening yard
WP	work plan

1.0 Introduction

CB&I Federal Services LLC (CB&I) prepared this Contractor Quality Control (CQC) Plan under Contract No. N62473-12-D-2005, Contract Task Order (CTO) 0008 to describe the quality control (QC) actions that will be implemented during the basewide radiological support and stockpile characterization activities at Hunters Point Naval Shipyard (HPNS), San Francisco, California. This CQC Plan will be used in conjunction with the following:

- *Final Construction Quality Management Plan, Contract N62473-12-D-2005, Unrestricted Environmental Multiple Contract Award Contract for Environmental Remediation Services at Various U.S. Department of the Navy, Marine Corps, and U.S. Department of Defense Installations within the NAVFAC Southwest and NAVFAC Atlantic Areas of Responsibility to Include the US Trust Territories of Puerto Rico and Guam* (Shaw Environmental & Infrastructure, Inc., 2012), which includes quality control directives (QCDs)
- *CB&I Management System* (CB&I, 2015a)

Radiological activities include gamma scan surveys and sampling of surface soil and soil/debris stockpiles, routine radiological compliance monitoring, air monitoring, and personnel exposure monitoring. Radiological work will be performed in accordance with U.S. Nuclear Regulatory Commission Radioactive Materials License 20-31340-01, and State of California Radioactive Materials License 7789-07 and associated procedures and work instructions. Radiological safety procedures and roles and responsibilities of the radiological organization are described in the Sitewide Radiation Protection Plan (Appendix A of the Work Plan [WP]).

This project-specific CQC Plan was developed to ensure project activities are conducted in a planned and controlled manner, the product of these activities conforms to contract requirements, and appropriate documentation exists to support each activity for which CB&I is responsible.

A Project QC Manager will be present at the work site to implement and manage the QC Program. The Project QC Manager will work closely with the Project Manager (PM) and with the U.S. Department of the Navy (Navy) quality assurance representatives to assure that the work is performed in compliance with specifications contained in the approved WP and this CQC Plan. The Project QC Manager has the authority to stop work if contract requirements are not being met. In the event that the Project QC Manager is unavailable, an alternate QC Manager will assume this responsibility.

The Program QC Manager for this Navy contract is responsible for developing, maintaining, and enforcing the QC Program for the contract, and will work directly with the PM and the Project QC Manager to assure that all work is performed in compliance with the contract. The Program

QC Manager will serve as an alternate contact for the Project QC Manager if questions arise regarding acceptability of materials or performance during the project.

The PM reports to the Program Manager for the contract, who has the responsibility and authority to ensure that the work is performed according to the approved specifications and to the Navy's satisfaction.

Attachment 1 depicts CB&I's project organization for this CTO. Attachments 2 through 9 are documents from the QCDs tailored to this CTO, which will help achieve statement CTO objectives. If additional project-specific quality procedures are required as the project progresses, these procedures will be inserted into Attachment 10.

2.0 Quality Control Organization

CB&I structured its corporate QC organization to support the Program Managers and PMs who have ultimate responsibility for the quality of services CB&I provides. The Program Managers and PMs are responsible for ensuring that personnel in their organizations understand the corporate and contract-specific QC programs and that their organizations' functions are set up and maintained effectively.

Quality issues are resolved at the lowest possible organizational level at each project site, to enable timely correction action development and implementation. Issues that cannot be satisfactorily resolved at the project level are elevated to and resolved at the corporate level.

CB&I's project organization chart, including QC personnel, is shown in Attachment 1. The figure illustrates the reporting and communication relationships between QC personnel, the CB&I field team, subcontractors, and Navy representatives. This structure provides the organizational freedom for personnel to identify and evaluate quality problems and discrepancies, provide recommended solutions, and ensure that appropriate corrective actions are taken.

The specific responsibilities and qualifications associated with each QC-related position are outlined in Attachment 2. The qualifications and experience of the proposed key appointees for this project are summarized in Attachments 3 and 4.

2.1 Quality Control Personnel and Qualifications

Key QC personnel for CB&I projects are assigned on the basis of appropriate experience and the determination that these individuals meet the contract and CTO-specific requirements. The Project QC Manager and Alternate Project QC Manager are appointed by the Program QC Manager. The following paragraphs identify the QC team for this CTO and highlight their responsibilities. Copies of appointees' resumes, certifications, and letters of designation are included in Attachments 3 and 4.

2.1.1 Project Quality Control Manager

The Project QC Manager, who reports directly to the Program QC Manager, will work closely with the PM, Radiation Safety Officer, Radiation Control Supervisor, and Navy QC representatives to assure that the work is performed in compliance with the specifications contained in the approved WP. The Project QC Manager has the authority to stop work if contract requirements are not being met. The Project QC Manager's responsibilities are listed in Attachment 2. In the event the Project QC Manager is unavailable, an Alternate Project QC Manager will assume this responsibility.

2.1.2 Alternate Project Quality Control Manager

In the event the Project QC Manager is unavailable, an Alternate Project QC Manager will assume the QC responsibilities outlined in Attachment 2 and described in this CQC Plan. The Alternate Project QC Managers designated for this project are identified in Attachment 4.

The project team, including subcontractors, will use procedures in this section to ensure quality and achieve project objectives.

2.2 Quality Control Directives

The following QCDs apply to this CTO:

- QCD 1.0, “Project Quality Control Personnel Duties, Qualifications, and Authority”
- QCD 2.0, “Project Quality Control Plans”
- QCD 3.0, “Design Review”
- QCD 4.0, “Coordination and Mutual Understanding Meeting”
- QCD 5.0, “Project Quality Control Meetings”
- QCD 6.0, “Submittals”
- QCD 7.0, “Documentation”
- QCD 8.0, “Quality Control Certifications”
- QCD 9.0, “Three Phases of Control”
- QCD 10.0, “Completion Inspections”
- QCD 11.0, “Testing”
- QCD 12.0, “Corrective Action Requests and Non-compliance”
- QCD 13.0, “Rework”
- QCD 14.0, “Change Control”
- QCD 15.0, “Organization and Personnel Certifications Log”
- QCD 16.0, “Field Startup”
- QCD 17.0, “PM Turnover”
- QCD 18.0, “Training”
- QCD 19.0 “Quality Audits”
- QCD 20.0 “Quality Control for Geophysical Surveys”

2.3 CB&I Quality Procedures

The following documents describe the administrative and technical requirements for uniform quality performance for this project. These procedures are developed, maintained, and hosted corporately within the CB&I Management System (CMS). Procedures can be accessed by any CB&I employee and will be provided to the government upon request (CB&I, 2015a).

- CMS-720-01-PR-00130, "Quality Management Organization" (supersedes EIP-Q-001, "Quality Organization")
- EIP-Q-002, "Stop Work Notice for Quality Related Issues" (no current CMS equivalent)
- CMS-720-01-PR-00120, "Project Quality Plans" (supersedes EIG-Q-003, "Project Quality Plan")
- CMS-720-02-PR-00480, "Receiving Inspection" (supersedes EIP-Q-004, "Receipt Inspection")
- CMS-720-01-PR-00230, "Construction Inspection Program" (supersedes EIP-Q-005, "Inspection")
- CMS-720-01-PR-00290, "Inspection and Test Plans" (supersedes EIP-Q-005, "Inspection" and EIP-Q-016, "Test Control")
- CMS-720-01-GL-00230, "Guidelines for Quality Surveillance Activities" (supersedes EIP-Q-006, "Surveillance")
- CMS-720-01-PR-00150, "Identification, Control, and Disposition of Nonconforming Product" (supersedes EIG-Q-007, "Nonconformance Reporting")
- CMS-720-01-PR-00170, "Corrective and Preventive Action" (supersedes EIG-Q-008, "Corrective Action")
- CMS-720-01-PR-00220, "Internal Audit Procedure" (supersedes EIG-Q-009, "Quality Audits")
- CMS-720-01-GL-00223, " Qualification and Assessment of Internal Audit Personnel" (supersedes EIP-Q-010, "Auditor and Lead Auditor Qualification Program")
- EIP-Q-014, "Management Assessment" (no current CMS equivalent)
- EIG-Q-015, "Quality Councils" (no current CMS equivalent)

Note: The QCDs take precedence over these procedures

3.0 Outside Organizations

To manage subcontractors and vendors effectively, CB&I carefully selects and prequalifies each firm. CB&I continuously and aggressively manages subcontractor costs, schedule, safety, and quality performance. The pre-qualification process ensures that subcontractors bring the same focus on quality, cost control, schedule discipline, and commitment to customer satisfaction as CB&I. Once an award is made to a subcontractor, CB&I manages the quality of the subcontractor's performance through the three-phase inspection process outlined in Section 9.0.

Laboratories providing environmental analyses are accredited as noted in Section 5.11 of the base contract (N62473-12-D-2005).

Names and qualifications of subcontractors proposed for this project are summarized in Attachment 5. Subcontractors will be subject to CB&I QC procedures. Testing and inspection procedures will be monitored by CB&I as described in Section 5.0.

4.0 Submittal Procedures

Submittals will be managed by CB&I as required by contract. The Project QC Manager will review and approve items prior to submittal. The Project QC Manager will certify that submittals are in compliance with contract requirements. Radiological data will be reviewed by the Project Radiation Safety Officer or designee prior to submittal. Submittals are further discussed under QCD 6.0.

5.0 Testing

In addition to implementing the three phases of the control system to ensure the overall quality of each definable feature of work (DFOW), CB&I will make use of formal testing procedures where applicable, including tests performed by subcontractors and/or off-site laboratories, to ensure conformance to applicable specifications and verify that control measures are adequate to provide a finished product which conforms to contract requirements. The Project QC Manager will ensure that sampling and testing are managed and performed as required by contract.

5.1 Testing Plan and Log

If necessary, the Project QC Manager will use the Testing Plan and Log, contained in Attachment 7, to manage project testing. As tests are performed, the Project QC Manager will record on the log the date the test was performed and the date the test results were forwarded to the Contracting Officer (KO) or Contracting Officer Representative (COR) as applicable. The Project QC Manager will attach a copy of the updated log to the last Daily Contractor QC Report of each month. Chemical or radiological sampling and analyses are normally not included in the log, since requirements are implemented by the Abbreviated Sampling and Analysis Plan (Appendix C of the WP).

5.2 Testing and Documentation

CB&I will submit test reports, containing test results to the KO and/or COR as required by contract. Test reports will cite applicable contract requirements, tests or analytical procedures used, and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, CB&I will notify the KO and/or COR immediately. CB&I will submit the signed test reports, certifications, and other documentation to the KO and/or COR via the Project QC Manager. The Project QC Manager shall submit a summary report of field tests in the Daily Contractor QC Report. Testing is further discussed under QCD 11.0.

6.0 Rework Items, Non-Compliances, and Corrective Action Requests

The Project QC Manager will review any instances where materials, equipment, or activities fail to meet the specified requirements, and will take appropriate action to prevent future occurrences.

6.1 Rework

A rework item is work that does not comply with the contract. There is no requirement to report a rework item that is corrected the same day it is discovered. All CB&I and subcontractor personnel will be responsible for identifying rework items and reporting them to the Project QC Manager. The Project QC Manager will coordinate with the Project Superintendent to ensure rework items are corrected in a timely manner. The Project QC Manager shall maintain a Rework Items List of work that does not comply with the contract, including those identified by the KO or his/her representative. The Project QC Manager will report identified and corrected items in the Daily Contractor QC Report and during Project QC Meetings and will attach a copy of the Rework Items List to the last Daily Contractor QC Report of each month. Rework items are further discussed under QCD 13.0.

6.2 Non-Compliances

The KO may also notify CB&I of any detected non-compliance with the contract. CB&I will take immediate corrective action after receipt of such notice. Such notice, when delivered to CB&I at the work site, shall be deemed sufficient for the purpose of notification. Non-compliances are further discussed under QCD 12.0.

6.3 Corrective Action Requests

CB&I will identify, track, and correct items, processes, and services that do not meet established requirements. Correction will focus on determining the cause of the deficiency and corrective actions will address the deficiency and prevent recurrence. Corrective Action Requests are further discussed under QCD 12.0.

6.4 Procedures for Tracking Laboratory Deficiencies

Laboratory testing requirements for radiological analyses and procedures for identifying and managing any deficiencies are addressed under the Abbreviated Sampling and Analysis Plan (Appendix C of the WP).

7.0 Documentation

A variety of documents will be developed at specified points or intervals during the course of this project to support the QC process. These items will be submitted to the government or maintained by CB&I and made available for review as required. QC-related project documentation may include:

- Testing plan and log
- Daily CQC reports
- Three-phase control inspection checklists (preparatory, initial, and follow-up)
- QC meeting minutes
- Rework items list
- Non-compliance/corrective action reports
- As-built drawings
- Material receipt inspections

Documentation is further discussed under QCD 7.0.

7.1 Daily Reports

CB&I shall submit reports for each day that work is performed as required by contract. Reports will be attached to the Daily Contractor QC Report. The reporting of work shall be identified by terminology consistent with the construction schedule. The "remarks" section of reports will include directions received, construction deficiencies and problems, QC problems, deviations from project plans, conflicts or errors in the drawings or specifications, field changes, instructions given and corrective actions taken, work progress and delays, safety hazards, meetings held, and visitors to the work site.

7.1.1 Daily Contractor Quality Control Report

The Project QC Manager is responsible for preparing and signing the Daily Contractor QC Report. Other QC, production, and health and safety documents may be attached to this report. The Project QC Manager will submit the report to the Navy by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.

7.1.2 Daily Contractor Production Report

The Project Superintendent or designee is responsible for preparing and signing the Daily Contractor Production Report. The report will be attached to the Daily Contractor QC Report.

7.1.3 Quality Control Specialist Report

If a QC Specialist is assigned, he/she shall prepare, sign, and date a report for each day that work is performed in his/her area of responsibility. This report shall include the same documentation requirements as are submitted with the Daily Contractor QC Report.

7.2 Quality Control Meeting Minutes

After the start of construction, the Project QC Manager will commence holding weekly QC meetings with the Site Superintendent, QC staff, and Site Safety and Health Officer. The Navy Remedial Project Manager/COR, Caretaker Site Office, Resident Officer in Charge of Construction, and Radiological Affairs Support Office (RASO) may also attend these meetings as required.

As a minimum, the following will be accomplished at each QC meeting as needed:

- Review the minutes of the previous meeting
- Review the status of work , inspections, testing, rework, and submittals
- Review the work, inspections, and testing to be accomplished in the next two weeks and documentation required
- Resolve QC, production, and safety concerns
- Address items that may require revising the project plans
- Review the accident prevention plan and/or activity hazard analyses as necessary
- Review environmental requirements and procedures as necessary
- Review the following, as applicable
  - Waste Management Plan
  - Radiological Protection Plan
  - Status of training completion and progress

The Project QC Manager will prepare the minutes of the meetings and provide a copy to the COR within two working days after the meeting.

7.3 Quality Control Validation

CB&I shall maintain files of original documents in a home office, including project documents. Copies of project documents will also be filed in the field office. Project files include, but are not limited to, inspection reports and checklists, Testing Plan and Log, Rework Items List, and punch lists. Reports are required from the QC Specialists (if assigned) for each day that work is performed in their area of responsibility. QC Specialist reports shall include the same documentation requirements as the Daily Contractor QC Report for their area of responsibility. QC Specialist reports are to be prepared, signed, and dated by the QC Specialists and shall be attached to the Daily Contractor QC Report prepared for the same day.

7.4 As-Built Drawings

The Project QC Manager shall ensure the as-built drawings are kept current on a daily basis and marked to show deviations from the contract drawings identified with the appropriate modifying documentation. The Project QC Manager or QC Specialist assigned to that area of responsibility shall initial each revision. Upon completion of work, the Project QC Manager will certify the drawings, attesting to their accuracy, and ensure that they are submitted to the CO per QCD 8.0.

8.0 Definable Features of Work

A DFOW is a representative portion of work that is separate and distinct from any other stage of work. Eight DFOWs have been identified for this project, as outlined in the following subsections and further described in the WP. Activities associated with the project will be conducted in accordance with the WP; Abbreviated Sampling and Analysis Plan (Appendix C of the WP); *Accident Prevention Plan/ Site Safety and Health Plan, Basewide Radiological Support at Hunters Point Naval Shipyard, San Francisco, California* (APP/SSHP; CB&I, 2015b); and Sitewide Radiation Protection Plan (Appendix A of the WP) for this project, which provide specific methods and requirements for implementation of the DFOWs.

8.1 Definable Feature of Work 1: Radiological Controls and Postings

CB&I will implement and maintain radiological controls for radiologically impacted areas that are not covered by an on-site radiological remediation contractor according to the current memorandum of understanding, which will be posted within the on-site trailer. Sites will be posted according to existing radiological conditions. Radiological postings will be placed and maintained every 15 meters along perimeter fencing for radiologically impacted sites. Postings and fencing will be inspected on a minimum quarterly basis. Additional fencing will be procured and set up as needed.

In addition, CB&I will maintain a basewide-tracking table of waste piles within the radiologically controlled areas and impacted areas at HPNS. The current version of the table (as of October 2, 2015) is provided as Appendix D. Information from other contractors performing radiological work at HPNS will be consolidated and updated on a regular basis. The radiological status of the waste piles will be verified at a minimum of every two weeks.

8.2 Definable Feature of Work 2: Radiological Surveys

Routine weekly, monthly, and quarterly surface surveys will be performed for those areas that are radiologically impacted at HPNS, but not currently controlled by another licensed radiological contractor. Surface surveys shall cover all radionuclides of concern for each site. Survey activities include dose monitoring, and the collection of swipe samples and static measurements. The main purpose of the surveys is to ensure that there is no change in dose reading at the perimeter that could negatively impact the public or environment and to ensure all security measures are in place. Routine surveys are discussed further in the Sitewide Radiation Protection Plan (Appendix A of the WP). Routine surveys include building surfaces and land areas.

8.3 Definable Feature of Work 3: Radiological Support to Other Contractors

Radiological support and supervision of non-radiological contractors performing work in radiologically impacted areas will be provided by qualified CB&I radiological control technicians (RCTs). At a minimum, the support includes radiological training and escort into and out of an impacted area. The radiological technician assigned to this task must ensure all personnel entering and exiting the impacted areas are properly trained, briefed, supervised, and scanned for radiological contamination upon exiting the site per U.S. Nuclear Regulatory Committee/California license requirements. Additionally, if the contractor is performing intrusive work, surveys of equipment may be required during work efforts.

Prior to entry to an impacted area, CB&I will ensure non-radiological remediation contractors entering the area have the required dosimetry, have completed the radiological awareness briefing, and have been briefed on the requirements established in the radiological work permit in accordance with applicable standard operating procedures. Persons entering an impacted area will sign in and out on an access log and comply with requirements established in the radiological work permit. In addition, personnel exiting an impacted area will be subject to a personnel survey by an RCT.

CB&I will perform radiological sampling and laboratory analysis (as required) in the event that a non-radiological contractor has to perform intrusive activities in an impacted area.

8.4 Definable Feature of Work 4: Incoming and Outgoing Surveys

In support of other contractors, surveys are required for both incoming equipment brought to HPNS and outgoing equipment leaving radiologically impacted areas. During these survey activities, accessible surfaces will be surveyed for removable and fixed surface contamination and the results documented. An equipment tracking log will be maintained for equipment entering and exiting radiologically impacted areas.

8.5 Definable Feature of Work 5: Portal Monitor

CB&I will procure, maintain, and operate a portal monitor for incoming and outgoing trucks loaded with both radiologically and non-radiologically contaminated soils and debris. The purpose of the portal monitor scan is to prevent the inadvertent shipment of materials or equipment exhibiting elevated radiation levels on to or off of HPNS. Hand screening may be required in instances when the portal monitor malfunctions or is unavailable. Loads that fail the portal monitor or hand scan will be escorted by a RCT back to the contractor who generated the soil, or will be dumped and radiologically screened in a controlled area. Additionally, the Base Realignment and Closure Caretaker Site Office Activity point of contact, Navy Remedial Project Manager, and RASO will be notified immediately (same day) if a load fails.

8.6 Definable Feature of Work 7: Stockpile Screening

Stockpiled soil and debris will be spread to an even thickness of 6 to 9 inches across a radiological screening yard (RSY) pad. The soil will then undergo gamma scan and static surveys, biased soil sampling as needed and systematic soil sampling for off-site gamma spectroscopy analysis.

The radiological surveying of soil on the RSY pad is performed in two stages. The first stage is a gamma scan survey conducted over 100 percent of the area. The data collected during the gamma scan are evaluated and if all readings are below the scan investigation level (IL), the second stage is not required. If the count rate exceeds the scan IL, the second stage requires an additional survey and possible sampling of the location where the count rate exceeded the gamma scan IL and nearby areas.

The second stage will consist of reacquiring the elevated scan location and conducting a one-minute static count. The nearby area will be rescanned to assess if the elevated reading is the result of a point source or distributed radioactive material. If the static (one minute) count is less than the instrument-specific static IL and there is no evidence of a point source, further investigation is not required.

Radiological surveys and sample results will be compiled and summarized for RASO review and concurrence prior to designating any material as non-low-level radioactive waste. If the static IL is exceeded or there is evidence of distributed contamination at or above either IL, the soil will sampled and analyzed as appropriate to confirm designation as low-level radioactive waste or low-level mixed waste. If the static measurements are below the IL, but there is a cluster of elevated gamma scan survey readings that exceeded the scan IL, a biased sample or samples, depending on the size of the area, will be collected to determine the nature and extent of contamination present. If the static count is less than the instrument-static IL and there is no evidence of a point source or distributed source, the soil will be systematically sampled as described in the WP.

The process described in this subsection will be repeated until all of the soil from the stockpile has been stages and scanned.

8.7 Definable Feature of Work 8: Soil Sampling

Soil samples will be collected for radionuclides of concern on excavated soil spread on RSY pads to provide analytical data to guide remediation decisions and support site closure.

8.8 Definable Feature of Work 9: Decontamination and Release of Equipment and Tools

Equipment and personnel exiting a work area will follow decontamination procedures presented in the APP/SSHP (CB&I, 2015b). Decontamination areas will be located near work boundary exits. The level of decontamination of equipment will be determined by the Site Health and Safety Officer and Project Radiation Safety Officer. The need for and degree of decontamination will be based on the characteristics of the material within the work area and the potential for transporting contaminants outside of the work area.

Equipment decontamination areas will be constructed by placing an impermeable surface (e.g., plastic sheeting) to catch material removed from equipment. At a minimum, equipment will be decontaminated by dry brushing. Dump trucks and haul trucks removing waste soils and materials from the site will proceed through the on-site truck wash prior to leaving the site.

9.0 Three Phases of Control

The Project QC Manager manages the three phases of control to adequately cover on-site and off-site DFOWs. The Project QC Manager may assign the Task Leader for DFOWs to other project personnel, including the Project Engineer, Project Geologist, Project Superintendent, QC Specialist, etc.

9.1 Preparatory Phase

The Project QC Manager shall notify the CO and/or COR, as applicable at least two work days, two weeks for off-site work, in advance of each preparatory phase meeting. The assigned lead shown on the project DFOW Matrix will conduct the meeting. At a minimum the Project QC Manager, QC staff, Project Superintendent, foreman, and Site Safety and Health Officer will attend. When a subcontractor will perform work, that subcontractor's superintendent shall attend.

9.1.1 Preparatory Phase Activities

The following will occur during the preparatory phase:

- Review each paragraph of the applicable specification sections.
- Review the contract drawings.
- Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.
- Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.
- Review the Testing Plan and Log, and ensure that provisions have been made to provide the required QC testing.
- Examine the work area to ensure that the required preliminary work has been completed.
- Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- Examine the required materials, equipment, and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data.
- Discuss construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems.

- Review the APP/SSHP (CB&I, 2015b) and appropriate activity hazard analyses to ensure that applicable safety requirements are met and that required material safety data sheets are submitted.

Results of the preparatory phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report.

9.2 Initial Phase

The Project QC Manager shall notify the CO and/or COR at least two work days, two weeks for off-site work, in advance of each initial phase. The assigned lead shown on the project DFOW Matrix will perform the initial phase and he/she will observe the initial segment of the DFOW to ensure that the work complies with contract requirements. Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report. Attachments contain this report. The following will be performed:

- Establish the quality of workmanship required
- Resolve conflicts
- Ensure that testing is performed by the approved laboratory
- Check work procedures for compliance with the APP/SSHP (CB&I, 2015b) and the appropriate activity hazard analyses to ensure that applicable safety requirements are met

Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report.

9.3 Follow-up Phase

The assigned lead shown on the project DFOW Matrix will perform the follow-up phase for ongoing work daily, or more frequently as necessary, until the completion of the work. Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report. The following will be performed:

- Ensure the work is in compliance with contract requirements
- Maintain the quality of workmanship required
- Ensure that testing is performed by the approved laboratory
- Ensure that rework items are being corrected
- Perform safety inspections

9.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases will be conducted for a deficiency if the quality of ongoing work remains or becomes unacceptable; there are changes in the applicable QC organization; there are changes in the on-site production supervision or work crew; work is resumed after substantial period of inactivity; or other problems develop. The three phases of control are further discussed under QCD 9.0.

10.0 Completion Inspections

Project inspections that demonstrate completeness are described in this section. Inspections may include a punch-out inspection, pre-final inspection, and final acceptance inspection.

10.1 Punch-Out Inspection

The Project QC Manager will manage completion inspections. Near the completion of all work or to verify that statement of objectives or performance work statements are met, the Project QC Manager will ensure work is inspected and a punch list developed. Punch list items include items that do not conform to the approved drawings, specifications and contract, and remaining rework items. The punch list will indicate the estimated correction dates of these items. A copy of the punch list will be provided to the COR, if required by contract. The Project QC Manager will ensure corrected items are verified. Once this is accomplished, he/she will schedule a pre-final inspection.

10.2 Pre-Final Inspection

The Navy will perform a pre-final inspection to verify that fieldwork is complete. A Navy punch list may be developed as a result of this inspection. The Project QC Manager will ensure that the items on this list are corrected prior to notifying the Navy that a final inspection with the client can be scheduled. Any items noted during the preliminary-final inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work.

10.3 Final Acceptance Inspection

If required by contract, the Project QC Manager will notify the CO and/or COR at least 14 calendar days prior to the date a final acceptance inspection can be held, stating that all items previously identified during the pre-final will be corrected and acceptable, along with any other unfinished contract work, by the date of the inspection. The Project QC Manager, Project Superintendent, and others deemed necessary will be present during the inspection with the Navy. If deficiencies remain or are identified during the inspection, the parties will agree on a course of action. Completion inspections are further discussed under QCD 10.0.

10.4 Inspection Documentation

Inspection records will be maintained by the Project QC Manager in accordance with QCD 7.0.

11.0 References

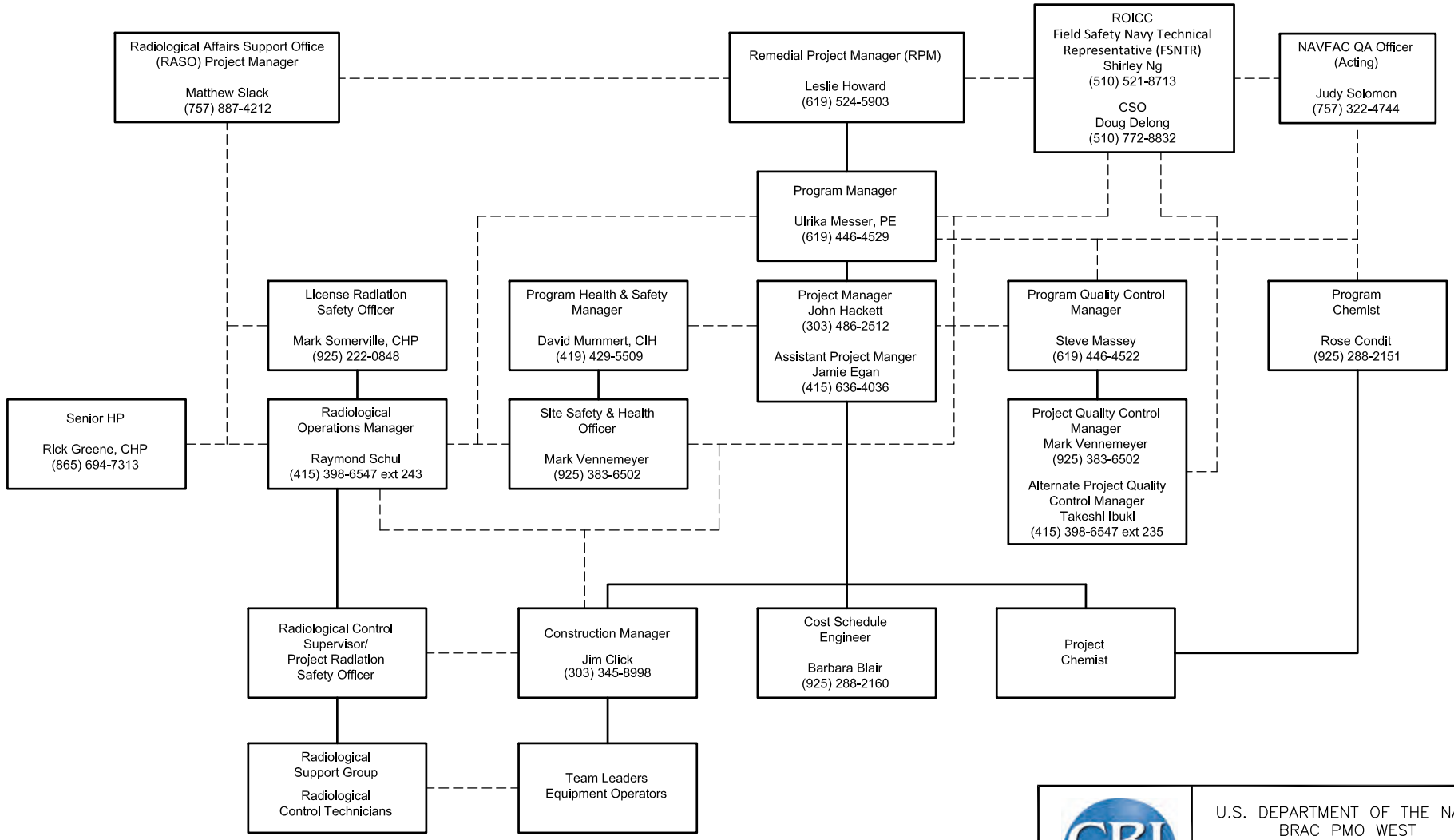
CB&I, 2015a, *CB&I Management System*.

