CHPRC-00189
Revision 16

# Environmental Quality Assurance Program Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

**P.O. Box 1600**
**Richland, Washington 99352**

Approved for Public Release;
Further Dissemination Unlimited

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Document Type: PLAN Program/Project: EP&SP

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CH2M HILL Plateau Remediation Company

Date Published
November 2019

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Release Approval Date

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# Executive Summary

This Environmental Quality Assurance Program Plan (EQAPP) was developed to support the U.S. Department of Energy based on U.S. Environmental Protection Agency guidance documents for application to environmental management activities (EPA/240/B-01/002, *EPA Requirements for Quality Management Plans*[1]). The EQAPP interfaces with the CH2M HILL Plateau Remediation Company Quality Assurance Program (PRC-MP-QA-599, *Quality Assurance Program*[2]), which includes the quality provisions of:

- DOE O 414.1D, *Quality Assurance*[3]
- 10 CFR 830, "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements"[4]
- EM-QA-001, *Office of Environmental Management Quality Assurance Program*[5]
- ASME NQA-1 – 2008, *Quality Assurance Requirements for Nuclear Facility Applications*,[6] including ASME NQA-1A – 2009, *Addenda A to ASME NQA-1 – 2008, Quality Assurance Requirements for Nuclear Facility Applications*[7]

[1] EPA/240/B-01/002, 2001, *EPA Requirements for Quality Management Plans*, EPA QA/R-2, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2016-06/documents/r2-final.pdf.

[2] PRC-MP-QA-599, *Quality Assurance Program*, CH2M HILL Plateau Remediation Company, Richland, Washington.

[3] DOE O 414.1D Chg 1 (Admin Chg), 2013, *Quality Assurance*, Attachment 2, "Quality Assurance Criteria," U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives-documents/400-series/0414.1-BOrder-d-admchg1.

[4] 10 CFR 830, "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements," *Code of Federal Regulations*. Available at: https://www.govinfo.gov/content/pkg/CFR-2010-title10-vol4/xml/CFR-2010-title10-vol4-part830-subpartA.xml.

[5] EM-QA-001, 2012, *Office of Environmental Management Quality Assurance Program*, Rev. 1, Office of Environmental Management, U.S. Department of Energy, Washington, D.C. Available at: https://energy.gov/sites/prod/files/em/EMQualityAssuranceProgram(EM-QA-001Revision1).pdf.

[6] ASME NQA-1 – 2008, *Quality Assurance Requirements for Nuclear Facility Applications*, American Society of Mechanical Engineers, New York, New York.

[7] ASME NQA-1A – 2009, *Addenda A to ASME NQA-1 – 2008, Quality Assurance Requirements for Nuclear Facility Applications*, American Society of Mechanical Engineers, New York, New York.

Quality assurance requirements pertaining to environmental activities include the following applicable requirement sections of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a).[8]

- ARTICLE XXXI QUALITY ASSURANCE states in part that throughout all sample collection, preservation, transportation, and analysis activities required to implement Ecology et al. (1989a) procedures for quality assurance and quality control shall be used.
- Section 6.5, QUALITY ASSURANCE of the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989b)[9] for *Resource Conservation and Recovery Act of 1976*[10] (RCRA) closure plans, the RCRA permit, and any other relevant plans that may be used to describe sampling and analyses at RCRA treatment, storage, and disposal units.
- Section 7.8, QUALITY ASSURANCE of the Action Plan (Ecology et al., 1989b) for Remedial Investigation/Feasibility Study or RCRA facility investigation/corrective measures study work plans, or in other work plans that may be used to describe sampling and analyses at *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[11] or RCRA past-practice units.

[8] Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: https://www.hanford.gov/?page=81.

[9] Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: https://www.hanford.gov/?page=82.

[10] *Resource Conservation and Recovery Act of 1976*, Pub. L. 94-850, 42 USC 6901 et seq. Available at: https://www.govinfo.gov/content/pkg/STATUTE-90/pdf/STATUTE-90-Pg2795.pdf.

[11] *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, Pub. L. 107-377 as amended, 42 USC 9601 et seq., December 31, 2002. Available at: https://www.csu.edu/cerc/researchreports/documents/CERCLASummary1980.pdf.

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# Terms

| | |
|---|---|
| AVS | Acquisition Verification Services |
| CAA | *Clean Air Act of 1963* |
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| CHPRC | CH2M HILL Plateau Remediation Company |
| CWA | *Clean Water Act of 1977* |
| DOE | U.S. Department of Energy |
| DQA | data quality assessment |
| DQI | data quality indicator |
| DQO | data quality objective |
| DUA | data usability assessment |
| EC | Environmental Compliance |
| EC&QA | Environmental Compliance and Quality Assurance |
| EM | Environmental Manager |
| EMS | Environmental Management System |
| EP | Environmental Protection |
| EP&SP | Environmental Program and Strategic Planning |
| EPA | U.S. Environmental Protection Agency |
| EQAPP | Environmental Quality Assurance Program Plan |
| FSP | field sampling plan |
| HASQARD | *Hanford Analytical Services Quality Assurance Requirements Document* |
| IEP | Integrated Evaluation Plan |
| MA | management assessment |
| MSA | Mission Support Alliance |
| NEPA | *National Environmental Policy Act of 1969* |
| NESHAP | “National Emissions Standards for Hazardous Air Pollutants” |
| NPDES | National Pollutant Discharge Elimination System |
| PAC | Project Assessment Coordinator |
| QA | quality assurance |

| | |
|---|---|
| QAP | Quality Assurance Program |
| QAPjP | quality assurance project plan |
| QC | quality control |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| SAP | sampling and analysis plan |
| SEPA | *State Environmental Policy Act* |
| SME | subject matter expert |
| SMP | Software Management Plan |
| TPA | Tri-Party Agreement |
| Tri-Party Agreement | *Hanford Federal Facility Agreement and Consent Order* |
| VP | Vice President |

# 1 Management and Organization

This Environmental Quality Assurance Program Plan (EQAPP) describes the quality assurance (QA) policy, requirements, roles, responsibilities, and authorities that support compliance with the environmental aspects of the CH2M HILL Plateau Remediation Company (CHPRC). The plan provides requirements for the planning, implementation, and assessment of environmental functions and activities, in support of Environmental Compliance (EC). QA oversight for environmental requirements, functions, and activities is provided by the Environmental Compliance and Quality Assurance (EC&QA) organization. This includes sampling and data collection, environmental monitoring and reporting, regulatory documentation, and other environmental compliance activities.

The Environmental Program and Strategic Planning (EP&SP) organization is responsible for verification and flow down of applicable environmental regulations and requirements including, but not limited to, the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a), also known as the Tri-Party Agreement (TPA); DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD); the *Resource Conservation and Recovery Act of 1976* (RCRA); the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA); 40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants" (NESHAP); National Pollutant Discharge Elimination System (NPDES); the *Clean Air Act of 1963* (CAA), the *Clean Water Act of 1977* (CWA), the *National Environmental Policy Act of 1969* (NEPA), and the other requirement sources listed in Attachment J.2 of the CHPRC Prime Contract (DE-AC06-08RL14788).

This EQAPP shall be reviewed periodically and updated as necessary.

## 1.1 Purpose

This document summarizes the overall policy, scope, applicability, and management responsibilities of the CHPRC environmental quality system. It identifies the basic QA requirements imposed by CHPRC for environmental programs, functions, and activities, as well as the implementation of the EQAPP.

## 1.2 Requirements

The management and organization of CHPRC environmental QA program and functions shall be consistent with the QA requirements found in the following documents:

- ANSI/ASQ E4-2004, *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use*, Section 5.2, "Management and Organization"
- EPA/240/B-01/002, *EPA Requirements for Quality Management Plans* (EPA QA/R-2), Section 3.2, "Management and Organization"
- ISO 14001:2015, *Environmental Management Systems—Requirements with Guidance for Use*, Clause 4.4, "Environmental Management System," and Clause 5.2, "Environmental Policy"
- Applicable QA requirements of the TPA (Ecology et al., 1989a)

## 1.3 Implementation

Applicable CHPRC procedures required to implement the quality program are listed below. Project-specific procedures are located on the CHPRC intranet.

- PRC-MP-QA-599, *Quality Assurance Program* (QAP)
- PRC-MP-MS-19361, *CH2M HILL Plateau Remediation Company Project Execution Plan*

- PRC-MP-EP-40220, *Environmental Program and Strategic Planning Roles, Responsibilities, and Functions*

### 1.3.1 CHPRC QA Policy

The CHPRC QA program's policy is implemented by PRC-MP-QA-599. The CHPRC Environmental Policy applies to anyone performing CHPRC work scope and is documented in PRC-POL-EP-5054, *CH2M HILL Plateau Remediation Company Environmental Policy*.

### 1.3.2 Responsibilities

All workers are responsible for performing work in accordance with the requirements set forth in this EQAPP. Those personnel performing oversight and verification have the authority and responsibility to identify quality problems, recommend solutions, and verify implementation of effective corrective actions.

Note: Employees are responsible for and have the authority to stop work when they are convinced that a situation exists that places themselves, their coworker(s), the public, or the environment in danger.

#### *1.3.2.1 CHPRC President and Chief Executive Officer*

The CHPRC President and Chief Executive Officer is responsible for the quality of environmental CHPRC activities, services, and products.

#### *1.3.2.2 Environmental Program and Strategic Planning Vice President*

The EP&SP Vice President (VP) is responsible for the interpretation and implementation of environmental codes, standards, and regulations. This key individual provides qualified staff to support safe and compliant work, maintains an interface with external environmental regulators, and promotes environmental regulatory compliance. This individual has overall responsibility for establishing, implementing and maintaining CHPRC's Environmental Management System (EMS) and is also responsible for ensuring the following:

- EP&SP work is performed in accordance with the CHPRC environmental QA program.
- Organizational charts, functional responsibilities, and levels of authority are defined and documented.
- Roles and responsibilities are clearly stated in PRC-MP-EP-40220.

#### *1.3.2.3 EC&QA Responsibilities*

EC&QA implements the CHPRC environmental QA program by providing environmental QA engineering support and implementing a rigorous assessment program that evaluates CHPRC performance in complying with environmental, QA, and EMS requirements. The assessment program assists in providing continuous improvement of environmental performance by systematic evaluation of conformance and compliance.

EC&QA implements PRC-PRO-QA-40091, *Integrated Assessment Planning*, in conjunction with PRC-PRO-EP-53109, *Environmental Audit Management*, to support the annual development the CHPRC Integrated Assessment Plan (IEP). The EP&SP Project Assessment Coordinator (PAC) is responsible for ensuring that an annual assessment schedule is developed and maintained in the IEP that supports oversight of recognized areas of environmental risk.

CHPRC/EC&QA assists Environmental Protection (EP) with the assessment and management of asbestos-containing materials related to demolition and renovation activities. Implementation and

compliance with asbestos requirements in accordance with NESHAP (40 CFR 61) applicable to CHPRC deactivation and demolition activities is managed by EP.

EC&QA personnel ensures that quality requirements related to environmental work are followed and implemented. Responsibilities include the following:

- Implementing the environmental QA program through quality engineering, surveillances, and assessments to measure and evaluate the effectiveness of implementation
- Ensuring that personnel have access to the appropriate management levels in order to plan, assess, and identify improvements to the quality systems
- Ensuring that staff maintain the appropriate level of independence from the organizations to be assessed
- Ensuring that assessors are qualified for leading, coordinating, scheduling, performing, and reporting assessments
- Ensuring that EC&QA activities are planned and needed resources are provided to meet any stated objectives
- Reviewing and approving environmental documents, including:
  - Data quality objectives (DQOs)
  - Data usability assessments (DUAs)
  - Sampling and analysis plans (SAPs)
  - Quality assurance project plans (QAPjPs)
  - Other documents, as requested or as deemed appropriate
- Conducting programmatic independent assessments and surveillances and report quality issues to management
- Interfacing, as needed, with the CHPRC QA Organization for coordination and support of environmental activities
- Interfacing, as practical, with U.S. Department of Energy (DOE) QA, legal, projects, and other regulatory agencies concerning environmental QA programs and issues

#### *1.3.2.4 Director of Environmental Protection*

The Director of EP is responsible for implementing environmental policies and procedures that meet applicable environmental laws, regulations, and DOE orders. Other responsibilities include the following:

- Ensuring regulatory compliance for CHPRC through interpretations, implementing procedures, and project support
- Managing and providing Environmental Compliance Officers for each project
- Implementing and maintaining the Environmental Requirements Management process
- Providing permitting and regulatory reporting services
- Coordinating near-field monitoring within CHPRC and with Mission Support Alliance (MSA) and other contractors

- Determining if company and/or facility/project-specific policies and procedures meet applicable legal and other environmental requirements based on applicable reviews
- Acting as the regulatory subject matter expert (SME) for environmental regulations
- Performing periodic management reviews of environmental activities and functions against organizational goals and commitments, and directing actions for continuous improvement
- Coordinating and supporting regulator inspections of CHPRC operations

#### *1.3.2.5 Project Environmental Manager*

The Project Environmental Manager has the overall responsibility to manage regulatory challenges and develop approaches to maintain environmental compliance within individual CHPRC projects. Facilitate the integration of environmental requirements into all aspects of project activities. Direct reporting to the project senior management. This roll is matrixed to the EP&SP VP and reports to the EP&SP VP on project activities. Other responsibilities include the following:

- Verifying requirements set(s), ensuring implementing documents are in place for all requirements, and ensuring that implementing information in the requirements management database is accurate and complete.
- Ensuring environmental requirements are addressed in project subcontracts.
- Ensuring the appropriate surveillances, inspections, and management assessments (MAs) are completed to assess compliance; corrective actions are developed, tracked, and completed consistent with compliance vulnerability; and compliance vulnerabilities are identified and strategies to improve are developed and implemented.
- Ensuring responses to regulatory inspection reports, notices of violation, etc. are provided to inspection on schedule and are accurate and complete.
- Ensuring resources are available to support planned project work, including preparation of permit documents.
- Ensuring project environmental documentation (permits, decision documents, etc.) is prepared, accurate, and complete.

# 2 Quality System Components

## 2.1 Purpose

The purpose of this section is to document how CHPRC manages its environmental QA program and defines the required steps for managing the system.

This EQAPP supports the CHPRC QAP (PRC-MP-QA-599) by flowing down QA requirements for environmental work activities. Such activities include, but are not limited to, environmental sampling and data collection; environmental technology programs; environmental monitoring and reporting; risk assessments; and preparation of pertinent environmental documents.

## 2.2 Requirements

CHPRC quality systems components involving environmental functions and activities shall be consistent with the QA requirements found in the following documents:

- ANSI/ASQ E4-2004, Section 5.3, “Quality System and Description”
- EPA/240/B-01/002, Section 3.3, “Quality System Components”
- ISO 14001:2015, Clause 4.4

This system shall be planned, documented, implemented, and periodically assessed as an integral part of a management system for environmental programs. The quality system shall include clear documentation of organizational structure, policies, and procedures; responsibilities, authorities, and resources; and requirement documents. Periodic assessments shall be performed to ensure that the quality system has been established, documented, and implemented effectively. Individuals responsible for planning, implementing, and assessing the quality system will have sufficient authority, organizational freedom, and access to management to identify noteworthy practices and quality problems.

EPA/240/B-01/002 requires that an organization document how the environmental quality system will be managed and to provide the following items, as included in this EQAPP:

- A description of the organization’s quality system that includes the principal components of the system and the roles and implementation responsibilities of management and staff with regard to these components. These components include, but are not limited to, the following:
  - Quality system documentation
  - Reviews and planning
  - MAs
  - Training
  - Systematic project planning
  - Project-specific quality documentation
  - Project and data assessments
- A list of the tools for implementing each component of the quality system including, but not limited to, the following:
  - Quality management plans (quality system documentation)
  - Quality systems audits (independent assessments, MAs, surveillances, work site assessments)

- Training plans
- QAPjP (project-specific quality documentation)
- DUAs (may include data verification, data validation, data quality indicators, and data quality assessments)

## 2.3 Implementation

All environmental activities employ a graded approach and will vary according to the nature of the activities and the intended use of the resulting information or data. Graded approach is a principal that dictates that preparation and planning will be commensurate with the degree of complexity and/or inherent risk in the work to be undertaken. The CHPRC graded approach is described in PRC-PRO-QA-259, *Graded Approach*.

Processes used to implement this EQAPP are utilized throughout the CHPRC QA management system. Activities that affect quality, such as MAs, training, project planning and execution, and DUAs, are performed in accordance with approved procedures appropriate to those activities.

Applicable procedures required to implement the environmental quality program are listed below. Procedures that implement the specific quality systems, such as procurement, documents, and records, will be identified in the implementation section specific to that quality system. Project-specific procedures are located on the CHPRC intranet.

- PRC-MP-QA-599, *Quality Assurance Program*
- PRC-PRO-QA-259, *Graded Approach*
- PRC-MP-MS-29238, *Assurance System Description*
- PRC-MP-EP-40220, *Environmental Program and Strategic Planning Roles, Responsibilities, and Functions*
- PRC-MP-EP-40182, *Environmental Management System Manual*

# 3 Personnel Qualification and Training

## 3.1 Purpose

PRC-MP-TQ-011, *CH2M HILL Plateau Remediation Company (CHPRC) Qualification and Training Plan*, describes a training management system to meet the technical, organizational, and professional development training requirements, regulations, and directives specified in the PRC contract (DE-AC06-08RL14788). PRC-MP-TQ-011 applies to CHPRC scope of work and describes how training is accomplished to maintain a qualified and trained work force capable of performing assigned work activities safely and compliantly.

## 3.2 Requirements

CHPRC personnel qualification and training involving environmental functions and activities shall be consistent with the QA requirements found in:

- ANSI/ASQ E4-2004, Section 5.4, "Personnel Qualification and Training"
- EPA/240/B-01/002, Section 3.4, "Personnel Qualification and Training"
- ISO 14001:2015, Clauses 7.2, "Competence" and 7.3, "Awareness"

Personnel shall have the necessary skills and experience to perform assigned duties. Training and qualification based on project-specific requirements shall be completed prior to the start of the work activity. The need to require formal qualification or certification of personnel performing certain specialized activities shall be evaluated and implemented where necessary. Objective evidence of personnel job proficiency shall be documented and maintained for the duration of the project or activity affected, or longer if required by statute or organization policy.

EMS auditors shall be trained and qualified in accordance with the process described in Appendix D, "Environmental Management System Assessment Program," of this EQAPP.

Auditors shall complete Course 604010, *CHPRC Assessment Training*. Lead auditors for independent assessments shall be qualified in accordance with PRC-PRO-QA-9662, *Independent Assessment Process*, Appendix C, "Lead Assessor Qualification Process."

## 3.3 Implementation

Applicable procedures required to implement these requirements are listed below. Project-specific procedures are located on the CHPRC intranet.