CB&I, 2015b, *Accident Prevention Plan/ Site Safety and Health Plan, Basewide Radiological Support, Hunters Point Naval Shipyard, San Francisco, California, December.*

Shaw Environmental & Infrastructure, Inc., 2012, *Final Construction Quality Management Plan, Contract N62473-12-D-2005, Unrestricted Environmental Multiple Contract Award Contract for Environmental Remediation Services at Various U.S. Department of the Navy, Marine Corps, and U.S. Department of Defense Installations within the NAVFAC Southwest and NAVFAC Atlantic Areas of Responsibility to Include the US Trust Territories of Puerto Rico and Guam*, September.

Attachment 1
Quality Control Organization Chart

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	500523-A1
---	---	Concord	*BLACK*	*10/8/15*						



LEGEND

- - - - - - - - LINES OF COMMUNICATION

———— LINES OF AUTHORITY

U.S. DEPARTMENT OF THE NAVY
BRAC PMO WEST
SAN DIEGO, CALIFORNIA

ATTACHMENT 1
QC ORGANIZATION CHART

BASEWIDE RADIOLOGICAL SUPPORT
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

Attachment 2
Project Quality Control Duties and Responsibilities

Project Quality Control Duties and Responsibilities

Duty	Responsibility	QCD
Pre-Construction Phase		
Establish Personnel Requirements	PM	1.0
Review Personnel Resumes	PM	1.0
Assign Duties	PM	1.0, 2.0
Prepare Organization Chart	PQCM	1.0, 2.0
Prepare Letters of Designation	PQCM	1.0, 2.0
Review Plans and Designs	PM, PQCM	3.0, 7.0
Identify Subcontractors	PM	1.0, 2.0
Submit Laboratory Information	PQCM	1.0, 2.0
Attend Training	all	1.0
Prepare Submittal Register	PQCM	2.0, 6.0
Prepare Definable Features of Work Matrix	PQCM	2.0, 9.0
Prepare Testing Plan and Log	PQCM	2.0, 11.0
Prepare Rework Items List	PQCM	2.0, 13.0
Assemble Forms	PQCM	2.0
Assemble Personnel Certifications	PQCM	8.0, 15.0
Conduct Coordination and Mutual Understanding Meeting	PQCM	4.0
Construction Phase		
Ensure Construction Quality	PM	1.0, 14.0, 16.0, 17.0
Review Definable Features of Work	PQCM	9.0
Ensure Submittals Approved and Submitted	PQCM	3.0, 6.0, 7.0
Conduct Project QC Meetings	PQCM	5.0
Conduct Preparatory Meetings	PQCM	9.0
Conduct Preparatory Inspections	PQCM	9.0
Conduct Initial Inspections	PQCM	9.0
Conduct Follow-Up Inspections	PQCM	9.0
Conduct Completion Inspections	PQCM	10.0
Manage Corrective Action Requests	PQCM	12.0
Manage Rework Items	PQCM	13.0
Provide QC Certifications	PQCM	8.0

Notes:

The PQCM may assign the lead for inspections to the other project personnel: Task Lead, Project Site Superintendent, etc.

PM	*project manager*
PQCM	*project quality control manager*
QC	*quality control*
QCD	*quality control directive*

Attachment 3
Project Quality Control Manager Letter of Designation, Resume, and Construction Quality Management Training Certificate

CONTRACTOR QUALITY CONTROL PLAN
Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California
CONTRACT NUMBER N62473 12 D 2005
CONTRACT TASK ORDER 08

PROJECT QUALITY CONTROL MANAGER
LETTER OF DESIGNATION

December 8, 2015

Mr. Mark Vennemeyer:
This letter will serve to assign you as the CB&I Federal Services LLC Project Quality Control (QC) Manager for the above-captioned contract task order. In this capacity, you will report directly to me and will administer the established requirements of the contract and Project QC Plan. In the case where you are not able to perform the Project QC Manager's duties, Mr. Takeshi Ibuki, Mr. Lee Laws, or Ms. Barbara Matz will serve as your Alternate Project QC Manager. You will manage the three phases of control. You are authorized to stop work that is not in accordance with the contract and will exercise this authority consistent with CB&I Federal Services LLC policies and procedures. You are authorized to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work.

If you have any questions or require additional information, please contact me at 619.446.4552.

Sincerely,

CB&I Federal Services LLC

Stephen Massey
Program QC Manager

Last Updated: 03 Oct 2014

Mark J. Vennemeyer

Professional Qualifications

Mr. Vennemeyer has performed waste management activities for twenty-two(22) years for a variety of private and government clients. For the past 10 years, he also serves as a Construction Quality Control Manager and Site Health and Safety Officer in addition to Transportation and Disposal Coordinator for Shaw's Government Services division in California. He is responsible for ensuring quality standards of workmanship on various remediation projects, inspection of activities and adherence with contractual requirements, safety of workers, compliance with regular training and medical oversight, waste characterization/classification, regulatory oversight, providing technical assistance in matters of Waste Transportation and Disposal Subcontracts, waste sampling, coordination and management of resources necessary to perform off-site transportation and disposal, preparation of waste profiles and shipping papers, and tracking waste shipments to ensure compliance with all applicable regulations.
Mr. Vennemeyer is experienced in "unknown" identification, Treatment Technology requirements, Federal and State (California) waste regulations, and database management. He has great familiarity with CB&I's Safety policies and capability to identify and implement safe work practices in the field.

Education

Bachelor of Science, Chemistry, University of California, Irvine, Irvine, California, [redacted]

Additional Training/Continuing Education

Shipping Hazardous Materials, San Jose, CA, 2014
SARA-OSHA 8-hour refresher, Online, 2014
First Aid / CPR, Concord, CA, 2012
OSHA 30 Hour Construction Safety, On-line, 2010
Construction Quality Management for Contractors, Concord, CA, 2010
Site Safety Officer, Irvine, CA, 2006
IATA Dangerous Goods Shipment, Emeryville, CA, 2004
Hazardous Waste Manifesting, Alameda, CA, 2002
Cyanide Training, Richmond, CA, 1998
Hazardous Waste Supervisor, Richmond, CA, 1998
Hazard Categorization, San Jose, CA, 1995
Emergency Response Training, San Jose, CA, 1995
Radiation Worker 2, Lawrence Livermore National Lab, 1994
40-Hour Hazardous Waste Operations, Sacramento, CA, 1992

Experience and Background

11/2011 - Present
QC Manager / Site Safety and Health Officer, CB&I Federal Services, San Francisco, California

QC manager and Safety officer for several large remedial projects at former Hunters Point Naval shipyard in San Francisco.
Operations included Radiological investigation and remediation; Soil Excavation and backfill; SVE System installation; Zero-valent iron and Bio-substrate Injection; Sampling and Analysis; Munitions investigation.
No lost-time incidents occurred during the project execution.

06/2007 - 10/2011
Quality Control Manager / Site Health and Safety Officer, Shaw Environmental & Infrastructure, Inc., Government Services, Alameda, California

Quality Control manager and Site Safety officer at the Alameda Point project(s). Pojects included contruction of in-situ Remediation systems (DVE for petroleum contamination, 6-phase underground heating for DNAPL plume).

The following is a summary of key projects:
Health & Safety / Quality control, Tank Closure Work / InSitu Treatability Study; Concord NWS, 140389, US Navy, Concord Naval Weapon Station, Concord, CA, 03/2011 - Present
2 Projects: #1 is a Treatability Study using injection to perform bioaugmentation and In-Situ treatment of chlorinated compounds. Site characterization and installation of monitoring wells was also preformed. A Solar-powered SVE system will be used to further remediate the site. #2 was a project to remove five (5) underground fuel tanks from the former Base gas station. All tanks had been cleaned by a previous contractor, Shaw was responsible for the removal of tanks and associated piping as well as backfill / restoration of site.

Accomplishments:
Work performed with no lost-time incidents and successful coordination between base personnel, subcontractors and Shaw staff.

QC & H&S, Moffett Field, 133816, US Navy, Moffett Field, Mountain View, CA, 05/2009 - Present
Site characterization and chemical / biological injection for treatment of chlorinated solvent contamination at 2 sites on Moffett Field. Installation of Monitoring wells, chemical injection and periodic groundwater monitoring are tasks under this job.

Accomplishments:
none

04/2006 - 06/2007
Quality Control Manager, Shaw Environmental & Infrastructure, Inc., Government Services, San Francicso, California

Served as Quality Control Manager and T&D Coordinator at former Treasure Island naval base. Acted as liaison between Navy construction personnel (engineers, Construction technicians) and Shaw. Provided daily reporting and documentation of activities performed each day.

12/2005 - 04/2006
Quality Control Manager / Inspector, Shaw Environmental & Infrastructure, Inc., Government Services, San Diego, California

Worked with operations personnel to establish QC procedures and documentation of Navy owned Treatment, Storage and Disposal facility. Inspection of satellite facility(ies) for compliance to Navy and regulatory requirements.

02/2005 - 11/2005
Construction Quality Control Manager, Shaw Environmental & Infrastructure, Inc., Government Services, Concord, California

Responsibilities include support of client projects as quality control manager. Also responsible for interaction with client's technical representatives, preparing portions of reports, oversight of field work, inspection of materials and work performed.

The following is a summary of key projects:
CQC Manager / SSHO, In-situ Treatability Study, 133816, US Navy, Moffett Federal Airfield, CA, 05/2009 - present
Treatability study for the in-situ remediation of chlorinated solvents. Injection of three (3) separate treatment compounds in distinct areas was done with a quarterly groundwater monitoring program to measure results.

Accomplishments:
All work accomplished with zero lost time incidents

Other Comments:
Additional work was awarded as followup to the initial activities.

QA Inspector, New York City Rapid Repairs Program, 148103, New York City Housing Authority, New York City, New York, $40,000,000.00, 01/2013 - 02/2013
Performed Construction Quality Oversight on work completed by city contractors. Work reviewed included temporary repair of homes damaged by Superstorm Sandy, replacement of water damaged electrical systems, home heating (boiler/furnace) and hot water. Verify and quantify work completed as part of project closeout.

Quality Control Manager / Alternate Site Safety & Health Officer, Hunters Point Shipyard, various, US Navy - BRAC-PMO-W, Hunters Point, San Francisco, CA, $23,000,000.00, 11/2011 - 11/2012
Multiple projects were simultaneously performed at Hunters Point Shipyard. These projects included the Remediation of soils contaminated with Polychlorinated Biphenyls (PCBs), removal of sanitary sewers and storm drain utilities contaminated with radiological hazards, investigation of chlorinated compounds in groundwater, and removal action for a potentially radiologically impacted site.

Accomplishments:
Zero Lost Time during project.

Awards/Client Commendations:
1000 day President's Safety Award.

05/2002 - 02/2005
Transportation and Disposal Coordinator, Shaw Environmental & Infrastructure, Inc., Government Technical Services, Concord, California

Responsibilities include providing technical support for clients as a transportation and disposal coordinator. Also responsible for waste characterization, profiling, manifesting, coordination of subcontractors and disposal facilties for remedial actions, waste tracking and technical documentation of removal / disposal actions.

The following is a summary of key projects:

T&D Coordinator, Carmel Valley Manor, , JM Electric, Carmel, CA, $20,000.00, 03/2005 - 03/2005

Removal and disposal of aged transformers and electrical equipment. Tasks included sampling, characterizing, profiling, manifesting, packaging of equipment according to all applicable federal, state and local regulations.

Transportation and Disposal Coordinator, Hunters Point Shipyard, various, U.S. Navy, San Francisco, CA, 02/2002 - 02/2005

Transport and Disposal Coordinator for various projects at Hunters Point. Responsible for waste sampling, characterization, profiling, manifesting, coordination of waste shipments and technical documentation of disposal activities.
During the span of the project, over 20,000 tons of waste was removed from site and sent to various permitted treatment/disposal facilties.

Transportation and Disposal Coordinator, Alameda Point, former Alameda Naval Air Station, various, U.S. Navy, Alameda, CA, 02/2002 - 02/2005

Coordination of disposal activities for various remedial projects at the Former Alameda Naval Air Station. Tasks included Investigation Derived and Treatment by-product Waste sampling, characterization, profiling, manifesting and coordination of disposal.

Awards/Client Commendations:
President's Safety Award

Transport and Disposal Coordinator, ORC - Cyril, 100735, US EPA, Cyril, OK, $6,000,000.00, 09/2003 - 06/2004

Demolition of a shut-down oil refinery. Disposal of all wastes associated with the facility including petroleum by-products, chemical catalysts, construction demolition debris, abandoned drummed wastes and "laboratory size" chemical bottles.
Much of the structure was recycled as scrap metal, but the area was cleared of Asbestos prior to any demolition activites starting.

Transport and Disposal Coordinator, Hamilton Army Airfield, US Army Corp of Engineers, Novato, CA, 05/2002 - 12/2002

This project was the removal from site and disposal of several thousand tons of waste excavated soil that was staged on site at an Army Airfield that was in closure. Tasks included classification of waste based on analytical results of samples, profiling of waste to seleceted TSDFs, tracking of waste shipments (using the manifest shipping documents) and confirmation of costs associated with transportation and disposal of waste.

12/2000 - 02/2002

Transportation and Disposal Coordinator, IT Corporation (The Shaw Group Inc. acquired substantially all of the operating assets of The IT Group, Inc., on May 23, 2002), Government Services, Concord, California

Responsibilities included providing technical support to client projects as Transport and Disposal

coordinator. Also responsible for field support of waste disposal operations, support of business development activities and composition of certain technical sections of reporting documents.

Mark J. Vennemeyer

Title: Scientist 3
Employee Number: [redacted]
Location: Concord, CA
Location2:
Business Unit: QA/QC, Field
Company: CBI Federal Services

Contact Information

Work Phone: 925-288-2383
Cell Phone: 925.383.6502

Skills

Group: ACCESS AUTHORIZATION
Category: SECURITY
Skill/Experience Level: Internet: Fundamental Knowledge
Skill/Experience Level: Microsoft Acrobat: Fundamental Knowledge
Skill/Experience Level: Microsoft Excel: Fundamental Knowledge
Skill/Experience Level: Microsoft Word: Fundamental Knowledge

Group: BUSINESS ADMINISTRATION SPECIALTIES
Category: EXECUTIVE MANAGEMENT
Skill/Experience Level: Corporate Policies & Procedures Administration: Fundamental Knowledge
Skill/Experience Level: Project Management: Fundamental Knowledge
Category: LEGAL
Skill/Experience Level: Environmental Law : Working Knowledge
Category: PROPOSALS
Skill/Experience Level: Letter Proposals : Fundamental Knowledge
Skill/Experience Level: Project Descriptions : Fundamental Knowledge
Skill/Experience Level: Resumes : Fundamental Knowledge
Skill/Experience Level: Scope of Work Analysis : Fundamental Knowledge
Skill/Experience Level: Technical Writing : Fundamental Knowledge

Group: COMPUTER/INFORMATION TECHNOLOGY SPECIALTIES
Category: COMPUTER APPLICATIONS (User)
Skill/Experience Level: Adobe Acrobat : Working Knowledge
Skill/Experience Level: DOS : Fundamental Knowledge
Skill/Experience Level: Internet : Working Knowledge
Skill/Experience Level: Lotus 1-2-3 : Fundamental Knowledge
Skill/Experience Level: ManageIT : Working Knowledge
Skill/Experience Level: Microsoft Access : Fundamental Knowledge
Skill/Experience Level: Microsoft Excel : Senior
Skill/Experience Level: Microsoft Power Point : Working Knowledge
Skill/Experience Level: Microsoft Word : Senior
Skill/Experience Level: Win 95 : Fundamental Knowledge
Skill/Experience Level: Windows 3.x : Fundamental Knowledge
Skill/Experience Level: Windows 98 : Fundamental Knowledge

Skill/Experience Level: Windows Vista: Working Knowledge
Skill/Experience Level: Windows XP : Working Knowledge
Skill/Experience Level: WordPerfect for Windows : Fundamental Knowledge
Category: COMPUTER/GENERAL
Skill/Experience Level: Computers (desktops/laptops) : Working Knowledge
Skill/Experience Level: Local Area Networks : Fundamental Knowledge
Skill/Experience Level: Peripherals : Fundamental Knowledge

Group: CONSTRUCTION/REMEDIATION SPECIALTIES
Category: CONSTRUCTION/REMEDIATION
Skill/Experience Level: Backfilling : Working Knowledge
Skill/Experience Level: Compaction : Working Knowledge
Skill/Experience Level: Concrete : Fundamental Knowledge
Skill/Experience Level: Construction Management : Fundamental Knowledge
Skill/Experience Level: Demolition : Fundamental Knowledge
Skill/Experience Level: Excavation : Working Knowledge
Skill/Experience Level: Field Inspection : Working Knowledge
Skill/Experience Level: General Construction : Fundamental Knowledge
Skill/Experience Level: Lead-Based Paint Abatement : Fundamental Knowledge
Skill/Experience Level: MTBE : Fundamental Knowledge
Skill/Experience Level: Operation/Maintenance : Fundamental Knowledge
Skill/Experience Level: Oversight : Fundamental Knowledge
Skill/Experience Level: Piping : Fundamental Knowledge
Skill/Experience Level: Site Remediation : Working Knowledge
Skill/Experience Level: Soil Handling/Testing : Fundamental Knowledge
Skill/Experience Level: Stabilization : Fundamental Knowledge
Skill/Experience Level: System Dismantling : Fundamental Knowledge
Skill/Experience Level: Transportation and Disposal : Expert
Skill/Experience Level: Trenching : Fundamental Knowledge
Category: GENERAL/SKILLED LABOR
Skill/Experience Level: Carpentry : Fundamental Knowledge
Skill/Experience Level: Concrete Finishing : Fundamental Knowledge
Skill/Experience Level: Pipe Fitting : Fundamental Knowledge
Skill/Experience Level: Trenching : Fundamental Knowledge
Skill/Experience Level: Welding : Fundamental Knowledge

Group: CONSULTING SPECIALTIES
Category: ASSESSMENT/EVALUATION
Skill/Experience Level: Radiological Surveys : Fundamental Knowledge
Skill/Experience Level: RCRA Facility Assessment : Fundamental Knowledge
Skill/Experience Level: Waste Characterization : Expert
Category: AUDITS
Skill/Experience Level: Compliance : Fundamental Knowledge
Skill/Experience Level: Environmental : Fundamental Knowledge
Skill/Experience Level: Health & Safety : Senior
Skill/Experience Level: Protocol Development : Fundamental Knowledge
Skill/Experience Level: Quality Assurance : Fundamental Knowledge
Category: CONSULTING
Skill/Experience Level: EH&S Management : Fundamental Knowledge
[redacted]
Skill/Experience Level: Contaminated Waste Disposal : Senior

Skill/Experience Level: Debris and Waste Management : Working Knowledge
Skill/Experience Level: Hazardous Substance Characterization : Senior
Category: LAND PLANNING
Skill/Experience Level: Regulatory Compliance : Working Knowledge
Category: OUTSOURCING/PRIVATIZATION
Skill/Experience Level: Construction Management : Fundamental Knowledge
Category: TRAINING (Provided to Client)
Skill/Experience Level: Asbestos Abatement : Fundamental Knowledge
Skill/Experience Level: Emergency Response to Hazardous Substance Releases : Working Knowledge
Skill/Experience Level: Environmental Regulations Course : Working Knowledge
Skill/Experience Level: Government Compliance : Fundamental Knowledge
Skill/Experience Level: Hazard Communication : Working Knowledge
Skill/Experience Level: Hazardous Waste Operations : Senior
Skill/Experience Level: Health and Safety Courses and Seminars : Fundamental Knowledge
Skill/Experience Level: Operations : Fundamental Knowledge
Skill/Experience Level: Project Management : Fundamental Knowledge
Skill/Experience Level: Quality Assurance/Quality Control : Fundamental Knowledge
Skill/Experience Level: RCRA Site-Specific Course : Fundamental Knowledge
Skill/Experience Level: Regulatory : Working Knowledge
Skill/Experience Level: Specific Chemical Hazards : Fundamental Knowledge
Skill/Experience Level: Total Quality Management : Fundamental Knowledge

Group: ENERGY DELIVERY SERVICES
Category: EQUIPMENT OPERATED
Skill/Experience Level: Air Compressor: Fundamental Knowledge
Skill/Experience Level: Articulated Truck: Fundamental Knowledge
Skill/Experience Level: Backhoe: Fundamental Knowledge
Skill/Experience Level: Backhoe/Excavator: Fundamental Knowledge
Skill/Experience Level: Bobcat: Fundamental Knowledge
Skill/Experience Level: CAT 320 Excavator: Fundamental Knowledge
Skill/Experience Level: Dozer/Loader: Fundamental Knowledge
Skill/Experience Level: Drill Rig: Fundamental Knowledge
Skill/Experience Level: Fork Lift: Working Knowledge
Skill/Experience Level: Front End Loader: Fundamental Knowledge
Skill/Experience Level: Jack Hammer: Fundamental Knowledge
Skill/Experience Level: Man Lifts: Fundamental Knowledge
Skill/Experience Level: Skid Steer: Fundamental Knowledge
Skill/Experience Level: Truck (Fundamental Knowledge
Skill/Experience Level: Vac Truck: Fundamental Knowledge

Group: ENVIRONMENTAL SPECIALTIES
Category: AIR
Skill/Experience Level: Perimeter Monitoring : Fundamental Knowledge
Category: ANALYTICAL
Skill/Experience Level: Data Validation : Fundamental Knowledge
Skill/Experience Level: Field Analytical Methods : Working Knowledge
Skill/Experience Level: Geotechnical Testing : Fundamental Knowledge
Skill/Experience Level: Laboratory Analytical Methods : Working Knowledge
Skill/Experience Level: X-ray Fluorescence (XRF): Fundamental Knowledge
Category: REGULATORY

Skill/Experience Level: Analysis : Fundamental Knowledge
Skill/Experience Level: CERCLA : Working Knowledge
Skill/Experience Level: Code of Federal Regulations : Senior
Skill/Experience Level: Compliance : Fundamental Knowledge
Skill/Experience Level: Emergency Response: Fundamental Knowledge
Skill/Experience Level: Hazardous Waste Evaluation : Senior
Skill/Experience Level: RCRA Compliance : Working Knowledge
Skill/Experience Level: TSCA : Working Knowledge
Category: WASTE MINIMIZATION/POLLUTION PREVENTION
Skill/Experience Level: Recycling : Fundamental Knowledge
Skill/Experience Level: Waste Minimization/Pollution Control : Fundamental Knowledge

Group: FACILITY MANAGEMENT-SRM/MISSION SUPPORT SERVICES
Category: BUSINESS OPERATIONS
Skill/Experience Level: Administration : Fundamental Knowledge
Skill/Experience Level: Procurement : Fundamental Knowledge
Skill/Experience Level: Property Management : Fundamental Knowledge
Skill/Experience Level: Quality Control : Senior
Skill/Experience Level: Safety Management : Senior
Category: ENVIRONMENTAL SERVICES
Skill/Experience Level: Bilge & Oily Waste Treatment Plant O&M : Fundamental Knowledge
Skill/Experience Level: Hazardous Waste Handling, Storage & Disposal : Expert
Skill/Experience Level: Laboratory Services : Fundamental Knowledge
Category: JOC/IDIQ/SUSTAINABILITY, RELIABILITY, MAINTENANCE (SRM) CONSTRUCTION
Skill/Experience Level: Construction Management : Fundamental Knowledge
Skill/Experience Level: Project Management : Fundamental Knowledge
Skill/Experience Level: Quality Control : Working Knowledge
Skill/Experience Level: Superintendent : Fundamental Knowledge
Category: LOGISTICS
Skill/Experience Level: Shipping & Packing : Fundamental Knowledge
Skill/Experience Level: Warehouse Operations : Fundamental Knowledge
Category: ROADS & GROUNDS SERVICES
Skill/Experience Level: Erosion Control : Fundamental Knowledge
Category: VEHICLE/EQUIPMENT O&M
Skill/Experience Level: Equipment Operations : Fundamental Knowledge
Skill/Experience Level: Vehicle Operations : Fundamental Knowledge

Group: FIELD SERVICES SPECIALTIES
Category: ABOVEGROUND STORAGE TANKS
Skill/Experience Level: Aboveground Storage Tanks : Fundamental Knowledge
Skill/Experience Level: Cleaning : Fundamental Knowledge
Skill/Experience Level: Removal : Fundamental Knowledge
Category: ASBESTOS
Skill/Experience Level: Abatement : Fundamental Knowledge
Skill/Experience Level: Asbestos : Fundamental Knowledge
Category: DRILLING
Skill/Experience Level: Borings : Working Knowledge
Skill/Experience Level: Drilling : Working Knowledge
Skill/Experience Level: Geoprobe : Working Knowledge
Skill/Experience Level: Monitoring Well Installation : Working Knowledge

Skill/Experience Level: Recovery Well Installation : Fundamental Knowledge
Category: DRUMS
Skill/Experience Level: Cleaning : Fundamental Knowledge
Skill/Experience Level: Crushing/Disposal : Senior
Skill/Experience Level: Drums : Expert
Skill/Experience Level: Removal : Fundamental Knowledge
Skill/Experience Level: Selection of Drum Type: Senior
Skill/Experience Level: Testing : Fundamental Knowledge
Skill/Experience Level: Waste Characterization : Expert
Skill/Experience Level: Waste Disposal & Shipping : Expert
Category: EQUIPMENT SKILLS
Skill/Experience Level: Backhoe: Fundamental Knowledge
Skill/Experience Level: Bobcat: Fundamental Knowledge
Skill/Experience Level: Bulldozer: Fundamental Knowledge
Skill/Experience Level: CAT 320 Excavator: Fundamental Knowledge
Skill/Experience Level: Drill Rig: Fundamental Knowledge
Skill/Experience Level: Dump Truck: Fundamental Knowledge
Skill/Experience Level: Fork Lift: Working Knowledge
Skill/Experience Level: Front End Loader: Fundamental Knowledge
Skill/Experience Level: Man Lifts: Fundamental Knowledge
Skill/Experience Level: Truck (Fundamental Knowledge
Skill/Experience Level: Truck (>26,001): Fundamental Knowledge
Skill/Experience Level: Vac Truck: Working Knowledge
Skill/Experience Level: Water Truck: Fundamental Knowledge
Category: OPERATIONS AND MAINTENANCE
Skill/Experience Level: Manuals/Procedures : Fundamental Knowledge
Skill/Experience Level: Pilot-Plant Operations : Fundamental Knowledge
Skill/Experience Level: Soil Vapor Extraction Systems : Fundamental Knowledge
Skill/Experience Level: Wastewater Treatment Plant Operations : Fundamental Knowledge
Category: SAMPLING
Skill/Experience Level: Air : Fundamental Knowledge
Skill/Experience Level: Drilling : Fundamental Knowledge
Skill/Experience Level: Drums : Working Knowledge
Skill/Experience Level: Fixed Laboratory Analysis : Fundamental Knowledge
Skill/Experience Level: Mobile Laboratory Analysis : Fundamental Knowledge
Skill/Experience Level: Sampling : Working Knowledge
Skill/Experience Level: Soil : Working Knowledge
Skill/Experience Level: Underground Storage Tanks : Fundamental Knowledge
Skill/Experience Level: Wipe : Working Knowledge
Category: SURVEY
Skill/Experience Level: General Surveying : Fundamental Knowledge
Skill/Experience Level: GPS Control : Fundamental Knowledge
Skill/Experience Level: Hazardous Waste Survey : Fundamental Knowledge
Skill/Experience Level: Horizontal and Vertical Control : Fundamental Knowledge
Skill/Experience Level: Topographic : Fundamental Knowledge
Skill/Experience Level: Utility Locates : Fundamental Knowledge
Category: UNDERGROUND STORAGE TANKS
Skill/Experience Level: Cleaning : Fundamental Knowledge
Skill/Experience Level: Removal : Fundamental Knowledge
Skill/Experience Level: Testing : Fundamental Knowledge
Skill/Experience Level: Underground Storage Tanks : Fundamental Knowledge

Group: PROJECT MANAGEMENT SPECIALTIES
Category: CONSTRUCTION MANAGEMENT - SUBCONTRACTS ADMINISTRATION
Skill/Experience Level: Bid Analysis: Working Knowledge
Skill/Experience Level: Change Management: Fundamental Knowledge
Skill/Experience Level: File Management: Fundamental Knowledge
Skill/Experience Level: Spreadsheet Development: Fundamental Knowledge
Skill/Experience Level: Subcontract Bid Evaluation: Fundamental Knowledge
Skill/Experience Level: Subcontract Conformance: Fundamental Knowledge
Skill/Experience Level: Subcontract Pricing and Costing: Fundamental Knowledge
Skill/Experience Level: Subcontractor Prequalification Review: Fundamental Knowledge
Skill/Experience Level: Time and Materials Cost Control: Fundamental Knowledge
Skill/Experience Level: Union Labor Experience: Fundamental Knowledge
Category: ENGINEERING PROJECT CONTROLS
Skill/Experience Level: Construction Management Planning & Scheduling : Fundamental Knowledge
Category: PROCUREMENT
Skill/Experience Level: Inspection: Fundamental Knowledge
Skill/Experience Level: Logistics: Fundamental Knowledge
Skill/Experience Level: Purchasing: Fundamental Knowledge
Category: PROJECT ACCOUNTING
Skill/Experience Level: Billing Support : Fundamental Knowledge
Skill/Experience Level: Cost Accounting : Fundamental Knowledge
Skill/Experience Level: Government Property : Fundamental Knowledge
Skill/Experience Level: Procurement/Sourcing : Fundamental Knowledge
Skill/Experience Level: Shaw Policies/Procedures : Working Knowledge
Category: PROJECT MANAGEMENT
Skill/Experience Level: Construction Management : Fundamental Knowledge
Skill/Experience Level: Contract Management - Cost Reimbursable: Fundamental Knowledge
Skill/Experience Level: Contract Management - Firm Fixed Price: Fundamental Knowledge
Skill/Experience Level: Contract Management - T&M : Fundamental Knowledge
Skill/Experience Level: Cost/Scheduling : Fundamental Knowledge
Skill/Experience Level: Project Management : Fundamental Knowledge
Skill/Experience Level: Site Management : Fundamental Knowledge
Skill/Experience Level: Technical/Report Writing : Fundamental Knowledge