- PRC-MP-TQ-011, *CH2M HILL Plateau Remediation Company (CHPRC) Qualification and Training Plan*
- PRC-POL-TQ-11337, *Employee Training*
- PRC-PRO-TQ-175, *Training Program Descriptions*
- PRC-PRO-TQ-459, *Environmental Training*
- PRC-PRO-OP-21712, *Required Reading*
- PRC-PRO-TQ-40164, *Personnel Training and Qualification*
- PRC-STD-TQ-40201, *CH2M HILL Plateau Remediation Company Training Implementation Matrix*

- PRC-STD-TQ-40221, *Environmental Compliance Officer Training Program Description*
- PRC-PRO-QA-40102, *Quality Assurance Engineer Training and Qualification Program*

### 3.3.1 Training Policy

The CHPRC training policy is located in PRC-POL-TQ-11337 and applies to all CHPRC workers. The training program governs the training requirements for CHPRC work, as well as subcontracted work. The CHPRC training program is described in PRC-MP-TQ-011.

Training programs are implemented by line and training management and include the following principles and practices:

- Establishment of training standards, procedures, and processes that meet contractual requirements and are consistent with industry-proven good practices.
- Identification of management responsibility for leading and coaching their employees, and ensuring that employees are trained, qualified, and proficient to perform assigned tasks.
- Evaluation of training programs to ensure regulatory compliance, and compliance with company standards and instructions, and to improve the training process.
- Support CHPRC training by balancing sufficient resources, budget, and schedule subject to financial constraints.

# 4 Procurement of Items and Services

## 4.1 Purpose

CHPRC procured items and services are to be of acceptable quality, demonstrated by the review of objective evidence for applicable items and services furnished by suppliers and subcontractors, source selection, source inspections, supplier audits, and examination of deliverables.

## 4.2 Requirements

CHPRC procurement of environmental items and services shall be consistent with the QA requirements found in the following documents:

- ANSI/ASQ E4-2004, Section 5.5, "Procurement of Items and Services"
- EPA/240/B-01/002, Section 3.5, "Procurement of Items and Services"
- ISO 14001:2015, Clause 8.1, "Operational Planning and Control"
- HNF-54800, *2018 Hanford Site Sustainability Plan*

The procurement of purchased items and services that directly affect the quality of environmental programs shall be planned and controlled to ensure that the quality and sustainability of the items and services is known, documented, and meets the technical requirements and acceptance criteria.

Procurement documents shall contain information clearly describing the item or service needed and the associated technical, quality, and sustainability requirements. The procurement documents shall specify the quality system elements for which the supplier is responsible and how the supplier's conformity to requirements will be verified.

Appropriate measures shall be established to ensure that procured items and services satisfy all stated requirements and specifications. When specifically stated in the procurement documents, suppliers shall have a demonstrated capability to furnish items and services that meet all requirements and specifications.

Procurement documents shall be reviewed for accuracy and completeness by qualified personnel prior to release. Changes to procurement documents shall receive the same level of review and approval as the original documents.

## 4.3 Implementation

Applicable procedures required to implement these requirements are listed below. Project-specific procedures are located on the CHPRC intranet.

- PRC-MP-AC-40500, *Acquisition Management Plan*
- PRC-PRO-AC-40480, *Acquisition Planning*
- PRC-PRO-AC-40478, *Procurement of Materials*
- PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*
- PRC-PRO-QA-301, *Control of Suspect/Counterfeit and Defective Items*
- PRC-PRO-AC-335, *Use and Control of Purchasing Card*

### 4.3.1 Requests for Material or Services

Requests for material or services are made in accordance with procedures defined in PRC-PRO-AC-40478. This procedure is written specifically for end users and requestors of materials and services to ensure that

identified processes, reviews, and approvals are obtained prior to procurement. An EP&SP representative will review and approve environmental procurements, as applicable.

### 4.3.2 Supplier Evaluation

PRC-PRO-QA-9662, *Independent Assessment Process*, and PRC-PRO-QA-3144, *Supplier Quality Assurance Program Evaluation*, implements a methodology that further provides due diligence in their contractual relationship with MSA, to perform Acquisition Verification Services (AVS) and other selected QA support activities.

### 4.3.3 Acquisition Verification Services

MSA AVS performs supplier evaluations and receipt inspection on behalf of CHPRC for designated procured items, as appropriate.

The procurement of items and services is controlled to ensure conformance with specified requirements. Such controls provide for the following, as appropriate:

- QA program requirements
- Design bases
- Source evaluation and selection
- Verification of supplier-furnished information
- Source inspections
- Control of nonconforming items
- Audits and surveillances

### 4.3.4 Analytical Services

CHPRC procures environmental analytical services from evaluated commercial laboratories operating under a QA program as specified by the applicable Statement of Work. Once approved, these laboratories will be listed on the MSA Evaluated Suppliers List. CHPRC may obtain onsite analytical services from the 222-S Laboratory for high activity samples or from the Pacific Northwest National Laboratory 325 laboratory.

Before delivery of the samples to the analytical laboratory, the unique analytical requirements shall be communicated to the laboratory. These requirements can be provided to the laboratory through the applicable procurement or work agreement document such as a Statement of Work, Letter of Instruction, Contract, SAP, or chain of custody, and should include the following:

- Required analytical method(s) and the parameters to be measured
- Types of samples to be analyzed (sample matrix)
- Types of quality control (QC) samples, frequencies, and acceptance criteria (e.g., detection limit)
- Sample handling requirements (e.g., holding, custody, and preservation requirements)
- Turnaround time (amount of time from sample receipt to data delivery) in the laboratory
- Data reporting requirements

# 5 Documents and Records

## 5.1 Purpose

The purpose of this section is to document appropriate controls for quality-related documents and records.

## 5.2 Requirements

CHPRC documents and records involving environmental functions and activities shall be consistent with the QA requirements found in the following documents:

- ANSI/ASQ E4-2004, Section 5.6, "Documents and Records"
- EPA/240/B-01/002, Section 3.6, "Documents and Records"
- ISO 14001:2015, Clause 7.5, "Documented Information"

The preparation, review, approval, issue, use, and revision of documents that specify quality requirements or prescribe activities affecting quality shall be controlled to ensure that correct documents are being used. Records shall be specified, prepared, reviewed, approved, and maintained. Specific record specification and retention requirements are documented in the CHPRC implementing procedures.

Sufficient records shall be specified, prepared, reviewed, authenticated, and maintained to reflect the achieved level of quality for completed work. An EC&QA representative review and approve documents as required or as requested that directly affect the quality of environmental programs.

### 5.2.1 TPA Action Plan

In addition to the requirements listed in Section 5.2, all environmental documents identified in Section 9.0 of the TPA Action Plan (Ecology et al., 1989b), entitled "Documentation and Records," must comply with the requirements of the TPA Action Plan.

## 5.3 Implementation

Applicable procedures required to implement these requirements are listed below. Project-specific procedures are located on the CHPRC intranet.

- PRC-GD-IRM-40128, *Records Inventory and Disposition Schedule (RIDS) Guide*
- PRC-MP-IRM-40119, *Document Control and Records Management Plan*
- PRC-PRO-EN-440, *Engineering Documentation Preparation and Control*
- PRC-PRO-EP-15334, *Effluent and Environmental Monitoring for Radionuclide Airborne Emissions*
- PRC-PRO-EP-15335, *Environmental Permitting and Documentation Preparation*
- PRC-PRO-EP-52797, *CERCLA Investigation-Derived Waste Procedure*
- PRC-PRO-EP-52798, *CERCLA Removal Action Procedure*
- PRC-PRO-EP-52799, *CERCLA Remedial Action Procedure*
- PRC-PRO-IRM-10588, *Records Management Processes*
- PRC-PRO-IRM-8310, *Document Control Processes*
- PRC-PRO-IRM-9679, *Administrative and Technical (Non-Engineering) Document Control*
- PRC-RD-EP-15332, *Environmental Protection Requirements*
- PRC-STD-IRM-40161, *Records Management Standard*

PRC-PRO-IRM-10588 prescribes the processes and requirements for managing the collection, disposition, identification, processing, maintenance, retirement, retention, retrieval, and usage of records as follows:

- Identify quality-related documents and records
- Prepare, review, approve, issue, use, authenticate, and revise documents and records
- Ensure that records and documents accurately reflect completed work
- Maintain documents and records including transmittal, distribution, retention (including retention times), access, preservation (including protection from damage, loss, and deterioration), traceability, retrieval, removal of obsolete documentation, and disposition
- Ensure compliance with all applicable statutory, regulatory, and U.S. Environmental Protection Agency (EPA) requirements for documents and records
- Apply accurate indexing of metadata, and provides timely retrieval of stored electronic records

PRC-PRO-IRM-9679 defines Environmental Documents as follows:

- Documents that provide data or information on which decisions affecting environmental cleanup activities are made, including engineering evaluation and cost analyses, groundwater monitoring reports, action memoranda, remedial investigations, feasibility studies, risk analyses, treatability studies, proposed plans, records of decision, explanations of significant differences, record of decision amendments, remedial design/remedial action work plans, 5-year reviews, RCRA corrective actions, TPA changes, *National Preservation Programs, Division A—Historic Preservation* analyses and reviews, natural resource damages assessments, etc.
- Environmental permits or documents that affect environmental permit conditions, including Part A and Part B applications; dangerous waste (RCRA) permits and permit modifications; treatment, storage, and disposal unit closure plans; air emissions permits and modifications, *Safe Drinking Water Act* system permits and design approvals; NPDES permits, state wastewater discharge permits; *Migratory Bird Treaty Act of 1918* take permits; *Endangered Species Act of 1978* biological assessments and habitat conservation plans; plans to ship hazardous wastes off the Hanford Site for treatment or disposal, etc.
- Environmental impact analyses under NEPA or *State Environmental Policy Act* (SEPA; RCW 43.21C) including categorical exclusions, environmental assessments, findings of no significant impact, NEPA records of decision, the Hanford Comprehensive Land-Use Plan, leases or land transfers, proposals affecting the Hanford Reach National Monument and the Columbia River, etc.
- Documents and changes to documents for activities with a potential for release of radioactive or hazardous material in excess of EP limits.
- Documents and changes to documents that design, fabricate, or modify environmental equipment related to compliance with environmental regulatory requirements.

- Documents and changes to documents that have or may have impact on waste activities, including but not limited to, the following:
  - Radiological and chemical characterization of waste
  - Waste sample analysis
  - Waste designation
  - TSD acceptance
  - Waste verification activities
  - Waste minimization and pollution prevention

Section 9.0 of the TPA Action Plan (Ecology et al., 1989b) contains a listing of primary and secondary documents that may be generated to implement environmental cleanup work activities, and it includes a description of the processes required to generate, review, and approve these documents.

Appendix A, "TPA-Defined Environmental Cleanup Documentation," of this EQAPP identifies typical environmental cleanup documentation as defined in the TPA Action Plan (Ecology et al., 1989b), which may be required for CERCLA, RCRA, or facility deactivation and decommissioning. These processes are shown relative to the corresponding functions: Investigation, Alternative Analysis, Decision, Implementation of Decision, and Project Closeout. Appendix A also distinguishes that these elements are conducted under the appropriate QA program.

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# 6 Computer Hardware and Software

## 6.1 Purpose

This section describes the methods used for computer hardware and software processes to support the acquisition, control, development, testing, installation, operation, maintenance, and retirement of computer hardware and software, as applicable, to the performance of environmental programs.

## 6.2 Requirements

CHPRC computer hardware and software supporting environmental functions and activities shall be consistent with the QA requirements found in:

- ANSI/ASQ E4-2004, Section 5.7, "Computer Hardware and Software"
- EPA/240/B-01/002, Section 3.7, "Computer Hardware and Software"
- ISO 14001:2015, Clause 9.1, "Monitoring, Measurement, Analysis and Evaluation"

Computer hardware and/or software configurations used to support environmental programs or work activities shall be installed, tested, used, maintained, controlled, and documented.

### 6.2.1 Software

PRC-PRO-IRM-309, *Controlled Software Management*, states that software management and quality planning is performed before the development, acquisition, or major modification of a software application. A Software Management Plan (SMP) is required to be written to define specific requirements, procedures, or methods for a particular software application or organization. SMPs must be reviewed and updated, as necessary, prior to the development, acquisition, or major modification of an application.

Section 2.0 of PRC-PRO-IRM-309 specifies the responsibilities of the Responsible Manager, Software Owner, Software SME, Design/Technical Authority, Independent Technical Reviewer(s), Quality Assurance, CHPRC Information Management, and the Production Readiness Review Board.

Computer software shall include design, data handling, data analysis, modeling of environmental processes and conditions, operations, process control of environmental technology systems (including automated data acquisition and laboratory instrumentation), and databases containing environmental data (EPA/240/B-01/002).

CHPRC personnel employ software with appropriate hardware to collect, manage, manipulate, and record environmental information and data. The purposes for these activities include preparation and issuance of environmental reports and permit information required by the TPA (Ecology et al., 1989a), and modeling using environmental data to evaluate various risk scenarios and identify potential risk management alternatives.

## 6.3 Implementation

Applicable procedures required to implement these requirements are listed below. Project-specific procedures are located on the CHPRC intranet.

- HNF-28242, *Software Management Plan*
- PRC-PRO-IRM-309, *Controlled Software Management*
- PRC-PRO-IRM-592, *Unclassified Computer Security*

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# 7 Planning

## 7.1 Purpose

This section describes planning that will be implemented within CHPRC to ensure that data or information collected are of the needed and expected quality for their desired use.

## 7.2 Requirements

CHPRC planning processes involving environmental functions and activities shall be consistent with the QA requirements found in the following documents:

- ANSI/ASQ E4-2004, Section 5.8, “Planning”
- EPA/240/B-01/002, Section 3.8, “Planning”
- ISO 14001:2015, Clauses 6, “Planning;” 8.1, “Operational Planning and Controls;” and 8.2, “Emergency Preparedness and Response”

Work at CHPRC shall be performed according to approved planning and technical documents and in the prescribed sequence defined therein.

### 7.2.1 Systematic Approach

A systematic planning process to collect environmental data, such as the DQOs process (EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process* [EPA QA/G-4]), shall be established, implemented, controlled, and documented as necessary to perform the following:

- Identify all relevant customers and their needs and expectations for the work to be performed.
- Identify the technical and quality goals that meet the needs and expectations of the customer.
- Translate the technical and quality goals into specifications that will produce the desired result.
- Consider any cost and schedule constraints within which project activities are required to be performed.
- Identify acceptance criteria for the result or measures of performance by which the results will be evaluated and customer satisfaction will be determined.

All planning documentation shall be reviewed and approved for implementation by authorized personnel before the affected planned work commences. Such documentation includes, but is not limited to, work plans, schedules, standard operating procedures, DQOs, sampling and analysis plans, and QAPjPs.

### 7.2.2 Planning Requirements in the TPA

Requirements relating to planning are described in the TPA (Ecology et al., 1989a), in which Sections 6.5 and 7.8 (both titled “Quality Assurance”) state that the level of QA/QC for the collection, preservation, transportation, and analysis of each sample which is required for implementation of the TPA shall be dependent upon the DQOs for the sample. Such DQOs shall be specified in RCRA closure plans, the RCRA permit, remedial investigation/feasibility study or RCRA facility investigation/corrective measures study work plans or in other work plans, or relevant plans that may be used to describe sampling and analyses at CERCLA or RCRA past-practices units, or RCRA TSD units.

The QA/QC requirements shall range from those necessary for non-laboratory field screening activities to those necessary to support a comprehensive laboratory analysis that will be used in final decision making.

Based upon the DQOs, CHPRC shall conduct QA/QC and sampling and analysis activities, which are taken to implement the TPA in accordance with the following EPA documents:

- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), as revised
- SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended

Section 6.5 of the TPA states that in some instances, RCRA TSD units are included in operable units and are scheduled for investigation and closure. CHPRC shall follow the provisions of Section 6.5 pertaining to QA/QC for sampling and analysis activities at land disposal units.

Section 7.8 of the TPA states that in regard to quality assurance requirements for construction of land disposal facilities, CHPRC shall comply with EPA/530-SW-86-031, *Technical Guidance Document Construction Quality Assurance for Hazardous Waste Land Disposal Facilities*.

Both of these sections of the TPA state that for analytical chemistry and radiological laboratories, CHPRC shall submit laboratory QA/QC plans to EPA and/or Ecology, or the lead regulatory agency for review as secondary documents prior to use of that laboratory.

## 7.3 Implementation

### 7.3.1 RCRA Activities

For RCRA permitting activities, all projects identified as operating under Interim Status requirements shall follow the planning process identified in PRC-RD-EP-15332, Section 2.19. For those activities identified as Final Status actions, the requirements of PRC-RD-EP-15332, Section 2.20 shall be applied. RCRA closure activities shall be conducted following the requirements listed in PRC-RD-EP-15332, Section 2.46.

### 7.3.2 CERCLA Activities

CERCLA activities shall follow the planning process contained in:

- PRC-PRO-EP-52797, *CERCLA Investigation-Derived Waste Procedure*
- PRC-PRO-EP-52798, *CERCLA Removal Action Procedure*
- PRC-PRO-EP-52799, *CERCLA Remedial Action Procedure* (as referenced in PRC-RD-EP-15332, Section 2.50)
- PRC-PRO-EP-15333, *Environmental Protection Processes*, Section 5.50
- PRC-PRO-EP-15335, *Environmental Permitting and Documentation Preparation*, Section 5.21

All CERCLA investigation-derived waste shall be planned and conducted following the requirements listed in PRC-PRO-EP-52797. For CERCLA removal actions, the planning process identified in PRC-PRO-EP-52798, Sections 3.1 through 3.8, shall be employed. All CERCLA remedial actions shall be planned and conducted following the requirements listed in PRC-PRO-EP-52799.

### 7.3.3 Major Decision Elements

The major decision elements for RCRA actions, and CERCLA and RCRA past-practice actions, are identified in Section 6.0, “Treatment, Storage, and Disposal Unit (TSD) Process,” and Section 7.0, “Past

Practices Processes," of the TPA Action Plan (Ecology et al., 1989b), respectively. These elements contain provisions designed to ensure collection of quality information and data and include application of the EPA DQOs process as defined in EPA/240/B-06/001, as revised, and EPA requirement document EPA/240/B-01/003, as revised. Together, these documents collectively employ a graded and logical approach to systematic planning of environmental cleanup activities to all CHPRC cleanup activities. The elements contained in the EPA guidance documents are designed to ensure collection and analysis of quality data. Each project must adhere to this process in order to ensure that quality data are obtained to complete the project successfully. It is the intent of this EQAPP to require that all projects follow and employ both the substantive and procedural elements of the above-listed EPA guidance documents.