Group: TECHNICAL SPECIALTIES
Category: CONTAMINANT REMEDIATION
Skill/Experience Level: Acids : Fundamental Knowledge
Skill/Experience Level: Alkaline : Fundamental Knowledge
Skill/Experience Level: Arsenic : Fundamental Knowledge
Skill/Experience Level: Benzene : Fundamental Knowledge
Skill/Experience Level: Cadmium : Fundamental Knowledge
Skill/Experience Level: Chromium : Fundamental Knowledge
Skill/Experience Level: Compressed Gases: Fundamental Knowledge
Skill/Experience Level: Corrosives : Fundamental Knowledge
Skill/Experience Level: Cyanide : Fundamental Knowledge
Skill/Experience Level: DCA : Fundamental Knowledge
Skill/Experience Level: DCE : Fundamental Knowledge
Skill/Experience Level: Dioxin : Fundamental Knowledge
Skill/Experience Level: Flammable : Working Knowledge

Skill/Experience Level: Heavy Metals : Working Knowledge
Skill/Experience Level: Lead : Working Knowledge
Skill/Experience Level: Lead-Based Paint : Working Knowledge
Skill/Experience Level: Mercury : Fundamental Knowledge
Skill/Experience Level: Oil Refinery Waste : Fundamental Knowledge
Skill/Experience Level: Oily Sludge : Fundamental Knowledge
Skill/Experience Level: PCA : Fundamental Knowledge
Skill/Experience Level: PCE : Fundamental Knowledge
Skill/Experience Level: Petrochemical Refinery Waste : Fundamental Knowledge
Skill/Experience Level: Petroleum/Oil : Working Knowledge
Skill/Experience Level: Radioactive Waste (i.e., Plutonium, Uranium, etc.) : Fundamental Knowledge
Skill/Experience Level: Reactives (Air, Water) : Fundamental Knowledge
Skill/Experience Level: TCA : Fundamental Knowledge
Skill/Experience Level: TCE : Fundamental Knowledge
Skill/Experience Level: TPH : Working Knowledge
Skill/Experience Level: TSCA Managed Waste : Working Knowledge
Category: HEALTH AND SAFETY
Skill/Experience Level: Accident Investigation : Working Knowledge
Skill/Experience Level: Construction : Working Knowledge
Skill/Experience Level: Health Physics : Fundamental Knowledge
Skill/Experience Level: Industrial Hygiene : Fundamental Knowledge
Skill/Experience Level: Manuals/Procedures : Fundamental Knowledge
Skill/Experience Level: Noise : Working Knowledge
Skill/Experience Level: OSHA Reportables : Working Knowledge
Skill/Experience Level: Personnel Monitoring : Working Knowledge
Skill/Experience Level: Program Development : Fundamental Knowledge
Skill/Experience Level: Site Safety/Health Officer : Expert
Category: MIXED WASTE
Skill/Experience Level: Characterization : Fundamental Knowledge
Skill/Experience Level: Mixed Waste : Fundamental Knowledge
Category: NUCLEAR/RADIOLOGY
Skill/Experience Level: Radioactive Waste Management : Fundamental Knowledge
Category: QUALITY ASSURANCE
Skill/Experience Level: Analytical/Chemical Quality : Fundamental Knowledge
Skill/Experience Level: Construction : Working Knowledge
Skill/Experience Level: Engineering : Working Knowledge
Skill/Experience Level: Manuals/Procedures : Fundamental Knowledge
Skill/Experience Level: Plan Preparation : Fundamental Knowledge
Skill/Experience Level: Quality Control : Senior
Category: TREATMENT/REMEDIATION
Skill/Experience Level: Air Sparging : Fundamental Knowledge
Skill/Experience Level: Bioremediation : Fundamental Knowledge
Skill/Experience Level: Chemical Oxidation : Fundamental Knowledge
Skill/Experience Level: Contaminated Sediments : Fundamental Knowledge
Skill/Experience Level: Decontamination : Working Knowledge
Skill/Experience Level: Demolition : Fundamental Knowledge
Skill/Experience Level: Excavation : Working Knowledge
Skill/Experience Level: Groundwater Treatment : Fundamental Knowledge
Skill/Experience Level: Hazardous Materials Cleanup : Working Knowledge
Skill/Experience Level: Hazardous Waste Transportation : Senior

Skill/Experience Level: Soil Remediation : Fundamental Knowledge
Skill/Experience Level: Treatability Testing : Fundamental Knowledge
Skill/Experience Level: Wastewater Treatment : Fundamental Knowledge

Other Information

Years of Experience

Previous Employers: 9.00
CB&I: 14
Total of 23.00 year(s) experience

Experience in EPA Regions

Region 9 (AZ CA HI NV American Samoa, Guam, TT)

Industry Experience

Environmental

NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST

U.S. ARMY Corps of Engineers

US Army Corps of Engineers®

NAVFAC

PRESENTS THIS CERTIFICATE TO

Mark Vennemeyer

WHO HAS SUCCESSFULLY COMPLETED

January 28 & 29, 2010

U.S.A.C.E. Construction Quality Management for Contractors

Kugan Panchadsaram PE, PMP
CQM Facilitator
Kugan & Associates Inc.

San Diego Chapter, Inc
"Building Your Quality of Life"

Glen Schaffer
AGC-San Diego Director of Marketing & Education
CQM Training Coordinator

This Certificate is valid for 5 years from the date above

the IT group

CERTIFICATE *of* COMPLETION

Presented To

Mark J. Vennemeyer

In Recognition of Having Successfully Completed the Prescribed Course of Study for

40-Hour HAZWOPER Training

OSHA 29 CFR 1910.120 (e) (2) (i) through (e) (2) (vii)

I certify that the above trainee has completed this training course as given by The IT Group or one of its subsidiaries.

10/16/1992

EFFECTIVE DATE

Don L. Unruh

DON L. UNRUH, CIH, CSP
Manager, Internal Training Group

Student Affiliation:
CB&I Federal Services
4433

Compliance Solutions
"Today's Training...Tomorrow's Solution"

3980 Quebec St., 2nd Floor, Denver CO 80207-1633 800-711-2706

Certificate of Completion

This is to certify that

Mark J. Vennemeyer

has been tested and successfully meets the training requirements for

8-Hour HAZWOPER Refresher
as per 29 CFR 1910.120(e)

Presented
Friday, June 12, 2015

Compliance Solutions Occupational Trainers, Inc.

Neval Gupta
Vice President

Jeffrey E. Kline
President/CEO

Certificate Number: *754898199*

American Red Cross

Mark Vennemeyer

has successfully completed requirements for

Adult and Pediatric First Aid/CPR/AED: 2 Years

Date Completed: 03/22/2014

conducted by: American Red Cross

Instructor: Michael H Houston

ID: 0V0WFA

Scan code or visit:
redcross.org/confirm

This Certifies

Successful Completion Of The

SIPP Part 1 HSE Training for Supervisors

Name of Training Course

05-01903

Course Number

3.00

CEU

Mark Vennemeyer

Name

W B Hodges

Instructor

April 22, 2015

Date

This certification is only valid for CB&I and its subsidiaries and is not to be relied upon by any other employers of the named individual.

This Certifies

Successful Completion Of The

SIPP Part 2 CB&I Construction Safety

Name of Training Course

05-01904

Course Number

1.00

CEU

Mark Vennemeyer

Name

Instructor

April 24, 2015

Date

This certification is only valid for CB&I and its subsidiaries and is not to be relied upon by any other employers of the named individual.

Attachment 4
Alternate Project Quality Control Manager Letter of Designation, Resume, and Construction Quality Management Training Certificate

CONTRACTOR QUALITY CONTROL PLAN
Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California
CONTRACT NUMBER N62473 12 D 2005
CONTRACT TASK ORDER 08

PROJECT QUALITY CONTROL MANAGER
LETTER OF DESIGNATION

December 8, 2015

Mr. Takeshi Ibuki, Mr. Lee Laws, Ms. Barbara Matz:

This letter will serve to assign you as CB&I Federal Services LLC Alternate Project Quality Control (QC) Manager for the above-captioned contract task order. In the case where the designated Project QC Manager, Mr. Lee Laws is unable to perform the Project QC Manager's duties, you will serve in that capacity with his responsibilities and authorities, report directly to me, and administer the established requirements of the contract and Project QC Plan. You will manage the three phases of control. You are authorized to stop work that is not in accordance with the contract and will exercise this authority consistent with CB&I Federal Services LLC policies and procedures. You are granted the authority to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work. You are authorized to act as an alternate for two weeks at one time and not more than 30 workdays during a calendar year. In the case where it is believed that these time periods will be exceeded, you must notify me.

If you have any questions or require additional information, please contact me at 619.446.4552.

Sincerely,

CB&I Federal Services LLC

Stephen Massey
Program QC Manager

Takeshi Ibuki

[redacted]

EXPERIENCE:

CB&I Federal Services, LLC

Radiological Engineer, May 2013 to Present

Remediation projects for Navy's former base at Treasure Island, San Francisco

- Quality Control of all radiological survey data that are submitted by radiological control technicians
- Analyze survey data
- Coordinate and consult radiological work plan, instruct survey documentation methods, provide advices about survey methods and instrumentation to radiological control technicians. Surveillance of activities as part of the three phases of control to ensure that work complies with the project plans
- Prepare radiological survey report for submission to the US Navy and the California Department of Public Health

Shaw Environmental & Infrastructure, Inc.

Radiological Controls Supervisor, May 2012 to February 2013

Remediation projects at Hunters Point Shipyard in San Francisco

- Supervise 14 radiological control technicians on a 27 acre site surveying soil, concrete, sediment, and steel
- Coordinate schedules and plans with other working groups
- Assign tasks, monitor progress and surveillance of work to ensure quality is maintained per the project plans
- Ensure personnel experience and training so that they can satisfactorily perform their duties
- Write daily reports, perform self-assessments, ensure all work is done in accordance with approved work plans and procedures
- Support New York City Rapid Repair Program (Hurricane Sandy Recovery) as an environmental health and safety officer

Shaw Global Services, LLC

Radiological Controls Specialist, July 2011 to December 2012

Support Recovery Projects at Fukushima Daiichi Nuclear Power Plant, Japan

- Installation of Shaw's simplified active water retrieve and recovery system (SARRY)
- Monitor radiation levels on work areas, calculate stay times and track worker exposure to ensure that limits are not exceeded
- Installation of the On-Site Wireless Radiation Monitoring System (SWRM)
- Provide trainings on the SWRM to Tokyo Electric Company Co. personnel and Toshiba engineers
- Maintenance and troubleshooting support for SWRM
- Assisted with business development efforts to forward negotiations

  Work with Ando Corp (a Japanese construction company)
- Provided support for and consulted on the recovery project plan in Minamisoma City, Fukushima Japan

Shaw Environmental & Infrastructure, Inc.

Radiological Controls Supervisor, February 2011 to July 2011

Remediation projects at Hunters Point Shipyard, San Francisco

Primary responsibilities included:

- Supervised field staff for survey, site remediation and decontamination, use of survey equipment and instrumentation, and support of radiation safety program
- Ensured Radiological Control Technician work was done compliance with project plans and other applicable procedures for safety program, survey, and/or remediation actions

- Ensured compliance with NRC, OSHA, and EPA directives, as well as applicable local, state, and federal statutes and codes
- Reviewed radiological field documentation for accuracy, quality, and completeness
- Ensured that each individual working at an impacted area complied with the requirement specified in the RWP
- Supported Fukushima Projects, Tokyo Japan (April to May 2011)

Aerotek Environmental & Engineering

Senior Radiological Controls Technician, September 2010 to February 2011
Remediation projects at Hunters Point Shipyard, San Francisco
Primary responsibilities included:

- Supervised and surveillance of radiological work performed by junior work crews
- Performed radiation and contamination surveys and performed air sampling and analysis
- Radiological survey
- Instrument checks
- Responded to radiological emergencies and conducted incident investigations

Kansai Electric Power Co., Takahama Nuclear Power Plant

Radioactive Waste Management, Supervisor, April 1995 to December 1999

- Prepared radiation level reports for submission to government.
- Supervised characterization disposal and transportation of radioactive waste.
- Performed hazard evaluations, recommended appropriate controls and monitoring procedures.
- Conducted audits of work areas and facilities. Performed ALARA reviews and recommended corrective actions as necessary.
- Created and implemented radiation and contamination control practices and maintenance of the work environment.

Environmental Radiation Safety Technician, Supervisor, April 1988 to April 1995

- Created policies and enforced standards for radiation safety in the work environment.
- Reviewed radiation safety reports submitted from subcontractors.
- Created permissible level of radiation exposure chart to be used during maintenance periods.
- Decontaminated equipment, environment and people.
- Supervised hazardous waste disposal and handling.
- Member of response team for radiological emergencies.

Radiation Safety Technician, April 1985 to April 1988

- Performed radiation and contamination surveys, inventories, leak tests and audits of work areas.
- Provided trained on the use of radiation measurement equipment and tools.
- Maintained safe work environments.
- Performed analysis of the effects of radiation on organs and tissues.

Plant Operator, September 1984 to April 1985

- Trained in Nuclear Power Plant operations.
- Checked data and monitored daily operations.
- Decontaminated and performed maintenance on nuclear systems and machinery.

EDUCATION:

University of California, Berkeley, B.S. in Mechanical Engineering, December [redacted]

CERTIFICATIONS AND TRAINING:

- ***US Army Corps of Engineers***, San Diego CA 2014. Construction Quality Management for Contractors.
- ***Japan Radioisotope Association***, Tokyo, Japan 1997: Complete System Maintenance Course, From Supply to Disposal of Radioisotope Products
- ***Certified in Class 1 Radiological Control***, Japan 1994: Passed national certification exam.

- ***National Institute of Radiological Science***, Chiba, Japan 1992: Human-Radiation Interface course and Radiation Protection and Safety course
- Fundamentals of Engineering (FE/EIT)
- 40 Hour HAZWOPER and 8-hr refreshers (current)
- OSHA 30-Hour Construction, 2013
- Japan Class 1 Radiological Control/Handing National Certificate (passing rate 20%)
- Japan Class 1 Work Environment Safety Control and Measurement

OTHER INFORMATION:

- [redacted]
- [redacted]
- [redacted]
- ***English Classes***, October 2001 to December 2002
- ***Nippon European Motors***, Car Repair Technician, January 2003 to December 2003
- ***College of Alameda***, Formal English Course Work, [redacted]
- ***Physics Tutor at College of Alameda***, September 2005 to December 2007

U.S. ARMY CORPS OF ENGINEERS

USACE LEARNING CENTER
HUNTSVILLE, ALABAMA

NAVFAC

CERTIFICATE

Takeshi Ibuki

SW9-02-14-00223

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

San Diego, CA	5/15/14 - 5/16/14	SW9 - NAVFAC Southwest	Michael Haliburton PMP, PE
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager

Kugan Panchadsaram	kugan@kugan.com	858-212-2941	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

Jeffrey D. Ziadzic
Chief, USACE Learning Center

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: https://www.myuln.net

Compliance Solutions

"Today's Training... Tomorrow's Solution"

3980 Quebec St, 2nd Floor Denver, CO 80207-1633 800-711-2706

Student Affiliation:
Aerotek
99071924

Certificate of Completion

This is to certify that

Takeshi Ibuki

has been tested and successfully meets the training requirements for

40-Hour HAZWOPER

29 CFR 1910.120(e)

Presented

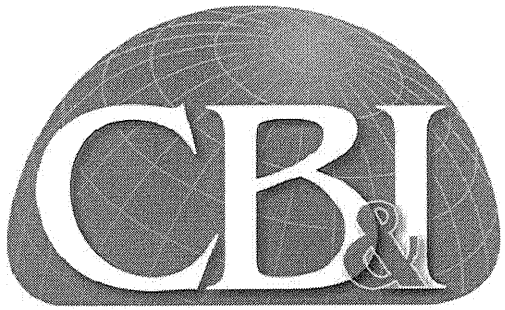
Monday, August 09, 2010

Compliance Solutions Occupational Trainers, Inc.

Certificate Number: 754811781

Neval Gupta
Vice President

Jeffrey Kline
President/CEO



This certificate is awarded to

Takeshi Ibuki

for the successful completion of the course

8-Hour HAZWOPER Refresher

Hours: 8 Hours 0 Min Credits: 0

Completion Date: 8/27/2013

Virgil Barton, Sr. Vice President
Quality, EHS, Regulatory Compliance,
Process Improvement

Certificate of Completion

Presented to:

TAKESHI IBUKI

On 2/20/2013, TAKESHI IBUKI successfully completed the OSHA 30 Hour Outreach Training for the Construction Industry.

Taylor Alan Sikes

OSHA Training Institute Education Center

USF University of South Florida

American Safety Council .com

OSHA Authorized Trainer

As an OSHA authorized trainer, I verify that I have conducted this OSHA outreach training class in accordance with OSHA Outreach Training Program requirements. I will document this class to my authorizing OSHA training organization. Upon successful review of my documentation, I will provide each student their completion card within 90 days of the end of the class.

Lee H. Laws

Professional Qualifications

Mr. Laws has more than 16 years of QA/QC experience with IT Corporation and The Shaw Group (May 2002 - Present), functioning since 1996, as Project QC Manager on the Navy EFA West Remedial Action Contract (RAC). This project experience has encompassed all phases of CERCLA Removal and Remedial Action cleanups, Superfund and National Priority List (NPL) sites, and numerous petroleum cleanups (e.g., USTs, ASTs) at federal facilities, industrial and residential properties under contracts from the U.S. Navy, U.S. Army Corps of Engineers (USACE), and U.S. Department of Energy (DOE).

Since 1999, Mr. Laws has served as the Lead QC Manager at Naval Station Treasure Island/Yerba Buena Island, which is a top priority Base Realignment and Closure (BRAC) base on the $250M Navy EFA West RAC. During this time period, the project backlog has grown to 16 environmental cleanup Contract Task Orders (CTO's 006, 012, 016, 036, 039, 040, 043, 045, 046, 089, 099, 102, 105, 106, 131, 134) with a total budget of over $37M, including a current backlog of over $20M. Treasure Island CERCLA, RCRA and petroleum cleanup projects have been executed with a high degree of involvement and oversight from the Navy, City of San Francisco, State and County regulatory agencies and local citizen groups who occupy the impacted property.

In support of this growing basewide cleanup program, Mr. Laws has prepared all CTO QC plans, provided ongoing project team and subcontractor coordination of task-specific QC inspections (including interface with two Government QA Resident Officers in Charge of Construction), and maintained all project QC documentation in a cost-effective MS-Access database. Mr. Laws produces project deliverables, including QC records and technical reports, in Adobe (pdf) format on CD-ROM, which substantially reduces project cost. Navy EFA West RAC six-month performance evaluations have consistently rated the Treasure Island QC Program "Level 1 - Outstanding," which has translated into an additional $1,664,316 of award fee profit (to-date) to IT Corporation and The Shaw Group

Education

High School Diploma, General Education, Pittsburg High Schol, Pittsburg, California, [redacted]

Additional Training/Continuing Education

USACE CQM Training, Sacramento, 2004
DHS Lead Supervisor/Monitor, UC Berkeley, 2000

Registrations/Certifications/Licenses

USACE Construction Quality Control Manager, 2004, Active, Nationwide, 11/2008

Experience and Background

05/2002 - Present
Project QC Manager, Shaw Environmental & Infrastructure, Inc., Quality, Concord, California

2002 - Present IT Corporation/Shaw Environmental & Infrastructure, Concord, California.
Project QC Manager on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC)

Naval Station Treasure Island, San Francisco, California.

Currently serve as the Lead QC Manager. Responsible for the planning, development and project team implementation of Project QC Plans and documentation on 10 environmental cleanup contract task orders with a total budget of over $37M. Projects involve the design, construction, operation, optimization and maintenance of remediation action systems (e.g., Soil Vapor Extraction); soil sampling, analysis, excavation, treatment, transportation and disposal; and site restoration in sensitive public housing areas. Mr. Laws effectively plans, coordinates and verifies task-specific QC inspections with Task Leaders, the Site Health & Safety Officer, Navy Resident Officers in Charge of Construction (ROICCs) and subcontractors. Mr. Laws also performs independent quality assurance audits, surveillances, and inspections of laboratories and field project activities to verify compliance with established QA program requirements

10/1996 - 05/2002
Project QC Manager, IT Corporation, Martinez, California

1996 - 2002 IT Corporation/Shaw Environmental & Infrastructure, Concord, California.
Project QC Manager on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC)

Naval Station Treasure Island, San Francisco, California.

Currently serve as the Lead QC Manager. Responsible for the planning, development and project team implementation of Project QC Plans and documentation on 10 environmental cleanup contract task orders with a total budget of over $37M. Projects involve the design, construction, operation, optimization and maintenance of remediation action systems (e.g., Soil Vapor Extraction); soil sampling, analysis, excavation, treatment, transportation and disposal; and site restoration in sensitive public housing areas. Mr. Laws effectively plans, coordinates and verifies task-specific QC inspections with Task Leaders, the Site Health & Safety Officer, Navy Resident Officers in Charge of Construction (ROICCs) and subcontractors. Mr. Laws also performs independent quality assurance audits, surveillances, and inspections of laboratories and field project activities to verify compliance with established QA program requirements.

China Lake Naval Air Weapons Station, Ridgecrest, California.
Served as the Project QC Manager. Responsible for the implementation of the site specific work plans and the quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan, specifications and requirements based on the program contract. Responsibilities also included performing reviews of documentation and the preparation of daily CQC reports that were submitted to the Navy on the next business morning.

Naval Communication Station, Stockton, California.
Served as the Site Health and Safety Officer. Responsible for providing independent surveillance of the routine implementation of the site safety and health plan. Conducted daily Tailgate Safety Meetings, verified personnel had necessary training and medical clearance to enter work area, performed daily equipment calibrations, monitored personnel for compliance with site safety and health plans, and performed monthly safety inspections.

Yerba Buena Island Housing, Yerba Buena, California.
Served as the Project QC Manager for Lead Base Paint Abatement. Responsible for the implementation of the site specific work plans and the quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports, which were submitted to the Navy on the next business morning.

Alameda Naval air Station, Alameda, California.
Served as the Project QC Manager and Site Superintendent. Responsibilities included implementation of the site specific work and quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Also performed reviews of documentation and prepared daily CQC reports, which were submitted to the Navy on the next business morning. My responsibilities as Site Superintendent included daily production, scheduling activities, ordering equipment and site safety.

Department of Defense Housing, Novato, California.
Served as the Project QC Manager. Responsible for the implementation of the site specific work and quality control plans, as well as daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports that were submitted to the Navy on the next business morning.

Naval Medical Center, Oakland, California.
Served as the Project QC Manager. Responsible for the implementation of the site specific work and quality control plans in addition to daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements, which were based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports which were submitted to the Navy on the next business

08/1995 - 10/1996
Quality Control Coordinator, IT Corporation, San Jose, California

1995 - 1996 IT Corporation, San Jose, California
Quality Control Coordinator, Engineers Services
Responsible for field QC activities, ensuring that fieldwork was being performed in accordance with the requirements written in the project work plans and procedures. Specific project experience and responsibilities included:

Hamilton Army Air Field, Novato, California.
Served as a Quality Control Inspector for the QC group. Responsible for daily field inspections and the preparation of daily QC reports. Performed reviews of documentation and other duties designated by the Program QC Manager.

07/1993 - 08/1995
Field Analytical Specialist II, IT Corporation, Field Analytical Services, Martines, California

1993 - 1995 IT Corporation, Martinez, California
Field Analytical Specialist II, Field Analytical and Sampling (FAS)
Responsible for organizing and participating in field analytical and sampling activities. Ensured sample protocols were followed, and coordinated between field and laboratory to meet project needs. Specific project experience and responsibilities included the following:

IBM, San Jose, California.
Served as a "lead man" for a demolition crew of three to six employees. Responsible for guidance and inspection of crew?s work. Insured health and safety around work area.

MCAGCC, Twenty Nine Palms, California.
Served as the sample coordinator working with the Jacobs Engineers Group Navy/Clean program at this DOE Superfund site. Acted as Liaison between the field and the laboratory: ordering glassware, coordinating sampling, documenting sampling, and maintaining the field database.

03/1989 - 07/1993
Assistant Field Analytical Specialist, IT Corporation, Martinez, California

1989 - 1993 IT Corporation, Martinez, California
Assistant Field Analytical Specialist, Field Analytical and Sampling (FAS)
Responsible for environmental monitoring on various RI/FS projects in the Western United States. Primary responsibilities were groundwater compliance, soil organic vapor sampling, and soil sampling. Some specific experience include the following:

Mather Air Force Base, Rancho Cordova, California.
Served as a sample team leader in the areas of SOV, soil, and groundwater sample collection. Trained new employees in proper sampling and documentation procedures. Responsible for providing instruction and performing tasks in the areas of monitoring well development, dedicated pump and packer installation, and proper operation of such equipment. Gained experience with sample collection around drill rigs and [redacted] Acted as liaison between the field and analytical laboratory. Fulfilled the Sample Coordinator's position in his absence.

Castle Air Force Base, Merced, California.
Served as Assistant Sample Coordina¬tor during this major RI/FS project. Acted as liaison between the field operations and the office. Helped supervise the groundwater sampling and pump installation phases of the project.

U.S. ARMY CORPS OF ENGINEERS

USACE LEARNING CENTER
HUNTSVILLE, ALABAMA

NAVFAC

CERTIFICATE

LEE LAWS

#SPK511400875

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

SACRAMENTO, CA	7/17-7/18/14	SACRAMENTO/SPK	DREW A. PERRY
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager

DREW A. PERRY	DREW.A.PERRY@USACE.ARMY.MIL	(916) 557-7779	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

Chief, USACE Learning Center

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: https://www.myuln.net

Last Updated: 09 Apr 2015

Barbara A. Matz

Professional Qualifications

Ms. Matz has over 25 years of experience in geology and hazardous waste site characterization, including field geology, soil and groundwater sampling, data evaluation, plan preparation, report writing, subcontractor oversight, environmental compliance, interaction with public utilities and regulatory agencies, site safety and QC oversight, and technical review. Ms. Matz has supported, designed, and managed soil and groundwater monitoring programs in accordance with RCRA and CERCLA regulations, and achieved closure of UST sites with approval of State agencies. She has worked with a wide variety of federal and state agencies, as well as large commercial clients. Ms. Matz has maintained excellent client relations, high health and safety standards, and met quality assurance objectives throughout her career. She is a certified Site Safety Officer and Quality Control Manager, and a registered California Professional Geologist.

Education

Master of Science, Geology, University of Nevada - Reno, Reno, Nevada, [redacted]
Bachelor of Science, Geology, University of Nevada - Reno, Reno, Nevada, [redacted]
Bachelor of Science, Biology, Michigan Technological University, Houghton, Michigan, [redacted]

Additional Training/Continuing Education

OSHA 8-hour HAZWOPER refresher, October 2014
USACE Quality Systems Management, online refresher, 2012
Site-specific Radiation Worker Training, Shaw Treasure Island, 2012
10-Hour Construction Safety, Shaw Findlay OH, 2011
50-hour Site Safety Officer Training, Shaw, Findlay OH, 2011
Sustainable Remediation Methods for Soils and Water, UC Berkeley Extension, 2011
XRF Operations and Safety, Shaw San Francisco, 2010
USACE Quality Systems Management, 2007
Contaminant Forensics, NW Env Training Center, 2007
OSHA 1926 Construction Site Supervisor, Shaw E&I, 2004
Characterization & Toxicity Assessment of Mine Waste, Geological Society of America, 2004
Aerial Photography Interpretation Workshop, Groundwater Res Assn of CA, 2003
Ecological Risk Assessment Short Course, UC Berkeley Extension, 2002
Natural Attenuation Short Course, UC Berkeley Extension, 2001
Lead and Asbestos Site Supervisor Refreshers, UC Berkeley Extension, 1997
Asbestos Sampler and Site Supervisor, Field Sciences Inst, Albq NM, 1996
Lead Sampler and Site Supervisor, Field Sciences Inst, Albq NM, 1996
OSHA Excavation Safety Training, IT Corporation, 1994
Graduate Geology Seminars - University of New Mexico, 1991-1993
OSHA Hazardous Waste Site Supervisor, IT Corporation, 1992
Radiation Safety, Sandia National Laboratories, 1991
OSHA 40-Hour Hazardous Waste Operations, IT Corporation, 1989

Registrations/Certifications/Licenses

USACE Construction Quality Control Manager, 2007, Active, Nationwide, expires 10/2017
Professional Geologist, 2000, Active, California #7117, expires 10/2016

Experience and Background

01/2013 – Present
Project Geologist/QCM/SSO, CB&I Federal Services, Concord, California

Acting QCM at former Alameda Naval Station, CA (August 2013 to present); alternate SSO for Site 29, Naval Weapons Station Seal Beach, Concord, CA (August 2013 to present); served as QCM and SSO at former Naval Station Treasure Island, San Francisco, CA (January 2013); provided QC review of reports and plans for a variety of sites in California, Nevada, and Arizona (January 2013 through present); supported U.S. Army Redstone Arsenal, Huntsville, AL, by writing and reviewing various chapters of RI Reports for groundwater and soil sites (February 2013 through present).

01/2007 - 01/2013
Task Manager, Shaw Environmental & Infrastructure, Inc., San Francisco, California

Project: Naval Station Treasure Island. Tasks: Site 12 SWDAs, Building 233 Demolition. Work included task management: subcontractor oversight, plan and report preparation, procurement support, field supervision, client/agency meetings; and QC oversight: inspections, daily reports, meetings, and field work variance preparation; acting QC / SSO during January 2013.