### 7.3.4 Significant Environmental Data Collection Activities

All significant environmental data collection activities that impact decision making actions require application of the DQO process as described in EPA/240/B-06/001 and PRC-PRO-SMP-53095, *Data Quality Objectives Planning Process*. After a DQO document is prepared, a QAPjP must then be developed by applying EPA/240/B-01/003. Together, these documents collectively employ a graded and logical approach to systematic planning of environmental cleanup activities to all CHPRC cleanup activities. The elements contained in these EPA guidance documents are designed to ensure collection and analysis of quality data.

Adherence to the process and elements listed in these documents is mandatory and incorporated by reference the QA requirements of Sections 6.5 and 7.8 of the TPA Action Plan (Ecology et al., 1989b).

### 7.3.5 DQO Development

The major elements of the DQO process include the following:

- State the Problem
- Identify the Goals of the Study
- Identify Information Inputs
- Define the Boundaries of the Study
- Develop the Analytical Approach
- Specify Performance or Acceptance Criteria
- Develop the Plan for Obtaining Data

Each project must adhere to this process, as defined in the EPA QA/G-4 Guidance Document and PRC-PRO-SMP-53095, in order to ensure that quality data are obtained to complete the project successfully. Adherence to the guidance will ensure that information needed as crucial input to the QAPjP and field sampling plan (FSP) has been properly obtained.

#### *7.3.5.1 Planning Environmental Data Collection Activities*

Prior to planning new characterization activities, acceptable or process knowledge may be used to evaluate whether additional sampling and analysis is required when the regulations do not require analytical data to support the characterization and it is determined to be adequate for that purpose. The DQO process is used to plan and design a sampling and analysis program to evaluate the physical and chemical properties of a waste stream. The EPA DQO process described in EPA/240/B-06/001 and CHPRC procedure PRC-PRO-SMP-53095 can be used to satisfy this requirement or alternative methods can be used to establish data quality requirements. The DQOs must be established prior to starting sampling and analysis activities to ensure that the proper type, quantity, and quality of data are collected to support the data user's needs. Application of the DQO process is designed to be flexible depending

upon the data needs; therefore, the level of rigor applied to DQO development is defined by the graded approach. Project and facility procedures, plans, or other work instructions will define their DQOs or other QA objectives along with the methods used to establish those requirements.

After completion of the DQOs or other QA objectives, SAP, waste analysis plan, or equivalent will be developed. As a minimum, the following sampling documents will be included:

- A sampling design that provides for a sufficient number of samples to support the decisions in the DQOs or other QA objectives and obtains samples that are representative of the waste being characterized. In addition, the analytical methods selected must measure the parameters of concern at the required level of detection, precision, and accuracy established in the DQOs or QA objectives.
- Identification of the sampling methods and equipment to be used and methods to clean the sampling equipment if they are not single use.
- Criteria for selecting sample sites or identification of sampling locations, amounts, and frequencies.
- Types of sample containers to be used along with any preservation, holding times, and custody requirements that may be applicable.
- Sample identification methods and any special instructions for handling, subdividing, or compositing the samples in the field that may be applicable.
- Identification of field QC samples (e.g., field duplicates, trip blanks, and field blanks) to be taken and their frequencies.
- Instructions for taking any required field measurements, or other sampling information, and methods for documenting the data collected.

### 7.3.6 Quality Assurance Project Plan Development

Once the DQO process has been completed, an FSP and QAPjP shall be developed incorporating the results of the DQO process. Together these documents comprise a SAP. The principal elements of the FSP include the following:

- Sampling Process Design
- Sampling Methods
- Sample Handling and Chain of Custody
- Analytical Methods
- Calibration
- QC

The following principal components of the QAPjP are identified in EPA/240/B-01/003 and Washington State Department of Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*:

- Project Management
- Data Generation and Acquisition
- Assessment and Oversight
- Data Validation and Usability

EPA/240/B-01/003 establishes the basic set of requirements by which a system of quality programs involving environmental data collection can be planned, implemented, and assessed. QAPjPs shall be developed based on the elements found in EPA/240/B-01/003, Table 8, "Elements of a Quality Assurance Project Plan."

It is the intent of this EQAPP to require that all projects follow and employ, as applicable, both the substantive and procedural elements of the above listed EPA guidance documents.

### 7.3.7 Environmental Information and Data Collection

Data collection through sampling and analyses activities is conducted in support of most CHPRC environmental functions and activities to demonstrate compliance to the TPA (Ecology et al., 1989a) and applicable federal, state, and local regulations and requirements. To ensure the generation of reliable data, all aspects of the environmental data collection process must be controlled to allow work to be performed in a uniform and repeatable manner. To achieve this, CHPRC performs tasks associated with data collection, data reduction, review, validation and reporting in accordance with approved work plans, procedures such as PRC-PRO-SMP-53095 or other forms of work instructions.

Analytical data reports generated by laboratories will be prepared in accordance with an approved Statement of Work, Contract, SAP, Letter of Instruction, or other procurement/work agreement documents used to acquire analytical services.

Sampling activities and laboratory analysis are conducted in accordance with the QA and QC requirements specified in HASQARD (DOE/RL-96-68) and analytical methods, such as SW-846 or other approved methods.

In the event that it cannot be demonstrated that data generated pursuant to the TPA were obtained in accordance with the QA/QC requirements of Sections 6 and 7 of the TPA, including laboratory QA/QC plans, sampling or analysis shall be repeated, as required, by the lead regulatory agency. Such action by the lead regulatory agency shall not preclude any other action that may be taken pursuant to the TPA. For other data, the lead regulatory agency may request QA/QC documentation. Any such data that do not meet the QA/QC standards required by Sections 6 and 7 of the TPA shall be clearly flagged and noted to indicate this fact.

#### *7.3.7.1 Environmental Data Management*

Environmental data will be managed to ensure the integrity and quality of the data is preserved. Data processing activities will be controlled to ensure that the introduction of errors are minimized while environmental data are being collected, transferred, stored, analyzed, and reviewed. CHPRC data processing work instructions will include some or all of the following controls to avoid errors during data handling and manipulation:

- Perform periodic checks/reviews to ensure data are not lost or incorrectly transcribed when transferred from one format to another.
- Minimize the number of data transfer steps and the number of personnel handling the data.
- Institute access control and accountability measures to protect hardcopy and electronic database files.
- Perform periodic reviews of manual calculations to ensure that the results obtained are accurate and correct.

Control software programs used to perform critical data reduction functions in accordance with PRC-PRO-IRM-309.

#### *7.3.7.2 Environmental Data Usability Assessment*

CHPRC will review environmental data for project usability. The purpose of assessing data usability to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project data needs. The data quality assessment (DQA) process is the scientific and statistical evaluation of previously verified and validated data to determine if information obtained from environmental data operations are of the right type, quality, and quantity to support their intended use (usability). The DQA process uses the entirety of the collected data to determine usability for decision making. If a statistical sampling design was utilized during field sampling activities, then the DQA will be performed following guidance in EPA/240/B-06/003, *Data Quality Assessment Statistical Methods for Practitioners*, (EPA QA/G-9S). When judgmental (focused) sampling designs are implemented in the field, data quality indicators (DQIs) such as precision, accuracy, representativeness, comparability, completeness, and sensitivity for the specific data sets (individual data packages) will be evaluated in accordance with EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation* (EPA QA/G-8). Data verification and data validation are integral to both the statistical DQA data evaluation process and the DQI evaluation process. Results of the DQA or DQI processes will be used to interpret the data and determine if the DQOs for an activity have been met.

Contract Laboratory Program type data validation is generally not required for routine waste characterization activities. The frequency and level of DUA will be described in the QAPjP or other work documents. As a minimum, the following problem areas must be resolved:

- Deviations from sampling strategy/procedures as identified in the sampling plan
- Missed holding times
- Improper or inadequate sample preservation, sample containers, or other sample handling problems
- Chain of custody or other sample integrity problems
- Laboratory QC sample result problems (e.g., QC sample results outside method specific tolerances)

Problems in any of these areas may result in data being rejected or used as qualified data if the problems do not impact the data usage as defined by the DQOs or other QA objectives. The results of this review, along with the resolution of the problems, will be documented in accordance with the project's corrective action or data verification/validation/assessment processes.

### 7.3.8 Transportation and Packaging

The QA requirements associated with transportation and packaging activities are addressed in PRC-PRO-TP-40476, *Transportation Program Management Plan*.

### 7.3.9 NESHAP/Radioactive Air Emissions

The NESHAP (40 CFR 61) QAPjP is located in Appendix C of this EQAPP. EC&QA provides QA Program oversight to ensure the monitoring and reporting of radioactive air emissions activities are in accordance with NESHAP; WAC 246-247, "Radiation Protection—Air Emissions"; DOE O 436.1, *Departmental Sustainability*; and DOE O 458.1, *Radiation Protection of the Public and the Environment*. This oversight includes but is not limited to surveillances and the review and approval of applicable documents including NESHAP QAP plans, QAPjPs, and programmatic assessments. EC&QA is independent of the work being conducted, and these surveillances constitute an independent external assessment.

The activities specific to radioactive air emissions measurements include the following:

- Collection of laboratory analyses performed to detect the presence of radioactive materials on particulate filter media, charcoal cartridge filters, silver zeolite cartridges, sodium hydroxide media, and silica gel or Drierite® cartridges
- Compilation of laboratory analyses with measured stack flow data or maximum stack flow rates to derive releases of radioactivity and average concentrations of radioactivity in sampled emissions
- Calculation of quantities of radionuclides released and average concentrations for a calendar year, for a specific discharge point or a specific area
- Validation of acquired data
- Preparation, review, and release of the annual reports

EC&QA is responsible for the following:

- Scheduling and conducting surveillances/assessments of air emissions activities
- Reviewing documents to assure data quality and QA objectives are met
- Verifying resolution of nonconforming items
- Approving QAPPs and QAPjPs

### 7.3.10 Near-Facility Environmental Monitoring

Near-facility environmental monitoring provides a level of assurance that the effluent and contamination controls for the various facilities and waste sites are effective. CHPRC groundwater sampling performs environmental sampling of soil and biota for preoperational surveys of sites in preparation for construction of new facilities or modification of existing facilities. The QA Requirements associated with Near-Facility Environmental monitoring are addressed in MSC-PLN-EI-23333, *Mission Support Contract, Environmental Quality Assurance Program Plan;* EC&QA performs required surveillances and assessments.

### 7.3.11 State-Regulated Wastewater Discharges

The discharge of liquid effluent streams to the ground is governed by wastewater discharge permits from Ecology, as required by RCW 90.48, “Water Pollution Control,” and WAC 173-216, “State Waste Discharge Permit Program,” except for wastewaters exempted from the permits. *State Waste Discharge Permit Number ST0004511 (Miscellaneous Streams)* (Ecology, 2013) applies to facilities managed by CHPRC and applies to all hydrotest, maintenance, and construction discharges. This permit requires routine sampling under certain circumstances.

EC&QA provides oversight to ensure compliance with the permit conditions.

### 7.3.12 National Pollutant Discharge Elimination System Discharges

The requirements of the CWA (Section 301), regarding discharges to the Columbia River, are met through compliance with the water discharge permitting system. The NPDES permit program implements the CWA prohibition on unauthorized discharges to the navigable waters of the United States. The NPDES permits allow the discharge of specific pollutants from specific outfalls at specified concentrations for a certain period of time.

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As of April 20, 2011, the outfall line to the Columbia River was severed and the end filled with concrete to permanently prevent any further liquids flowing into the Columbia River. As a result of these activities, CHPRC no longer requires coverage under an NPDES permit; therefore, it was terminated. Consequently, the NPDES QAPjP appendix in this document was deleted.

### 7.3.13 Facility Decommissioning Process: Deactivation and Decommissioning Sites

The facility decommissioning process implements the approach DOE uses to take a facility from operational status to final disposition or closure. The facility decommissioning process is described in Section 8.0 of the TPA Action Plan (Ecology et al., 1989b) and applies to facilities and structures.

### 7.3.14 Planning for Modeling

Planning for modeling projects ensures that a model is scientifically sound, robust, and defensible and is just as important as planning traditional environmental measurements for data collection projects. To ensure proper planning of PRC environmental modeling activities, the environmental QA program shall invoke the use of the EPA guidance document for environmental modeling (EPA/240/R-02/007, *Guidance for Quality Assurance Project Plans for Modeling*, EPA QA/G-5M). This document is the companion document to the EPA requirements document (EPA/240/B-01/003), noted above in Section 7.3.6. The QAPjP for modeling is located in Appendix E of this EQAPP.

Modeling shall be in accordance with EM-QA-001, *Office of Environmental Management Quality Assurance Program*, Attachment H, “Model Development, Use, and Validation.”

#### *7.3.14.1 Modeling Development*

The modeling development and application process shall contain the following elements:

- Modeling needs and requirements analysis
- Model development
- Model application

#### *7.3.14.2 Model Quality Objectives*

Systematic planning and quality objectives should be applied to modeling projects. Model quality objectives should be established based on the study objectives, intended use of the output, and the type of modeling to be performed.

A graded approach is used to apply a level of planning rigor, QA, and uncertainty assessment commensurate with the nature of the work being performed and the intended use of the model output data. As a result, an acceptable plan for some modeling studies may require a qualitative discussion of the process and its objectives, while others may require extensive documentation to adequately describe their complexity.

QA and uncertainty assessments are two aspects in modeling studies that are very closely linked. Based on the perception of acceptable uncertainty, the manager and modeler must consider several factors that can be broadly characterized as a tradeoff between risk in model results due to uncertainty, versus the uncertainty and risk in the management decision. Several factors must be considered, including the type of modeling needed; data needed to support the modeling effort; and the assessment of modeling accuracy, costs, and schedule. However, it is the type of modeling, as well as the intended use of the modeling results, that dictates the type of uncertainty and sensitivity analyses to be performed. QA controls and uncertainty analysis both provide assurance that the modeling results are correct.

Hence, these aspects play critical roles in establishing model quality objectives that ensure meaningful model results for decision making.

### 7.3.15 Environmental Calculations

Performing calculations is necessary in the process of environmental engineering to ensure systems following environmental regulations meet the requirements of those regulations as documented in the *Code of Federal Regulations*, and that cleanup actions are evaluated appropriately for risk to human health and the environment. PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issue* provides more guidance.

### 7.3.16 Environmental Technology QA Requirements

Environmental technologies include, but are not limited to, facilities, structures, systems, or components that are used to remediate environmental contamination; prevent, control, or remove pollutants; or treat, dispose of or store hazardous, radioactive, or mixed wastes. For example, an engineered barrier or cap constructed over the top of a waste burial site is a form of environmental technology.

The QA requirements applicable to environmental technologies relate principally to planning, implementing, and assessing their design, construction, and operation. These requirements are established based on the guidance provided in EPA/240/B-05/001, *Guidance on Quality Assurance for Environmental Technology Design, Construction, and Operation* (EPA QA/G-11).

Processes used to design new or modified equipment, structures, systems, and components are conducted in accordance with project/facility-specific procedures. The processes include the use of sound engineering and scientific principles and standards; incorporation of applicable requirements and design basis in design work; identification and control of design interfaces; and verification of the adequacy of design outputs and products.

Following successful design verification, designs of environmental technologies are also validated. Validation requirements are documented and may be addressed in construction QA plans or other project planning documents. Validation includes, but is not limited to, technical assessments, qualification tests, pre-operational tests, and use of models and mockups.

Applicable procedures required to implement these requirements are listed below. Project-specific procedures are located on the CHPRC intranet.

- PRC-PRO-IRM-309, *Controlled Software Management*
- PRC-RD-EP-15332, *Environmental Protection Requirements*
- PRC-PRO-EP-15333, *Environmental Protection Processes*
- PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issue*
- PRC-PRO-EP-40253, *Risk Assessment and Modeling Integration*
- PRC-PRO-EP-52797, *CERCLA Investigation-Derived Waste Procedure*
- PRC-PRO-EP-52798, *CERCLA Removal Action Procedure*
- PRC-PRO-EP-52799, *CERCLA Remedial Action Procedure*

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# 8 Work Processes

## 8.1 Purpose

This section describes how work processes will be implemented in accordance with environmental quality requirements when applied to environmental functions and activities. To achieve the requirements, work shall be performed according to approved plans and technical documents using controlled procedures. Work processes consist of a series of actions planned and carried out by qualified personnel using approved procedures, instructions, and equipment under administrative, technical, and environmental controls.

## 8.2 Requirements

CHPRC work processes involving environmental functions and activities shall be consistent with the QA requirements found in the following documents:

- ANSI/ASQ E4-2004, Section 5.9, “Implementation of Work Processes”
- EPA/240/B-01/002, Section 3.9, “Implementation of Work Processes”
- ISO 14001:2015, Clauses 8.1, “Operational Planning and Controls;” 8.2, “Emergency Preparedness and Response;” and 9.1, “Monitoring, Measurement, Analysis and Evaluation”

Work at CHPRC shall be performed according to approved planning and technical documents using controlled procedures and in the prescribed sequence defined therein. Implementation of work shall be accomplished with a level of management oversight and verification commensurate with the importance of the particular project and the intended use of the project results.

Implementation of work processes shall be monitored and include the routine measurement of performance against established technical and quality specifications to ensure continued satisfactory performance. The independence of personnel monitoring the work performance shall be commensurate with the nature and importance of the activity.

Laboratory QA/QC includes a comprehensive program that includes the use of matrix spikes, duplicates, matrix spike duplicates, laboratory control samples, surrogates, tracers, and blanks. Appendix B, “Soil and Groundwater Remediation Quality Assurance Project Plan,” contains a complete description of these QC samples including sampling methods, handling and custody, information on their holding times, field and laboratory QC elements, and acceptance criteria.

Inspection and testing of specified items, services, and processes shall be conducted using established acceptance and performance criteria. Equipment used for inspections and tests shall be calibrated and maintained. Calibration of the analytical equipment (gas chromatograph, spectrophotometer, pH meter, and other analytical equipment) is performed in accordance with HASQARD (DOE/RL-96-68, Volumes 3 and 4; SW-846 analytical methods, or the manufacturer’s procedures for calibration).

This EQAPP describes or references the processes, including the following roles, responsibilities, and authorities of management and staff to perform the following tasks:

- Ensure that work is performed according to approved planning and technical documents
- Identify operations needing procedures (e.g., standardized, special, or critical operations), preparation (including form, content, and applicability), review, approval, revision, and withdrawal of these procedures; and policy for use

- Control and document the release, change, and use of planned procedures, including any necessary approvals, specific times and points for implementing changes, removal of obsolete documentation from work areas, and verification that the changes are made as prescribed

## 8.3 Implementation

Applicable procedures required to implement these requirements are listed below. Project-specific procedures are located on the CHPRC intranet.

- PRC-RD-EP-15332, *Environmental Protection Requirements*
- PRC-PRO-EP-15333, *Environmental Protection Processes*
- PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issue*

## 8.4 Project Specific

### 8.4.1 Soil and Groundwater Remediation Project

The Soil and Groundwater Remediation Project QAPjP is located in Appendix B of this document.