05/2002 - 12/2011
Project Geologist, Shaw Environmental & Infrastructure, Inc., Concord, California

Project: TERC II National Park Service. Provided support to client projects as technical and task manager, site geologist, site safety and QC officer. Investigated sites at national parks including Yosemite, Lassen Volcanic, Redwood, Whiskeytown, and Death Valley. Responsibilities included budget and plan preparation, field work variance preparation, client meetings, supervision of technical staff and subcontractors, data evaluation, and report preparation.

The following is a summary of key projects:
Technical Manager, Treasure Island Site 12, 122412, US Navy, Treasure Island, San Francisco, CA, $12,000,000.00, 03/2007 - present
Remediation of former solid waste disposal areas by excavation and soil replacement, including radiation monitoring and confirmation sampling for chemical and radiological contaminants.

Accomplishments:
Planning, subcontractor oversight, client meetings, data management and presentation, reporting, QC oversight.

Technical/Task Manager, TERC II - NPS, 870508, USACE and National Park Service, Yosemite National Park, CA, $3,000,000.00, 05/1999 - Present
Budget preparation, plan preparation, procurement support, supervision of Shaw and subcontractor field personnel, soil and groundwater sample collection, site safety and QC oversight, data evaluation, report preparation, and meetings with client and regulatory agencies.

Accomplishments:
Closure of three UST sites, closure pending on one additional UST site.

Outreach, WalMart, WalMart, various, 01/2006 - 10/2006
Prepare and distribute Environmental Compliance Manuals to WalMart stores in Arkansas, Louisiana, Arizona, and Colorado.

Accomplishments:
Planning, manual preparation, manual distribution, store manager training.

Site Geologist, Navy CLEAN RAC - NAVSTA Treasure Island, 843431, Navy, Treasure Island, San Francisco, CA, 04/2003 - 06/2005
Building 233 Survey - Procurement support, plan preparation, supervision of Shaw and subcontractor field personnel, soil and groundwater sampling, data evaluation, and report preparation.

Project Geologist, Treasure Island CTO 99, US Navy, Treasure Island, San Francisco, CA, 04/2003 - 02/2005
Data gaps investigation of CERCLA sites.

Accomplishments:
Field sampling, data evaluation, report preparation.

Project Geologist, Hamilton Field, USACE and Army, Hamilton Field, Novato, CA, 06/1997 - 05/1999
Investigation of former army airfield, including soil, sediment, and water sampling.

Accomplishments:
Plan preparation, field sampling, subcontractor oversight, reporting, client and regulatory meetings.

Project Scientist, Sandia National Laboratories, US Department of Energy, Sandia National Laboratories, Albuquerque, NM, 11/1989 - 06/1997
Planning, budget preparation, procurement, field sampling, subcontractor oversight, reporting, client and regulator interaction.

Accomplishments:
Managed groundwater monitoring tasks at two landfills, managed basewide background groundwater monitoring, participated in building decontamination/demolition sampling, and various small sampling and reporting tasks on the base.

Project Scientist, Nevada Test Site, Off-Site Projects, various, US Department of Energy, various sites around U.S., 10/1993 - 05/1997
Supported off-site projects at Hattiesburg MS and Rifle CO - field sampling, subcontractor oversight, reporting. Intermittent assignments concurrent with Sandia and other off-site projects.

Accomplishments:
Managed confirmation sampling program, installed deep monitoring wells, met site requirements within QC and H&S standards.

Project Scientist, Carswell NAS, US Navy, Carswell Naval Air Station, Forth Worth TX, 04/1995 - 05/1995
Monitoring well installation, groundwater sampling.

Accomplishments:
Subcontractor oversight, client interaction.

04/2003 - 01/2007
Task Manager, Shaw Environmental & Infrastructure, Inc., San Francisco, California

Project: Naval Station Treasure Island. Tasks: Environmental Baseline Study, Site 12 Trench Investigation, Building 233 Survey. Work included field sampling, subcontractor oversight, plan and report preparation, procurement support, client meetings.

06/1997 - 05/2002
Project Geologist, IT Corporation (The Shaw Group Inc., acquired substantially all of the operating assets of The IT Group, Inc., on May 23, 2005), Concord, California

Performed as task manager, technical manager, and site geologist for a variety of sites and clients. Responsible for budget input, plan preparation, procurement support, field planning, field supervision of staff and subcontractors, review of analytical data, preparation of reports, meetings with client and applicable regulators to review work and needs.

11/1989 - 06/1997
Geologist, IT Corporation, Albuquerque, New Mexico

Planning, site supervision, reporting.

Professional Affiliations

Geological Society of America, Professional Member, none, 2004
American Institute of Professional Geologists, Registered Member, none, 2002
Northern California Geological Society, Regular Member, President, 2007-2009, 2000

Barbara A. Matz

Title: Scientist 4
Employee Number: [redacted]
Location: Concord, CA
Location2:
Business Unit: Fed AS&E West, Home
Company: Shaw Environmental, Inc

Contact Information

Work Phone: 925-288-2337
Cell Phone: 415-713-8482

Skills

Group: FIELD SERVICES SPECIALTIES
Category: DRILLING
Skill/Experience Level: Borings : Working Knowledge
Skill/Experience Level: Drilling : Working Knowledge
Skill/Experience Level: Geoprobe : Working Knowledge
Skill/Experience Level: Monitoring Well Installation : Working Knowledge
Category: SAMPLING
Skill/Experience Level: Asbestos : Fundamental Knowledge
Skill/Experience Level: Drilling : Working Knowledge
Skill/Experience Level: Drums : Fundamental Knowledge
Skill/Experience Level: Sampling : Working Knowledge
Skill/Experience Level: Soil : Working Knowledge
Skill/Experience Level: Underground Storage Tanks : Working Knowledge
Skill/Experience Level: Wipe : Working Knowledge
Category: UNDERGROUND STORAGE TANKS
Skill/Experience Level: Cleaning : Fundamental Knowledge
Skill/Experience Level: Closure : Working Knowledge
Skill/Experience Level: Removal : Working Knowledge
Skill/Experience Level: Testing : Fundamental Knowledge

Group: TECHNICAL SPECIALTIES
Category: GEOLOGY
Skill/Experience Level: Engineering Geology : Fundamental Knowledge
Skill/Experience Level: Fault Studies : Working Knowledge
Skill/Experience Level: Geologic Studies : Working Knowledge
Skill/Experience Level: Geological Age Dating : Working Knowledge
Skill/Experience Level: Geophysical Survey : Fundamental Knowledge
Skill/Experience Level: Geotechnical Studies : Fundamental Knowledge
Skill/Experience Level: Remote Sensing : Working Knowledge
Skill/Experience Level: Seismicity Evaluation : Fundamental Knowledge
Skill/Experience Level: Structural Geology : Working Knowledge
Skill/Experience Level: Structural Mapping : Working Knowledge
Category: SITE INVESTIGATION
Skill/Experience Level: Aerial Photography Interpretation : Working Knowledge
Skill/Experience Level: Borehole Television : Fundamental Knowledge

Skill/Experience Level: Excavation of Test Pits/Trenches : Working Knowledge
Skill/Experience Level: Ground Penetrating Radar : Fundamental Knowledge
Skill/Experience Level: Groundwater Monitoring/Recovery Well Installation: Working Knowledge
Skill/Experience Level: Permeability Testing : Fundamental Knowledge
Skill/Experience Level: RCRA Facility Investigation : Working Knowledge
Skill/Experience Level: Remedial Action Plan : Working Knowledge
Skill/Experience Level: Remedial Investigation : Working Knowledge
Skill/Experience Level: RI/FS : Working Knowledge
Skill/Experience Level: Risk Assessment : Fundamental Knowledge
Skill/Experience Level: Site Investigation : Working Knowledge
Skill/Experience Level: Subsurface Investigation : Working Knowledge
Skill/Experience Level: Test Pits : Working Knowledge
Skill/Experience Level: Topographic Survey : Working Knowledge
Skill/Experience Level: Trenching : Working Knowledge
Category: WATER RESOURCES
Skill/Experience Level: Limnology : Fundamental Knowledge
Skill/Experience Level: Storm Water Management : Fundamental Knowledge
Skill/Experience Level: Water Quality : Fundamental Knowledge
Skill/Experience Level: Wells : Working Knowledge

Other Information

Years of Experience

Previous Employers: 0.00
CB&I: 25.25
Total of 25.25 year(s) experience

Experience in EPA Regions

Region 6 (AR LA NM OK TX)
Region 8 (CO MT ND SD UT WY)
Region 9 (AZ CA HI NV American Samoa, Guam, TT)

Industry Experience

Environmental

U.S. ARMY CORPS OF ENGINEERS

PROFESSIONAL DEVELOPMENT SUPPORT CENTER
HUNTSVILLE, ALABAMA

CERTIFICATE

This is to certify that

BARBARA MATZ

has completed the Corps of Engineers Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS

Given at **Sacramento, CA** (Location) By **Sacramento** (Instructional District) **17 & 18 OCTOBER 2007** (Date)

Facilitator

Expires: October 18, 2012
Verification (916) 557-7708

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE

Chief, USACE Professional Development Support Center

Attachment 5
Outside Organizations

Outside Organizations

Organization Name/Address/Phone	Description of Services
TestAmerica	Environmental Analytical Services
JRM/Harris Blade/Indian Eyes	Heavy Equipment Rental Services

Attachment 6
Submittal Register

SUBMITTAL REGISTER

CONTRACT NUMBER
N62473 12 D 2005
CTO 0008

Title and Location: ***Basewide Radiological Support, Hunters Point Naval Shipyard, San Francisco, California***

Contractor
CB&I Federal Services LLC

Specification Section
Scope of Work

Transmittal No.	Item No.	Specification Paragraph No.	Description of Item Submitted	Type of Submittal									Classification		Reviewer	Contractor Schedule Dates			Contractor Action			Government Action		Remarks
				Data	Drawings	Instructions	Schedules	Statements	Reports	Certificates	Samples	Records	Information only	Government approved		Submit	Approval needed by	Material needed by	Code	Date	Submit to government	Code	Date	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
	001	Section 7.0	Copy of NRC and CA License and SOPs					X		X			X											
	002	Section 7.0	MOU Modifications/Revisions		X			X						X										
	003	Section 7.0	Kickoff Meeting Minutes					X						X										Within 10 days of meeting
	004	Section 7.0	Monthly Status Reports					X					X											
	005	Section 7.0	Internal Draft Project Plans and SAP		X		X	X						X										
	006	Section 7.0	Draft Work Plan		X		X	X						X										
	007	Section 7.0	Final Work Plan		X		X	X						X										
	008	Section 7.0	Draft Radiological Protection Plan		X			X						X										
	009	Section 7.0	Final Radiological Protection Plan		X			X						X										
	010	Section 7.0	Draft Waste Management Plan		X			X						X										
	011	Section 7.0	Final Waste Management Plan		X			X						X										
	012	Section 7.0	Draft Abbreviated SAP		X			X						X										
	013	Section 7.0	Draft Abbreviated SAP		X			X						X										
	014	Section 7.0	Draft APP/SSHP		X			X						X										
	015	Section 7.0	Final APP/SSHP		X			X						X										
	016	Section 7.0	Radiological Waste Pile Tracking		X			X						X										Once every two

SUBMITTAL REGISTER

CONTRACT NUMBER
N62473 12 D 2005
CTO 0008

Title and Location: ***Basewide Radiological Support, Hunters Point Naval Shipyard, San Francisco, California***

Contractor
CB&I Federal Services LLC

Specification Section
Scope of Work

Transmittal No.	Item No.	Specification Paragraph No.	Description of Item Submitted	Type of Submittal									Classification		Revi ewer	Contractor Schedule Dates			Contractor Action			Government Action		Remarks
				Data	Drawings	Instructions	Schedules	Statements	Reports	Certificates	Samples	Records	Information only	Government approved		Submit	Approval needed by	Material needed by	Code	Date	Submit to government	Code	Date	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
			Table																					weeks
	017	Section 7.0	Access Log									X	X											All contractors must sign before entering an RCA
	018	Section 7.0	Equipment Tracking Log									X	X											As needed
	019	Section 7.0	Equipment Calibration Records									X	X											As needed
	020	Section 7.0	Portal Monitor Setup and Daily Tests									X	X											As needed
	021	Section 7.0	Truck Survey Logs									X		X										Submit survey alarms to Navy/RASO immediately
	022	Section 7.0	Portal Monitor Summary Report	X				X				X		X										Monthly
	023	Section 7.0	Annual Dosimeter Report	X				X				X	X											Provide to individuals
	024	Section 7.0	Task-Specific Work Instructions	X	X	X		X				X		X										As needed

Attachment 7
Testing Plan and Log

Testing Plan and Log

Contract No. N62473 12 D 2005 Contract Task Order 0008			Hunters Point Naval Shipyard San Francisco, California							Contractor CB&I	
Specification Section and Paragraph Number	Test Procedure	Test Name	Accredited/ Approved Laboratory		Sampled By	Location of Test On Site or Off Site		Frequency of Test	Date Completed	Date Forwarded to Contracting Officer	Remarks
			Yes	No							
*											

Notes:

** Analytical testing requirements are provided in the Abbreviated Sampling and Analysis Plan (Appendix C of the Work Plan).*

CB&I CB&I Federal Services LLC

Attachment 8
Definable Features of Work Matrix

Definable Features of Work Matrix
CONTRACTOR QUALITY CONTROL PLAN
Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California
CONTRACT NUMBER N62473-12-D-2005
CONTRACT TASK ORDER 0008

Plan/ Specification Section	Schedule Cross Reference	Feature of Work	Task Lead	Preparatory	Initial	Follow-Up	Completion
Work Plan/2.1	W.E. 4	Radiological Controls and Postings	Minh Chi	Mark Vennemeyer	Mark Vennemeyer	Minh Chi	Minh Chi
Work Plan/2.2	W.E. 4	Radiological Surveys	Minh Chi	Mark Vennemeyer	Mark Vennemeyer	Minh Chi	Minh Chi
Work Plan/2.3	W.E. 4	Radiological Support to Other Contractors	Minh Chi	Mark Vennemeyer	Mark Vennemeyer	Minh Chi	Minh Chi
Work Plan/2.4	W.E. 4	Incoming & Outgoing Surveys	Minh Chi	Mark Vennemeyer	Mark Vennemeyer	Minh Chi	Minh Chi
Work Plan/2.5	W.E. 4	Portal Monitor	Minh Chi	Mark Vennemeyer	Mark Vennemeyer	Minh Chi	Minh Chi
Work Plan/2.1.1	W.E. 4	Stockpile Screening	Minh Chi	Mark Vennemeyer	Mark Vennemeyer	Minh Chi	Minh Chi
Work Plan/2.1.1	W.E. 4	Soil Sampling	Minh Chi	Mark Vennemeyer	Mark Vennemeyer	Minh Chi	Minh Chi
APP/SSHP	W.E. 4	Decontamination and Release of Equipment and Tools	Minh Chi	Mark Vennemeyer	Mark Vennemeyer	Minh Chi	Minh Chi

Notes:
W.E. *work element*

Attachment 9
Organization and Personnel Certifications

Organization and Personnel Certifications Log
Definable Features of Work Matrix
CONTRACTOR QUALITY CONTROL PLAN
Basewide Radiological Support
Hunters Point Naval Shipyard
San Francisco, California
CONTRACT NUMBER N62473 12 D 2005
CONTRACT TASK ORDER 08

Definable Feature of Work	Certification Requirement	Code	Organization	Individual	Verified by/Date Verified	Certificate Expires
All Project Tasks	40-Hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response, including 8-Hour Refresher	P	CB&I	(all personnel)		
Lab Analysis	U.S. Department of Defense Environmental Laboratory Accreditation Program	S				

Legend:

Column 1, Definable Feature of Work: Refer to Construction Quality Control Plan table for list of definable features of work. List in order.

Column 2, Certification Requirement: State the certification required for the subcontractor, supplier, and/or individual.

Column 3, Code: S = Certificate required for the firm, that is, subcontractor or supplier; P = certificate required for the person performing the work.

Column 4, Organization: Subcontractor or supplier organization name.

Column 5, Individual: Name of certified individual (note: if certification requirement only applies to the firm, note name of person who provided certificate).

Column 6, Verified By/Date Verified: CB&I individual who verified certificates for organization and/or individuals. Verification required no later than Preparatory Inspection.

Column 7, Certificate Expires: Note the certificate expiration date.

Notes:

This log will be included in the Construction Quality Control Plan as an appendix with columns 1, 2, and 3 are filled in. Remaining columns will be completed when information becomes available.

CB&I CB&I Federal Services LLC

Attachment 10
Procedures

PROCEDURE

Procedure Title:	**Project Quality Plans**	**CMS Number:**	**CMS-720-01-PR-00120**
Procedure Owner:	**Corporate Quality**	**Issuing Authority:**	**Director Global Quality**

PROJECT QUALITY PLANS

5	Issued for Use – Total rewrite for new Project Procedures Manual Process. (No Rev Bars)	PDJ	17 Oct 2013
4	Issued for Use – Revised 1.0 Purpose, 4.0 Procedure and 5.0 References. (See Rev Bars)	BDO	01 Apr 2010
0	Issued for Use	GB	29 Jul 2008
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

Project Quality Plans (PQPs) are used by CB&I to identify project procedures and supporting documentation to be used for project execution. This includes identifying the critical CMS documents used to control and attain designed product quality and to meet contractual and regulatory obligations. A PQP can also define the Quality objectives specific to the work covered by the plan and the resources and responsibilities assigned.

This procedure describes the structure of PQPs and the responsibilities for the implementation of Quality Plans.

2.0 SCOPE

This procedure applies to all CB&I projects and pre-contract activities when required for a given proposal.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure:

- Business Development Managers (BDM)
- Proposal Managers
- Project Managers / Project Directors
- Quality Managers

4.0 PROCEDURE

4.1 Quality Plans – Pre-contract

4.1.1 When a Quality Plan is required as part of a proposal, the relevant Quality Manager shall coordinate with the Proposal Manager or, if necessary, the Business Development Manager to ensure a Quality Plan is developed. The plan, as a minimum, shall contain the following documents:

- The CB&I Global Quality Policy
- The CB&I Regional Quality Policy, if applicable
- Description of Quality activities within the project on how to execute and manage
- Listing of procedures required to execute the project

4.2 Quality Plans – Project

4.2.1 Project Quality Managers are responsible for the creation, maintenance, and implementation of PQPs. If a Quality Plan is developed during the pre-contract phase, it shall be utilized as the basis for the PQP.

4.2.2 Standardized PQPs for specific product lines may be utilized in lieu of generating project specific documents.

4.3 Structure

4.3.1 PQPs contain (or refer to) the following elements, as a minimum:

- The CB&I Global Quality Policy and/or CB&I Regional Quality Policy, if applicable
- Definition of Scope of Work covered by the project
- Quality Objectives and metrics to be used to monitor performance towards those objectives
- Organization and responsibilities for the execution of the scope
- Description of Quality activities within the project on how to execute and manage and associated CB&I Management System (CMS) documents, as applicable:

- Project Management
- Quality
- Project Controls
- Engineering
- Procurement
- Subcontracts
- Fabrication
- Construction
- Commissioning
- Document Control/Records Management

4.3.2 Additional functions may be added according to need of the project.

4.3.3 Major projects shall utilize the CMS-720-01-FM-00015 PQP Template and modify in accordance with the project specific requirements. However the content of the project quality plan shall include but not limited to the following:

- INTRODUCTION
- SCOPE
  - Scope and Purpose
  - Applicability
- DEFINITIONS
- CB&I QUALITY MANAGEMENT SYSTEM (CMS) OVERVIEW
- PROJECT QUALITY MANAGEMENT SYSTEM OVERVIEW
- MANAGEMENT RESPONSIBILLITY
- RESOURCE MANAGEMENT
  - Provision of resources
  - Human Resources
  - Infrastructure
  - Work environment
  - Project Organization and Responsibilities
- PROJECT REALIZATION
  - Planning
  - Customer-Related Processes
  - Design and Development
  - Estimating
  - Purchasing
  - Subcontracting
  - Fabrication
  - Construction
  - Commissioning
- MEASUREMENT, ANALYSIS, AND IMPROVEMENT
  - Monitoring and Measuring
  - Analysis of Data
  - Improvement

4.3.4 For small projects, including standard products, templates may be used and modified as needed to accurately list the small project requirements. A Project Quality Plan can be created for each standard product project by including a copy of the Standard Project Quality Plan. Forms which can be used as baseline templates for several standard product types are referenced in 5.0.

4.3.5 At the discretion of the Quality Manager, a specific PQP may be deemed unnecessary if not practical and/or not commercially viable in cases of short-term small projects

and/or standard products involving routine scopes of work such as tank maintenance, shut-down repairs, etc. In these cases, the pertinent CMS documents affecting product or service quality shall be identified using Inspection and Test Plans (ITP's).

4.3.6 A Project Procedures Manual report can be run from Project EDMS for a snap-shot of the applicable Issued for Use documents which have been applied to the project. The report generated will include both Primary and Secondary documents which have been loaded into the Folder 9 "Project Execution Plans and Procedures". This report will be considered an Attachment to the Project Quality Plan and is a live document.

4.4 Approval and Revision

4.4.1 Project Quality Plans shall be prepared by Project Quality Manager and approved by the Project Manager, as a minimum. Based on the contractual requirements, client approval might be required. Once approved, any further revisions to the Project Quality Plans can be approved by the Project Quality Manager, unless there are fundamental changes to the plan.

5.0 REFERENCES

ISO 10005	Quality Management – Guidelines for Quality Plans
CMS-720-00-PL-00010.0001	CB&I Global Quality Policy
CMS-720-01-PR-00290	Inspection and Test Plans
CMS-720-01-FM-00015	Major EPFC Type Project Quality Plans Template
CMS-720-01-FM-71001	SPS Standard Project Quality Plan
CMS-720-01-FM-71002	Project Quality Control Details - API 620
CMS-720-01-FM-71003	Project Quality Assurance Details - API 620
CMS-720-01-FM-71004	Project Quality Assurance Details - API 650
CMS-720-01-FM-71005	Project Quality Control Details - API 650
CMS-720-01-FM-71006	Project Quality Assurance Details - ASME Sec I,VIII, or NBIC
CMS-720-01-FM-71007	Project Quality Control Details - ASME Sec I,VIII, or NBIC
CMS-720-01-FM-71008	Project Quality Assurance Details - AWWA
CMS-720-01-FM-71009	Project Quality Control Details - AWWA
CMS-810-00-PR-00018	Archiving and Storage of Project Documents

6.0 TERMINOLOGY

None

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

8.0 ATTACHMENT

None

PROCEDURE

Procedure Title:	**Receiving Inspection**	**CMS Number:**	**CMS-720-02-PR-00480**
Procedure Owner:	**Global Quality**	**Issuing Authority:**	**Director Global Quality**

RECEIVING INSPECTION

1	Issued for Use – Incorporated some approved comments from Global Review that did not transfer to document when accepting all comments in Track Changes. Majority of comments were captured. (See Rev Bars)	PDJ	28 Jun 2013
0	Issued for Use – Total Rewrite – This procedure Supersedes CMS-720-01-PR-00480, Deleted “Plate Structures” from the Title, Changed all CMS-720-01 referenced documents to CMS-720-02 with the exception of Business & Technical Glossaries and moved glossaries to 7.0 Exhibits. (No Rev Bars)	PDJ	10 Jun 2013
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure details the use of the following Receiving Inspection Reports (RIR) for receipt of plate, for non-plate items and for multiple plates.

1.1 Form CMS-720-02-FM-00480 Receiving Inspection Report (Plate): This form is used for plate receipt inspections (i.e., has a sketch of a plate for the recording of micrometer thickness readings). This document is used only for items ordered for a contract.

1.2 Form CMS-720-02-FM-00481 Receiving Inspection Report (Warehouse): This form is used for non-plate items. This form is used only for items ordered for a contract.

1.3 Form CMS-720-02-FM-00482 Receiving Inspection Report (Sample Multiple Plate Inspection): This form is utilized for plate receipt inspections. This document is used only for items ordered for a contract.

1.4 If stock or unassigned material is applied, then form CMS-720-02-FM-00520 Verification of "Unassigned" Material (see CMS-720-02-PR-00520) is used in accordance with procedure CMS-720-02-PR-00520 Plate Structures Verification of Unassigned Material.

2.0 SCOPE

This procedure applies to all personnel required to generate or process RIRs.

The use of RIR forms is required when specified by the standard Material Control Classification Requirements table (CMS-720-02-PR-00440) or project specific "S" Table, and when specified by Purchasing for Material ID Code "B".

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure:

- Procurement Buyer
- Fabrication Shop Quality Manager
- Site (Project) Quality Manager
- Superintendent (Foreman)
- Project Manager/Construction Supervisor
- Shop/Site Quality Control (QC)
- Welding Manager

4.0 PROCEDURE

4.1 Procedure Steps

4.1.1 The Material ID Code defines which items require initiation of an RIR. The receiving requirements are specified by Material ID Codes recorded on requisitions (i.e., Bills, Shipping Order, etc.)

4.1.2 Shop QC or the Site (Project) Quality Manager will initiate RIRs as specified by Material ID Codes. When RIRs are required, one will be initiated for each item or each piece. For Multiple Plate Receipt Inspection, form CMS-720-02-FM-00482 Receiving Inspection Report is utilized.

4.1.3 Shop QC will print and distribute RIR's to Receiving along with any appropriate documents to assist Receiving.

4.1.4 RIRs should be initiated at the time orders are prepared and be available to Receiving when the material arrives. RIRs are sent to Receiving with a copy of the shipping notice, and any other documentation needed for receipt.

4.1.5 RIRs for direct shipments to a site plus a copy of this procedure will be sent to the Site (Project) Quality Manager or Superintendent (Foreman) through the Project Manager or the Project Quality Manager.

4.1.6 Manufacturing/ Construction Receiving will receive materials and items, and perform required inspection operation and complete the receiving portion of the RIR.

4.1.7 The Superintendent (Foreman) is responsible for completion of RIRs and assists Purchasing in resolving nonconformities.

4.1.8 RIRs, when they are printed or made, should contain the following:

- Contract number
- Order Number
- Item Number
- Supplier
- Quantity Ordered
- Material Specification
- Description
- Routing of Report, if applicable
- Report Initiated By and Date
- Any special receiving inspections to be performed on the item such as:
  - Measurements - when measurements beyond the normal checks of length and width for plates, length and nominal diameter for piping, or nominal diameter for forgings is required.
  - Thickness - when special measurements are required to determine the actual backing and/or cladding thickness of composite materials in lieu of the normal check of the composite thickness.

4.1.9 For Material ID Code "B" Materials, Purchasing determines the need for spot (10%) inspections. If spot inspections are required, Purchasing will notify the receiving location of the material requiring inspection. Form CMS-720-02-FM-00480 or CMS-720-02-FM-00481 is initiated at the location for those items requiring inspection.

4.1.10 For all material and items received, where an RIR has been initiated, the receiving location record all applicable information requested under "Receiving Inspection". All information is taken directly from the actual material or items received.

4.1.11 The receiving location records the following information:

- Quantity received and inspected
- Whether shipment is partial or complete
- Material specification (as it is marked on the material by the supplier or manufacturer)
- Supplier identification numbers (heat, slab, lot, plate identifier, serial, etc. marked on the material by the supplier or manufacturer)
- For plate, required thickness readings (see paragraph 4.2)
- Whether dimensions agree with Order, Sketch or Drawing
- Show identification number of micrometer or digital thickness gage used. If none used, complete blank with "N/A"
- Indicate whether material received is acceptable or unacceptable
- If it is unacceptable, explain why
- Indicate whether the material has been tagged or marked “Hold” or segregated
- Show by whom the inspection was completed and when the material or items was received

4.1.12 Receiving will return all completed RIRs to the Shop or Site QC as soon as the material or items are unloaded and checked.

4.1.13 Shop or Site QC will verify the information on RIRs reported by Receiving, complies with the requirements of the purchase order and Material Verification Summary Sheet (MVSS) as each RIR is returned.

4.1.14 A sequential number is assigned to the RIR and marked on the RIR in the lower right hand corner.

4.1.15 The MVSS will be marked to indicate the check has been made and the RIR series number recorded.

Note: Verifying an RIR means they have been checked to determine the reported information complies with the requirements of the purchase order and any referenced specifications (i.e., markings, dimensions (e.g., for plate the correct length, width and thickness), etc.). The markings shall be complete and traceable to the MTR, the length and width dimensions are minimums (i.e., a trim allowance has been added so as to be able to fabricate an item) unless noted otherwise, and the thickness is within both the minimum and maximum allowable specification tolerance.

4.1.16 When a partial shipment of items is received, and individual RIRs are not issued, the Shop or Site QC representative is responsible for initiating additional RIRs to cover the unshipped balance.

4.1.17 Shop or Site QC will check the supplier's documentation (Material Test Reports (MTRs), Certificates of Conformance (COCs), NDE and test reports, etc.) and if acceptable, releases the material or item for use by initialing and dating the "Material Released for Fabrication" block on the RIR Form and sending a copy to Receiving. The completed RIR shall be filed in the project EDMS.

4.1.18 Note: The EDMS may also be used to manage the progress of the RIR from initiation to completion.

4.1.19 Shop or Site QC will review RIR's completed by Receiving and will release material for use or coordinate resolution of nonconformities.

4.1.20 If any nonconformities exist and a decision has been made not to return the material or item to the supplier or a decision is made to scrap it, Shop or Site QC shall complete the "Description" block of the NONCONFORMITIES section of the RIR. The RIR is initialized, dated and forwarded to the Welding Manager & Quality Manager.

4.1.21 Upon receipt, the Welding Manager & Quality Manager, as applicable, completes the "Disposition" block of the RIR. The RIR is initialized and dated, and a copy is forwarded to Purchasing.

4.1.21.1 The Quality Manager initiates the disposition and once the disposition has been completed, the Quality Manager initials and dates the "Disposition Completed" block of the RIR.

4.1.21.2 For positive dispositions, the Quality Manager releases the material or item for use by initialing and dating the "Material Released for Fabrication" block and a copy is forwarded to Receiving and Purchasing.