### 8.4.2 Other Projects

Other projects do not use a project-specific QAPjP, but instead use this EQAPP as their Environmental QAPjP.

# 9 Assessment and Response

## 9.1 Purpose

The purpose of this section is to describe the scope to which the EC&QA organization develops, maintains, and implements an assessment program of environmental functional and work activities. This program documents how the organization determines the effectiveness of the quality system, the performance of the environmental programs to which it applies, EC, and the EMS.

The adequacy of the quality system components defined by this EQAPP is assessed annually.

## 9.2 Requirements

The CHPRC assessment program involving environmental functions and activities shall be consistent with the QA requirements found in the following documents:

- ANSI/ASQ E4-2004, Section 5.10, “Assessment and Response”
- EPA/240/B-01/002, Section 3.10, “Assessment and Response”
- ISO 14001:2015, Clauses 9.1, “Monitoring, Measurement, Analysis and Evaluation,” 9.1.2, “Evaluation of Compliance;” 9.2.2, “Internal Audit Programme;” and 9.3, “Management Review,” and 10.2, “Nonconformity and Corrective Action”

The CHPRC scope to which the Environmental QA process is applied includes activities and implementation needed to perform the following:

- Environmental data collection
- Environmental technology programs
- Environmental monitoring
- Environmental reporting
- Environmental regulatory documentation
- Compliance and implementation activities for the projects
- Assurance and implementation of the EMS
- Procurement

EC&QA will assess compliance to applicable environmental laws and regulations through the performance of environmental assessments. This includes a strategic, in-depth review of targeted environmental regulatory program areas within CHPRC including, but not limited to, the following:

- CERCLA
- RCRA
- NEPA/SEPA (RCW 43.21C)
- Cultural/Ecological Resource Protection
- CAA/NESHAP (40 CFR 61)
- *Toxic Substances Control Act of 1976*
- CWA/NPDES
- EMS

Assessments of environmental compliance areas and programs shall be planned, scheduled, and periodically conducted, and results evaluated to determine the suitability and effectiveness of the assessed areas. These activities shall include an evaluation to determine and verify whether technical requirements, not just procedural compliance, are effectively implemented. Assessments shall be performed according to approved written procedures, based on the scope of the assessment and the approved lines of inquiry. All assessments are generally scheduled and tracked via the IEP as part of the overall assessment schedule. However, adhoc audits may also be performed.

This EC&QA assessment program includes the following:

- Plan and perform assessments; and report assessments results to appropriate levels of management
- Selection of the proper assessment tool
- Determine the level of competence, experience, and training necessary to ensure that personnel conducting assessments are technically knowledgeable, and have no direct involvement or responsibility for the work being assessed
- Ensure that personnel conducting assessments have sufficient authority, access to programs, management, documents, and records, and organizational freedom for the following:
  - Identify both quality problems and noteworthy practices
  - Propose recommendations for resolving quality problems
  - Independently confirm implementation and effectiveness of solutions
- Identify corrective actions to be taken in response to issues, ensuring timely responses to corrective actions, and confirming the implementation and effectiveness of corrective actions

### 9.2.1 Management Assessments

MAs evaluate how well management processes are meeting organizational objectives and customer expectations. MAs are normally performed to determine whether programs are properly established and effectively implemented.

MAs are performed in accordance with PRC-PRO-QA-246, *Management Assessment*. If the scope of the assessment activity is narrowly focused (i.e., specific activity, discrete scope, only a portion of a program/process) then PRC-PRO-QA-40090, *Work Site Assessment*, should be used.

### 9.2.2 Work Site Assessment

The WSA provides a tool for management evaluation of work, typically at the system, process, or Integrated Management system/EMS activity level. The WSA helps management to determine the adequacy, effectiveness and implementation of policies, requirements and standards. The WSA is designed to provide an appropriate level of rigor, but allow administrative flexibility not included in the MA process. The WSA process is performed in accordance with PRC-PRO-QA-40090.

### 9.2.3 Management Observation Program

The Management Observation Program is a tool to help improve CHPRC performance by establishing and maintaining a management presence in the field. Management observations assess the knowledge of workers and compliance with CHPRC policies and procedures; identify and correct unsafe conditions/behaviors; and promote two-way communication between management and the workers. The program is performed in accordance with PRC-PRO-QA-40099, *Management Observation Program*.

### 9.2.4 Independent Assessments/Audits

Independent assessments are planned and conducted to measure the adequacy of work performed against defined requirements and to determine the effectiveness of requirements implementation. Independent assessments evaluate defined requirements against applicable codes and standards sets, the quality of items and processes to identify deviations from the assigned requirements, and opportunities for improvements in the work activities being assessed.

These assessments are typically broad-based in-depth programmatic assessments performed to verify compliance and effective performance. Independent assessments will be performed in accordance with PRC-PRO-QA-9662. If the scope of the assessment activity is narrowly focused, then use PRC-PRO-QA-9769, *Surveillance Process.*

### 9.2.5 Environmental Management Systems Assessments

Internal audits performed to meet the requirements of ISO 14001:2015-based PRC-MP-EP-40182 are scheduled, planned, and conducted in accordance with Appendix D of this EQAPP.

### 9.2.6 Surveillances

Surveillances are similar in concept to independent assessments but differ in the extent covered. Surveillances may be conducted to verify conformance with specified requirements and to evaluate the adequacy and effectiveness of activities affecting the quality of work processes and products. Surveillance activities are performed in accordance with PRC-PRO-QA-9769.

### 9.2.7 Environmental Compliance Inspections

EC inspections are performed to determine compliance with PRC-RD-EP-15332, permit requirements, and project level procedures. The inspection activities may be performed in accordance with the processes discussed previously, depending on the breadth and scope of the inspection, but in each will include, as necessary, the activities described in this section. The Inspection Lead will notify the responsible Environmental Manager (EM) within a month of the inspection. The EMs will be the point of contact for compliance inspections. Each EM will designate and document a backup to the EM to contact when the EM is not available. An SME will be involved in each inspection, as deemed necessary by the Inspection Lead.

The Inspection Lead will prepare a checklist of the requirements being inspected. These checklists are guidelines and do not restrict review of other requirements relative to the inspection subject. Checklists may be retained for “Information Only” purposes and are not considered records. The EC Inspection Lead will conduct the inspection evaluating specified requirements by observing the activity, interviewing personnel associated with the performance and control of the activity, and/or reviewing pertinent documents and records associated with the activity.

The Inspection Lead will immediately notify the responsible management of the following potential conditions:

- Imminent danger to personnel
- Negative environmental impacts
- Critical data errors
- Equipment damage
- Regulatory noncompliance

Upon completing the EC inspection, the Inspection Lead will provide an informal outbriefing to the responsible manager of the assessed organization. The EC inspection report number will be obtained from the IEP. The IEP tracking number is assigned by the EP&SP or Project Functional/PAC, as required, by PRC-PRO-QA-40091.

Any findings and opportunities for improvement identified in the report will be entered into the Condition Reporting and Resolution System in accordance with PRC-PRO-QA-052, *Issues Management*.

## 9.3 Implementation

Applicable procedures required to implement these requirements are listed below. Project-specific procedures are located on the CHPRC intranet.

- PRC-MP-EP-40182, *Environmental Management System Manual*
- PRC-PRO-EP-53109, *Environmental Audit Management*
- PRC-MP-QA-40092, *CHPRC Assessment Program Plan*
- PRC-PRO-QA-052, *Issues Management*
- PRC-PRO-QA-246, *Management Assessment*
- PRC-PRO-QA-9662, *Independent Assessment Process*
- PRC-PRO-QA-9769, *Surveillance Process*
- PRC-PRO-QA-40090, *Work Site Assessment*
- PRC-RD-EP-15332, *Environmental Protection Requirements*
- PRC-MP-EP-40220, *Environmental Program and Strategic Planning Roles, Responsibilities, and Functions*
- PRC-PRO-QA-40099, *Management Observation Program*

# 10 Quality Improvement

## 10.1 Purpose

This section documents how the organization will improve the organization's quality system. The quality of CHPRC environmental activities is the responsibility of each CHPRC worker involved in any activity that impacts the environment. Such activities include, but are not limited to, environmental sampling and analysis and waste remediation. EC&QA assists in monitoring and assessing environmental quality improvement efforts to ensure that a process, item, or service is of the type and quality needed and expected by the client.

## 10.2 Requirements

CHPRC quality improvement involving environmental functions and activities shall be consistent with the QA requirements found in:

- ANSI/ASQ E4-2004, Section 5.11, "Quality Improvement"
- EPA/240/B-01/002, Section 3.11, "Quality Improvement"
- ISO 14001:2015, Clauses 9.1, 9.1.2, 9.3, 10.2, and 10.3, "Continual Improvement"

A quality improvement process shall be established and implemented for continual development and improvement of the quality system.

Procedures shall be established and implemented to prevent as well as detect and correct problems that adversely affect quality during all phases of technical and management activities. When problems are found to be significant, the relationship between cause and effect and the root causes shall be determined. The root causes should be determined to the extent practicable before permanent preventive measures are planned and implemented. Appropriate actions shall be planned, documented, and implemented in a timely manner.

PRC-PRO-QA-052 establishes the requirements and responsibilities for identifying, planning, implementing, and evaluating the effectiveness of quality improvement activities and describes the process to ensure continuous quality improvement, including the roles and responsibilities of management and staff found in Section 3.11 in EPA/240/B-01/002.

Environmental samples are considered to be nonconforming when the quality or integrity of the sample can no longer be assured, the nonconformance reporting process will be used to document the nonconforming condition unless another problem reporting mechanism is defined in project plans or procedures. Some examples of sample nonconformances are missing or broken chain of custody, sampling instructions not followed, lost sample traceability, or duplicated sample identification numbers.

- The QA Manager supporting a facility or activity may order a suspension of activities, if conditions affecting quality have not been addressed by cognizant management. Any suspension of subcontractor activities will be issued through the applicable CHPRC Contract Specialist.

- All organizations shall implement systematic approaches for performing their work in a manner that will achieve quality objectives while safely and effectively accomplishing missions.

## 10.3 Implementation

Applicable procedures required to implement these requirements are listed below. Project-specific procedures are located on the CHPRC intranet.

- PRC-MP-EP-40182, *Environmental Management System Manual*
- PRC-MP-QA-40092, *CHPRC Assessment Program Plan*
- PRC-MP-QA-599, *Quality Assurance Program*
- PRC-PRO-EM-058, *Event Initial Investigation and Critique Meeting Process*
- PRC-PRO-EM-060, *Reporting Occurrences and Processing Operations Information*
- PRC-PRO-MS-067, *Lessons Learned*
- PRC-PRO-QA-052, *Issues Management*
- PRC-PRO-QA-24741, *Performance Analysis Process*
- PRC-PRO-QA-298, *Nonconforming Items*
- PRC-PRO-QA-40102, *Quality Assurance Engineer Training and Qualification Program*

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# Appendix A

# TPA-Defined Environmental Cleanup Documentation

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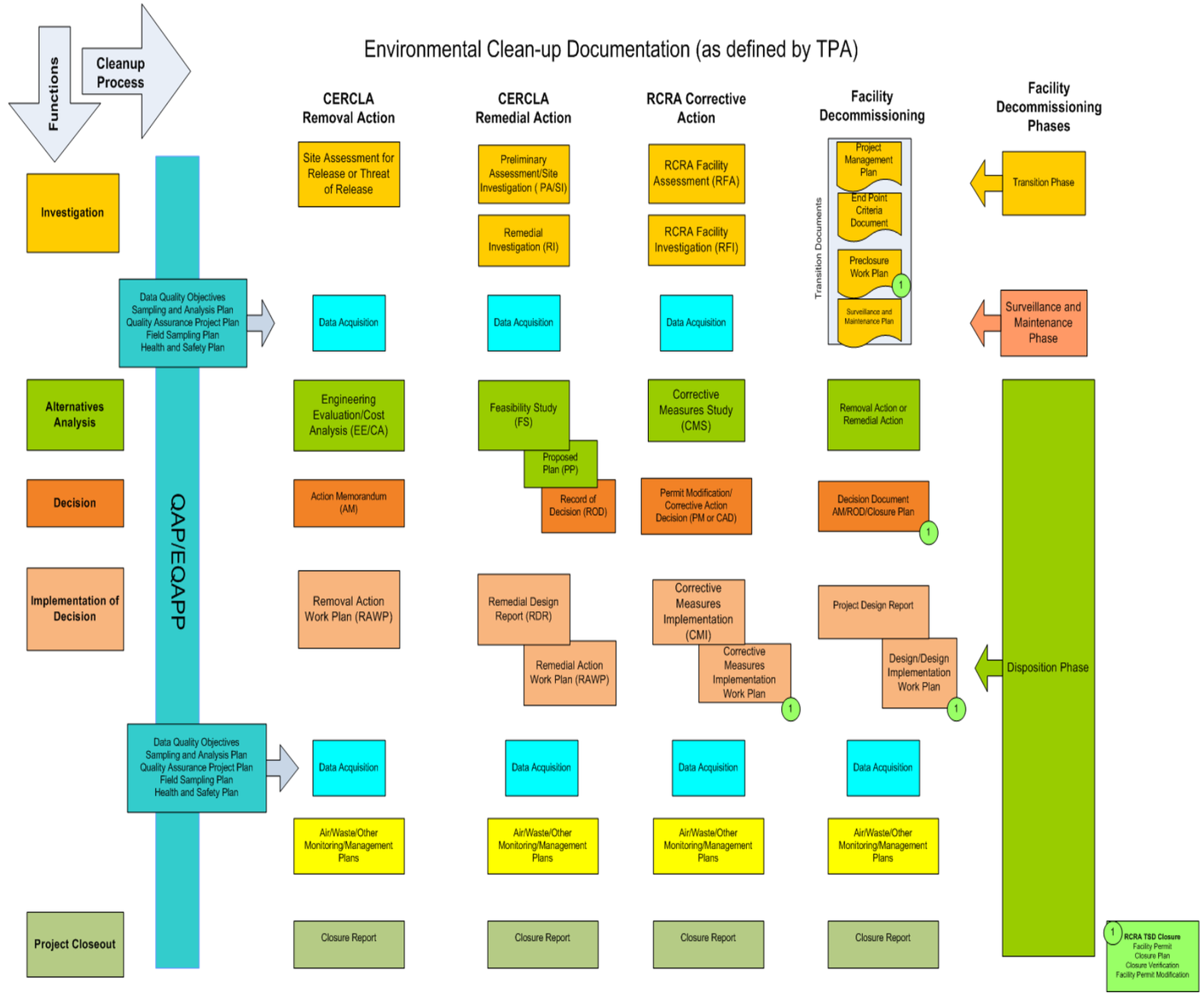


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*Resource Conservation and Recovery Act of 1976*.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
EQAPP = Environmental Quality Assurance Program Plan
QAP = quality assurance plan
RCRA = *Resource Conservation and Recovery Act of 1976*
TPA = Tri-Party Agreement (Ecology et al., 1989)
TSD = treatment, storage, and disposal

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# Appendix B

# Soil and Groundwater Remediation Quality Assurance Project Plan

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# Terms

| | |
|---|---|
| BTR | Buyer's Technical Representative |
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| CHPRC | CH2M HILL Plateau Remediation Company |
| CRRS | Condition Reporting and Resolution System |
| DoD/DOE QSM | *Department of Defense and Department of Energy Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* |
| DOE | U.S. Department of Energy |
| DOE-RL | U.S. Department of Energy, Richland Operations Office |
| DOECAP-AP | DOE Consolidated Audit Program – Accreditation Program |
| DQA | data quality assessment |
| DQI | data quality indicator |
| DQO | data quality objective |
| DUA | data usability assessment |
| DVZ | deep vadose zone |
| DWTP | Dangerous Waste Training Plan |
| EC&QA | Environmental Compliance and Quality Assurance |
| Ecology | Washington State Department of Ecology |
| EP | Emergency Preparedness |
| EPA | U.S. Environment Protection Agency |
| ERDF | Environmental Restoration Disposal Facility |
| FS | feasibility study |
| GWMP | groundwater monitoring plan |
| HASQARD | *Hanford Analytical Services Quality Assurance Requirements Document* |
| HEIS | Hanford Environmental Information System |
| IDMS | Integrated Document Management System |
| IHEL | Industrial Hygiene Equipment Laboratory |
| LCS | laboratory control sample |
| M&TE | measuring and test equipment |
| MB | method blank |

| | |
|---|---|
| MS | matrix spike |
| MSD | matrix spike duplicate |
| OU | operable unit |
| PE | performance evaluation |
| QA | quality assurance |
| QAE | quality assurance engineer |
| QAPjP | quality assurance project plan |
| QC | quality control |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| RI | remedial investigation |
| S&GRP | Soil and Groundwater Remediation Project |
| S&IH | Safety and Industrial Hygiene |
| SAP | sampling and analysis plan |
| SMR | Sample Management and Reporting |
| SOP | standard operating procedure |
| SOW | statement of work |
| Tri-Party Agreement | *Hanford Federal Facility Agreement and Consent Order* |
| VOC | volatile organic compound |

# B1 Background

The primary goals of the Soil and Groundwater Remediation Project (S&GRP) are to prevent groundwater degradation, remediate groundwater, monitor groundwater, and remediate waste sites at the Hanford Site. The purpose of cleanup is to return groundwater and waste sites to beneficial use, where possible, or at least to prevent further degradation.

# B2 Project/Task Description

S&GRP focuses on the following four objectives:

- Shrink the Contaminated Area. Reduce the contaminated surface area to eliminate the threat to groundwater through removal actions on soil contamination waste sites under the purview of CH2M HILL Plateau Remediation Company (CHPRC).
- Reduce Recharge. Reduce the transport of contaminants to groundwater from water released onto the soil.
- Remediate Groundwater. Shrink groundwater contaminant plumes through pump and treat operations, other remedial activities, and monitored natural attenuation.
- Monitor Groundwater. Determine impacts to groundwater from applicable regulated units, track the movement of groundwater contamination, monitor the shrinkage of plumes to determine the effectiveness of remediation, determine the location for ongoing drilling of extraction, injection, and monitoring wells, and decommission existing groundwater monitoring wells that are no longer functional or useful.