4.1.21.3 For negative dispositions, the Quality Manager shall mark or stamp in the bottom right corner "Unacceptable for Use". The RIR is initialed and dated and a copy is forwarded to Purchasing, Shop QC, Site QC and Receiving.

4.1.21.4 Purchasing is responsible for the disposition of the material or item.

4.1.22 If nonconforming material or items were found as a result of a spot check, Shop or Site QC and their Quality Manager shall give consideration to checking other similar material or items depending upon the nature of the nonconformity.

4.1.23 When heat treating or nondestructive examination is part of the material specification, and it is to be performed by CB&I, the material will be nonconforming when received. Purchasing shall indicate in the "Description" block of the NONCONFORMATIES section, when the RIR is initiated, what action is required by CB&I before the material can be considered as conforming to the material specification. After receipt, the material is handled per above.

4.1.24 By checking against the entries on the MVSS, Shop or Site QC will ensure the RIRs are returned from Receiving as material is received. Where nonconformities exist, the Quality Manager verifies the copies have been returned and the dispositions have been completed.

4.1.25 Shop QC files the RIR by contract in numerical order. For nonconforming material, the RIR is filed only after the Quality Manager has returned a copy indicating the disposition has been completed

4.2 General Receiving Instructions

4.2.1 Plate shall be gauged at each corner and at the midpoint of each long side. Readings shall be taken at 3/8 in. (9mm) to 3/4 in. (19mm) from the plate's edge. When a single RIR is utilized to receive more than one plate, plates with identical JDE item numbers shall be documented. Micrometer readings shall be traceable to the individual plates. See CMS-720-02-FM-00482 for an example.

Note: Micrometers and digital thickness gages shall be calibrated in accordance with the Corporate Calibration Program.

Note: For roofs and suspended decks & outer bottoms of non-double integrity LT&C plate structures, the use of a micrometer/digital thickness gage is not mandatory for all plates. Only the top plate, from one of the bundles, for each piece mark need be checked with a micrometer/digital thickness gage; the remaining plates need only be confirmed with a tape or ruler. Document tape or ruler checks within the picture of the plate on the CMS-720-02-FM-00480 form.

4.2.2 A plate is normally acceptable as far as permissible variation under specified thickness is concerned if it does not under run the ordered thickness by more than 0.014 in (0.34mm). If the under run is more, it shall be reported by Receiving to Purchasing as a nonconformity.

4.2.3 Purchasing shall determine with Engineering whether the plate is useable. For plates with localized areas of under run where allowances have been made for shop or site fabrication, Purchasing, in conjunction with the shop or site, shall determine whether the plate is useable*.

Note: Useable - means the localized area of thinning is located in the drop-off (e.g., scrap) material portions of the plate or that the item to be cut from the plate can be positioned so that the localized thin area is drop-off. If fabricated items require special positioning, due to the above, controls shall be put in place to ensure the area(s) of local thinning will not be used.

4.2.4 Acceptable width and length will depend on various conditions such as the application, allowances made for shop or site fabrication and permissible mill variations. Any variation on the minus side from the ordered width or length shall be reported by Receiving to Purchasing as a nonconformity. Purchasing, in conjunction with the shop or site, shall determine whether the plate is useable.

Note: Useable - means the item to be fabricated can still be properly fabricated from the undersized plate.

4.2.5 The surface of material and items, top surface of all plates, when received, shall be inspected for defects such as laminations, gouges, scabs, pits, etc. Surface defects reported by Receiving shall be cleared by Purchasing with the Quality Manager before the material is released.

4.2.6 Material or items that require special weather protection, such as aluminum, 9% Ni, etc., shall be inspected and then stored appropriately after receipt.

4.2.7 Structural items requiring identification that is not individually marked by the supplier with the supplier's material identification number must be individually marked when received or when the bundle is broken and material is issued for use.

4.3 Conditional Release

4.3.1 When requested by the Project Manager (PM) or his delegate, material or items requiring MTRs or COCs with incorrect or missing documentation may be conditionally released for fabrication by Shop or Site QC.

4.3.2 For material or items to be conditionally released, the received material or item must be confirmed (via the RIR) as being of the correct size and shape and must be adequately marked so that it can be properly identified.

4.3.3 Shop or Site QC shall mark or stamp a copy of the RIR in the bottom right corner "Material Conditionally Released" and initial and date the statement. Copies shall be filed in the project EDMS and distributed to Receiving and to the Quality Manager.

4.3.4 The Quality Manager shall establish procedures to maintain traceability of the material or item so that in the event of a nonconformity, it can be located and held for disposition. No conditionally released material shall be shipped to the Site or Client without the proper transfer of authority to control the conditional release until it is resolved.

4.3.5 When proper documentation is received from the supplier and found to be acceptable by Shop or Site QC, the original RIR shall be released and copies of the RIR shall be filed in the project EDMS and distributed to Receiving and the Quality Manager.

4.3.6 When missing or corrected documentation is not received from the supplier, the material or item is then considered nonconforming and shall be handled as per above.

4.4 Nonconforming Release

4.4.1 When requested by the PM or his delegate, nonconforming material or items may be released for fabrication by the Quality Manager if it is determined that the nonconformity will be favorably resolved and that it does not affect any of the necessary fabrication processes.

4.4.2 The Quality Manager shall mark or stamp a copy of the RIR in the bottom right corner "Material Released Nonconforming", initial and date the statement and forward copies to Receiving and to Purchasing.

4.4.3 The Quality Manager shall establish procedures to maintain traceability of the material or item so that in the event the nonconformity cannot be positively resolved, the material can be located and removed. Nonconforming materials or items shall not be shipped to the Site or Client without the proper transfer of authority to control the nonconforming release until it is resolved. The Quality Manager ensures nonconformities have been resolved and shall assist the Superintendent (Foreman) with receiving functions.

5.0 REFERENCES

CMS-720-02-PR-00420	Plate Structures Detail Material ID Code
CMS-720-02-PR-00520	Plate Structures Verification of Unassigned Material
CMS-720-02-FM-00480	Receiving Inspection Report (Plate)
CMS-720-02-FM-00481	Receiving Inspection Report (Warehouse)
CMS-720-02-FM-00482	Receiving Inspection Report (Sample Multiple Plate Inspection)
CMS-720-02-FM-00520	Verification of “Unassigned” Material

6.0 TERMINOLOGY

Term	***Definition***
Receiving	Any location where receiving of materials or items takes place

(Shop, Site, Supplier, etc.)

7.0 EXHIBITS

Exhibit 7.1 CMS-720-01-FM-00020 – Business Glossary

Exhibit 7.2 CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None

PROCEDURE

Procedure Title:	**CONSTRUCTION INSPECTION PROGRAM**	**CMS Number:**	**CMS-720-01-PR-00230**
Procedure Owner:	**Corporate Quality**	**Issuing Authority:**	**Director Global Quality**

CONSTRUCTION INSPECTION PROGRAM

1	Issued for Use – Total re-write. (No Rev Bars)	PDJ	19 Aug 2013
0	Issued for Use	DLK	18 Jul 2008
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure describes the inspection activities used by CB&I Construction Quality Management to ensure the effectiveness of quality control and technical compliance of subcontracted and self-perform work and to identify systemic weaknesses in the Construction, Installation, Commissioning, and Subcontractor activities.

2.0 SCOPE

This procedure covers all site construction inspection activities performed by CBI or its subcontractors. Inspection activities include:

- Specific pre-determined inspection Hold, Witness, Review, and Surveillance points that are identified on Inspection and Test Plans (ITP's) against specific stage inspection/test activities,
- QC surveillance activities that are not identified specifically on ITPs.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure:

- CB&I Quality Manager [QM]
- CBI Construction Management [CCM] (Self Perform)
- CB&I Inspectors
- Sub-Contractors

4.0 PROCEDURE

4.1 Inspection & Test Plans (ITP)

Prior to the start of Construction activities, QM will either prepare detailed ITP's (for self-perform work) or have subcontractors prepare ITP for their scope of work.

Refer to CMS-720-01-PR-0029 Inspection and Test Plans (ITP) for further information.

4.2 Notification of Inspection (NOI)

QM will instigate a process of inspection notification to be used by CBI Construction Management and Subcontractor Quality to notify QM when those inspection points identified as Hold, Witness, and Review points on ITP have been reached. CBI Construction Management and Subcontractor QC, as applicable, will perform and verify acceptance of the inspection before issuing the Notification of Inspection to QM.

4.3 Extent of Inspection

4.3.1 Hold Points

Minimum 100% coverage required. Any deviation to this requirement is to be made on a case by case basis by QM. Should circumstances or experience indicate that a Hold point is unnecessary, ITP should be revised accordingly.

4.3.2 Witness Points

Minimum 100%; however, with the approval of QM this may be reduced to a minimum of 80%.

4.3.3 Review Points

Minimum 100% required.

When the Review is coupled with HOLD or WITNESS Point the inspector will add the word 'Witnessed' by his signature. When the activity is not witnessed, the inspector shall add the words 'reviewed only' by his signature.

4.3.4 Surveillance Points

The surveillance points indicated on ITP can be considered as 'Planned" surveillance points.

These surveillance points will be covered initially on the commencement of the work covered by the ITP and, thereafter, at the direction of QM until the work covered by that ITP is complete. The frequency and extent of the surveillance activities will be at the discretion of CB&I Quality Manager and shall be defined or referenced in the Project Quality Plan.

In order to record the results of the surveillance activities, Inspectors utilize the CMS-720-01-FM-00230 Quality Surveillance Report.

Note: These 'Planned' surveillance activities are in addition to the normal monitoring activities undertaken by inspection personnel during their time in the field. There is no requirement to document "normal" monitoring activities unless problems are identified, in which case the QM will decide upon the method of reporting on a case by case basis.

4.4 Deficiencies

Identified deficiencies to specified requirement as a result of an inspection activity (H, W, and R), shall be handled as follows;

- In process Inspection (W and R) – Deficiencies are recorded on the NOI for correction.
- For an item that does not comply with the specification, drawing, code, etc., that cannot be corrected during the normal course of fabrication / erection or has a major cost associated with it, an NCR should be raised in accordance with CMS-720-01-PR-00150 Identification, Control, and Disposition of Nonconforming Product Procedure.
- Final Inspection (H) – add to a punch list

4.5 Recording Results of Inspections

4.5.1 The results of Hold, Witness, and Review points are recorded on Inspection & Test Reports/Checklists, as identified in the Recording Document column of the ITP. These documents then form part of the QC Documentation Package becomes part of the System Turnover records.

4.5.2 Planned surveillance activities will be reported on the 720-01-FM-00230 Quality Surveillance Report.

4.6 Monitoring Results of Inspections

4.6.1 At the discretion of CB&I Quality Manager, inspection and surveillance results will be monitored by the CMS-720-01-FM-00231 Inspection Monitoring Form. The parameters defined in the monitoring form can be suited for project needs and scope.

4.6.2 A range of Reports may be generated from the CMS-720-01-FM-00231 Inspection Monitoring Form. A weekly and/or monthly report will be issued to CBI Construction Quality Management.

4.6.3 The CMS-720-01-FM-00231 Inspection Monitoring Form and the NOIs will be maintained in related EDMS folder together with ITPs.

4.7 Guidelines for CB&I Inspector Site Surveillance and Monitoring Activities

4.7.1 Surveillance activities can be classed as either 'Planned' or 'Unplanned' (random).

4.7.2 The guidelines that are equally valid for Planned and Unplanned surveillance activities have been detailed in CMS-720-01-GL-00230 Guidelines for Quality Surveillance Activities.

5.0 REFERENCES

CMS-720-01-PR-00290	Inspection and Test Plans (ITPs)
CMS-720-01-PR-00150	Identification, Control and Disposition of Nonconforming Product
CMS-720-01-GL-00230	Guidelines for Quality Surveillance Activities
CMS-720-01-FM-00230	Quality Surveillance Report
CMS-720-01-FM-00231	Inspection Monitoring

6.0 TERMINOLOGY

Term	***Definition***
CBI Quality Manager (QM)	The Project Quality Manager or Site QA/QC Manager, or their delegates.
Inspection Hold Point (H)	A **Hold Point** is established by an interested party when they require being present for a particular inspection and/or test activity or when continued work may not take place until released by the interested party. This Hold is documented by sign-off on the Recording Document. Unless otherwise specified, work may not proceed beyond the Hold Point unless release is given in writing by the party establishing the Hold Point. Hold Points are indicated on an ITP with an 'H'.
Inspection Review Point (R)	A **Review Point** is established by an interested party for a particular activity when they desire to review the documented results for that activity. This review is documented by sign-off on the Recording Document. Review Points are indicated on an ITP with an 'R'.
Inspection Surveillance Point (S)	A **Surveillance Point** is established by an interested party for a particular activity which they will monitor periodically. Surveillance shall be documented by sign-off on the Recording Document when the interested party is present during the activity. Surveillance Points are indicated on an ITP with an 'S'. Surveillance Points that are specifically assigned to activities on an ITP can be considered **'Planned'** Surveillances and, since there will often be no Recording Document for a Surveillance Point, they will be documented on the Quality Surveillance Report.
Inspection Witness Point (W)	A **Witness Point** is established by an interested party when they request to be present for a particular activity. This witness shall be documented by sign-off on the Recording Document when the interested party is present during the activity. Unless otherwise specified, an activity with a Witness Point may proceed, without the presence of the party establishing the Witness Point, providing the required documented notification was made.
Quality Surveillance Report	Report on which the results of "planned" quality surveillances are recorded.

Notification of Inspection (NOI)	The written advice to CBI Quality Management that a Hold, Witness or Review Point on an ITP is ready for their inspection. The format of the NOI shall be established by the CB&I Site Quality Manager.
Inspection Monitoring Form	The Form used to log and monitor the results of the planned quality Inspection and Surveillance activities.
Unplanned Surveillance Activities	The following terms are used interchangeably in this procedure; random/periodic surveillance and monitoring. These activities performed by CB&I inspectors are not identified with an 'S' on the ITP (i.e., not 'Planned' surveillance activities).

7.0 EXHIBITS

Exhibit 7.1	CMS-720-01-FM-00020 – Business Glossary
Exhibit 7.2	CMS-720-01-FM-00021 – Technical Glossary

8.0 ATTACHMENTS

None

PROCEDURE

Procedure Title:	Inspection and Test Plans (ITP)	CMS Number:	CMS-720-01-PR-00290
Procedure Owner:	Global Quality	Issuing Authority:	Director Global Quality

INSPECTION AND TEST PLANS (ITP)

Rev	Changes	Approved	Date
7	Issued for Use – Moved ITPs from 8.0 Attachments to 5.0 References, No change to content, Issuing Authority approval not required. (No Rev Bars)	BDR	01 Aug 2013
6	Issued for Use - Added reference to ITP Forms as a parent document. Added missing reference procedures. Added new planned WP.	HS	07 May 2013
5	Issued for Use – Major rewrite – No Revision Bars	PDJ	04 Jan 2013
4	Issued for Use – Incorporated consistency review comments (grammatical), Issuing Authority approval not required. (No Rev Bars)	BDR	25 Aug 2009
0	Originally Approved Issued for Use 17 Jul 2008	DLK	17 Jul 2008

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1.0 PURPOSE

This procedure establishes the method for developing Inspection and Test Plans (ITP) within CB&I including inspection requirements, third party involvement and procedures to verify the quality of work, services and materials. This document also describes the process for requesting, reviewing and approving of supplier and subcontractor ITPs.

2.0 SCOPE

This procedure applies to Quality, Construction, Fabrication, Procurement, Project Management and Engineering within CB&I. It is important to note, when CB&I is the contractor, CB&I staff develop the ITPs for CB&I's scope of work. Suppliers and subcontractors develop ITPs for their scope of work with CB&I staff reviewing and approving the plans.

3.0 RESPONSIBILITIES

The following functions have responsibilities defined in this procedure:

- Fabrication
- Quality
- Construction
- Project Management
- Engineering
- Procurement
- Subcontracts

4.0 PROCEDURE

4.1 General – For Self Performed Work

4.1.1 Fabrication Shop Quality Managers are responsible for development of the ITP providing the required activities, tests, acceptance criteria and recording documents as well as distribution within the Fabrication Shop for review.

4.1.2 Construction Quality Managers are responsible for ensuring the initial development of the ITP, providing required activities, tests, acceptance criteria, and recording documents as well as distribution within Construction Management for review.

4.1.3 Project Quality Managers are responsible for ensuring the ITP development is performed by Shop and Construction Quality Managers and that the contents are agreed with Fabrication/Construction Management and where necessary, approved by the Client.

4.1.4 Fabrication Shop and Construction personnel including Quality Control (QC) and Project Management personnel are responsible for executing the various elements of the ITP.

4.2 General – For Supplier and Subcontractor Activities

The supplier or subcontractor is responsible for creating the Inspection & Test Plan based upon CB&I derived inspection requirements. Supplier related inspection activities and requirements are referenced in CMS-760-04-PR-21000, Source Inspection Coordination and Execution. Subcontractor inspection and testing requirements are included in the Subcontract.

4.3 General - Overall

4.3.1 An Inspection & Test Plan (ITP) shall identify the inspection requirements, customer and third party involvement and procedures to produce and verify the quality of work, services, and materials.

4.3.2 The ITP shall encompass, as appropriate, all manufacturing, fabrication, inspection & testing to be implemented during the execution of the Scope of Work referenced in the client contract or Purchase Order (P.O.)

4.3.3 All planned inspection and testing activities by CB&I, the client and other parties shall be listed in the ITP. Individual discipline specific ITPs shall be prepared for projects involving multiple disciplines such as civil, tankage, piping, electrical & instrumentation, etc. based on the scope of work. The inspection and testing activities shall be listed in a sequential order. More than one activity may progress simultaneously.

4.3.4 All project quality / certification requirements shall be listed in the ITP. This includes code, client, and CB&I internal requirements.

4.3.5 CMS ITP Templates are given in Attachment.

4.4 Inspection Points

4.4.1 Inspection points (Hold/ Witness/ Review/ Surveillance) may be designated by the client, jurisdictional authority, or assigned by the Project Inspection Coordinator (for suppliers), or the Quality Representative directly responsible for inspection of the work (for CB&I Self Performed and Subcontractors) depending on project or code requirements.

4.4.2 An **Inspection Hold Point** is established by an interested party when they require being present for a particular activity or when continued work may not take place until released by the interested party. This hold is documented by sign-off on the Recording Document. Unless otherwise specified, work may not proceed beyond the Hold Point unless release is given in writing by the party establishing the Hold Point. Typical Inspection Hold Points may include the following:

- Pre-inspection meetings with suppliers
- Receiving inspection of plant materials
- First welds
- Hydrostatic/Pneumatic Testing
- Overload Test
- Factory acceptance tests

4.4.3 An **Inspection Witness Point** is established by an interested party when they request to be present for a particular activity. This witness shall be documented by sign-off on the Recording Document when the interested party is present during the activity. Unless otherwise specified, an activity with a Witness Point may proceed, without the presence of the party establishing the Witness Point, providing the required documented notification was made. Typical Inspection Witness Points may include the following:

- Orientation of valve operators
- Continuity checks of circuits
- Weld Joint Fit-Up
- Performance Testing
- Mechanical Run Testing

4.4.4 An **Inspection Review Point** is established by an interested party for a particular activity when they desire to review the documented results for that activity. This review is documented by sign-off on the Recording Document.

4.4.5 An **Inspection Surveillance Point** is established by an interested party for a particular activity which they will monitor periodically. Surveillance shall be documented by sign-off on the Recording Document when the interested party is present during the activity.

4.4.6 Client Inspection Hold and Witness Points shall be scheduled in writing with the client by CB&I to prevent any misunderstandings.

Note: In the event the above listed definitions (4.4.2 – 4.4.5) are inconsistent with the applicable fabrication code/ standard governing the work, the code/ standard will take precedence.

4.5 ITP Format & Information Required

4.5.1 The terminology and format for an ITP is shown as an example in CMS-720-01-FM-00290 and CMS-720-01-FM-00291. This format shall be used within CB&I, and may be used by a supplier or subcontractor, as applicable. The supplier or subcontractor may adopt an alternative format which includes the same level of information, as applicable to the type of material/ equipment provided. Note: additional information may be added to this format without the necessity for a Deviation Request.

4.5.2 Information to be included in the ITP whether to be used within CB&I or with a supplier/subcontractor are as follows:

Column	ITP Information Fields	Description of Fields
1	Activity No.	Indicates the activity or task number.
2	Activity Description	Indicates the associated quality inspection and/or test activity, or activities to be carried out. The extent of the description must be sufficient to show every quality inspection verification activity undertaken within CB&I or by the supplier/subcontractor during the production of the applicable equipment, material, fabrication or service. Suppliers are responsible for determining ITP activities particular to their Scope of Work; however, CB&I may choose to insert any additional activities which may be considered necessary.
3	Controlling Document	Indicates the identification of the control procedures, or work instruction references governing the quality of the work. This includes procedures for the control of special processes requiring acceptance/ approval by CB&I or the client prior to use.
4	Responsible Party	Identifies the party responsible for execution of the activity and/ or acceptance of the results. This may be Construction, QC, etc.
5	Acceptance Criteria	Indicates either the Acceptance criteria or the procedure containing the acceptance criteria pertaining to the activity. Note: References to applicable project specifications, codes and standards should be included where applicable.
6	Recording Document	Indicates the verification documents providing confirmation of satisfactory completion of the task i.e. NDE Reports, Pressure Test Records, etc.
7	Inspection Involvement – CB&I	Indicates the level of inspection involvement (Hold, Witness, Review, and Surveillance) by CB&I Personnel or CB&I Subcontracted Personnel.
8	Inspection Involvement – QC	Indicates the level of inspection involvement (Hold, Witness, Review, and Surveillance) by Quality Control Personnel.
9	Inspection	Indicates the level of inspection involvement (Hold, Witness, Review, and

	Involvement - Client	Surveillance) by the client.
10	Inspection Involvement – Third Party	Indicates those activities which will be subject to inspection (Hold, Witness, Review, Surveillance) by a third party organization such as an Authorized Inspector, etc.

4.6 Supplier ITP Submission and Reviews

4.6.1 As indicated in the Engineering procedure, Requisitioning and Technical Bid Analysis, CMS-830-00-PR-02040, the Requisitioning Engineer, once the engineering technical requirements are defined, is responsible for providing the preliminary package to the Project Inspector Coordinator.

4.6.2 The Project Inspection Coordinator, in accordance with CMS-760-04-PR-21000, prepares an Inspection Requirements Form (IRF), CMS-760-04-FM-21002. An IRF shall be completed for each Material Requisition for Quotation (MRQ), these documents shall be provided to the supplier as a package.

4.6.3 The Project Inspection Coordinator shall include and clearly identify in the Inspection Requirements Form any specific engineering requirements for witnessed inspections.

4.6.4 After the supplier receives the MRQ, the supplier shall review, clarify and bid on the MRQ and provide the necessary feedback to the CB&I MRQ Originator.

4.6.5 After the Purchase Order (P.O.) has been issued to the supplier, the supplier shall create a detailed ITP, as required, in an agreed upon format after receipt of a P.O./Contract from CB&I.

4.6.6 Supplier originated ITP's are submitted to CB&I no later than the date / time frame specified in the P.O./Contract.

4.6.7 Supplier ITPs will be reviewed by the Project Inspection Coordinator, the Requisitioning Engineer and the client, as applicable. Consolidated review comments/ approvals will be returned to the supplier in accordance with the Project document control procedures specified in the P.O. Supplier ITPs may be agreed and finalized during the Pre-inspection Meeting.

4.6.8 For supplier or sub-supplier activities, the supplier or sub-supplier ITPs are approved by the Requisitioning Engineer after review by the Project Inspection Coordinator and client, as applicable.

4.7 Major Sub-Supplier ITP Requirements

4.7.1 The determination of whether an ITP is required for a sub supplier is the responsibility of the Project Inspection Coordinator with input from the Requisitioning Engineer and supplier. Individual ITP's may be required for major sub-suppliers performing manufacturing or fabrication work for the supplier. A partial listing is provided below for guidance:

- Castings / Forgings
- Electric Motors / Drivers Low Voltage 200HP (150 kW) and above, and all medium Voltage motors
- Control Panels
- Pumps
- Gear Units
- Fans / Blowers
- Burners
- Pressure Vessels / Heat Exchangers

- Fabricated Piping
- Fabricated Structural Steel, i.e. skids, bases, platforms, ladders, etc.
- Critical service components, i.e. items in cryogenic service, etc.
- Major valves required for safe shutdown of the facility including cryogenic valves

4.8 Subcontractor ITP Submission, Review and Approval

4.8.1 Subcontracts shall include requirements for the subcontractor to develop project specific ITPs in accordance with the inspection and test requirements of the project.

4.8.2 Subcontractors shall submit the ITPs in accordance with the subcontract for review and approval of CB&I. Expectations for the ITPs and project requirements shall be reviewed and discussed in the Kick-Off Meeting with the Subcontractor.

4.8.3 Subcontractor ITPs shall be reviewed by CB&I for completeness and accuracy against project, code and CMS requirements. CB&I Project Quality Manager or designee is responsible for the review of ITPs along with input from Engineering and Construction/Fabrication, as applicable. The CB&I Project Quality Manager or designee shall collate all comments, including any from the Client, and return the ITP with the comments to the subcontractor.

4.8.4 When all comments have been satisfactorily addressed by the subcontractor and the ITP revised and resubmitted accordingly, the CB&I Project Quality Manager or designee shall approve the ITP

4.8.5 Subcontractor ITPs should be approved prior to the Pre-Inspection Meeting, where applicable and shall be approved prior to the start of any associated work.

4.9 Review and Approval

4.9.1 For self perform work, after the ITP is completed, the ITP shall be reviewed for approval by the Project Quality Manager or designee.

4.9.2 If necessary, the Project Manager, or designee, shall forward the ITP to the client and to the jurisdictional authorities for input regarding inspection involvement.

4.9.3 If client or jurisdictional authority comments are received, the ITP shall be revised and updated by the Project Quality Manager or designee. The Project Manager, or designee, shall send an updated ITP to the client and jurisdictional authority for final approval.

4.9.4 Supplier or sub-supplier SITPs will be returned to the supplier or sub-supplier for incorporation of CB&I comments.

4.10 Inspection

4.10.1 Timely notification of an Inspection Point shall be made to the party who established the inspection involvement, as agreed on the approved ITP.

4.10.2 Results of an Inspection point shall be documented. If no issue exists, the appropriate recording document is completed and the process proceeds to the next inspection point.

4.10.3 If an issue is identified during in-process inspection, it is documented as part of the recording document. The issue may be mitigated per the provisions of an existing approved procedure and re-inspected for acceptance.

4.10.4 If an issue is identified after final acceptance, it is considered a non-conformance and shall be handled in accordance with CMS-720-01-PR-00150 “Identification, Control and Disposition of Nonconforming Product”.

4.10.5 Inspection at supplier facilities will be in accordance with CMS-760-04-PR-21000, Source Inspection Coordination and Execution.

5.0 REFERENCES

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary
CMS-720-01-WP-00230	Construction Inspection Program
CMS-720-01-PR-00150	Identification, Control and Disposition of Nonconforming Products
CMS-720-01-PR-00230	Construction Inspection Program
CMS-720-01-PR-00270	Management of Quality Records and Data
CMS-720-01-FM-00290	Inspection and Test Plan Cover
CMS-720-01-FM-00291	Inspection and Test Plan Details
CMS-720-02-FM-11501	ITP - Site Survey
CMS-720-02-FM-11502	ITP - SITE Preparation Works
CMS-720-02-FM-11503	ITP - Installation of Perimeter Fencing
CMS-720-02-FM-11504	ITP - Installation of Foundation Piles
CMS-720-02-FM-11505	ITP - Earthworks
CMS-720-02-FM-11506	ITP - Concrete Works
CMS-720-02-FM-11507	ITP - Installation of Underground Piping
CMS-720-02-FM-11508	ITP - Roads, Paving and Landscaping
CMS-720-02-FM-11509	ITP - Installation of Building & HVAC Systems
CMS-720-02-FM-11510	ITP - Installation of Fireproofing Materials
CMS-720-02-FM-11511	ITP - Steel Structural Prefabrication
CMS-720-02-FM-11512	ITP - Installation of Structural Steel
CMS-720-02-FM-11513	ITP - Installation of Static Equipment
CMS-720-02-FM-11514	ITP - Installation of Rotating Equipment
CMS-720-02-FM-11515	ITP - Installation of Storage Tanks
CMS-720-02-FM-11516	ITP - Installation of Storage Spheres
CMS-720-02-FM-11517	ITP - Installation of Fired Heaters
CMS-720-02-FM-11518	ITP - Piping Prefabrication
CMS-720-02-FM-11519	ITP - Installation of piping Systems
CMS-720-02-FM-11520	ITP - Installation of Grout
CMS-720-02-FM-11521	ITP - Installation of Electrical Systems
CMS-720-02-FM-11522	ITP - Installation of Instrumentation
CMS-720-02-FM-11523	ITP - Painting Works
CMS-720-02-FM-11524	ITP - Installation of Insulation

CMS-720-02-FM-11525	ITP - Installation of Package Units
CMS-720-02-FM-11526	ITP - Installation of Safety Equipment
CMS-720-02-FM-11527	ITP - Installation of Telecommunication Systems
CMS-720-02-FM-11528	ITP - Installation of Special Equipment
CMS-760-04-PR-21000	Source Inspection Coordination and Execution
CMS-810-00-PR-00018	Archiving and Storage of Project Documents
CMS-830-00-PR-02040	Requisitioning and Technical Bid Analysis

6.0 TERMINOLOGY

Term	***Definition***
Inspection Hold Point (H)	A **Hold Point** is established by an interested party when they require being present for a particular inspection and/or test activity or when continued work may not take place until released by the interested party. This hold is documented by sign-off on the Recording Document. Unless otherwise specified, work may not proceed beyond the Hold Point unless release is given in writing by the party establishing the Hold Point.
Inspection Witness Point (W)	A **Witness Point** is established by an interested party when they request to be present for a particular activity. This witness shall be documented by sign-off on the Recording Document when the interested party is present during the activity. Unless otherwise specified, an activity with a Witness Point may proceed, without the presence of the party establishing the Witness Point, providing the required documented notification was made.
Inspection Review Point (R)	A **Review Point** is established by an interested party for a particular activity when they desire to review the documented results for that activity. This review is documented by sign-off on the Recording Document.
Inspection Surveillance Point (S)	A **Surveillance Point** is established by an interested party for a particular activity which they will monitor periodically. Surveillance shall be documented by sign-off on the Recording Document when the interested party is present during the activity..

7.0 EXHIBITS

None

8.0 ATTACHMENTS

None

Guideline Title:	**GUIDELINES FOR QUALITY SURVEILLANCE ACTIVITIES**	**CMS Number:**	**CMS-720-01-GL-00230**
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GUIDELINES FOR QUALITY SURVEILLANCE ACTIVITIES

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1.0 PURPOSE

This guideline describes the surveillance activities performed by CB&I Quality Inspectors on site to check the effectiveness of quality control and technical compliance of subcontracted and self-perform work.

2.0 SCOPE

This procedure covers all site construction inspection activities performed by CBI or its subcontractors. Surveillance activities include:

- Surveillance points that are identified on Inspection and Test Plans (ITP's) against specific stage inspection / test activities
- QC surveillance activities that are not identified specifically on ITPs

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this guideline:

- CB&I Inspectors

4.0 GUIDELINE

Surveillance activities can be classed as either 'Planned' or 'Unplanned' (random).

The guidelines that are equally valid for Planned and Unplanned surveillance activities have been detailed as follows:

4.1 Material Control and Traceability

Construction site control of materials (including subcontractors) are monitored via routine surveillance of materials activities, verification of materials by reviewing material certificates, and witnessing of material testing, where practical.

4.2 Material Receipt & Storage

4.2.1 The Construction site receiving practices (including subcontractors) are monitored to assure receipt of material is properly recorded and any deficiencies reported. The storage of materials is monitored to assure they are stored safely in a manner which prevents damage and are segregated from other non-project materials. Special attention is directed to segregation of various grades of materials.

4.2.2 Receipt of tagged items is monitored in the manner described above and verified assuring adequate protection against damage, corrosion and ingress of dirt or water.

4.3 Material Traceability

Materials are monitored daily as part of this program to assure compliance with requirements. The following are also reviewed, when required by the contract:

- Structural steel and piping materials traceable to material certificates;
- Welding consumables traceable to test certificates;
- Cables traceable to a batch number and drum through the cable schedule and pulling slips;
- Tagged equipment traceable through registers, indexes and record drawings;
- Structural and piping components are sampled to assure they can be traced from the fabrication drawings to the materials certificates;
- The control of off-cuts (drop material) is also monitored, and maintains traceability to the material certificate when applicable.
- Material preservation.

4.4 Welding (Structural and Piping)

4.4.1 The Construction site welding activities (including subcontractor activities) are monitored through the verification of welder qualifications, welder history logs, welding monitoring, and verification of welding parameters. These activities are carried out on a random basis as established in this program.

4.4.2 Surveillance activities for welding are implemented on random basis and cover all activities from qualification of welding procedures to completion of the welding log(s). Planned surveillance is provided in the ITP for following topics:

4.4.2.1 Welding Procedure Qualification

Where applicable, tests carried out to verify a welding procedure, to validate the fracture toughness or corrosion resistance of a material or a consumable are monitored. The subsequent NDE/ Inspection and mechanical or corrosion testing of samples may also be witnessed.

4.4.2.2 Welder Qualification

Welders shall be qualified to work with the welding process and positions they shall utilize on the work.

Structural welders and welding operators shall be qualified in accordance with AWS D1.1, or equivalent codes approved by CB&I. Piping welders and welding operators shall be qualified in accordance with ASME IX or equivalent codes approved by the CB&I.

4.4.2.3 Weld Profile Grinding

Special attention is given to the enhanced weld profiles in the fatigue sensitive structural areas to assure compliance with the requirements of the drawings, as it applies.

4.4.2.4 Welding Records

A review of the construction site welding log or register is performed to assure the data is correct and current. The weld repair rates are also monitored and any trends showing increased weld repair rates are analysed to determine the cause. Increased weld repair rates attributed to a practice, consumable or welder are highlighted to Construction Site Management or subcontractor for corrective action.

4.4.2.5 Welding Consumables

Control of consumables is checked to assure handling, storage and safety precautions are in accordance with manufacturer and project contract requirements. A check is made to assure Data Sheets / Test Certificates, as required, are available for consumables prior to use. Consumables having limited storage are checked to assure the shelf life has not expired.

Welding repair rates are continually monitored on a weekly basis with the emphasis on the determination of trends, showing an increase in the repair rate related to any one aspect such as a welding practice(s), process, joint configuration, filler material or welder performance. These metrics are reported in the appropriate Welding Repair Checklist.

4.5 Dimensional Control

Dimensional control activities relating to the construction site are monitored and verified through a series of report reviews and by witnessing the construction site personnel taking dimensional checks.

4.5.1 Specialized Review

Due to the specialized nature and the equipment involved in dimensional control, CB&I personnel verifying the dimensional control activities of the Construction site work may require additional resources from specialized personnel. If these services are required, the need is determined during the preparation of the ITP.

4.6 Non Destructive Examination (NDE)

4.6.1 The Construction site NDE/ Inspection activities are monitored and verified through verification of inspector's qualifications, daily surveillance and cross-checking of materials, connections, and welds previously inspected by the construction site subcontractor or onsite CB&I personnel. These activities are carried out on a random basis and only by qualified CB&I site Quality personnel. Personnel must be qualified in the NDE/ Inspection techniques being verified.

4.6.2 Particular consideration is given to the construction site practices for the storage, handling and use of ionizing (radiation) sources to assure that all radiographic work can be carried out in a safe manner.

4.6.3 The use of ionizing sources shall be closely monitored to assure the sources are being utilized in a safe manner.

4.6.4 Surveillance within this discipline is carried out mainly on a random basis to monitor the performance of the construction site NDE/ Inspection technicians and to assure that recording of test results is carried out in the prescribed manner. This is achieved by participating in the original inspections and by spot checking of documents (i.e., welding logs). One of the main functions of this activity is to assure that the examination of welds is kept up to date and that no backlog of testing or processing of test results occurs.

4.6.4.1 Visual Examination

The quality of visual examination is verified by examining the materials and welds randomly, on a periodic basis and in critical areas defined in the ITP. If the standard of acceptance is found to be lacking, corrective action is implemented and the action verified to be effective. No further NDE/ Inspection is performed until visual acceptance is achieved.

4.6.4.2 Radiographic Examination

The quality of radiographic examination is verified by reviewing radiographic films randomly on a periodic basis and in critical areas defined in the ITP. The review not only covers the interpretation of the films but also considers quality aspects of the films such as density, definition, film development and sensitivity.

4.6.4.3 Ultrasonic Examination

Ultrasonic Examination is verified by witnessing the examination of critical areas. These areas are identified on the ITP. CB&I may verify the examination at the site by physical cross checking of welds previously examined by construction site personnel or, and any discrepancies between the results are subject to a joint examination and final conclusion. Witnessing the qualification of the process technique may be performed.

4.6.4.4 Magnetic Particle and Liquid Penetrant Examination

Magnetic Particle and Liquid Penetrant Examinations are verified by witnessing the examination of critical areas. These areas are identified on the ITP. Witnessing the qualification of the process technique may be performed.

4.7 Positive Material Identification (PMI)

PMI is verified by witnessing the examination and reviewing the records of critical areas as identified on the ITP. The extent of PMI and methods to be used are specified in CB&I procedures. The CB&I Welding Engineer may be required to be involved in the review and acceptance of PMI methods.

4.8 Surface (Coating, Fire Proofing & Wrapping) Protection

4.8.1 Construction site material and equipment surface protection activities (including subcontractor activities) are monitored and verified through daily surveillance and verification of the coating quality. These activities are carried out on a random basis as determined by the ITP.

4.8.2 The construction site practices for control of environmental conditions in areas where coating is carried out are monitored to assure that the operation is being carried out in a safe and acceptable manner.

4.8.2.1 Coating Qualification Tests

Tests to verify a coating practice are monitored. The preparation and coating of test panels are to be monitored including testing by means of visual examination, thickness measurements and adhesion tests.

4.8.2.2 Operator Qualification

All operators for surface coatings including painting and metalizing are qualified for the relevant process. Qualifications are reviewed and testing is monitored.

4.8.2.3 Environmental Conditions

Environmental conditions and steel temperatures are monitored daily at the start and during application of the coatings.

4.8.2.4 Surface Preparation

Surface preparations are continually monitored on a daily basis. It includes visual examination to assure removal of spatter, surface defects and slag after completion of fabrication. Particular attention to the edges of the material is required to assure the required radius has been achieved in all instances. Visual examination is also carried out on sections prior to blasting to assure that the solvent cleaning and steam cleaning has removed all organic and inorganic contaminates. After blast cleaning, a visual examination is carried out to assure the required finish (cleanliness) has been achieved and the surface roughness is determined by use of a comparator.

4.8.2.5 Coating Application

Dependent on the process, the wet film thickness and/or dry film thicknesses are monitored. Calibration verification of electromagnetic thickness gauges may be performed.

4.8.2.6 Documentation

The construction site coating log is checked and a review of the coating documentation is carried out on a periodic basis. Any increase in repair rate whether attributed to a practice, consumable or operator is highlighted to the construction site supervisor or subcontractor for corrective action where appropriate.

4.8.2.7 Consumables

The control of consumables is checked on a periodic basis to assure they are being stored under the environmental conditions specified by the

manufacturer and that the recommended safety precautions for their storage and handling are being followed. Consumables having limited storage stability shall be checked to assure that they are being used in rotation according to the shelf life expiration date.

4.9 Electrical

4.9.1 The surveillance activities for the electrical discipline are carried out on a random basis reviewing activities from the receipt of equipment, through the installation, testing and preservation to Mechanical Completion/ Ready for Commissioning.

4.9.2 Planned surveillance focuses on aspects where non-conformance could affect the integrity of the development, delay the schedule or result in increased maintenance. These activities are to be provided in the QSR and review the following topics.

4.9.2.1 Receiving Inspection

The construction site receiving inspection system is monitored by the CB&I Quality Representative. The CB&I Quality Representative's verification includes a physical check of the equipment and a review of the documentation to assure that the requirements of the specification have been met. Any discrepancies are reported.

4.9.2.2 Installation of Packages and Equipment

Surveillance is carried out on the installation and testing of packages, high voltage and low voltage cables, earthing and trays as detailed in the QSR. Particular attention regarding the use of the correct 'Ex' rating on equipment, segregation between differing voltages, routing, earthing, termination and the glanding of cables is made.

4.9.2.3 All equipment is monitored during the construction phase to assure preservation is being carried out on a planned basis in accordance with manufacturer recommendations.

4.10 Instrumentation

4.10.1 The status of Mechanical Completion/ Ready for Commissioning (MC) is reviewed periodically to assure completion is on an ongoing basis and that any outstanding work or punch list items, including those originating from the equipment suppliers, are cleared and signed off accordingly.

4.10.2 Electrical Inspector, in conjunction with the commissioning group, assists in the preparation of all punch lists relating to electrical sub-systems, instrument and telecommunication systems.

4.10.3 The construction site installation, testing and preservation of instruments and telecommunications systems are monitored and verified through on-site surveillance and verification.

4.10.4 Attention is provided to calibration of test equipment such as: pressure gauges, welding machines, ultrasonic test equipment and other equipment requiring calibration.

4.10.5 The surveillance activities for instrument and telecommunications are implemented on a random basis reviewing activities from the receipt of equipment, through the installation, testing and preservation to Mechanical Completion/ Ready for Commissioning.

4.10.6 Surveillance focuses on aspects where non-conformance could affect the integrity of the development, delay the schedule or result in increased maintenance. These activities are provided in the ITP and review the following topics:

4.10.6.1 Receiving Inspection

The construction site receiving inspection system is monitored by the CB&I Quality Representative. The CB&I Quality Representative's verification

includes a physical check of the equipment and a review of the documentation to assure that the requirements of the specification have been met. Any discrepancies are reported.

4.10.6.2 Installation of Supplier Packages and Equipment

Surveillance is implemented on the installation and testing of packages, field instruments' cables, tubing and trays.

All equipment is monitored during the construction phase to assure preservation is being carried out on a planned basis in accordance with the manufacturer recommendations.

4.10.6.3 Mechanical Completion/ Ready for Commissioning

The status of Mechanical Completion/ Ready for Commissioning is reviewed monthly to assure it is being completed on an on-going basis and that any outstanding work or punch list items, including those originating from the equipment suppliers, are cleared and signed off accordingly

The Instrumentation Inspector, in conjunction with the commissioning group, assists in the preparation of all punch lists relating to instrumentation and telecom sub-systems.

4.11 Piping

4.11.1 Piping activities are monitored and verified through witnessing of tests identified in the ITP. Additionally, planned and random surveillances are performed as identified below.

4.11.2 Aspects as required by the specifications with regard to flushing (if permitted), pressure testing, chemical cleaning and reinstatement of pipework are reviewed.

4.11.3 Surveillance of piping and mechanical activities is carried out on a random basis to monitor all activities from receipt to Mechanical Completion/ Ready for Commissioning. The surveillance also assures that the work is being documented on an ongoing basis and that punch list work is being recorded and addressed.

4.11.4 Planned surveillance is detailed in the ITP and reviews the installation and testing of pipework to assure that it is in accordance with the project drawings and specifications. The following points are addressed:

- The piping class/ material are correct and the piping (including pipe supports) is installed according to specification and isometric drawings, pipe support drawings and P&ID's;
- The valve type(s), rating(s) and installation direction are correct;
- Following installation, critical pipework is punched to assure compliance with requirements;
- A punch list is produced listing all outstanding items/actions.
- The flushing of selected piping systems is witnessed to assure specification requirements are met;
- Pressure testing practices are reviewed and selected pressure tests are witnessed to assure they comply with the agreed test practices. Special emphasis is placed on safety and the permit to work is checked for the selected tests, prior to any pressure testing;
- Bolt tensioning/ torquing is monitored to assure that it is carried out in accordance with the relevant practice;
- Upon completion of a test, the system is checked to assure that it has been drained (dried when specified), reinstated and system preservation carried out in readiness for release to commissioning;
- When piping is specified to be insulated, a check is made to assure that all coating and where required, heat tracing is complete prior to the application of the insulation.

- The piping is checked to assure that it is correctly identified, direction flow arrows and color-coding are correct and in accordance to specification;
- Any discrepancies found are recorded and brought to the attention of the CB&I Construction Manager and the Construction site subcontractor QC, if applicable.
- Equipment is monitored during the construction phase to assure preservation is being carried out on a planned basis in accordance with manufacturer recommendations and construction site procedures, as applicable.

4.12 Mechanical Completion/ Ready for Commissioning

4.12.1 The status of Mechanical Completion/ Ready for Commissioning is reviewed periodically to assure it is being completed on an on-going basis and that any outstanding work or punch list items, including those originating from the equipment suppliers, are cleared and signed off accordingly.

4.12.2 The Inspector, in conjunction with the commissioning group, assists in the preparation of punch lists relating to piping sub-systems.

4.13 Mechanical Equipment

4.13.1 The mechanical activities are monitored and verified through witnessing of tests. These activities are implemented as determined by the ITP.

4.13.2 Surveillance of mechanical activities is carried out on a random basis to monitor all activities from equipment receipt to Mechanical Completion/ Ready for Commissioning. The surveillance assures that mechanical activities are carried out in accordance with the project drawings, data sheets and specifications.

4.13.3 The planned surveillance of mechanical activities including rotating equipment, pumps, valves etc. is determined in conjunction with Project Engineering. Surveillance activities include, among others, verification of equipment levels, alignment checks, torquing, etc.

4.13.4 All equipment is monitored during the construction phase to assure preservation is being carried out on a planned basis in accordance with manufacturer recommendations. These activities are provided in the ITP and cover the following topics:

4.13.4.1 Receiving Inspection

The construction site receiving inspection system is monitored by the QM. The QM's verification includes a physical check of the equipment and a review of the supplier documentation to assure that the requirements of the specification have been met. Any discrepancy is reported.

4.13.4.2 Mechanical Completion/ Ready for Commissioning

The status of Mechanical Completion/ Ready for Commissioning is reviewed periodically to assure it is being completed on an on-going basis and that any outstanding work or punch list items, including those originating from the equipment suppliers, are cleared and signed off accordingly. The Mechanical Inspector, in conjunction with the commissioning group, assists in the preparation of all punch lists relating to mechanical equipment.

4.14 Insulation

Construction site material and insulation activities (including Subcontractor activities) are monitored and verified through planned and random surveillance and verification activities.

4.15 Preservation

4.15.1 Construction site personnel are responsible for handling, storage and preservation of materials and equipment intended for the project, as the material is turned over.

4.15.2 A spot check is conducted on a periodic basis to assure that preservation records are up to date and manufacturers' preservation requirements and frequencies are in compliance.

5.0 REFERENCES

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary
CMS-720-01-PR-00150	Identification, Control and Disposition of Nonconforming Product
CMS-720-01-PR-00230	Construction Inspection Program
CMS-720-01-FM-00230	Quality Surveillance Report
CMS-720-01-FM-00231	Inspection Monitoring

6.0 TERMINOLOGY

Term	***Definition***
Inspection Surveillance Point (S)	A **Surveillance Point** is established by an interested party for a particular activity which they will monitor periodically. Surveillance shall be documented by sign-off on the Recording Document when the interested party is present during the activity. Surveillance Points are indicated on an ITP with an 'S' Surveillance Points that are specifically assigned to activities on an ITP can be considered **'Planned'** Surveillances and since there will often be no Recording Document for a Surveillance Point, they will be documented on the Quality Surveillance Report
Quality Surveillance Report (QSR)	Report on which the results of "planned" quality surveillances are recorded.
Inspection Monitoring Form	The Form used to log and monitor the results of the planned quality Inspection and Surveillance activities.
Unplanned Surveillance Activities	The following terms are used interchangeably in this procedure; random / periodic surveillance and monitoring. These activities performed by CB&I inspectors, are not identified with an 'S' on the ITP i.e. not 'Planned' surveillance activities.

7.0 EXHIBITS

None

PROCEDURE

Procedure Title:	**Identification, Control, and Disposition of Nonconforming Products**	**CMS Number:**	**CMS-720-01-PR-00150**
Procedure Owner:	**Corporate Quality**	**Issuing Authority:**	**Director Global Quality**

IDENTIFICATION, CONTROL, AND DISPOSITION OF NONCONFORMING PRODUCTS

2	Issued for Use – Total re-write. (No Rev Bars)	PDJ	20 Mar 2014
1	Issued for Use – Incorporated consistency review comments (grammatical), Issuing Authority Approval not required. (No Rev Bars)	BDR	14 Aug 2009
0	Issued for Use	DLK	17 Jul 2008
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure describes the process and responsibilities for the identification, control, and disposition of nonconforming product. The objective is a uniform and consistent practice to prevent the unintended use or delivery of product which does not conform to product requirements.

2.0 SCOPE

This procedure applies to all CB&I Business Units and their operations except Nuclear Projects. Supplier related Non-conformance Reports issued by source inspectors are processed in accordance with CMS-760-04-PR-33000.

3.0 RESPONSIBILITIES

The following functions have responsibilities defined in this procedure:

- CB&I Employees (this includes all contracted personnel)
- Subcontractors
- Supervisors
- Engineers
- Quality Manager
- Responsible Managers (or Owners of the Nonconforming product)

4.0 PROCEDURE

4.1 General

Nonconforming product can occur at any stage of a project.

4.2 Identification of Nonconforming Product

4.2.1 A Non-Conformance is a condition that renders the product to be out of compliance with the requirements of the project specifications, codes, specified drawings, etc.

4.2.2 The Quality Manager will review and determine if the reported product is indeed nonconforming.

Unacceptable conditions detected during Non-Destructive Examination (NDE) are considered in-process and are documented on the component or NDE report. Adequate control is provided by the NDE reporting process and therefore these do not need to be treated as nonconforming product.

4.3 Control of Nonconforming Product.

The following controls shall be implemented to prevent unintended use or delivery of nonconforming product:

4.3.1 The Quality Manager shall ensure that all nonconforming products are assigned a unique identifying number.

4.3.2 The Quality Manager will register all nonconforming products with an entry on the project NCR Log (CMS-720-01-FM-00150). The NCR Log should include Client, subcontractor, and Third Party NCRs. NCR Log can be replaced by a client equivalent log or Quality Management Software that shall include the principles and manages the requirements of this procedure.

4.3.3 Nonconforming product may not be released for delivery without documented Conditional Release approved by the Project Manager and Quality Manager.

4.3.4 Hold Tags affixed to the item should be used to help control nonconforming product, or potentially nonconforming product. If the Hold Tag is not practical to use (i.e., the NCR Hold Tag cannot be affixed to a nonconforming item), it shall be noted on the NCR Form. The following minimum information is required on the Hold Tag (CMS-720-01-FM-00152):

- Product identification number
- NCR No.
- Date the non-conformance was identified
- Name of the individual making the observation

4.3.5 When practical, nonconforming product shall be segregated from conforming product. Segregation is to be achieved by placing the item in a designated location that will prevent unintended use.

4.4 Document the Non-conformance

4.4.1 The Quality Manager with the assistance of the Responsible Manager will initiate a Non-conformance Report, NCR, for each instance of nonconforming product unless already documented on special purpose forms described elsewhere in the CMS.

4.4.2 The NCR shall be documented using CMS-720-01-FM-00151. A project specific NCR format may be used only if required by Client. In case of using Client dictated format, Quality Manager shall ensure that the NCR disposition and approvals will include, as a minimum, the requirements defined in this procedure.

4.5 Action for Correction

4.5.1 The Responsible Manager, with assistance from the Quality Manager and, as needed, responsible Engineer, will generate a proposal to eliminate the nonconformity.

4.5.2 This is a narrative of what will be done to eliminate the nonconformity and shall be documented on the NCR. It may include procedures, method statements, ITPs, etc.

4.6 Action By, Date, Target Completion Date

4.6.1 This will define the Responsible Manager of the NCR correction, date, and target completion date.

4.7 Proposed Corrective Action to Prevent Reoccurrence

4.7.1 The Quality Manager will perform a root cause analysis and define the necessary actions to be taken to prevent the non-conformance reoccurrence. If the root cause of Non-conformance is systematic and/or symptomatic, a separate Corrective action shall be issued and followed by Corrective Action Process (CMS-720-01-PR-00170). Corrective Action Request (CAR) number shall be noted on NCR, if issued.

4.8 Disposition and Approval

4.8.1 Based on the agreed Action on nonconformity, the disposition is identified on the NCR.

4.8.2 The Quality Manager shall evaluate each NCR to identify which parties need to approve the proposed Correction.

- As a minimum this shall include the discipline Lead Engineer.
- These approving parties shall be identified on the NCR.
- Quality Manager shall obtain the necessary approvals on recommended disposition as per contractual and applicable codes and standards requirements.

4.8.3 The following defines the baseline requirements for identification and approval requirements of dispositions:

NCR Disposition Approval Matrix

Disposition	Quality Manager Approval	Lead Engineer Approval	Client Approval
REWORK, NO Deviation	Yes	Yes	No
REPAIR, NO Deviation	Yes	Yes	No
REPAIR, Deviation	Yes	Yes	May*
USE-AS-IS, Deviation Acceptable	Yes	Yes	May*
USE-AS-IS, Revise Requirement	Yes	Yes	May**
REJECT	Yes	Yes	May***

* If required by the Contract

** If the requirement is internal to which the item is not conforming, Client approval is not necessary unless the requirement is approved by client previously. If it is a client requirement, Client approval is required.

*** If the nonconforming item is “free issued” by Client, Approval is required

4.8.4 Rework and Repair without deviation does not require Client approval. As a baseline, however, Rework and Repair shall follow contractual requirements from client if applicable.

4.8.5 The Quality Manager is responsible to obtain the approval of the all parties. Any third party approvals required by local codes and standards shall be identified by Quality Manager and shall be obtained.

4.8.6 After approval is obtained, the Quality Manager shall issue the NCR to the Responsible Manager to execute the correction.

4.9 Correct the Nonconforming Product

4.9.1 The Responsible Manager shall correct the Nonconforming Product in accordance with the approved disposition.

4.9.2 After correction the NCR shall be submitted to the Quality Manager to verify the nonconformity has been corrected.

4.10 Verification and Release

4.10.1 The Quality Manager shall review the item and any required documentation to verify satisfactory correction and sign to document his approval.

4.10.2 The Quality Manager shall coordinate the approval and release of other responsible parties before closing out the NCR and releasing the product.

4.10.3 The Quality Manager shall file the closed NCR in the project EDMS and close the item on the NCR Log.

4.10.4 The Quality Manager shall approve the removal of Hold tags (if used).

4.11 NCR Status

4.11.1 The Quality Manager shall regularly review the status of the NCRs for completeness and timely closure.

4.12 Records

4.12.1 NCRs and NCR Logs are quality records and shall be maintained in the project EDMS.

4.13 Process Performance

4.13.1 The Quality Manager is responsible to collect, evaluate, and report corporate metrics via his immediate Functional supervisor.

4.13.2 The Quality Manager shall evaluate NCRs for trends adverse to quality and report status to management each month.

5.0 REFERENCES

CMS-720-01-PR-00170	Corrective and Preventive Action
CMS-760-04-PR-33000	Source Inspection Non-conformance Reports
CMS-720-01-FM-00150	Non-conformance Report (NCR) Log
CMS-720-01-FM-00151	Non-conformance Report (NCR)
CMS-720-01-FM-00152	NCR Hold Tag

6.0 TERMINOLOGY

Term	***Definition***
Concession	Permission to use or release a product that does not conform to specified requirements
Correction	Action to eliminate a detected nonconformity (also referred to a Disposition)
Corrective Action	Action to eliminate the cause of a detected nonconformity or other undesirable situation
Deviation Permit	Permission to depart from the originally specified requirements of a product
NCR	Non-conformance Report
Non-conformance	A non-conformance is the non-fulfilment of requirements.
Product	The result of a process (or set of interrelated or interacting activities which transforms inputs into outputs). There are four generic product categories: • Services • Software • Hardware • Processed Materials
Repair	Action on a nonconforming product to make it acceptable for the intended use
Reprocess/In Process	The product is returned to manufacturing to repeat standard operations steps, including inspections and tests, with the intent to correct the non-conformance.
Responsible Manager	Responsible Manager is the person responsible to execute the corrections/ corrective actions defined in the NCR report and is part of the Project/ Construction/Fabrication Management Team

Term	***Definition***
Requirement	A requirement is a need or expectation that is either: • Stated • Generally implied to be a custom or common practice for CB&I, its customer, and other interested parties • Obligatory
Rework	Action on a nonconforming product to make it conform to the requirements
Use-as-Is	Releasing the nonconforming item as it is after considerations and approval of: • Deviation from requirements are within acceptable limits • Revising the requirements

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

8.0 ATTACHEMENTS

None

Procedure Title:	**Corrective and Preventive Action**	**CMS Number:**	**CMS-720-01-PR-00170**
Procedure Owner:	**Corporate Quality**	**Issuing Authority:**	**Senior VP Global Systems**

CORRECTIVE AND PREVENTIVE ACTION

2	Issued for Use – Incorporated consistency review comments (grammatical), Issuing Authority approval not required. (No Rev Bars)	BDR	22 Sep 2009
1	Issued for Use – Added specific responsibilities throughout, added sections 4.6.7.1, 4.6.7.2 and 4.7.1, added hyperlinks to section 5.0 (see rev bars).	BDO	10 May 2009
0	Issued for Use	DLK	17 Jul 2008
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure establishes the program for the identification of existing and potential systemic type nonconformities and issues representing conditions adverse to the achievement of Quality. This procedure defines the analysis of data, assignment of responsibility, and development and implementation of appropriate corrective and preventive actions (CA/PA) within CB&I.

2.0 SCOPE

This procedure applies to all CB&I Project Operation Units and describes the corrective and preventive action program within CB&I.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this procedure:

- CB&I Executive Management
- Director of Global Quality
- Management Team
- Process Owners
- Responsible Person (Auditee or Auditees Line Manager or Owner of the Process being audited)
- Project Operations Unit Quality Manager
- Project Quality Manager

4.0 PROCEDURE

4.1 General

4.1.1 CB&I Executive Management is responsible for providing the resources necessary to assure the effective implementation of the CA/PA program. Executive Management is also responsible for monitoring corrective actions as an integral part of the Management Review process, and for supporting the implementation of required corrective and preventive actions.

4.1.2 The Director of Global Quality, Project Operations Unit (POU) Quality Manager and Project Quality Managers are responsible for the following:

- Ensuring a uniform and consistent approach for establishing corrective and preventive action controls within the organization
- Establishing the CB&I Global, Project Operations Unit CA/PA implementation procedures
- Providing input to CB&I Management Reviews
- Ensuring resolution of escalated organizational issues
- Final authority for decisions.

4.1.3 The Management Team consists of applicable Corporate, Project Operations, Manufacturing or Site Level Unit Management and Quality Management personnel. This team may also include representatives from design engineering or appropriate functions as needed. The team has a leader who is responsible for the following activities:

- Review of CA/PA inputs
- Assignment and tracking of Corrective Action Requests
- Review of Corrective Action Plans
- Verification of the effectiveness of Corrective and Preventive Actions

4.1.4 The Process Owner or designee is responsible for the following:

- Accountability for a specific business process within the CB&I organization.

- Collecting, trending, monitoring, analyzing, initiating and reporting applicable categories for potential corrective and preventive actions within their functional groups,
- Investigating and the implementation of corrective and preventive actions assigned to their functional groups by the Management Team.