S&GRP produces a variety of products in conjunction with the listed activities. Examples of these include the following:

- *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) regulatory documents
- *Resource Conservation and Recovery Act of 1976* (RCRA) regulatory documents
- Descriptions of work for drilling and well decommissioning campaigns
- Statements of work (SOWs)
- Data quality objective (DQO) reports
- Data usability assessments (DUAs)
- Work plans
- Sampling and analysis plans (SAPs)/groundwater monitoring plans (GWMPs)
- Borehole summary reports
- Test plans
- Remediation reports
- Design media for remediation facilities
- Quarterly and annual groundwater monitoring reports
- Annual summary reports for treatment systems

Activities conducted by S&GRP include the following:

- Groundwater pump and treat system design, construction, operation, and maintenance
- Well drilling supporting groundwater remediation and waste site characterization
- Test pit excavation
- Coordination of geophysical data acquisition
- Sampling
- Aquifer testing
- Field screening/analysis
- Sample shipping
- Coordination of laboratory services
- Data management

S&GRP is also responsible for contracting with commercial laboratories for the analysis of all CHPRC environmental samples. Accordingly, S&GRP provides the Buyer's Technical Representative (BTR) oversight of the laboratories, oversees the quality of analytical data received from the laboratories, communicates priorities and schedule requirements to the laboratories, arranges for the shipping of samples to the laboratories, and manages data received from the laboratories.

## B3 Program

The overall quality assurance (QA) program requirements for S&GRP are governed by PRC-MP-QA-599, *Quality Assurance Program*, and the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement; Ecology et al., 1989), Sections 6.5 and 7.8.

CHPRC implements QA requirements based on a graded approach. The graded approach for environmental activities that involve generating, acquiring, or using environmental data is based on the intended use of the data, analytical protocol selected, and data quality indicators (DQIs) of accuracy, precision, comparability, completeness, representativeness, bias, and sensitivity.

This document (CHPRC-00189) encompasses all environmental activity performed by CHPRC. This S&GRP Quality Assurance Project Plan (QAPjP) is subordinate to CHPRC-00189.

Supporting Information B-3, "Matrix of Implementing Procedures," lists specific CHPRC and S&GRP implementing procedures. Environmental regulations require the development of remedial investigation (RI) and feasibility study (FS) work plans, proposed plans, remedial design/remedial action work plans, and various SAPs for CERCLA operable units (OUs), as well as RCRA facility investigation/corrective measures study work plans for RCRA past-practice units and groundwater monitoring plans for regulated units that disposed of dangerous waste in or on the land. SAPs, or equivalent documents, in turn, contain a QAPjP. U.S. Environmental Protection Agency (EPA) guidance (EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5)) and Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, are the basis for unit-specific QAPjPs. This QAPjP describes how S&GRP accomplishes work in support of those unit-specific QAPjPs and addresses the general QA elements applied across S&GRP waste sites and groundwater remediation activities.

This QAPjP defines the processes used by S&GRP to produce data of known quality and ensure that operations are fully compliant with all applicable quality affecting requirements. This plan provides additional QA requirements for S&GRP such as quality objectives, methods, operational approaches, and goals for performing the work scope. This plan also explains how to achieve project goals and supplements the quality management system provided in PRC-MP-QA-599.

Table B-1 describes the relationship between various sections of this QAPjP and EPA/240/B-01/003.

**Table B-1. Quality Assurance Project Plan Section Descriptions**

| Criteria* | Title | QAPjP Section |
|---|---|---|
| Project Management | Project/Task Organization | B1, B2, B3 |
| | Problem Definition and Background | B1 |
| | Project Task Description | B1, B2, B3 |
| | Quality Objectives and Criteria | B5.1, B5.2, B7.1 |
| | Special Training/Certification | B4 |
| | Documents and Records | B6 |
| Data Generation and Acquisition | Sample Process Design | B5, B7 |
| | Sampling Methods | B7.2 |
| | Sample Handling and Custody | B7.3 |
| | Analytical Methods | B7.4 |
| | Quality Control | B5.1, 5.2, Supporting Information B-2, “Equations Routinely Used to Calculate Quality Control Parameters” |
| | Instrument/Equipment Testing, Inspection and Maintenance | B10 |
| | Instrument/Equipment Calibration and Frequency | B10 |
| | Inspection and Acceptance of Supplies and Consumables | B10 |
| | Non Direct Measurement | B7, Supporting Information B-1, “QA Requirements Specific to Onsite Measurement” |
| | Data Management | B2, B3 |
| Assessment and Oversight | Assessment and Response Actions | B5, B11, B12 |
| | Reports to Management | B5, B11, B12 |
| Data Validation and Usability | Data Review, Verification, and Validation | B7.5, B7.6 |
| | Verification and Validation Methods | B7.5, B7.6 |
| | Reconciliation with User Requirements | B7.6 |

*EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*.

The policy of CHPRC and S&GRP management is to direct activities in a manner that is cost effective and ensures that the results meet or exceed the customer’s expectations. The achievement of quality requires the total commitment of all S&GRP workers (Figure B-1). The quality management system described in this QAPjP fosters compliance with approved standards, plans, and procedures. Those standards, plans, and procedures incorporate expectations for safety and environmentally protective work within controls to

support the principles and functions of the Integrated Environment, Safety, and Health Management System. All S&GRP personnel have the authority to stop work when serious quality, safety, or health conditions exist. DOE-0343, *Hanford Site Stop Work Procedure*, gives all Hanford workers the responsibility and authority to stop work when they are convinced that a situation exists that places themselves, their coworker(s), or the environment in danger.

As necessary, CHPRC's Environmental Compliance and Quality Assurance (EC&QA) group will review this QAPjP when added work scope elements require additional QA considerations. As part of the review and update process, EC&QA will seek input from S&GRP.

## B3.1 Business Services

S&GRP Business Services is responsible for the overall implementation and direction of the estimating, cost engineering, and planning and scheduling functions that provide services, reporting, and methods for timely and accurate response to the client, project management, departmental, and company requirements. Business Services is also responsible for Records Management and Reporting.

## B3.2 Operations

The Operations team runs six pump and treat facilities on the Hanford Site. The organization provides the necessary trained and qualified resources required to implement remediation activities at the pump and treat facilities. Operations consists of 100 Area Operations, 200 Area Operations, Engineering and Maintenance.

### B3.2.1 100 Area Operations

100 Area Operations runs five pump and treat water treatment facilities HX, DX, KX, KR-4, and K West. The goal is to eliminate the risk of contaminated groundwater reaching the Columbia River. These facilities extract contaminated groundwater from beneath the surface via a network of wells, transfer the groundwater to the treatment facility which removes contaminants, and inject the clean, treated water back into the aquifer.

### B3.2.2 200 Area Operations

The 200 West Pump and Treat consists of the two main process buildings, a Lime System/Pad, and six transfer buildings. The 289T (Bio Building and Bio Pad) treats nonradioactive contaminants in groundwater using a combination of biological, filtration, and organic vapor stripping processes. The Bio Building consists of a separate administrative area with a lunchroom, restrooms, control room, laboratory, and electrical equipment room. The Lime System/Pad treats the biosludge prior to disposal at the Environmental Restoration Disposal Facility (ERDF). Process equipment is located throughout the main process area of the Bio Building, Bio Pad, and Lime System/Pad. The 289TA (Rad Building) removes radioactive contaminants from groundwater via ion-exchange media. Extraction wells are connected to the main process buildings via three extraction transfer buildings: 289TB (ETB-1), 289TC (ETB-2), and 289TF (ETB-3). Injection wells are connected to the main process buildings via three injection transfer buildings: 289TD (ITB-1), 289TE (ITB-2), and 216-ZP1A (Injection Manifold Building).

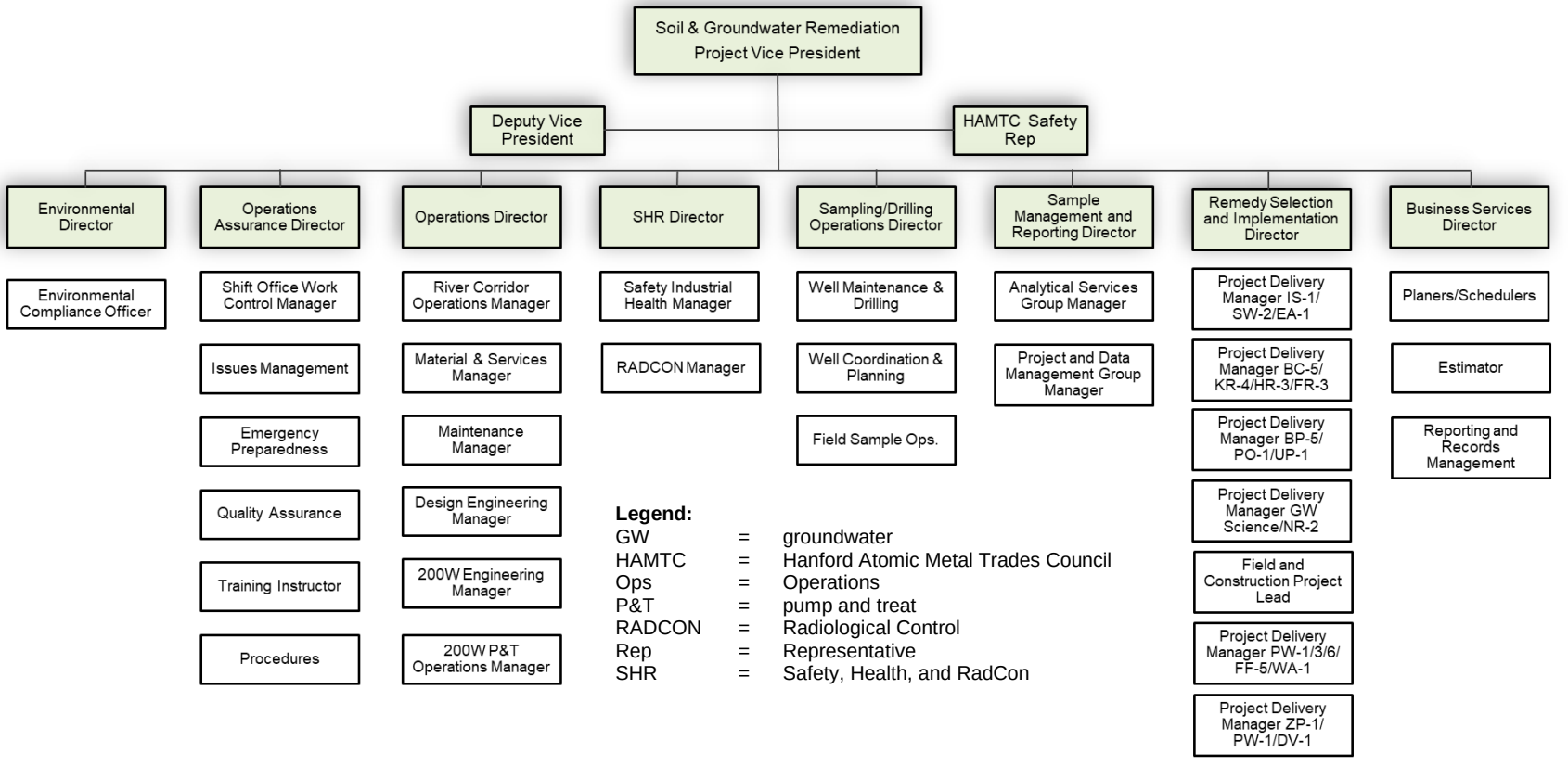


**Figure B-1. Soil and Groundwater Remediation Project Organization**

### B3.2.3 Engineering

The S&GRP engineering program includes elements to ensure the appropriate development and maintenance of the technical baseline for S&GRP. This includes a definition of the elements needed for a design baseline, appropriate approval authorities, and technical staff. Technical direction is applied to the design of new facilities and the maintenance of existing facilities. Technical direction includes equipment specification, engineering strategy, independent review of designs, and acceptance testing strategy/oversight. Project teams include engineering staff to ensure that systems, structures, and components safely and efficiently perform their defined functions.

Configuration control of the design basis and baseline is a key element of the engineering program. The program implements elements to provide independent checking, assessments, evaluations, and engineering processes, including value engineering, for implementing continuous improvement.

S&GRP design authorities, under the leadership of the Engineering Manager, define and maintain the design basis, verify that the project design meets the functional design criteria, technical specifications, and applicable standards, and appropriately integrate safety and sustainability into the design. Individual design authorities will specify equipment design criteria. CHPRC requirements document PRC-RD-EN-1819, *CHPRC Engineering Requirements*, contains overarching engineering requirements, including Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings and Leadership in Energy and Environmental Design. Other CHPRC procedures and requirements documents capture additional engineering requirements.

### B3.2.4 Maintenance

The maintenance department is responsible for efficiently maintaining the pump and treat facilities including preventive and corrective maintenance and implementing modifications to improve the operation and reliability of the facilities. In addition to the maintenance of pump and treat facilities, the maintenance department supports other groups and projects within the S&GRP, such as sampling equipment calibration and maintenance, maintaining the automated well level network, NR-2 apatite injections, etc.

## B3.3 Sample Management and Reporting

The Sample Management and Reporting (SMR) organization provides centralized management, planning, development, and oversight of sampling, sample and data management, and analytical activities within S&GRP; the following primary responsibilities are included:

- Support proper project planning for data quality through peer review of DQO reports, groundwater monitoring plans, and SAPs
- Serve as the primary interface between project data users and onsite and offsite analytical laboratories to ensure required laboratory performance levels
- Ensure the quality of field and analytical data through implementation of multiple quality control (QC) measures
- Ensure the integrity and traceability of data through implementation of proper and appropriate sample and data management processes
- Evaluate and document quarterly and annual laboratory performance data
- Develop SOWs for contracts with commercial analytical laboratories and perform BTR responsibilities for those laboratories

- Develop the groundwater monitoring schedule and act as the primary interface between project scientists, the sampling organization, and the well maintenance organization relative to sample collection, water level measurements, and constituent analysis in accordance with specific project requirements and monitoring plans

### B3.3.1 Company Representative to the HASQARD Focus Group

The U.S. Department of Energy (DOE), Richland Operations Office (DOE-RL) issues DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). The HASQARD Focus Group maintains this document, provides interpretations, and modifies the document in response to changes in applicable DOE Orders, *Code of Federal Regulations*, as well as regulatory and industry standards. This Focus Group consists of representatives from Hanford Site contractors, Pacific Northwest National Laboratory, DOE-RL, the DOE Office of River Protection, and Hanford Site regulatory agencies (e.g., the Washington State Department of Ecology [Ecology], Washington State Department of Health, and EPA, Region X).

The Director of SMR (or delegate) is the company representative to the HASQARD (DOE/RL-96-68) Focus Group. Responsibilities include assisting in identification of QA requirements and providing guidance and direction for analytical and sampling requirements. HASQARD requires implementation of a consistent level of quality in field sampling and analytical activities as well as laboratory analytical services. Analytical services for CHPRC are provided by offsite laboratories that are required to comply with *Department of Defense and Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories* (DoD/QSM, 2019). HASQARD requirements beyond those within the DoD/DOE QSM are also evaluated under the DOE Consolidated Audit Program – Accreditation Program (DOECAP-AP).

## B3.4 Sampling/Drilling Operations

The Sampling Operations Organization is responsible for collecting groundwater, soil, vapor, and multi-media samples, processing the samples as necessary, and shipping the samples for analysis. The following primary responsibilities are included:

- Collect representative samples according to qualified procedures and training
- Serve as the subject matter experts for sampling activities within CHPRC
- Maintain a diverse inventory of sampling equipment, vehicles, and trained personnel to support current and project sampling activities

The Drilling Operations Organization serves as the central site resource responsible for the installation and maintenance of groundwater wells and drilling activities on the Hanford Site. The organization is responsible for identifying, developing, and maintaining the necessary contract and CHPRC resource base to support safe, efficient installation of wells and characterization borings. The following primary responsibilities are included:

- Planning, coordinating, and implementing well drilling and decommissioning for Hanford Site wells according to project-specific requirements. This includes drilling wells to Washington State standards and preparing all required submittals and notifications required by state law. It also includes providing well-related information for site databases. Decommissioning includes identifying all wells that are surplus to monitoring and remediation needs or that represent a pathway for contaminant migration to groundwater then sealing the well to Washington State standards to eliminate the pathway.

- Providing maintenance and modification of existing wells, installation and removal of pumps, and cleaning and remediation of wells for optimal usage. Updating site databases to document changes to well configuration.
- Operating the modular storage units established for purgewater management under a CERCLA non-time critical removal action (i.e., DOE/RL-2009-39, *Investigation-Derived Waste Purgewater Management Action Memorandum*, and DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*). S&GRP operates the modular storage units in accordance with the regulatory standards for miscellaneous units to ensure purgewater management is protective of human health and the environment. Routine operation of the modular storage units includes inspection, freeboard measurement, maintenance, leak detection riser water level measurements, purgewater truck transfers, and inter-tank transfers. Upon completion of service, S&GRP will disassemble and disposition the modular storage units to minimize the need for further maintenance, is protective, and returns the land to appearance and use of surrounding land areas to the degree possible given the nature of the activity. Design, operation, and closure standards for the removal action are addressed in detail in Appendix A of DOE/RL-2009-39.

## B3.5 Remedy Selection and Implementation

One of S&GRP's missions is to restore groundwater to drinking water standards and to protect the Columbia River by removing contaminants of concern. The Remedy Selection and Implementation group evaluates thousands of samples yearly and ensures compliance with state and federal laws. This group is also responsible for collecting pump-and-treat data and tracking trends to show cleanup performance.

### B3.5.1 RCRA Groundwater Monitoring

RCRA groundwater monitoring ensures that CHPRC and DOE are compliant with groundwater protection requirements, including state and federal laws. The treatment, storage, and disposal units include operating landfills and liquid effluent units; inactive cribs, ponds, and ditches; and the single-shell tank farms. Scientists evaluate results of approximately 6,000 analyses each year to determine the impacts of these units on groundwater quality. The annual Hanford Site RCRA groundwater monitoring report documents the evaluated results (in upcoming final status site-specific permits, the annual Hanford Site groundwater monitoring report will be used).

### B3.5.2 Groundwater Remediation Operable Units

Hanford Site OUs are designated to group numerous units into manageable areas for investigation, response action, and prioritizing cleanup. There are ten groundwater OUs: six along the Columbia River and four within the Central Plateau. The OU Project Managers are responsible for investigating groundwater contamination and implementing remediation processes. The Project Managers coordinate the characterization of groundwater plumes, development of conceptual models of contaminant distribution, assessment of risk, fate and transport modeling, and evaluation of remedial alternatives to support the remedial action decision-making process. After remedies (e.g., pump and treat and barriers) are defined, the OU Project Managers also coordinate design, construction, and monitoring of the performance of groundwater remedial actions.

### B3.5.3 Deep Vadose Zone Project

DOE, contractors, EPA, and Ecology are collaborating to identify solutions for characterizing, remediating, and monitoring the deep vadose zone (DVZ). The vadose zone is the area between the surface and the groundwater at Hanford's Central Plateau. The vadose zone is approximately 76.2 m (250 ft) thick; the DVZ is the region just above the groundwater. The vadose zone was contaminated during Hanford Site plutonium production operations.