4.2 Corrective Action (CA)

4.2.1 Input Guidelines

The following guidelines are used to determine if an individual input is classified as requiring a corrective action (CA):

- The allocation and implementation of a Corrective Action will be based on the potential "risk" to the company activities.
- Issues representing significant conditions adverse to the achievement of Quality.
- Systemic, recurring or trends of nonconformities occurring in one, some, or all Project Operations, Fabrication and Site/ Project Level Units within CB&I.
- Systemic Project Operations Unit nonconformities which require the attention of Global Quality Management
- Repetitive conditions which should receive management attention to preclude repetition. This would include other similar conditions of major significance.
- A significant design error found after the component has been completed and accepted.
- Conditions indicative of either a fundamental material problem or process out of control.
- Recurring audit findings of non-conformity
- Executive Management Review results representing significant risk to the business or significant non-conformities

4.2.2 Potential corrective action input must contain the following information:

- A clearly defined problem statement
- The procedure, requirement or standard that is being or has the potential of being violated
- Objective evidence to support the problem statement

4.3 Preventive Action (PA)

Preventive action is the use of tools, techniques, and analysis of data in order to anticipate potential problems or identify undesirable trends. Corrective/ Preventive Action Requests (Quality CAR's) requiring preventive action may be generated from, but are not limited to the following sources:

- Input from CB&I employees or other sources
- Quality indicator trending – Analysis of Quality System data which prompts investigation for a negative performance trend such as results from process monitoring, Key Performance Indicators (KPI) analysis or client perceptions.

4.4 Corrective and Preventive Action (CA/PA)

Quality CAR's requiring corrective action are generated from, but are not limited to the following sources. These same sources may also result in preventive actions:

- Issues identified during the performance of internal or external audits may be escalated into the CA/PA process for investigation
- Re – current, non-conformities that require escalation as a Corrective Action

- Management Team review of key metrics and nonconformity trends to identify and act on unacceptable performance or unfavorable trends, which could indicate issues with the overall Quality System
- Direct inputs of isolated issues from clients or employees such as significant design errors found after the item has been completed and accepted. These inputs may be directed to any member of the Management Team within a timely manner via email or any other means of communication.
- Issues identified as an output of the Management Review process.
- Any failure in process to conform to state, federal, or other applicable code requirements.

4.5 Observations

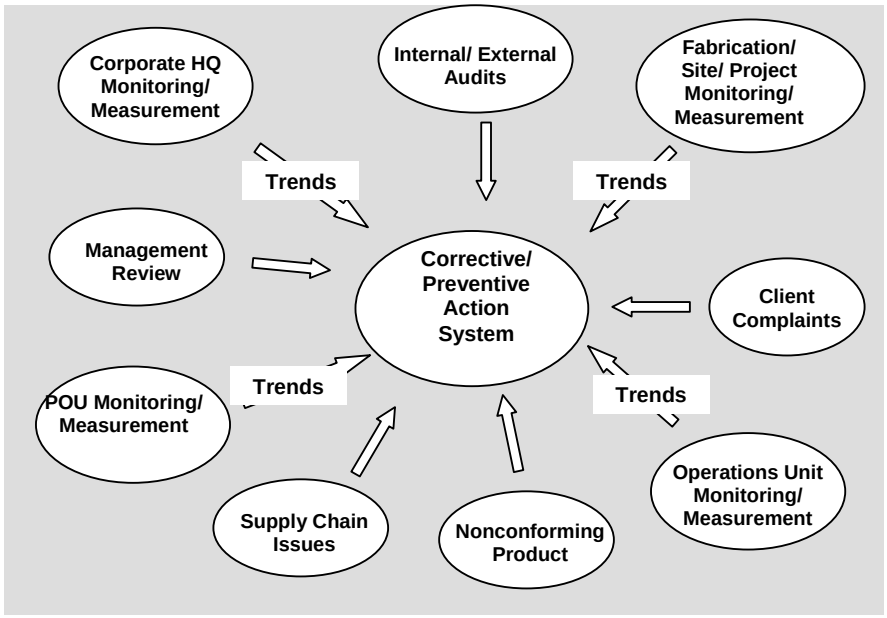
4.5.1 Situations may exist during an audit where the Management Team identifies activities that are potentially non-conforming or may require improvement, but do not present an immediate "risk" to the Project or Audit being undertaken.

4.5.2 The Management Team may recommend recording the activity as an "Observation" within the Audit Report for future reference and for the Responsible Person / Process Owner to periodically review to prevent potential escalation

4.6 General Requirements

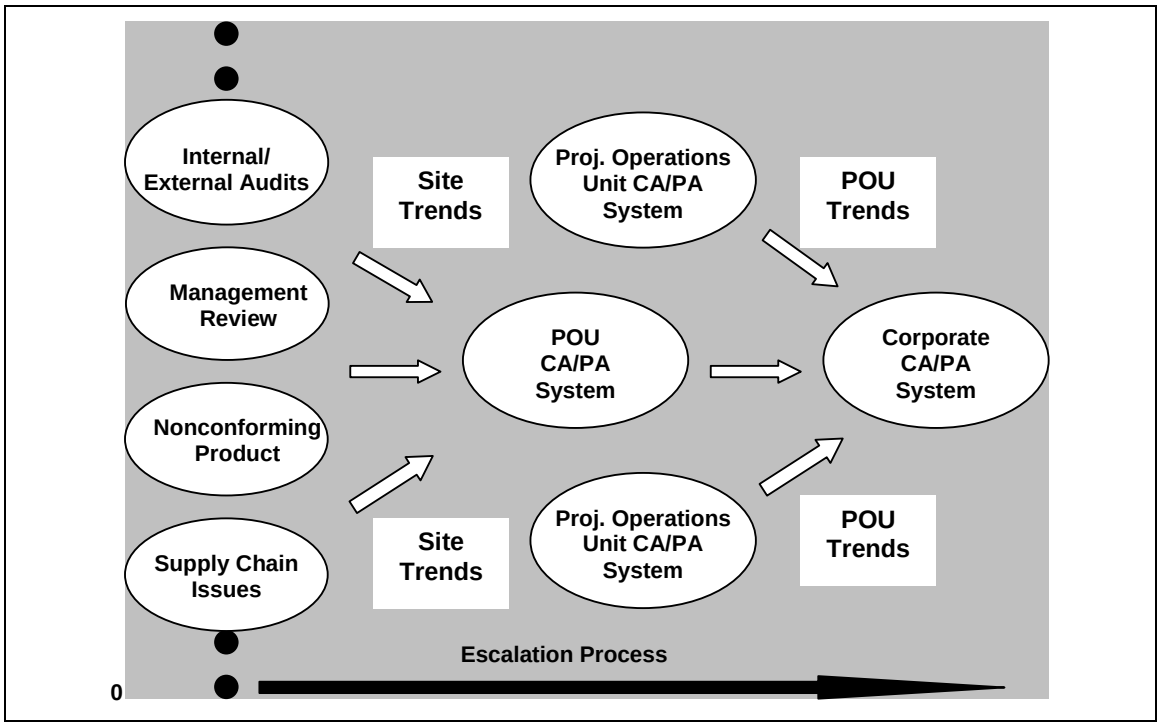
4.6.1 General

4.6.1.1 In addition to those inputs described above, the following procedures/ processes are related to the CA/PA Process:



4.6.1.2 Actual CB&I procedures, among others, relating to the CA/PA process or serving as inputs to the CA/PA processes are listed in the reference section of this document.

4.6.1.3 In addition, the CA/PA Process is generally viewed as a Global escalation process as depicted below:



4.6.2 Elements of an effective CA/PA Process

Regardless as to whether the action/ activities are considered Corrective or Preventive, an effective CA/PA Process includes the following elements:

- Analysis
- Investigation
- Identification of action required to correct or prevent issues
- Verification of effectiveness of corrective or preventive action after implementation
- Dissemination of information and communication with Executive Management

4.6.3 Elements of an Effective Investigation process include:

4.6.3.1 Problem Identification and Definition

- Demonstration of an understanding of the scope and impact of issue
- Evidence of immediate steps taken to limit or contain the damage.

4.6.3.2 Root Cause Investigation

- Evidence of investigation to determine the fundamental cause(s) of the issue
- Documented evidence as to the results of the investigation to include the results of the analysis, determination of failure modes, and conclusions as to the root cause(s).

4.6.3.3 Rationale

- If an investigation is not performed, the justification for not performing the investigation is documented.
- The documentation should include the name of the person responsible for the decision and date.

4.6.4 Reviews

The Management Team shall hold periodic, e.g. quarterly, meetings with the applicable functional Process Owners to review key metrics for trends. Other inputs may be evaluated at this time as well. This review considers the following:

- During situations when isolated issues from clients or employees are communicated to a member of the Management Team, the member evaluates the issue based upon its business risk, systemic nature or failure to conform to state or federal regulations.
- If the evaluation concludes that the issue may contribute to a business risk, system issue or a potential regulatory, code authority non conformance, the member assembles an "ad hoc" Management Team meeting as soon as possible to discuss the issue and determine the course of action mitigating the issue. This may include engineering or Project Operations Unit (POU) management.
- All other issues received are reviewed during the next scheduled periodic meeting.

4.6.5 CA/PA Determination

The Management Team will review each source input to determine whether it is to be considered a "CA/PA". If the input is determined to be a "CA/PA" then the following shall occur:

- A unique identification number shall be assigned
- An investigator (generally the process owner or designee) is assigned
- A due date is established. Typically, the due date is 30 days from the issue date, but can be adjusted depending upon the severity or complexity of the issue.

4.6.6 Acknowledgement

If a client initiates the issue, an acknowledgement letter shall be sent to the client unless it is not in the best interest of CB&I (e.g. in the case of open or potential litigation) in which case a client letter will not be issued. This will be documented in the CA/PA files.

4.6.7 Investigation

4.6.7.1 The assigned Responsible Person is notified by a "Corrective/ Preventive Action Request" (Quality CAR). The Quality CAR will contain the relevant information regarding the issue and the scheduled response date. The Responsible Person will develop the Corrective Action Plan, milestones, if applicable, and completion deadline.

4.6.7.2 The Responsible Person will be allocated a maximum of (5) working days with which to respond to the Auditor in writing, as to the proposed Corrective Action to clear the Non-Conformance. Following agreement by the Auditor, both parties will have a maximum of (2) months with which to implement the Corrective Action and verify its acceptance.

4.6.7.3 Should more time be required for implementation, then the Responsible Person will confirm in writing to their Line Manager, Auditor and the Project Operations Unit Quality Manager the reason(s) for the proposed extension.

4.6.7.4 Each Corrective Action Report shall be identified by a prefix relating to the project (and/or audit) and numbering individual CAR's sequentially.

4.6.7.5 The Line Manager of the Auditee and Project Operations Unit Quality Manager will monitor the progress of the plan's implementation and report to the Management Team of significant changes to the schedule. The

Management Team will determine the acceptability of significant changes to the plan, and may determine if escalation is required if the plan is not met.

4.6.8 Closure

Upon completion of the Corrective Action Plan, the Responsible Person will review the actions to ensure the issue has been addressed.

- CA/PA closure methods may include additional training, process modification, etc.
- Adequate Quality CAR responses should include objective supporting documentation or other evidence to facilitate closure whenever possible.
- The Line Manager of the Auditee and Project Operations Unit Quality Manager may determine that additional action or further verification is required, and can request additional activity.
- If the Line Manager of the Auditee and Project Operations Unit Quality Manager determine the Corrective Actions have adequately addressed the issue, the CA/PA issue is closed. The Line Manager of the Auditee signs off on the "Corrective/ Preventive Action Request".

4.6.9 Verification of Effectiveness

Effectiveness and verification checks may consist of a review of documentation (e.g. training records, etc) or other objective evidence that illustrates that potential for recurrence has been minimized. This information is included in the CA/PA files as part of closure.

4.7 Records

The Responsible Person and/or Process Owner may maintain all documentation regarding the CA/PA until the CA/PA is closed, at which time any documents supporting the investigation or CA/PA activities are transferred to the Quality Managers or Director, GQM to be maintained in the CA/PA file. Records resulting from this procedure are maintained as follows:

Identification	Storage	Protection	Retrieval	Retention	Disposition
CA/PA File (Completed Quality CAR and associated documentation)	Electronic Document Management System	Software Backup/ Retrieval Controls	Quality Managers; Corporate Director, GQM	See CMS-810-00-PR-00018, Archiving and Storage of Project Documents	See CMS-810-00-PR-00018, Archiving and Storage of Project Documents

5.0 REFERENCES

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary
CMS-720-01-PR-00150	Identification, Control and Disposition of Nonconforming Product
CMS-720-01-PR-00220	Internal Quality Management System Audits
CMS-720-01-PR-00230	Subcontractor Quality Surveillance Program
CMS-720-01-PR-00240	Quality System Management Review
CMS-720-01-PR-00280	Module/ Equipment Receiving Inspection (Fabrication Plant and Site)
CMS-810-00-PR-00018	Archiving and Storage of Project Documents

6.0 TERMINOLOGY

Term	***Definition***
CA/PA	Acronym for Corrective and Preventive Action. A system of formally documenting activities for corrective and preventive actions.
Closed CA/PA Action	A CA/PA is considered as "Closed", when it is determined that all CA/PA activities have been completed and verified, when appropriate.
Corrective Action	Actions taken to eliminate the causes of detected nonconformities, Project Operations issues or other undesirable situations in order to prevent recurrence.
KPI	Acronym for Key Performance Indicator.
Management Team	A team consisting of Corporate, Project Operations, Fabrication or Site/ Project Level Unit Management and appropriate representatives who review process type issues for CA/PA reporting. This team may also consist of a representative from the design engineering group or POU functions.
POU	Project Operations Unit
Preventive Action	Actions taken to eliminate the causes of a potential non-conformity, defect or other undesirable situation as identified by trend or other analysis.
Quality CAR	Acronym for Corrective/ Preventive Action Request. The form and all associated documentation used to document Quality related CA/PA activities.
Verification	Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled.

7.0 EXHIBITS

Exhibit 7.1 CMS-720-01-FM-00170 - Corrective/ Preventive Action Report (CAR)

PROCEDURE

Procedure Title:	**Internal Quality Audits**	**CMS Number:**	**CMS-720-01-PR-00220**
Procedure Owner:	**Global Quality**	**Issuing Authority:**	**Director Global Quality**

INTERNAL QUALITY AUDITS

7	Issued forUse – Total rewrite, cleaned up track changes (No Rev Bars)	PDJ	03 Jun 2013
6	Issued for Use – Revised section 3.0 and 4.1.1 to include GFN Leaders. No change to content. Issuing Authority Approval not required. (See Rev Bars)	LDH	17 Dec 2012
0	Issued for Use	DLK	17 Jul 2008
Rev	**Changes**	**Approved**	**Date**

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1.0 PURPOSE

This procedure establishes the responsibilities and practices for managing and conducting internal quality audits.

2.0 SCOPE

This procedure applies to all internal quality audits performed at CB&I.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined within this procedure:

- Executives and Senior Management
- Director Global Quality
- Global Functional Network (GFN) Leaders
- Quality Directors
- Quality Managers (at all levels)
- Internal Quality Auditors (Lead Auditors and Auditors)
- Audit Contact (Auditee)

4.0 PROCEDURE

4.1 General

4.1.1 CB&I executives and GFN Leaders are responsible for ensuring CMS processes and procedures are continually improved, effective and are responsible for corrective and preventive actions resulting from internal quality audits.

4.1.2 Internal quality audits are used to evaluate the performance and effectiveness of the CB&I Management System (CMS) at all CB&I locations.

4.1.3 The Director Global Quality has overall authority and responsibility for the development of internal quality audit processes and procedures. Additional responsibilities include:

- develops corporate internal quality audit programs identifying the auditable area, region/location, operating group, business unit , or project point of contact, audit team, and audit date;
- appoints qualified audit personnel to conduct corporate-level internal quality audits; coordinates and supports quality directors, and managers, with planning, staffing, and execution of audits.

4.1.4 Quality directors and managers are responsible for planning, staffing and execution of quality audits in their respective areas.

4.2 Audit Objectives

4.2.1 Audit objectives may vary according to the region/location, operating group, business unit, project, and subject matter.

4.2.1.1 Global quality audits are generally broad in scope, focus on business operations, and gather evidence to determine conformity to CMS processes and procedures.

4.2.1.2 Quality audits are conducted to appraise internal operations, determine the level of conformity to quality manuals, and examine the functionality of CMS processes and procedures. Audits at this level may also examine third-party certification requirements, supplier performance, code and regulatory compliance applicable to the business unit and sample project activities.

4.2.1.3 Quality audits of projects are conducted to verify conformance to specific project management plans, codes/regulations, client, and CMS

requirements. The scope of project audits may include sub-contractors, material suppliers, fabricators (CB&I and others), and any or all functions related to project execution,

4.3 Audit Personnel

4.3.1 Quality auditors shall be qualified and independent of the function being audited.

4.3.2 Lead quality auditors and audit staff designated by quality directors or managers are responsible for the execution of audits.

4.3.3 Quality Directors and managers shall maintain records of auditor training, qualifications, and periodically assess the performance of audit personnel. Details on auditor qualification are provided in CMS-720-01-GL-00223 Qualification and Assessment of Internal Quality Audit Personnel.

4.4 Audit Programs

4.4.1 Quality directors and managers shall develop an audit program comprised of a comprehensive list of auditable locations, or projects, functional groups, and an audit schedule within their scope of responsibility.

4.4.2 The audit program shall consider various factors including, but not limited to:

- current status and effectiveness of quality management performance during product realization e.g., design, engineering, procurement, construction, fabrication, and commissioning;
- outcomes of previous audits, assessments, trends, management reviews, and customer feedback;
- results of oversight activities by government regulatory agencies, third-party certification bodies, or standards organizations;
- effects of changes related to management structure, re-organization, and program functionality, and;
- potential for loss or adverse affects upon human health and safety, or environmental impacts.

4.4.3 Project audit programs may be stand-alone documents, or incorporated into project specific documents, or project quality plans. Project audit programs evaluate conformance to client requirements, conformance to project quality plans, CMS requirements and contract terms.

4.4.4 A list of auditable functions or topics shall be reviewed regularly and updated by the director and/or quality managers using output from management reviews, past audit performance, potential or frequency of factors listed in paragraph 4.4.2, and the availability of audit personnel and other sources as appropriate.

4.4.5 An audit schedule shall be developed by the director and quality manager for their areas of responsibility that considers the maturity of the quality management program.

4.4.6 Audit program development is detailed in CMS-720-01-WI-00220 Work Instruction for Internal Quality Audits.

4.5 Audit Notification

4.5.1 Not less than two (2) weeks prior to the audit, the lead auditor shall notify the audited organization, location or project via the quality management database. The notification shall include the audit start date, proposed audit activities, and a single point of contact.

4.5.2 If the notification form letter Audit Plan/Notification (CMS-720-01-FM-00220) is used, send the form by email to the audited organization and include the audit plan from the quality management database. Details are provided in CMS-720-01-WI-00220 Work Instruction for Internal Quality Audits.

4.6 Use of the Quality Management Database

4.6.1 Use of the quality management database is mandatory for all CB&I business units and projects for audit planning, reporting, and corrective action management.

4.6.2 The quality management database shall be used by auditors to:

- Develop specific audit plans and checklists
- Record all audit information and notes
- Electronically record and capture audit observations and audit findings
- Monitor and track corrective action
- Generate reports and track close-out status

4.6.3 Use of "Finding Only Reports" in the quality management database is the exception, not the rule. In the rare instance when the quality management database cannot be used due to operational constraints, use the following hardcopy forms for recording audit information:

- Audit Plan/Notification CMS-720-01-FM-00220
- Audit Finding Form CMS-720-01-FM-00221
- Audit Report CMS-720-01-FM-00222

4.6.4 Further information on the use of the quality management database is detailed in CMS-720-01-WI-00220 Work Instruction for Internal Quality Audits.

4.7 Auditing

4.7.1 Audits begin with an opening meeting where the participants are introduced to the audit team, audit topics are discussed, the schedule is refined, and any questions regarding the audit are answered. Attendee names shall be recorded.

4.7.2 Audit nonconformities (findings) are conveyed as opportunities to improve a process, procedure, or the performance of work outputs and are supported by objective evidence. Individuals are not named in the finding.

4.7.3 Nonconformities (findings) related to the functionality of CMS work processes or procedures, are directed to the GFN for corrective action.

4.7.4 All other nonconformities (findings) of conditions that do not conform to requirements stated in primary CMS work processes or procedure are directed to the audit contact person in the applicable organization for corrective action.

4.7.5 All nonconformities (findings) require corrective actions (quality actions) in the quality management database.

4.7.6 Positive observations, if evident during the audit, are conditions recognized as best practices or exemplary performance that may be recorded by auditors in the final report.

4.7.7 Conversely, auditors may observe isolated conditions of minor consequence or significance and record these conditions as observations. Observations may present potential conditions, when un-reported, may result in functional deficiencies or deviation from processes or procedures.

4.7.8 Unless directed by the Lead Auditor, observations do not require corrective actions (quality actions) in the quality management database.

4.7.9 The audit concludes when all functional areas are examined. A closing meeting is held to convey audit results and attendee names are recorded.

4.7.10 CMS-720-01-WI-00220 Work Instruction for Internal Quality Audits provides additional information tor auditors on how to carry out audits.

4.8 Audit Reporting

4.8.1 Audit reports shall be submitted by the lead auditor to the audit contact (designated by the audited organization) within two (2) weeks from the audit closing date.

4.8.2 With the exception of Corporate (CMS) findings identified in audit reports shall be directed to the audit contact designated by the audited organization.

4.8.3 Corporate-level CMS findings identified in audit reports shall be directed to the Global Functional Network (GFN) Team Leader.

4.8.4 CMS-720-01-WI-00220 Work Instruction for Internal Quality Audits provides auditors with specific details on report distribution.

4.8.5 To ensure timely close-out and, to facilitate accurate reporting of key performance indicators (KPI's), the lead auditor and audited organization shall reach mutual agreement on the corrective actions for audit findings.

4.9 Corrective Actions

4.9.1 With the exception of Corporate (CMS) nonconformities Corrective actions shall be assigned by the audit contact to the applicable manager or process owner of the audited organization for resolution.

4.9.2 Corporate (CMS) nonconformities (findings) are assigned to the appropriate Global Functional Network (GFN) Team Leader by the Lead Auditor.

4.9.3 Corrective actions shall be processed in conjunction with CMS-720-01-PR-00170 Corrective and Preventive Action and the detailed steps described below.

4.9.4 No later than ten business days after receipt of the audit report, recipients of audit findings shall develop quality actions in the quality management database application.

4.9.4.1 To create a quality action, open the quality management database application and enter the required information identified with an asterisk (Due Date, Assigned To, and Action Title.

4.9.4.2 Describe the plans to affect corrective and preventive action.

4.9.4.3 Periodically update the Action Progress.

4.9.5 If a quality action requires more than one assignee or several tasks, a new quality action may be added.

4.9.6 Evidence of completed corrective and preventive actions are documented and added as a new file attachment to the quality action.

4.9.7 Upon completion of the corrective and preventive action(s), the action assignee enters the relevant information in the quality management database, to include downloading all relevant documents providing evidence of corrective action, and selects 'Save'. Saving the quality action results in sending an e-mail alert to the person who originally assigned the action.

4.10 Audit Performance and Follow-up

4.10.1 Quality directors and managers shall record the audit performance of quality management processes on a suitable spreadsheet as an input to their management reviews and to the Director Global Quality for summarization into the annual global review. In addition, directors and managers shall:

4.10.1.1 Report monthly KPI data for consolidation into executive summaries.

4.10.1.2 Monitor corrective actions resulting from audit findings to ensure timely close-out.

4.10.1.3 Verify effectiveness of implemented corrective actions during follow-up audits.

4.11 Audit Records

Audit records are stored in the Quality Management Database.

5.0 REFERENCES

CMS-720-01-PR-00170	Corrective and Preventive Action
CMS-720-01-PR-00270	Control of Quality Records
CMS-720-01-GL-00223	Qualification and Assessment of Internal Quality Audit Personnel
CMS-720-01-WI-00220	Work Instruction for Internal Quality Audits
CMS-720-01-FM-00220	Audit Plan/Notification
CMS-720-01-FM-00221	Audit Finding Form
CMS-720-01-FM-00222	Audit Report

6.0 TERMINOLOGY

Term	***Definition***
Audit Finding	In the context of quality management system audits, the term “audit finding” is synonymous with nonconformity to specified requirements.
Audit Observation	Audit observations can indicate either conformity or nonconformity with audit criteria, or opportunities for improvement.
Audit Program	All activities necessary for planning, organizing, and conducting a set of one or more audits for a specific time frame and purpose.
Objective Evidence	Verifiable, qualitative or quantitative information, records, or statements of fact pertaining to the quality of an item or service, or to the existence and implementation of a quality system element, which is based on observation, measurement, or test and can be verified.
Quality Management Database	The computer application used in the planning and execution of internal quality audits. The quality management database is designed to record audit information, create audit reports, finding reports, corrective actions, and summarize audit information in management reviews.

7.0 EXHIBITS

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary

8.0 ATTACHMENTS

None

GUIDELINE

Guideline Title:	**Qualification and Assessment of Internal Quality Auditors**	**CMS Number:**	**CMS-720-01-GL-00223**
Guideline Owner:	**Global Quality**	**Issuing Authority:**	**Director Global Quality**

QUALIFICATION AND ASSESSMENT OF INTERNAL QUALITY AUDITORS

1	Issued for Use – Total re-write	PdJ	10 Jun 2013
0	Issued for Use	PdJ	05 Dec 2012
Rev	**Changes**	**Approved**	**Date**

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Qualification and Assessment of Internal Quality Auditors

CMS Number:	Revision:	Approval Date:
CMS-720-01-GL-00223	1	30 Jun 2013

1.0 PURPOSE

This guideline establishes the minimum qualification criteria and methods to periodically assess and qualify quality audit personnel.

2.0 SCOPE

The scope of this guideline applies globally to designated audit personnel.

3.0 RESPONSIBILITIES

The following personnel have responsibilities defined in this guideline:

- Global Quality Director
- Quality Directors
- Quality Managers
- Lead Auditors
- Auditors

4.0 GUIDELINE

4.1 The practices set forth in this document apply to persons designated as lead auditors and auditors. This guideline provides criteria for minimum work experience, education, and training and methods for proficiency assessment of audit personnel.

4.2 Regulatory (e.g., government or international standards) or certified quality management systems may mandate auditor qualifications more stringent than described in this guideline. In such cases, specific auditor qualifications are developed to meet applicable requirements.

4.3 Directors and managers are responsible for designating qualified and competent audit personnel. In all cases, audit personnel must be independent of the activity or function being audited.

4.4 Qualification criteria for audit personnel is detailed in the table below:

Parameter	Auditor	Lead Audit
Education	Attend course(s) in ISO 9001 Internal Auditing or equivalent.	Same
OJT Training	On an audit team as an observer for at least 3 audits.	Observed as an auditor by a lead auditor; participated on audit team for at least 3 audits.
Experience	N/A	Complete one audit as lead quality auditor, with a qualified lead quality auditor.
Competence	N/A	Demonstrated ability to conduct audits on time, professionally, & with minimum supervision.

4.5 The director or quality manager may consider credit for past audit experience relevant to:

- Certification or registration agencies
- Quality management systems
- Quality assurance programs
- Corporate internal audits
- Regulatory compliance audits
- Second and third party audits

- Surveillance and assessments of projects, suppliers or vendors, engineering, procurement, fabrication and construction companies.

4.6 Auditors and lead auditors maintain their proficiency through active participation in at least one audit per year or may receive additional auditor training as directed by their manager or director.

4.7 Lead auditors and auditors will be assessed initially and annually by their respective manager or director. Results of proficiency assessments and qualification shall be recorded on CMS-720-01-FM-00223 Auditor Proficiency Assessment and Qualification Record and maintained by the issuing manager or quality director.

4.7.1 Assessment of auditor qualification should include the following information:

4.7.1.1 Audit participation (lead or audit team)

4.7.1.2 Number of audits performed in the last calendar year)

4.7.1.3 Auditor training

4.7.2 Proficiency assessments by managers or directors may include:

4.7.2.1 Review of the audit plan.

4.7.2.2 Discussion of auditor performance, communication, or proficiency with audit attendees or individuals interviewed.

4.7.2.3 Timeliness of audit notification

4.7.2.4 Effectiveness of audit findings.

4.7.2.5 Content of audit report

4.7.3 Results of annual proficiency assessments are recorded on CMS-720-01-FM-00224 Auditor Proficiency Assessment and Qualification Record.

4.8 Records of auditor training are maintained according to CMS-500-03-PR-00001 Training and Development and CMS-500-03-WI-00010 Recording Training - Global. The Auditor Proficiency and Qualification Record (CMS-720-01-FM-00224) shall be maintained by the respective manager or director.

5.0 REFERENCES

CMS-720-01-FM-00020	Business Glossary
CMS-720-01-FM-00021	Technical Glossary
CMS-720-01-PR-00220	Internal Audit Procedure
CMS-720-01-WI-00220	Work Instructions for Internal Quality Audits
CMS-720-01-FM-00224	Auditor Proficiency Assessment and Qualification Record
CMS-500-03-PR-00001	Training and Development

6.0 TERMINOLOGY

None

7.0 EXHIBITS

None

1. PURPOSE

The purpose of this procedure is to provide instructions for performing and documenting independent, management-directed assessments of project activities and functional areas.

2. SCOPE

This procedure is applicable when conducting management-directed quality/independent assessments on Shaw E&I projects and functional areas. Quality Audits are managed in accordance with EIG-Q-009. Surveillances are managed in accordance with EIP-Q-006.

3. REFERENCES

- Shaw E&I *Quality Management System Manual*
- EIP-Q-006, "Surveillance"
- EIG-Q-007, "Nonconformance Reporting"
- EIG-Q-008, "Corrective Action Requests"
- EIG-Q-009, "Quality Audits"

4. DEFINITIONS

- **Assessment**—Targeted evaluation of activities, processes, functional areas, or project performance conducted to identify performance weaknesses, provide insights to management, or identify best practices to promote improvement across E&I organizations.
- **Assessor**—Individual assigned by Quality Services management to plan and conduct assessment activities and report results. Individuals are selected based on experience or familiarity with areas included in the scope.
- **Opportunity for Improvement (OFI)**—A recommendation for improvement not necessarily based upon requirements but focused upon process improvement opportunities. An OFI may also be a statement of fact regarding the potential for a noncompliance which could lead to a more serious problem if not identified and/or corrected, but which does not constitute a lack of compliance with established requirements.

5. RESPONSIBILITIES

5.1 Director of Quality Services

The Director of Quality Services is responsible for coordinating corporate sponsored management assessments. Responsibilities include scheduling, resource planning, and tracking of resolution of issues identified during assessment activities. The Director of Quality Services may delegate some or all of these duties to the Audit Program Manager. The Legal Department may be consulted if the information may potentially be considered business sensitive.

5.2 Responsible Manager

The Responsible Manager shall provide access to all personnel and material required for the performance of assessment activities. This is to include any necessary training, clearances, and restrictions to include any photography limitations. He or she shall also ensure necessary and timely corrective action for issues identified during assessment activities. He or she shall

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disseminate any relevant corrective actions or lessons learned to their affected organizations to preclude recurrence.

5.3 Assessment Team Lead

The Assessment Team Lead is responsible for coordinating the assessment within the constraints defined by the Management Sponsor and providing leadership to other assessment team members. Whenever possible, assessment activities should be performed in a manner that is not disruptive to ongoing work or operations.

5.4 Assessor

Prepare for the assessment by reviewing documents relevant to their assigned scope. Follow directions of the Lead Assessor and conduct themselves in a professional manner consistent with the conduct of audits. Maintain all information in strict confidence.

5.5 Management Sponsor

Management assessments shall be initiated at the request of a responsible level of management. This typically includes executive management, Operations Management, and Business Management leadership. Objectives should be defined.

5.6 Legal Department

The Legal Department shall communicate any necessary restrictions for the management of sensitive information.

6. PROCEDURE

An assessment may be formal or informal based on management expectations. Assessments may provide an independent evaluation of scope, status, adequacy, programmatic compliance, and/or implementation effectiveness of quality or business processes. An assessment may be focused on a single activity or process within an individual work group. Management assessments are typically unplanned and are initiated at the direction of a responsible level of management.

Assessments shall be based upon requirements and/or management policies and expectations and shall be performed to assess the conformance of an activity or function to the specified requirements.

6.1 Planning

The Management Sponsor should be consulted to ensure the objectives of the assessment are understood. If necessary, the Legal Department should be consulted if the assessment should be managed as a business sensitive work product. Assessment planning should include review of all documents and requirements relative to the subject and scope of the assessment. Documents to be reviewed may include the following, as applicable:

- Shaw E&I *Quality Management System Manual*
- Shaw E&I procedures that apply to the activity, product, or service
- Legal and contractual documents
- Specifications
- Codes, standards, or regulatory requirements
- Project work plans, instructions, drawings, and project-specific procedures

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- Project quality plans
- Project status reports
- Input from senior and/or project management

A Management Assessment Plan (EI-Q014.01, or equivalent) should be completed to organize assessment planning information.

6.2 Preparation

Based upon the scope and the documented requirements, the Lead Assessor should determine the method for conducting the assessment. Methods may include personnel interviews, observing activities, and/or reviewing documentation.

The Lead Assessor shall obtain an assessment number from the E&I Audit Program Manager for assessments managed by corporate resources. Responsible management or input from the sponsor should be solicited for any special concerns and should be included on the assessment plan. The assessment plan and any associated checklists prepared to guide assessment activities should be approved for use by the Lead Assessor.

Responsible management of the organization/area to be evaluated should be notified of assessment logistics and scope by e-mail or memorandum. Attachment 2 provides a representative example.

6.3 Performance

Assessors shall use the following methods, as applicable, to meet assessment objectives:

- Conduct interviews with knowledgeable individuals.
- Review the supporting documentation and records as available.
- Observe real time work performance or operational activity.
- Perform analysis of past, present, and future state performance.
- Assess competency of assigned resources.
- Assess the effectiveness of assigned management.
- Evaluate the effectiveness and efficiency of existing work processes to meet performance objectives.
- Based upon observations and reviews, determine the degree of conformance to the applicable requirements. Consider the potential consequences that not meeting requirements may have to the client or in mitigating Shaw's performance risk.
- Solicit input from knowledgeable management or technical resources as needed.
- Identify recommendations for process modification, staffing, training, organizational changes, or other means for continual improvement.
- Document conclusions and reference information used to formulate the conclusions (e.g., checklists, notes).
- Performance observations should be communicated to the Management Sponsor and the Director of Quality Services.

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6.4 Reporting

Efforts should be made during the assessment process to clearly communicate observations to responsible supervision. A post-assessment briefing shall be offered to the Responsible Manager and Management Sponsor to review results and any issues, deficiencies, or performance improvement insights. This briefing should be verbal and may include a written draft summary.

Assessment activities may be documented on a final assessment report, depending on the needs of the Management Sponsor. The Lead Assessor should provide the draft report for review and comment by the Responsible Manager prior to issuance. The report and documentation of any resultant deficiencies should be completed within 30 working days and presented to the Management Sponsor. A typical report format has been provided as an attachment to this procedure. The report may be transmitted using a memorandum via email or hard copy.

Distribution for the report should be determined by the Management Sponsor. This may include the customer of the assessment (senior management as directed), management of the evaluated area, Director of Quality Services, E&I Audit Program Manager, applicable Quality Manager, Assessment Team, Legal, and additional distribution as requested. If required by Legal, the report will be marked as a privileged communication. The Legal Department will communicate the necessary restrictions.

6.5 Corrective Action

An item, condition (e.g. in-process corrective actions), or material that deviates from procedures, drawings, specifications, or other requirements and which can be readily corrected within the scope of such documents should be corrected and documented in the assessment report as an “in process corrective action.”

Items, conditions, or materials that cannot be readily corrected should be documented as a deficiency. The Responsible Manager is responsible for responding to the deficiency and for determining and implementing corrective actions.

Items that meet the criteria of a Corrective Action Request should be documented and processed in accordance with Procedure No. EIG-Q-008, “Corrective Action Requests.”

Items that meet the criteria of a nonconformance in accordance with Procedure No. EIG-Q-007, “Nonconformance Reporting,” should be handled in accordance with that procedure. Corrective actions shall be sufficient to correct the issue or nonconformance and shall be completed and documented in a timely manner.

Management of the assessed area is responsible for ensuring appropriate disposition and resolution of issues identified in the assessment report. Quality Services personnel may follow up to evaluate effectiveness of resolution of issues identified during assessments based on significance of issues identified or as directed by senior management.

Opportunities for Improvement identified during the assessment should be discussed with responsible management and the Management Sponsor. These items should be included in the assessment report.

6.6 Records

Records generated as a result of this procedure shall be retained in a Project or Central Filing System. Records to be maintained include the following:

- Assessment Notification
- Assessment Plan
- Assessment Report

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- Checklists or annotated guidance documentation are required to be maintained only if needed as additional support for the report conclusions.

7. ATTACHMENTS

- Attachment 1, Management Assessment Process
- Attachment 2, Assessment Notification (typical format)
- Attachment 3, Assessment Report (typical format and content)

8. FORMS

- EIP-Q-014.01, Assessment Plan

9. RECORDS

- EIP-Q-014.01, Assessment Plan
- Assessment Notification
- Assessment Report

10. REVISION HISTORY AND APPROVAL

Revision Level Revision Date	Revision Description	Responsible Manager
00 06/29/2011	Initial issue	Bryan Koehler
01 12/27/2011	Modified format only to align with Governance Management framework.	Bryan Koehler

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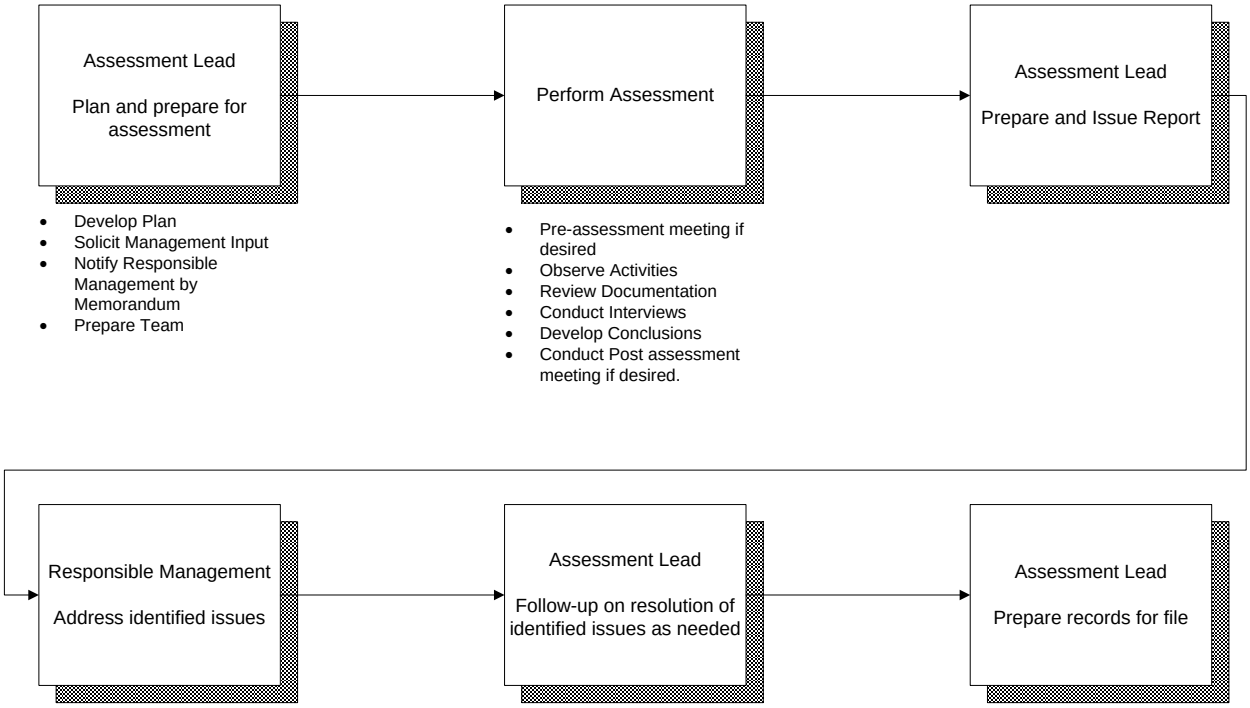
Attachment 1
Management Assessment Process



Attachment 2
Assessment Notification (typical memo format; e-mail notification may be used)

To: (insert Responsible Management of Assessed Area)

From: (Insert Name), Assessment Team Lead

Date: (Insert Month, Day, Year)

RE: E&I Management Assessment, (Insert Number obtained from Audit Program Manager)

Shaw E&I Quality Services has scheduled an Assessment at the (insert Office Location or Project Title and Location) on (insert Month, date range, and year). There will be a pre-assessment entrance meeting on (Insert Month and day, and time). A close-out briefing is tentatively scheduled for (Insert Month and day, and time). Please provide this notification information to individuals in your organization that have not been included on distribution that should be made aware of the information.

The purpose of this assessment is to evaluate (insert purpose and reference to applicable client and E&I requirements). The scope will include: (Insert list of bulleted scope elements).

-

The assessment team consists of (Insert Assessment Team Lead, Title; Team Members, Titles, Technical Specialists, Titles).

A conference room should be made available for the team for the duration of the assessment. Key individuals knowledgeable of the core projects and business processes should be accessible; any schedule constraints should be communicated during the opening meeting so the assessment team may make the best use of the available time. Additionally, the request by the assessment team for records should be provided in a timely manner during the assessment, otherwise will not be considered available.

The results of the assessment will be summarized in a report within 30 working days after completion of the assessment.

The Assessment Team appreciates your cooperation in our collective commitment toward continual improvement. Should you have any questions, please contact me at (Insert Assessment Team Lead's phone number and email).

Cc: Responsible Management of Assessed Area (one organizational level above addressee)
Management Sponsor (Applicable Senior Management)
E&I Director of Quality Services
E&I Audit Program Manager
Legal Department (if applicable)
Assessment Team
Assessment File - Baton Rouge

Attachment 3
Assessment Report (typical format and content)

Cover Sheet:

Assessment Title

Organization/Location Evaluated

Assessment Number

Assessment Dates

Lead Assessor and Date

Report: (Include Table of Contents if desired for complex, lengthy reports)

Executive Summary

(Concise management level discussion of assessment purpose, scope, and overall results, both positive and negative).

Assessment Details:

I. Scope Element Evaluated

(Provide a brief discussion of methodology used to evaluate area and sufficient detail to support conclusions and issues identified. Include both positive and negative observations noted with supporting evidence/basis).

Summary of Issues/Improvement Opportunities

I. Issues:
(Include a table of individual deficiencies, referenced corrective action documentation number used to track disposition and resolution of the item).

Sequential Number	Identified Deficiency Description (Reference Requirement)	Corrective Action Document Number

II. Improvement Opportunities (OFIs)
(Include a table of individual opportunities for improvement – indicate whether function/location specific or whether applicable across E&I organizations).

Sequential Number	Description of Improvement Opportunity (OFI)

Attachments:

A. Assessment Team (List Lead, Team Member, and Technical Specialist as appropriate)

B. Personnel Contacted (List names of individuals contacted during the assessment, titles/organization/department, and role in assessment, e.g., pre-and post-assessment briefings, assessment performance, etc.)

C. Documents Reviewed (List documents reviewed, including title, revision, and/or date).

Management Assessment Plan

Assessment Number:	**Organization:**
Contract/Project Number:	**Location:**

Assessment Scope:

The purpose of this assessment is to evaluate (insert purpose and reference to relevant client and E&I requirements). The scope will nominally include: (insert bulleted scope elements to be assessed)

-
-

ASSESSMENT PERSONNEL	ASSESSMENT SCHEDULE
Assessment Team Lead: Name, Title **Team Member:** Name, Title **Technical Specialist:** Name, Title	**Assessment Dates:** **Pre-Assessment Conference:** Date / Time **Post-Assessment Briefing:** Date / Time

Reference Documents:

Follow-up Items:	**Special Concerns/Items:**

TEAM ASSIGNMENTS

Lead (Insert Name):

Team Member (Insert Name):

Technical Specialist (Insert Name):

ASSESSMENT PLAN APPROVAL

Assessment Team Lead: **Date:**

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1. PURPOSE

The purpose of this procedure is to establish the framework for conducting quality councils.

2. SCOPE

This procedure applies to corporate Quality Leadership Council for Shaw Environmental & Infrastructure Group (Shaw E&I) and any sub-tier quality councils.

3. REFERENCES

None

4. DEFINITIONS

None

5. RESPONSIBILITY

5.1 Procedure Responsibility

The Senior Director of EHS&Q is responsible for the issuance, revision, and maintenance of this procedure.

5.2 Action/Approval Responsibilities

5.2.1 Chairperson

The senior manager at the level of the council will be designated as the council chairperson and facilitate meetings consistent with the direction of this procedure.

5.2.2 Secretary

The senior Quality Services representative or chairperson designee in the absence of a Quality Services representative will be designated as the council secretary. The Secretary shall maintain records and help coordinate the meeting at the direction of the Chairperson, consistent with the direction of this procedure.

6. PROCEDURE

Quality councils are an integral part of Shaw E&I's Continual Improvement Program. A Corporate Leadership Quality Council is held by executive management, to include representation from operations and business management. Other quality councils are encouraged at other levels within the organization, as supported by responsible management (e.g., regional managers, office managers, project managers). Essential provisions of this procedure include the following:

- Quality Council Charter, Purpose, and Duties
- Organization
- Membership
- Subcommittees
- Quality Council Meetings

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- Reporting Requirements

6.1 Quality Council Charter, Purpose, and Duties

The company quality policy states:

Shaw E&I is committed to consistently meeting client project objectives, requirements, and expectations. Our quality management system supports this endeavor by providing all employees with a framework to plan, perform, monitor, and improve work performance and results. We strive to develop and implement processes that enable timely identification and prevention of nonconforming performance and results. Shaw E&I leaders recognize project teams and individuals who deliver cost effective solutions that help our clients meet their project objectives.

Quality councils help to fulfill this policy by providing a mechanism for management and employees to take a proactive role in providing an atmosphere for continual improvement.

6.1.1 Charter

The charter of each quality council is to promote continual improvement through the Quality Management System at the management level of the council, within the quality policy, procedures, and guidelines of the company. Each quality council is chartered to act within the bounds of the authority approved for that management level.

6.1.2 Purpose

The purpose of each quality council is to create an environment that actively involves management and employees in the continual improvement process to improve work performance and results for both internal and external customers.

6.1.3 Duties

It is expected that the duties of each quality council will evolve to meet the needs of the management level that it serves. A list of key quality council duties is provided below:

- Monitor the activities of any lower level councils.
- Coordinate and monitor quality assurance inspections, surveillances, audits, and assessments.
- Verify that nonconformances are resolved in a timely manner through corrective and preventive actions.
- Facilitate the awareness and implementation of the Quality Management System.

6.2 Organization

Quality councils should function at various management levels across the company, including corporate, business line, and division levels. Quality councils serving large business lines may, at their discretion, create program or project safety councils.

Quality councils at all levels are empowered with the authority to act through the membership and participation of the senior manager at the level of the council (e.g., President at corporate level, business line manager at business line level). Authority to act includes the management authorities stated in various company procedures for the management level responsible for the safety council.

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6.3 Membership

Each quality council should have a chairperson and secretary. The senior manager at the level of the council will be designated as the council chairperson. The senior Quality Services representative at the level of the council should be the secretary. In the absence of a Quality Services representative at a particular council location, the chairperson will appoint a secretary who is knowledgeable in company Quality Management System requirements.

Total membership of each quality council should be limited to approximately eight people and should be equally divided between management and other employees. It is the responsibility of the chairperson to provide a quality council membership that represents a cross section of the employees within the council's responsibility. It is important that quality council members be knowledgeable of operations within the organization represented by the council so that employees can communicate potential problems and ideas for improvement to members of the quality council.

Quality council members are expected to serve at least a 1-year term before rotating. The position of a chairperson does not rotate and remains the senior manager of the council level. The secretary does not rotate unless there are multiple Quality Service representatives at the level of the council.

6.4 Subcommittees

Much of the work of each quality council can be accomplished by subcommittees. Each subcommittee will have as its chairperson a member of the quality council appointed by the council chairperson. Subcommittee membership should have representation between management and other employees so that the necessary authority and influence exist to act upon recommendations for improvement, solve potential problems, and provide solutions to the quality council.

6.5 Quality Council Meetings

Quality council meetings should be held at least bi-monthly, preferably as part of a regularly scheduled management meeting. It is estimated that approximately 30 minutes to 1 hour will be required for the conductance of a quality council meeting.

6.5.1 Agenda

The agenda for each quality council meeting should be documented. The following topics may be considered:

- Client performance feedback
- Performance objectives and goals, and performance metrics
- Suitability, adequacy, and effectiveness of the Environmental Management System
- Training, awareness, and competence
- Continual improvement initiatives
- Results of surveillances, audits, and management assessments
- Nonconformance, corrective, and preventive actions
- Current and planned work controls (e.g., procedures, equipment, trained personnel)
- Inefficient, wasteful, or non-value-added work processes

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- Preventive action and corrective action taken since the last quality council meeting
- Report of activity and findings since the previous quality council meeting from any subcommittee chairperson, including progress on action items
- Status of Wildly Important Goal (WIG) progress

6.5.2 General Rules of Operation

The general rules of operation are listed below:

- Quality council and committee members participate on company time.
- Quality council meetings are open to all employees.
- Quality councils are encouraged to operate by consensus. When a vote is needed, a simple majority with one vote per member shall prevail.
- The chairperson of the quality council may not overrule a decision of the quality council. The chairperson may refer an issue to a higher level council prior to action, or for resolution, as appropriate.
- Quality councils must operate within their level of assigned management authority.
- Spending authority is limited to that of the quality council chairperson.
- Quality councils may not change company policy and procedures or guidelines established by a higher level quality council; however, quality councils may recommend revisions to policy, procedures, or guidelines.
- Work rules cannot be set beyond the authority of the quality council.
- Quality council members are to seek employee input regarding value-added continual improvement opportunities. Also activities with heightened levels of operational risk without (or ineffective) controls.

6.6 Reporting Requirements

Each quality council is required to prepare meeting minutes to summarize the council's activities. This report is to be prepared by the secretary and maintained. Minutes should be distributed to interested parties, at the discretion of the chairperson.

7. ATTACHMENTS

None

8. FORMS

None

9. RECORDS

None

10. REVISION HISTORY

Revision Level Revision Date	Revision Description	Responsible Manager
0	Initial issue. Content based on HS018, Safety Councils.	Andrew Johnson

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Revision Level Revision Date	Revision Description	Responsible Manager
02/07/2012		

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Appendix F
Project Work Instructions

WORK INSTRUCTION

Work Instruction Title:	**D2005-0008-001 - Material and Equipment Release Surveys**	**CMS Number:**	**N/A**
Work Instruction Owner:	**Federal Services HSE**	**Issuing Authority:**	**CFS HSE&Q Director**

D2005-0008-001
MATERIAL AND EQUIPMENT RELEASE SURVEYS

0	Initial submittal.	JRH	
Rev	**Changes**	**Approved**	**Date**

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CMS Number:	Revision:	Approval Date:
N/A	0	

1.0 PURPOSE

This work instruction describes the methods of surveying equipment, materials (including concrete, asphalt, miscellaneous debris, etc.) or vehicles for release for unrestricted use.

2.0 APPLICATION

This work instruction applies to all site personnel responsible for the unrestricted release of equipment and materials used in a radiologically controlled area.

3.0 REQUIREMENTS

Implementation of this instruction requires its users to have knowledge of radiation safety principles and CB&I CMS-710-07-PR-04000, *Radiation Safety Program*.

3.1 The following personnel have responsibilities in this WI:

- Project/Program Radiation Safety Officer (PRSO)
- Radiological Control Supervisor (RCS)
- Lead Radiological Control Technician
- Radiological Control Technician

3.2 Responsibilities

3.2.1 The PRSO is responsible for the maintenance, management, and revision of this work instruction. The PRSO is also responsible for ensuring workers comply with the requirements of this WI.

3.2.2 The RCS is responsible for the field oversight of the radiological control technician (RCT) performing tasks detailed in this WI.

3.2.3 The lead RCT may be assigned responsibility by the PRSO or RCS for the field oversight at a specific work site of RCTs performing tasks detailed in this WI.

3.2.4 The RCT is responsible for compliance with this work instruction and for addressing any issues or suggested modifications with the RCS or PRSO.

4.0 REFERENCES

CFR, Title 10, Part 20, Standards for Protection against Radiation, U.S. Government Printing Office, Washington, D.C., January 1, 2011, available online at 10CFR20 (current version).

CMS-710-07-PR-04000, *Radiation Safety Program*

CMS-710-07-PR-04005, *Radiation Safety Training*

CMS-710-07-PR-04011, *Radiological Surveys and Monitoring*

CMS-710-07-PR-04013, *Radiation Detection Instrumentation*

CMS-710-07-WI-04008, *Radiological Work Permits*

CMS-710-07-WI-40111, *Performing and Documenting Radiation and Contamination Surveys*

CMS-710-07-FM-40111, *Radiological Survey Forms,* example

SPL-SOP-8.10.2*, Radiation Monitoring Instrumentation*

U.S. Atomic Energy Commission, Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, Table 1.

5.0 WORK INSTRUCTION

5.1 Prerequisites

5.1.1 Surveys will be performed by an RCT who will be trained on the use of the specific instrumentation and will be aware of proper survey technique as contained in any site specific work instructions and/or the Sitewide Radiation Protection Plan

5.1.2 Prior to performing a radiation survey, personnel should review previous survey data and familiarize themselves with possible radiological hazards.

5.1.3 As low as reasonably achievable principles of time, distance, and shielding are used at all times.

5.1.4 Work activities are performed in accordance with the applicable site- or task-specific Radiological Work Permit (RWP).

5.1.5 Instrumentation used for material and equipment release survey will be chosen such that the values tabled in Regulatory Guide 1.86 can be reliably detected above any background levels.

5.1.6 Prior to conducting any surveys, ensure that all survey instrumentation has satisfactorily completed daily function checks and is operating within control limits. Function checks shall be performed twice daily, once in the morning and once at the end of the day. Daily function check requirements are detailed in SPL-SOP-8.10.2, *Radiation Monitoring Instrumentation*.

5.1.7 Verify the minimum detectable activity (MDA) has been calculated for the selected instrument, if appropriate, and is less than the site release limit. The MDA for all instrumentation, used for conducting unrestricted release surveys, must be less than the site release criteria (RG 1.86 tabled values).

5.1.8 Personal Protective Equipment (PPE) should be appropriate for the level of contamination expected and shall be in compliance with both the applicable Site Health and Safety Plan and Radiological Work Permit if applicable.

5.2 Equipment and Material General Survey Protocol

Clearance and release of equipment and material will be performed through routine scans and measurements as contained in approved processes including MARSAME. Material best analyzed by volumetric measurement methods, (i.e. dirt, asphalt rubble, cement rubble) will be analyzed for radioactive material content by an accredited, offsite laboratory.

5.3 Survey of Material and Equipment

5.3.1 Prior to surveying verify that all meters have been pre-operationally inspected per SPL-SOP-8.10.2, *Radiation Monitoring Instrumentation*.

5.3.2 Establish instrument background in an appropriate area and MDA for each meter. Material chosen as background reference material will be similar in chemical, physical and radiological characteristics and will also be non-radiologically impacted from site operations.

5.3.3 Record data on the appropriate survey forms in accordance with CMS-710-07-WI-40111, *Performing and Documenting Radiation and Contamination Surveys*. Instruments used in surveys must be capable of achieving an MDA that is less than the applicable release limits.

5.3.4 Scans of the items may use the following (or equivalent of):

- Ludlum 43-93 Alpha/Beta Scintillator coupled with a Ludlum 2360
- Ludlum 43-68 Gas Proportional Detector coupled with a Ludlum 2360
- Ludlum 19, Exposure Rate Meter

5.3.5 While Surveying:

- Use the scan speed of 1.25 cm/s for alpha/beta surveys.
- Obtain static measurements at locations showing the highest count rate during the scan.
- Locations will be determined by the RCT in accordance with PRSO or RCS guidance. The typical count time for the static measurement is one minute.
- Identify and mark any items that exceed investigational levels.
- Record data on the appropriate survey forms (See CMS-710-07-FM-40111, *Radiological Survey Forms*).
- Segregate potentially contaminated items from non-contaminated items, if necessary.

5.4 Direct Probe Surveys for Total Contamination

5.4.1 Direct probe surveys are used to determine total contamination levels. Direct probe surveys may be used in concert with swipe surveys to complete a contamination survey. Direct probe surveys may be used to demonstrate that total contamination levels are less than the removable contamination release criteria. (In this case swipes may not be required, as determined by the PRSO). Total contamination readings should be taken prior to swiping the surveyed surface.

5.4.2 Obtain proper instrumentation for the survey type. Ensure that the instruments are currently calibrated (i.e. calibration sticker attached to meter) and have satisfactorily completed a function check in accordance with SOP-SPL-8.10.2 prior to use.

5.4.3 Obtain a survey map of the item to be surveyed. The completed map should indicate where survey readings are to be taken. .

5.4.4 Take a background reading in the same area as the survey. Record the area background on the survey form.

5.4.5 Scan the item (as appropriate for the item classification). Take a direct stationary reading at each survey location and record the cpm value. Typically one stationary reading will be taken per survey location. This reading will be corrected to a 100 cm2 area reading by the probe Area Correction Factor (ACF).

5.5 Swipe Surveys for Removable Contamination

5.5.1 Swipes are not necessary if direct probe readings demonstrate that the total contamination levels are below the removable contamination levels.

5.5.2 If required, obtain swipes, envelopes, and a survey map of the item to be surveyed. Swipe each designated location.

5.5.3 Each survey location should be pre-identified (written) on the swipe backing paper, or as the swipe is taken. Close the swipe backing paper and place the swipes together in the envelope. The envelope should be labeled with the area, date, and technician. Additional information may be placed on the envelope, or on the swipe backing.

5.5.4 Transport the swipes to the counting facility.

5.6 Instrument Data Quality

5.6.1 At the end of the shift the instruments will be given a post operational check consisting of the steps used in the preoperational check, per SOP-SPL-8.10.2. The results will be recorded on the appropriate forms.

5.6.2 The PRSO or RCS shall review all survey data prior to the release of any items. Upon PRSO or RCS approval, RCTs will perform material and equipment release actions.

5.7 Records

Copies of the records generated by this work instruction are maintained on site for the duration of project activities. Original records are periodically transmitted to the CB&I Federal Services LLC Concord, CA office for storage in the central file system.

6.0 ATTACHMENT

U.S. Atomic Energy Commission, Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, Table 1 – Acceptable Surface Contamination Levels

Radionuclide[a]	Disintegrations/minute/100-square-centimeters (dpm/100 cm^2)		
	Average[b c f]	Maximum[b d f]	Removable[b e]
U-nat, ^{235}U, ^{238}U & associated decay products	5,000 (α)	15,000 (α)	1,000 (α)
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100	200	20
Th-nat, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000	3,000	200
β-γ emitters (nuclides with decay modes other than α-emissions of SF) except ^{90}Sr and others noted above.	5,000 (β-γ)	15,000 (β-γ)	1,000 (β-γ)

Notes:

U.S. Atomic Energy Commission, 1974, Termination of Operating Licenses for Nuclear Reactors, Regulatory Guide 1.86, Washington D.C.

[a]Where surface contamination by both α- and β-γ-emitting nuclides exists, the limits established for α- and β-γ-emitting nuclides should apply independently. [The values apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item.]

[b]As used in this table, dpm means the rate of emission by radioactive material as determined by correcting the counts per minute observed by the appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contamination should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent material, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. [The use of dry material may not be appropriate for tritium.] When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire area should be wiped. [Except for transuranics and ^{226}Ra, ^{227}Ac, ^{230}Th, ^{228}Th, ^{231}Pa, and α-emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination (i.e., removable and fixed) are within the limits for removable contamination.]

[f]The average and maximum radiation levels associated with surface contamination resulting from β-γ-emitting nuclides should not exceed 0.2 mrad/hr @ 1 cm and 1.0 mrad/hr @ 1 cm, respectively, measured through 7 milligrams per square centimeter (mg/cm^2) of total absorber.]

Note: Comments in brackets [ ] have been added by CB&I.