## B3.6 Operations Assurance

Operations Assurance is a structured process for executing project activities that supports improving operational efficiencies and performance. Operations Assurance consists of training, procedures, Lessons Learned, Issues Management, Shift Office, Emergency Preparedness (EP), and Project QA.

### B3.6.1 Training

Chapter B4 provides the Personnel Training and Qualification requirements.

### B3.6.2 Issues Management

S&GRP Issues Management provides the project with oversight of the Condition Reporting and Resolution System (CRRS) process. Issues Management personnel are available to assist in completion of corrective actions.

CRRS is a user-friendly, intranet database that all employees can use to report and track issues, conditions, or events, positive or needing improvement, from initiation to resolution.

### B3.6.3 Work Control/Shift Office

S&GRP work control provides the work management process for initiating, validating, developing instruction, approving, scheduling, releasing, performing, changing, and closing out work documents.

The S&GRP Shift Office provides consistent, updated information regarding ongoing and scheduled work activities occurring within S&GRP. The Shift Office will provide a perspective of daily work in progress and highlight potential impacts. This information is available to all project team members, visitors, and assessors. For questions or assistance, email the ^SGRP-Shift Office.

### B3.6.4 Emergency Preparedness

S&GRP EP ensures the protection of workers, the public, and the environment. The team trains Facility Emergency Response Organizations at facilities to respond to emergency events that could happen at their projects. EP develops and maintains S&GRP emergency response procedures and plans. The team also conducts routine EP drills to evaluate the effectiveness of the program and provide constant assurance of emergency readiness.

### B3.6.5 Project Quality Assurance Engineer

Project quality assurance engineers (QAEs) are responsible for integrating quality into the project documents and for performing project specific surveillances to ensure the attainment of quality.
The Project QAE may confer with EC&QA and resolve any identified issues relating to environmental data collection, monitoring, and reporting.

The Project QAE, integrating with EC&QA, will provide quality engineering support for project documentation including, but not limited to, DQOs, SAPs, and QAPjPs for appropriate quality requirement implementation. Project QAEs are responsible for maintaining their QAE qualification.

The CHPRC QA organization supporting a facility or activity defines the QA program and has independent authority to assess the systematic implementation of specified requirements. The organization also has direct access to management at a level necessary for effecting appropriate action. QA has sufficient authority, access to work areas, and organizational freedom to accomplish the following objectives:

- Identify quality problems.
- Initiate, recommend, or provide solutions to quality problems through designated channels.

- Verify implementation of solutions.
- Ensure that S&GRP controls further processing, delivery, installation, or use of defective materials, equipment, and services until proper disposition of the nonconformance, deficiency, or unsatisfactory condition has occurred.

Facility/program QAEs interface with their QA Manager for assistance and technical advice on QA programmatic matters and implementation issues. The CHPRC organization structure and assignment of responsibility is designed to assure that quality is achieved and maintained by those who perform the work. The achievement of quality is verified by persons not directly responsible for supervising or performing the work.

## B3.7 Environmental Manager

The Environmental Manager is responsible for ensuring that S&GRP implements environmental protection, chemical management, and environmental compliance requirements.

## B3.8 Environmental, Safety, Health, and Radiological

The Environmental, Safety, Health, and Radiological Director is responsible for project level direction and coordination of environmental, safety, industrial hygiene, and radiological activities.

### B3.8.1 Safety and Industrial Hygiene Manager

Safety and Industrial Hygiene (S&IH) provides services to the project that include S&IH oversight. S&IH is responsible for ensuring that the project follows safe work practices in accordance with state and federal safety and health regulations by analyzing hazards and prescribing controls for work performed by S&GRP and its subcontractors.

## B3.9 Radiological Engineer/Radiological Control Supervisor

Radiological Control is responsible for providing the safest work environment possible by performing the following:

- Implement radiological control and protection requirements.
- Evaluate and prescribe appropriate radiological protection equipment for S&GRP work activities.
- Conduct hazard screening as part of the work planning process to identify radiological hazards and establish necessary controls.
- Verify radiological conditions of the work area are consistent with work planning assumptions prior to entry into the work area or commencement of the radiological work activity.

# B4 Personnel Training and Qualification

Personnel shall be trained and qualified to ensure that they are capable of performing assigned work. Line management confirms that an employee's training is appropriate and up to date prior to performing any fieldwork. Personnel shall maintain job proficiency through continuing training. Training records are maintained for each employee in an electronic training record database.

A combination of general and job specific safety and operational training is provided to prepare employees to operate and maintain S&GRP activities in a safe, effective, efficient, and environmentally sound manner. PRC-PRO-TQ-459, *Environmental Training* and PRC-MP-TQ-011, *CH2M HILL Plateau Remediation Company (CHPRC) Qualification and Training Plan*, form the basis for the training provided

to personnel assigned or matrixed to S&GRP. A training coordinator is assigned to ensure that S&GRP personnel receive the required training and maintain their qualification.

State regulations require that drillers hold a valid State of Washington drillers license per WAC 173-162, "Regulation and Licensing of Well Contractors and Operators." Certified journeyman electricians with qualifications meeting WAC 296-401B-455, "Opportunity for Gaining Credit for Previous Work Experience in Certain Specialties," Subcategory 03A, are required for electrical connections on pumps in resource protection wells. S&GRP flows these requirements down to drilling contractors.

Sampling personnel are required to have training in U.S. Department of Transportation hazardous material general awareness, and hazardous material driver's training as directed by management.

Personnel are required to follow a Dangerous Waste Training Plan (DWTP) to meet the requirements of WAC 173-303-330, "Dangerous Waste Regulations," "Personnel Training." S&GRP has two DWTPs, PRC-STD-TQ-40234, *Soil and Groundwater Remediation Project Accumulation Areas Dangerous Waste Training Plan* and SGRP-STD-TQ-54227, *Groundwater Well Sampling, Inspection, and Maintenance Supplemental Dangerous Waste Training Plan*. PRC-STD-TQ-40234 addresses that RCRA dangerous waste governed directly under the RCRA regulations. SGRP-STD-TQ-54227 is a supplemental to the DWTP and applies to RCRA well inspection and maintenance personnel (e.g., samplers, maintenance, field work supervisor, groundwater scientists).

# B5 Quality Improvement

Corrective actions identified from CHPRC assessments will be processed in accordance with PRC-PRO-QA-052, *Issues Management*. Nonconformances identified by CHPRC will be processed in accordance with PRC-PRO-QA-298, *Nonconforming Items*. Subcontractor nonconformances will be processed in accordance with contract documents and subcontractor QA Program requirements.

Problems with well construction, sample collection, sample custody, or data acquisition that affect the quality of data or impair the ability to acquire data due to failure to meet contract requirements, or failure to follow procedure shall be documented in accordance with PRC-PRO-QA-298; PRC-PRO-QA-9769, *Surveillance Process*, or the condition report as described in PRC-PRO-QA-052, as appropriate. The SMR group maintains procedures to evaluate, disposition, and document issues associated with sampling, sample analysis, data reporting, and data qualification.

QA surveillance reports are provided to project management for action or information depending on the results of surveillance. Surveillance reports and assessments are processed in accordance with PRC-PRO-QA-052.

## B5.1 Field Quality Control

The project-specific standard operating procedures (SOPs), SAP, or other work control documents usually require various types of field QC samples be taken as part of the sample collection process. Field QC samples include blanks, duplicates, and split samples. These field QC samples are used to monitor the integrity of field samples during sample collection, transportation, storage, and laboratory analysis. Field QC samples are submitted to the analyzing laboratories as field samples. Field QC samples are analyzed for the same set of analytes as their corresponding field samples. The following sections describe the various types of field QC samples in more detail.

### B5.1.1 Field Blanks

Field blanks are used to monitor for potential sample contamination that may occur during sample acquisition, transportation, storage, and sample analysis. Field blanks are typically prepared to match the

sample matrix as closely as possible. High-purity deionized water[1] is the preferred blank matrix when water-based samples are collected, and silica sand is typically used for the field blank when soil or other solid samples are acquired. When water samples require preservation reagents (e.g., nitric acid or sodium hydroxide), the same preservation reagents are used to make up the corresponding field blank. Three types of field blanks support the field sampling process as described below.

- Trip blanks ("full trip blanks") are used to monitor for potential sample contamination from the sampling container, preservation reagents, or storage conditions. Trip blanks are prepared and sealed prior to traveling to the sampling site, transported to the sampling site (not opened in the field), and then shipped as part of the sample set to the laboratory. Full trip blanks may be used for all or a subset of the analyses as defined by project-specific SOPs, SAP, or other work control document. When used for volatile organic compounds (VOCs) analysis only, the QC samples are frequently identified as a daily trip blank.

- Field transfer blanks (also called "daily trip blanks") are used to document possible contamination during field acquisition of VOC samples. Field transfer blanks are sample bottles (already containing any required sample preservative) filled at the sample collection site with high-purity deionized water or silica sand. The blank is sealed at the sampling site and becomes part of the sample set sent to the laboratory. Field transfer blanks shall be prepared daily for sites sampling for VOC analysis or shall accompany samples as specified in the project-specific SOPs, SAP, or other work control documents. Typically, one set of field transfer blanks is prepared each day that VOC field samples are collected. If VOC samples are collected on the same day and shipped to multiple laboratories, a set of field transfer blanks is collected for each analyzing laboratory.

- Equipment blanks, also known as equipment rinsate blanks, are used to monitor the effectiveness of the decontamination process for reusable sampling equipment. Equipment blanks are not usually required for dedicated sampling equipment, disposable sampling equipment, or vendor-provided sampling equipment (e.g., used during a borehole drilling event). They are samples of high-purity deionized water or silica sand contacted with the sampling surfaces of equipment used to collect samples prior to using that equipment for field sampling. Equipment blanks are collected at the frequency specified in the project-specific SOPs, SAP, or other work control documents. An equipment blank shall be collected from each type of reusable sampling equipment to ensure that the decontamination procedures are effective for the specific equipment types. Equipment blanks shall be analyzed for the same analytes as samples collected using that equipment or as specified in the project-specific SOPs, SAP, or other work control documents.

### B5.1.2 Field Duplicates

Field duplicates provide information regarding the homogeneity of the sample matrix and the precision of the sampling and analysis processes. Field duplicates are two samples that are intended to be identical and shall be collected as close as possible in time and location. Each sample in the sample-duplicate pair receives its own unique sample number. Unless specified differently in the project-specific SOPs, SAP, or other work control documents, the volume needed for soil or solid-phase field duplicates (except for VOC analysis) is collected and homogenized before being divided into two samples in the field. Soil or solid-phase samples submitted for VOC analyses are not to be homogenized or split; instead it is necessary to collect collocated samples. Field duplicates are normally collected at a frequency of 5% of the samples collected per matrix or as specified in the project-specific SOPs, SAP, or other work control documents.

[1] High-purity water is generally defined as water that has been distilled or deionized (or both) so it will have a conductivity less than 1.0 µS/cm (greater than 1.0 megaohm-cm resistivity) (DOE/RL-96-68).

### B5.1.3 Field Split Samples

Field split samples serve as interlaboratory comparison samples and are a variation of field duplicate samples. Field split samples are two samples that are intended to be identical and shall be collected as close as possible in time and location. Unless specified differently in project-specific SOPs, SAP, or other work control documents, the volume needed for soil or solid-phase splits (except for VOC analysis) is collected and homogenized before being divided into two samples in the field. Soil or solid-phase samples submitted for VOC analyses are not homogenized, instead, it is necessary to collect collocated samples. The frequency and method for collection of field split samples are directed by the project-specific SOPs, SAP, or other work control documents.

### B5.1.4 Collocated Samples

Collocated samples are taken where homogenizing samples for duplicate or split samples would impact the quality of the resulting data or as specified in the project-specific SOPs, SAP, or other work control documents. Collocated samples are independent samples collected as close as possible to the same point in space and time and are intended to be as identical as is practical. Collocated samples are not homogenized. Because of the possible loss of volatile analytes when generating field duplicates or field splits, it is necessary to collect samples for VOC analysis as collocated samples. For liquid VOC samples, duplicate, or split samples are typically collected sequentially during the sampling event. Collocated soil cores collected for VOC analyses shall be sealed immediately and shipped to the laboratory as soon as possible.

Using several types of field QC samples monitors the adequacy of the sampling system and the integrity of samples from field collection through laboratory analysis. Field QC samples and their typical frequencies are listed in Table B-2. SAPs and groundwater monitoring plans address project specific field QC frequency, if applicable. Field and laboratory QC sample results are evaluated according to criteria defined in Table B-3. Laboratory performance is evaluated according to criteria discussed in Section B5.4.

**Table B-2. Quality Control Samples**

| Sample Type | Primary Characteristics Evaluated | Frequency |
|---|---|---|
| **Field Quality Control** | | |
| Equipment Blank | Contamination from nondedicated sampling equipment | As needed[a,b] |
| Full Trip Blank | Contamination from containers, preservative reagents, storage, or transportation | 1 per 20 sampling event (well trips [c] or other media samples) |
| Field Transfer Blank | Contamination from sampling site | 1 each day VOCs are sampled; additional field transfer blanks are collected if VOC samples are acquired on the same day for multiple laboratories (wells or other media samples) |
| Field Duplicate Samples | Reproducibility/sampling precision | 1 in 20 sampling events (well trips or other media samples[c]) |
| Field Split Samples | Inter-laboratory comparability | As needed<br>When needed, the minimum is one for every analytical method, for analyses performed. |
| **Laboratory Batch Quality Control[d]** | | |
| Carrier | Recovery/yield | Added to each sample and quality control sample[e] |
| Method Blanks | Laboratory contamination | 1 per analytical batch[e] |

**Table B-2. Quality Control Samples**

| Sample Type | Primary Characteristics Evaluated | Frequency |
|---|---|---|
| Laboratory Sample Duplicate | Laboratory reproducibility and precision | 1 per analytical batch[e] |
| Matrix Spikes | Matrix effect/laboratory accuracy | 1 per analytical batch[e] |
| Matrix Spike Duplicate | Laboratory reproducibility, and Method accuracy and precision | 1 per analytical batch[e] |
| Surrogates | Recovery/yield for organic compounds | Added to each sample and quality control |
| Tracers | Recovery/yield | Added to each sample and quality control |
| Laboratory Control | Method accuracy | 1 per analytical batch[e] |
| **Laboratory Performance Evaluation** | | |
| Audit/Assessment | Overall laboratory performance and operations conformance to requirements | Annually[f] |
| Performance Evaluation Programs[g] | Laboratory accuracy | Annual |
| Double-Blind Standards | Laboratory accuracy/Inter-laboratory comparison | Quarterly |

Note: The information in this table does not represent U.S. Environmental Protection Agency or Washington State Department of Ecology requirements; it is intended solely as guidance.

a. For portable pumps, equipment blanks are collected 1 per 10 well trips. Whenever a new type of nondedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

b. Vendor provided borehole equipment is considered dedicated equipment and equipment blanks are not typically acquired in this instance.

c. A sample for groundwater sampling is a well trip, defined as any time a well is accessed for sampling. For groundwater monitoring, field duplicates and full trip blanks are run at a frequency of 1 in 20 well trips (i.e., 5% of the well trips) for all groundwater monitoring wells sampled within any given month (not just those restricted to a single TSD unit). For example, if a month has 181 wells scheduled, then 10 field duplicates will be collected. For all other samples, a sample is the media (e.g. soil, resin, powder, etc.) collected at a specific location or depth interval (e.g. during drilling).

d. A batch is a group of up to 20 samples that behave similarly with respect to the sampling or testing procedures being employed and which are processed as a unit. Batching across projects is allowed for similar matrices (e.g., Hanford groundwater).

e. Unless not required by, or different frequency is called out, in laboratory analysis method.

f. DOE Consolidated Audit Program – Accreditation Program requires annual audit of commercial laboratories.

g. Nationally recognized program, such as DOE Mixed Analyte Performance Evaluation Program or Environmental Resource Associates.

DOE = U.S. Department of Energy

TSD = treatment, storage and disposal

VOC = volatile organic compound

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| **General Chemical Parameters** | | | | |
| Alkalinity | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Chemical Oxygen Demand | MB | < MDL<br>< 5% sample concentration | N/A | Flag with "C" |
| | LCS | 80%-120% recovery | N/A | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | N/A | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | N/A | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | N/A | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | N/A | Review data[d] |
| Oil and Grease | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | 70%-130% recovery | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Total Dissolved Solids | MB | < MDL<br>< 5% sample concentration | N/A | Flag with "C" |
| | LCS | 80%-120% recovery | N/A | Flag with "o"[a] |
| | DUP[b] | ≤ 20% RPD | N/A | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | N/A | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | N/A | Review data[d] |
| Total Suspended Solids | MB | < MDL<br>< 5% sample concentration | N/A | Flag with "C" |
| | LCS | 80%-120% recovery | N/A | Flag with "o"[a] |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| | DUP[b] | ≤ 20% RPD | N/A | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | N/A | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | N/A | Review data[d] |
| Total Organic Carbon/<br>Total Inorganic Carbon | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Total Organic Halides/<br>Extractable Organic Halides | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| **Ammonia and Anions** | | | | |
| Ammonia/TKN | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Anions by IC | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| Cyanide (Total)/Cyanide (Free) | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Cyanide Metal Complexes | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Sulfide | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| **Metals** | | | | |
| ICP-AES Metals | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| ICP-MS Metals | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Hexavalent Chromium | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Mercury by Cold-Vapor Atomic Absorption | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Uranium (Total) by ICP-MS | MB | < MDL<br>< 5% sample concentration | | Flag with "C" |
| | LCS | 80%-120% recovery | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 35% RPD | Review data[d] |
| | MS / MSD[c] | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| **Volatile Organic Compounds** | | | | |
| Methane by RSK-175 | MB | < MDL<br>< 5% sample concentration | N/A | Flag with "B" |
| | LCS | % recovery statistically derived[f] | N/A | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | N/A | Review data[d] |
| | MS / MSD[c] | % recovery statistically derived[f] | N/A | Flag with "N" |
| | EB, FTB | < MDL<br>< 5% sample concentration | N/A | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | N/A | Review data[d] |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| Total Petroleum Hydrocarbons - Gasoline by GC | MB | < MDL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | | Review data[d] |
| | MS / MSD[c] | 70%-130% recovery | | Flag with "N" |
| | SUR | 60%-140% recovery | | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Volatile Organics by GC-MS | MB | < MDL[h]<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | | Review data[d] |
| | MS / MSD[c] | 70%-130% recovery | | Flag with "T" |
| | SUR | 70%-130% recovery | % recovery statistically derived[f] | Review data[d] |
| | EB, FTB, FXR | < MDL[h]<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| **Semivolatile Organic Compounds** | | | | |
| Extractable Petroleum Hydrocarbons by GC (aliphatic and aromatic hydrocarbon fractions) | MB | < MDL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | | Review data[d] |
| | MS / MSD[c] | 70%-130% recovery | | Flag with "N" |
| | SUR | 60%-140% recovery | | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Herbicides by GC | MB | < MDL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS / MSD[c] | % recovery statistically derived[f] | | Flag with "N" |
| | SUR | % recovery statistically derived[f] | | Review data[d] |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| PAHs by GC-MS | MB | < MDL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS / MSD[c] | % recovery statistically derived[f] | | Flag with "T" |
| | SUR | % recovery statistically derived[f] | | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| PCBs by GC | MB | < MDL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS / MSD[c] | % recovery statistically derived[f] | | Flag with "N" |
| | SUR | % recovery statistically derived[f] | | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Pesticides by GC | MB | < MDL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS / MSD[c] | % recovery statistically derived[f] | | Flag with "N" |
| | SUR | % recovery statistically derived[f] | | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Phenols by GC-MS | MB | < MDL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o"[a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS / MSD[c] | % recovery statistically derived[f] | | Flag with "T" |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| | SUR | % recovery statistically derived[f] | | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Semivolatile Organics by GC-MS | MB | < MDL[h]<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[g] | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS / MSD[c] | % recovery statistically derived[f] | | Flag with "T" |
| | SUR | % recovery statistically derived[f] | | Review data[d] |
| | EB, FTB | < MDL[g]<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Total Petroleum Hydrocarbons – Diesel or Kerosene by GC | MB | < MDL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | 70%-130% recovery or % recovery statistically derived[f] | | Flag with "o" [a] |
| | DUP[b] or MS / MSD[c] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS / MSD[c] | 70%-130% recovery | | Flag with "N" |
| | SUR | 60%-140% recovery | | Review data[d] |
| | EB, FTB | < MDL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Dioxins and Furans, Total and/or Congeners by HRGC/HRMS | MB | < PQL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | % recovery statistically derived[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | SUR | 60%-140% recovery | | Review data[d] |
| | EB, FTB | < PQL<br>< 5% sample concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| PCB Congeners by HRGC/HRMS | MB | < PQL<br>< 5% sample concentration | | Flag with "B" |
| | LCS | % recovery statistically derived[f] | | Flag with "o"[a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | SUR | % recovery statistically derived[f] | | Review data[d] |
| | EB, FTB | < PQL<br>< 5% sample concentration | | Flag with "Q" |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| **Radiological Parameters** | | | | |
| AEA (Radium-226, Neptunium, Thorium, Uranium, Plutonium, Americium, and Curium isotopes) | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o"[a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | Tracer | 30%-105% recovery | | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Carbon-14 | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Chlorine-36 | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | Tracer | 30%-105% recovery | | Review data[d] |
| | Carrier | 40%-110% recovery | | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Plutonium-241 | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | Tracer | 30%-105% recovery | | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| GEA | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Gross Alpha | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Gross Beta | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o"[a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Iodine-129 | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | Carrier | 40%-110% recovery | | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Nickel-63 | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS | 75%-125% recovery | | Review data[d] |
| | Carrier | 40%-110% recovery | | Review data[d] |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Selenium-79 | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | Carrier | 40%-110% recovery | | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Total Alpha Radium by Gas Flow Proportional Counting (Method 903.0 or equivalent) | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | Carrier | 40%-110% recovery | | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Radium-226 by Lucas Cell Method 903.1 or equivalent) | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | Tracer | 30%-105% recovery | | Review data[d] |
| | Carrier | 40%-110% recovery | | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Radium-228 by GPC (Method 904.0/9320) | MB | < MDC<br>< 5% sample activity concentration | N/A | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | N/A | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | N/A | Review data[d] |
| | Tracer | 30%-105% recovery | N/A | Review data[d] |
| | Carrier | 40%-110% recovery | N/A | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity | N/A | Flag with "Q" |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |
| | | concentration | | |
| | Field Duplicate[b] | ≤ 20% RPD | N/A | Review data[d] |
| Strontium-90 | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | Tracer | 30%-105% recovery | | Review data[d] |
| | Carrier | 40%-110% recovery | | Review data[d] |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Technetium-99 | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o"[a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| Tritium | MB | < MDC<br>< 5% sample activity concentration | | Flag with "B" |
| | LCS | 80%-120% recovery or statistically derived limits[f] | | Flag with "o"[a] |
| | DUP[b] | ≤ 20% RPD | ≤ 30% RPD | Review data[d] |
| | MS | 75%-125% recovery | | Flag with "N" |
| | EB, FTB | < MDC<br>< 5% sample activity concentration | | Flag with "Q" |
| | Field Duplicate[b] | ≤ 20% RPD | --[e] | Review data[d] |
| **Summa Canisters** | | | | |
| **Analyte** | **QC Element** | **Acceptance Criteria** | | **Corrective Action** |
| | | **Gaseous** | | |
| TO-15 | MB | < MDL | | Flag with "B" |
| | LCS | 70%-130% recovery or statistically derived limits[f] | | Flag with "o" [a] |
| | DUP[b]/LCSD[c] | ≤ 30% RPD | | Review data[d] |
| | SUR | % recovery statistically derived[f] | | Review data[d] |

**Table B-3. Field and Laboratory Quality Control Elements and Acceptance Criteria**

| Analyte/Method | QC Element | Acceptance Criteria | | Corrective Action |
|---|---|---|---|---|
| | | Water | Soil | |

Note: Specific analytes and methods for determination are available from SMR.

a. The reporting laboratory will apply the "o" flag with SMR concurrence.

b. Applies when at least one result is greater than the laboratory PQL (chemical analyses) or greater than five times the MDC (radiochemical analyses).

c. Either a sample duplicate or a MSD is to be analyzed to determine measurement precision (if there is insufficient sample volume, an LCSD is analyzed with the acceptance criteria defaulting to the DUP/MSD criteria

d. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data.

e. A field duplicate RPD for soils is not recommended because of possible soil matrix heterogeneity effects.

f. Laboratory-determined, statistically derived control limits based on historical data are used here. Control limits are reported with the data.

g. For the common laboratory contaminants acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criterion is less than five times the MDL.

**Data Flags**:

B, C = possible laboratory contamination: analyte was detected in the associated method blank – laboratory applied. The B flag is used for organic analytes and radioanalytes. The C flag is used for general chemical parameters and inorganic analytes,

o = result may be biased: associated laboratory control sample result was outside the acceptance limits – laboratory applied.

N = result may be biased: associated MS result was outside the acceptance limits (all methods except GC-MS) – laboratory applied.

Q = problem with associated field QC samples: results were out of limits – SMR review.

T = result may be biased: associated MS result was outside the acceptance limits (GC-MS only) – laboratory applied.

AEA = alpha energy analysis
DUP = laboratory sample duplicate
EB = equipment blank
FTB = full trip blank
GC = gas chromatography
GC-MS = gas chromatography – mass spectrometry
GEA = gamma energy analysis
GPC = gas proportional counter
HRGC = high-resolution gas chromatography
HRMS = high-resolution mass spectrometry
IC = ion chromatography
ICP-AES = inductively coupled plasma – atomic emission spectroscopy
ICP-MS = inductively coupled plasma – mass spectrometry
KPA = kinetic phosphorescence analyzer
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
MB = method blank
MDC = minimum detectable concentration
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
N/A = not applicable
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PQL = practical quantitation limit
QC = quality control
RPD = relative percent difference
RSK = EPA Robert S. Kerr Environmental Research Center
SMR = Sample Management and Reporting
SUR = surrogate
TKN = Total Kjeldahl Nitrogen
TO = toxic organic

## B5.2 Laboratory Quality Control

The environmental analytical laboratories contracted to CHPRC maintain internal QA and QC programs. Laboratory QC includes batch QC consisting of laboratory sample duplicates, matrix spikes (MSs), matrix spike duplicates (MSDs), laboratory control samples (LCSs), method blanks (MBs), surrogates, and for radionuclide analyses tracers and carriers. These batch QC samples are required by EPA analytical method protocols, by HASQARD (DOE/RL-96-68), and by DOD/DOE QSM. Table B-2 lists the laboratory batch QC samples and their typical frequencies. Table B-3 outlines the batch QC acceptance criteria. SAPs and groundwater monitoring plans address project specific laboratory QC frequencies and acceptance criteria, as applicable:

1. Method Blank. An analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample

preparations and analytical procedure. The MB is used to estimate potential contamination resulting from the sample preparation and analysis.

2. Laboratory Control Sample. A control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material used to evaluate laboratory accuracy.

3. Laboratory Sample Duplicate. A laboratory sample duplicate is a second aliquot of a client sample that is taken through the entire sample preparation and analytical process. Laboratory duplicates are used to evaluate the precision of a method in a given sample matrix.

4. Matrix Spike. An aliquot of a client sample spiked with a known concentration of target analyte(s) that is then taken through the entire sample preparation and analytical process. The MS is used to assess the bias of a method in a given sample matrix. Thus, MS results are an indicator of the effect the sample matrix has on the accuracy of measurement of the target analytes.

5. Matrix Spike Duplicate. A replicate spiked aliquot of a client sample that is taken through the entire sample preparation and analytical process. MSD results are used to estimate the precision of a method in a given sample matrix.

6. Surrogate (organic analyses only). An organic compound added to every sample in the analysis batch (field samples and batch QC samples) prior to preparation. The surrogate is typically similar in chemical composition to the analyte being determined, but is not normally encountered in environmental samples. Surrogates are expected to respond to the preparation and analytical process in a manner similar to the analytes of interest. Because surrogates are added to every client sample and batch QC sample, they are used to evaluate overall analytical method performance in a given matrix.

7. Tracer (radioanalytical analyses only). Generally added to an aliquot of sample prior to the sample preparation step. A tracer is a known quantity of radioactive isotope that is different from the isotope of interest but is expected to behave similarly. A tracer does not chemically interfere with the target radioisotope during radiochemical preparation, separation, and counting. Sample results are generally corrected based on tracer recovery.

8. Carrier (radioanalytical analyses only). Carriers are typically nonradioactive elements (e.g., natural strontium, barium, yttrium). They are added to samples prior to sample processing and behave similarly to the radionuclide of interest during sample processing. Thus carriers allow the overall chemical yield for the analytical preparation steps to be determined. The yield of the carrier may be determined gravimetrically or by means of one of the inductively coupled plasma methods.

## B5.3 Sample Holding Times

Laboratories are required to analyze samples within the holding time specified in EPA or other recognized standard procedures. In some instances, sample constituents not analyzed within the holding times may be compromised by volatilizing, decomposing, chemical changes, or biological activity. SMR personnel flag data from samples analyzed outside the holding time in the Hanford Environmental Information System (HEIS) database with an ‘H.’ A sample holding time begins at the time and date of sample collection recorded on the chain of custody or when the sample is extracted. The sample holding time ends when the sample or sample extract is analyzed. Table B-4 (for water samples) and Table B-5 (for soil samples) list the holding times for constituents frequently analyzed by S&GRP. Both tables list the sources for the holding time requirements.

A project team may determine the applicability of holding times based on sampling and analysis constraints, data use, or other technical criteria. The project team shall document these holding time determinations in the applicable DQO document, SAP, or other work control document.

**Table B-4. Groundwater Preservations and Holding Times**

| Constituents | Preservation | Holding Times |
|---|---|---|
| **General Chemistry Parameters** | | |
| Alkalinity | Cool ≤6°C | 14 days[a] |
| Chemical Oxygen Demand | H2SO4 to pH <2<br>Cool ≤6°C | 28 days[a] |
| Oil and Grease | HCl to pH <2<br>Cool ≤6°C | 28 days[b] |
| Total Dissolved Solids | Cool ≤6°C | 7 days[d] |
| Total Suspended Solids | Cool ≤6°C | 7 days[d] |
| Total Organic Carbon/Total Inorganic Carbon | HCl or H2SO4 to pH <2<br>Cool ≤6°C | 28 days[a,b] |
| Total Organic Halides/Extractable Organic Halides | H2SO4 to pH <2<br>Cool ≤6°C | 28 days[c] |
| Specific Conductance | Cool ≤6°C | 28 days[a] |
| Ammonia/TKN | H2SO4 to pH <2<br>Cool ≤6°C | 28 days[a] |
| Bromide, Chloride, Fluoride, Sulfate | Cool ≤6°C | 28 days[a,b,e] |
| Nitrate, Nitrite, Phosphate | Cool ≤6°C | 48 hours[a,e] |
| Cyanide (Total) / Cyanide (Free) / Cyanide (Amenable)/ Cyanide Metal Complexes | NaOH to pH >=12<br>Cool ≤6°C | 14 days[a,b,e] |
| Sulfide | ZnAc+NaOH to pH > 9<br>Cool ≤6°C | 7 days[a,b,e] |
| **Metals** | | |
| ICP-AES Metals/ICP-MS Metals | HNO3 to pH <2 | 6 months[a,b,e] |
| Hexavalent Chromium | Cool≤6°C | 24 hours[b,e] |
| Mercury by Cold-Vapor Atomic Absorption | HNO3 to pH <2 | 28 days[a,b,e] |
| **Volatile Organic Compounds** | | |
| Methane by RSK-175 | HCl or H2SO4 to pH <2<br>Cool ≤6°C | 14 days preserved[g] |
| Total Petroleum Hydrocarbons – Gasoline | HCl to pH <2<br>Cool ≤6°C | 7 day unpreserved[f]<br>14 days preserved[f] |
| Volatile Organics by GC-MS | HCl or H2SO4 to pH <2<br>Cool ≤6°C | 7 days unpreserved[h]<br>14 days preserved[h] |
| **Semivolatile Organic Compounds** | | |
| Extractable Petroleum Hydrocarbons by GC (aliphatic and aromatic hydrocarbon fractions) | HCl to pH <2<br>Cool ≤6°C | 14 days before extraction[f]<br>40 days after extraction[f] |

**Table B-4. Groundwater Preservations and Holding Times**

| Constituents | Preservation | Holding Times |
|---|---|---|
| Herbicides by GC | Cool ≤6°C | 7 days before extraction[a,h]<br>40 days after extraction[a,h] |
| Polycyclic Aromatic Hydrocarbons (PAHs by GC-MS) | Cool ≤6°C | 7 days before extraction[a,h]<br>40 days after extraction[a,h] |
| Polychlorinated Biphenyls (PCBs by GC), | Cool ≤6°C | 1 year before extraction[a]<br>40 days after extraction[i] |
| Pesticides by GC | Cool ≤6°C | 7 days before extraction[a,h]<br>40 days after extraction[a,h] |
| Phenols by GC-MS | Cool ≤6°C | 7 days before extraction[a,h]<br>40 days after extraction[a,h] |
| Semivolatile Organics by GC-MS | Cool ≤6°C | 7 days before extraction[h]<br>40 days after extraction[h] |
| Total Petroleum Hydrocarbons – Diesel Kerosene, Motor Oil by GC | HCl to pH <2<br>Cool ≤6°C | 14 days before extraction[h]<br>40 days after extraction[k] |
| Dioxins/Furans, Total and/or Congeners by HRCH/HRMS | Cool ≤6°C | 30 days before extraction[j]<br>45 days after extraction[j] |
| PCB Congeners by HRGC/HRMS | Cool ≤6°C | 1 year before extraction[a]<br>40 days after extraction[i] |
| **Radiological Parameters** | | |
| AEA (Radium-226, Neptunium, Thorium, Uranium, Plutonium, Americium, and Curium isotopes) | HNO3 to pH <2 | 6 months[l] |
| Carbon-14 | None | 6 months[l] |
| Chlorine-36 | None | 6 months[l] |
| Plutonium-241 | HNO3 to pH <2 | 6 months[l] |
| GEA | HNO3 to pH <2 | 6 months[l] |
| Gross Alpha / Gross Beta | HNO3 to pH <2 | 6 months[e] |
| Iodine-129 | None | 6 months[l] |
| Nickel-63 | HNO3 to pH <2 | 6 months[l] |
| Selenium-79 | HNO3 to pH <2 | 6 months[l] |
| Total Alpha Radium by Gas Flow Proportional Counting (method 903.0 or equivalent) | HNO3 to pH <2 | 6 months[l] |
| Radium-226 by Lucas Cell (method 903.1 or equivalent) | HNO3 to pH <2 | 6 months[l] |
| Radium-228 by GPC (method 904.0/9320) | HNO3 to pH <2 | 6 months[l] |
| Strontium-90 | HNO3 to pH <2 | 6 months[l] |
| Technetium-99 | HNO3 to pH <2 | 6 months[l] |
| Tritium | None | 6 months[l] |

Note: Complete reference citations are provided in Chapter B13 of this appendix.

## Table B-4. Groundwater Preservations and Holding Times

| Constituents | Preservation | Holding Times |
|---|---|---|

a. 40 CFR 136, Table II.

b. SW-846, Table 3-2.

c. SW-846, Method 9020B.

d. APHA/AWWA/WEF, 2012, Standard Method 2540A.

e. SW-846, Table 2-40(B).

f. Ecology Publication ECY 97-602.

g. EPA Standard Operating Procedure RSKSOP-175.

h. SW-846, Table 4-1.

i. SW-846, Method 8082A.

j. SW-846, Methods 8280 and 8290.

k. By analogy with semivolatile organics (SW-846, Table 4-1; Weakland, 2017, "Clarification of sample and extraction holding times for ECY-97-602").

l. DOE/RL-96-68, Vol. 2, Appendix A.

## Table B-5. Soil and Sediment Holding Times

| Constituents | Preservation | Holding Times |
|---|---|---|
| **General Chemistry Parameters** | | |
| Alkalinity | Cool ≤6°C | 14 days[a] |
| Chemical Oxygen Demand | Cool ≤6°C | 28 days[a] |
| Oil and Grease | Cool ≤6°C | 28 days[b] |
| Total Organic Carbon/Total Inorganic Carbon | Cool ≤6°C | 28 days[b] |
| Total Organic Halides, Extractable Organic Halides | Cool ≤6°C | 28 days[c] |
| Ammonia | None | 28 days[a] |
| Bromide, Chloride, Fluoride, Sulfate | None | 28 days before extraction[a]<br>28 days after extraction[b,e] |
| Nitrate, Nitrite, Phosphate | None | 28 days before extraction[a]<br>48 hours after extraction[b,e] |
| Cyanide (Total) / Cyanide (Free) / Cyanide (Amenable) Cyanide Metal Complexes / | Cool ≤6°C | 14 days before extraction[b,d]<br>14 days after extraction[b,d] |
| Sulfide | Cool ≤6°C | 7 days[b] |
| **Metals** | | |
| ICP-AES Metals/ ICP-MS Metals | None | 6 months[b] |
| Hexavalent Chromium | Cool ≤6°C | 30 days before extraction[b]<br>24 hours after extraction[f] |
| Mercury by Cold-Vapor Atomic Absorption | None | 28 days[b] |
| **Volatile Organic Compounds** | | |
| Total Petroleum Hydrocarbons – Gasoline by GC | Cool ≤6°C | 14 days[g] |
| Volatile Organics by GC-MS | Cool ≤6°C for Grab sample<br>Frozen for 5035 sampling | 14 days[h] |

**Table B-5. Soil and Sediment Holding Times**

| Constituents | Preservation | Holding Times |
|---|---|---|
| **Semivolatile Organic Compounds** | | |
| Extractable Petroleum Hydrocarbons by GC (aliphatic and aromatic hydrocarbon fractions) | Cool ≤6°C | 14 days before extraction[g]<br>40 days after extraction[g] |
| Herbicides by GC | Cool ≤6°C | 14 days before extraction[h]<br>40 days after extraction[h] |
| Polycyclic Aromatic Hydrocarbons (PAHs by GC-MS) | Cool ≤6°C | 14 days before extraction[h]<br>40 days after extraction[h] |
| Polychlorinated Biphenyls (PCBs by GC) | Cool ≤6°C | Up to 1 year before extraction[j]<br>40 days after extraction[j] |
| Pesticides by GC | Cool ≤6°C | 7 days before extraction[i]<br>40 days after extraction[i] |
| Phenols by GC-MS | Cool ≤6°C | 14 days before extraction[h]<br>40 days after extraction[h] |
| Semivolatile Organics by GC-MS | Cool ≤6°C | 14 days before extraction[h]<br>40 days after extraction[h] |
| Total Petroleum Hydrocarbons – Diesel, Kerosene, Motor Oil by GC | Cool ≤6°C | 14 days before extraction[l]<br>40 days after extraction[l] |
| Dioxins/Furans, Total and/or Congeners by HRCH/HRMS | Cool ≤6°C | 30 days before extraction[k]<br>45 days after extraction[k] |
| PCB Congeners by HRGC/HRMS | Cool ≤6°C | Up to 1 year before extraction[j]<br>40 days after extraction[j] |
| **Radiological Parameters** | | |
| AEA (Radium-226, Neptunium, Thorium, Uranium, Plutonium, Americium, and Curium isotopes) | None | 6 months[a] |
| Carbon-14 | None | 6 months[a] |
| Chlorine-36 | None | 6 months[a] |
| Plutonium-241 | None | 6 months[a] |
| GEA | None | 6 months[a] |
| Gross Alpha / Gross Beta | None | 6 months[a] |
| Iodine-129 | None | 6 months[a] |
| Nickel-63 | None | 6 months[a] |
| Selenium-79 | None | 6 months[a] |
| Total Alpha Radium by Gas Flow Proportional Counting (Method 903.0 or equivalent) | None | 6 months[a] |
| Radium-226 by Lucas Cell (Method 903.1 or equivalent) | None | 6 months[a] |
| Strontium-90 | None | 6 months[a] |
| Technetium-99 | None | 6 months[a] |
| Tritium | None | 6 months[a] |

**Table B-5. Soil and Sediment Holding Times**

| Constituents | Preservation | Holding Times |
|---|---|---|

Note: Complete references are provided in Chapter B13 of this appendix.

a. DOE/RL-96-68, Vol. 2, Appendix A.

b. SW-846, Table 3-2.

c. SW-846, Method 9023.

d. SW-846, Method 9013A.

e. SW-846, Method 9056A.

f. SW-846 Method 7196A.

g. Ecology Publication ECY 97-602.

h. SW-846, Table 4-1.

i.. SW-846 Method 8141B.

j. SW-846 Method 8082A.

k. SW-846, Methods 8280 and 8290.

l. By analogy with Semivolatile Organics (SW-846, Table 4-1; Weakland, 2017, "Clarification of Sample and Extraction Holding Times for ECY-97-602").

## B5.4 Laboratory Performance

In addition to laboratory QC, SMR personnel assess laboratory performance through performance evaluation (PE) programs, double-blind standards, and laboratory audits. PE programs are national studies in which the participating laboratories analyze blind standards for chemical and radiological constituents. The most common PE programs are managed by the Environmental Resources Associates; soil and water proficiency testing programs managed by Sigma-Aldrich, and the Mixed Analyte Performance Evaluation Program managed by DOE. SMR staff evaluate PE program results for each laboratory per Table B-6.

**Table B-6. Performance Evaluation Program Acceptance Criteria**

| Requirement | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Participation in National Performance Evaluation program | Annual | 80% | Review laboratory corrective action plan. Divert samples to alternative laboratory, if necessary. |
| | | No consecutive failures | Review laboratory corrective action plan. Divert samples to alternative laboratory, if necessary. |
| Double-Blind Performance Evaluation Program | Quarterly | 80% | Notify laboratory. Review data. Divert samples to alternative laboratory, if necessary. |

In addition to the national PE programs, SMR maintains an internal double-blind performance assessment program for groundwater. Double-blind standards, which are prepared to look like groundwater samples, are submitted to the laboratories in triplicate or quadruplicate on a quarterly basis. These standards provide useful information on the precision and accuracy of laboratory methods. At the discretion of SMR staff, the constituent list and spiking levels may be adjusted to assist in the evaluation of laboratory performance and resolution of potential problems. SMR maintains specific information on the constituents, spiking levels, and laboratory performance in project files. On a quarterly basis, SMR staff assess the double-blind standard laboratory performance. Table B-7 provides the acceptance criteria for the double-blind samples.

**Table B-7. Double-Blind Standards Suggested Frequency and Acceptance Criteria**

| Constituent | Sample Frequency | Control Limits* (%) |
|---|---|---|
| **General Chemistry Parameters** | | |
| Total organic carbon (potassium hydrogen phthalate spike) | Quarterly | ±25 |
| Total organic halides (2,4,5-trichlorophenol spike) | Quarterly | ±25 |
| Total organic halides (carbon tetrachloride, chloroform, tetrachloroethene, and trichloroethene spike) | Quarterly | ±25 |
| Chloride | Semiannually | ±25 |
| Cyanide | Quarterly | ±25 |
| Fluoride | Semiannually | ±25 |
| Nitrate | Semiannually | ±25 |
| Nitrite | Semiannually | ±25 |
| **Metals** | | |
| Arsenic | Annually | ±20 |
| Barium | Annually | ±20 |
| Cadmium | Annually | ±20 |
| Chromium (total) | Quarterly | ±20 |
| Cobalt | Annually | ±20 |
| Copper | Annually | ±20 |
| Hexavalent chromium | Quarterly | ±20 |
| Iron | Annually | ±20 |
| Magnesium | Annually | ±20 |
| Manganese | Annually | ±20 |
| Mercury | Annually | ±20 |
| Nickel | Annually | ±20 |
| Potassium | Annually | ±20 |
| Silver | Annually | ±20 |
| Sodium | Annually | ±20 |
| Uranium (total) | Annually | ±20 |
| Vanadium | Annually | ±20 |
| Zinc | Annually | ±20 |
| **Volatile Organic Compounds** | | |
| Carbon tetrachloride | Quarterly | ±25 |
| Chloroform | Quarterly | ±25 |
| Tetrachloroethene | Quarterly | ±25 |
| Trichloroethene | Quarterly | ±25 |

**Table B-7. Double-Blind Standards Suggested Frequency and Acceptance Criteria**

| Constituent | Sample Frequency | Control Limits* (%) |
|---|---|---|
| **Radiological Parameters** | | |
| Gross alpha (plutonium-239 spike) | Quarterly | ±40 |
| Gross beta (strontium-90 spike) | Quarterly | ±30 |
| Cesium-137 | Semiannually | ±30 |
| Cobalt-60 | Semiannually | ±30 |
| Iodine-129 | Quarterly | ±30 |
| Plutonium-239 | Semiannually | ±30 |
| Strontium-90 | Quarterly | ±30 |
| Technetium-99 | Quarterly | ±30 |
| Tritium | Semiannually | ±30 |

Note: Double blind standards are generally submitted in triplicate or quadruplicate.

*Each result must be within the specified percentage of the known value to be acceptable.

Internal laboratory surveillances and external audits also help minimize laboratory quality problems. The DOECAP-AP oversees accreditation of commercial laboratories via third-party accreditation bodies. The DOD/DOE QSM is the basis for these audits. SMR staff may participate as observers or technical experts in DOECAP-AP audits of laboratories under contract to CHPRC.

SMR personnel and project scientists evaluate and trend field and laboratory QC results. Annual groundwater reports document the results of the evaluations.

SMR personnel communicate laboratory performance issues identified through QC evaluations to the laboratory for resolution. Each laboratory implements a corrective action program that tracks and documents issue resolution. SMR monitors laboratory corrective action and performance to ensure that the corrective actions taken are adequate to resolve issues and prevent recurrence. Additionally, depending upon the nature of the laboratory performance issue, SMR may use the CRRS for laboratory issue tracking, documentation, and resolution.

## B6 Documents and Quality Records

Documents shall be prepared, reviewed, approved, issued, used, and revised, as appropriate, to prescribe processes, specify requirements, or establish designs. Records shall be identified and maintained.

The most current version of this QA Project Plan is posted on the CHPRC Environmental Compliance and Quality Assurance Website. The tasks performed by S&GRP typically result in the publication of a plan or report that is subsequently retained in the Integrated Document Management System (IDMS). Records associated with S&GRP will be maintained in accordance with PRC-PRO-IRM-10588, *Records Management Processes*.

CHPRC procedure PRC-PRO-IRM-10588 specifies record retention requirements. Records include but are not limited to the following documents:

- Plans or reports
- Analytical data packages
- Electronic data deliverables
- Completed procedure data sheets
- Quality Assurance Inspection Plan records
- Procurement documents or submittals
- Measuring and test equipment (M&TE) calibration records
- Nonconformance reports

Contract-related documentation will be managed in accordance with PRC-PRO-AC-16405, *Submittal Management System*.

Field log books are controlled and maintained in accordance with PRC-PRO-OP-24382, *Logkeeping* and SGRP-PRO-PM-50079, *Field Sampling Operations Controlled Field Logbooks*.

S&GRP procedures will provide guidance on records generated for specific groundwater remediation and protection activities.

Environmental data are loaded into the HEIS according to CP-15383, *Common Requirements of the Format for Electronic Analytical Data (FEAD)*, SGRP-PRO-OP-50010, *Sample Management and Reporting Sample Documentation Processing*, and applicable appendices of SGRP-GD-SMP-50115, *Guidance on Performing Various Sample Management and Reporting Group Work Processes*.

Documentation related to the maintenance of groundwater treatment facilities is produced and retained in accordance with PRC-PRO-WKM-12115, *Work Management*.

# B7 Work Processes

Work shall be performed in accordance with established technical standards and administrative controls using approved instructions or procedures. Items shall be identified and controlled to ensure their proper use. Items shall be maintained to prevent damage, loss, or deterioration. S&GRP personnel and subcontractors shall use equipment for process monitoring and data collection that is calibrated and maintained, as appropriate.

## B7.1 Quality Objectives and Criteria

Data used to make environmental decisions are collected in accordance with DQOs to ensure that data quality is sufficient for its intended usage. The DQO process ensures that data collected are of a type, quantity, and quality commensurate with the importance and intended application for the data. DQIs for groundwater and soil data include precision, accuracy, completeness, comparability, representativeness, bias, and sensitivity. DQOs and DQIs ensure that decisions made using the data are technically and scientifically sound and legally defensible. S&GRP utilizes a DQO process adapted from EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA-QA/G-4), and described in PRC-PRP-SMP-53095, *Data Quality Objectives Planning Process.*

Indirect measurement data feed into the DQO process. These data may be from previous DQO reports, existing RI/FS reports, existing SAPs/GWMPs, and data stored in the Waste Information Data System, HEIS, Hanford Geographic Information System, and IDMS.

## B7.2 Sampling Methods

Field sampling shall comply with HASQARD (DOE/RL-96-68), Volumes 1 and 2 requirements. Sampling in support of S&GRP activities is performed in accordance with technical procedures that include but are not limited to the following:

- SGRP-PRO-SMP-50043, *Operational Monitoring Groundwater Sampling*
- SGRP-PRO-OP-50056, *Container Sampling*
- SGRP-PRO-SMP-50060, *Field Characterization and Treatment Monitoring Activities Groundwater Sampling*
- SGRP-PRO-SMP-50061, *Non-VOC Soil and Sediment Sampling*
- SGRP-PRO-SMP-50062, *VOC Soil and Sediment Sampling*
- SGRP-PRO-OP-50064, *Routine and Non-Routine Soil-Gas Sampling*

Samples are often obtained during implementation of the following administrative procedures:

- SGRP-PRO-OP-50022, *Test Pit Excavation in Contaminated Areas*
- SGRP-PRO-EN-50030, *Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings*
- SGRP-PRO-EN-52125, *Geoprobe, Casing Driving, and Push Technology Installations*

Failures that occur in the sampling process or sample handling are controlled in accordance with PRC-PRO-QA-9769, PRC-PRO-QA-052 (CRRS), PRC-PRO-QA-298, SGRP-PRO-SMP-50015, *Sample Management and Reporting Sample Issue Resolution and Problem and Discrepancy Process* or SGRP-PRO-SMP-50016, *Sample Management and Reporting Request for Data Review (RDR)*, as appropriate.

## B7.3 Sample Handling and Custody

Sample custody will be maintained to ensure the maintenance of sample integrity throughout the sampling and analysis process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date.

Sample chain of custody is described in SGRP-PRO-SMP-50051, *Chain of Custody/Sample Analysis Request*. Sample handling is addressed in SGRP-PRO-SMP-50047, *Sample Packaging, Transporting and Shipping*, and SGRP-PRO-OP-50054, *Sample Storage Units*. Coordination of sampling is addressed in SGRP-PRO-OP-50006, *Sample Management and Reporting Sampling Documentation Preparation and Control*.

## B7.4 Analytical Methods

SOWs issued to onsite laboratories specify compliance with HASQARD (DOE/RL-96-68). SOWs issued to offsite laboratories specify compliance with the DoD/DOE QSM, which mostly includes the requirements of HASQARD. CHPRC flows down the HASQARD requirements not covered by the QSM

to the contract laboratories via the environmental laboratory contract SOW. Additionally, SOWs indicate that analytical methods to be used are those found in EPA methods compilations or other nationally recognized methods compilations such as American Society for Testing Materials. S&GRP issues SOWs in compliance with acquisition planning procedures.

Analytical methods are specified in the SAPs/GWMPs generated for specific OUs, waste sites, or other discrete units. When there is an issue with the laboratory, the Task Lead and SMR staff resolve the issue in accordance with SGRP-PRO-SMP-50015.

Onsite measurements are acquired as described in field screening and field analytical procedures. Field screening shall comply with the requirements in HASQARD (DOE/RL-96-68), Volume 3.

## B7.5 Data Review, Verification, Validation, and Reporting

Analytical data generation is governed by applicable procedures. Data verification is performed in accordance with SGRP-PRO-SMP-50011, *Sample Management and Reporting Data Deliverable Receipt Control and Verification*. Environmental analytical data are validated in accordance with SGRP-PRO-SMP-50013, *Sample Management and Reporting Data Package Validation Process*. Typically, data validation is performed by a qualified independent, third-party vendor. Similarly, other pertinent data are gathered and recorded per operating procedures. The levels of data validation and specific validation review requirements are stated in SGRP-GD-SMP-50116, *Data Validation for Radiochemical Analyses*, and SGRP-GD-SMP-50117, *Data Validation for Chemical Analyses.*

DQIs are used to help determine the acceptability and utility of data to the user. Principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. Data quality is defined by the degree of rigor in the acceptance criteria assigned to DQIs.

Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated from analyses of sample/sample duplicate/replicate, LCS/LCSDs, and/or MS/MSD pairs. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.

Accuracy is how close a measured value agrees with its accepted reference value. Accuracy is usually measured as percent recovery. Quality control analyses used to measure accuracy include LCSs, spiked samples, and surrogates.

Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.

Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.

Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring the approved plans were followed during sampling and analysis.

Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (i.e., high, low, or unknown) from the sample's true value. Bias may be introduced during sampling, analysis, and data processing.

Sensitivity is an instrument's or method's minimum concentration that can be reliably detected or measured (i.e., instrument detection limit or limit of quantitation, respectively).

## B7.6 Data Usability Assessments

DUAs involve assessing sampling and analytical data with the user data requirements. The DUA evaluates data verification and/or data validation results to determine if the analytical data are of the correct type and are of adequate quality to meet project data quality objectives. The DUA may consist of data verification, data validation, data quality assessment (DQA), DQI evaluation, and reporting. If a statistical sampling design was utilized during field sampling activities, then the DQA will be performed following guidance in EPA/240/B-06/002, *Data Quality Assessment: A Reviewer's Guide* (EPA QA/G-9R) and EPA/240/B-06/003, *Data Quality Assessment Statistical Methods for Practitioners* (EPA QA/G-9S). When judgmental (nonstatistical) sampling designs are implemented, DQIs for the specific data sets (individual data packages) will be evaluated in accordance with EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation* (EPA QA/G-8).

Data verification and data validation are integral to both the DQA evaluation process and the DQI evaluation process. Results of the DQA or DQI processes are used to interpret the data and determine if the DQOs for the data collection activity have been met. The DQA process compares field sampling activities against those proposed in sampling documents and provides an evaluation of the resulting data. This process is described in SGRP-PRO-SMP-54383, *Data Usability Assessment*. DQA and DQI processes are performed on a task by task basis. When a data acquisition campaign has been completed and data validation has been performed, the Task Lead implements SGRP-PRO-SMP-54383 or hires a subcontractor to do so. DQAs and DQIs are subject to independent review by the S&GRP QAE.

# B8 Design

Items and processes shall be designed using sound engineering/scientific principles and appropriate standards. Design work, including changes, shall incorporate applicable requirements and design bases. Design interfaces shall be identified and controlled. The adequacy of design products shall be verified or validated by individuals or groups other than those who performed the work. Verification and validation work shall be completed before approval is granted to implement the design.

Design activities will be conducted in accordance with the QA program controls described in PRC-MP-QA-599, Section 6.0, "Design," and the technical requirements specified in PRC-RD-EN-1819, PRC-PRO-IRM-309, *Controlled Software Management*, and PRC-PRO-EN-440, *Engineering Documentation Preparation and Control*. Supporting Information B-3, "Matrix of Implementing Procedures," lists additional design control implementing procedures. Spare parts identified in the operating guidance and design specifications of the system will be assured and maintained in accordance with PRC-PRO-EN-129, *Controlling Spare Parts Inventory*.

# B9 Procurement

Procured items and services shall meet established requirements and shall perform as specified. Prospective suppliers shall be evaluated and selected on the basis of specified criteria as appropriate with respect to the graded approach.

Procurement will be conducted in accordance with the following implementing procedures:

- PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*
- PRC-MP-AC-40500, *Acquisition Management Plan*
- PRC-PRO-AC-40480, *Acquisition Planning*
- PRC-PRO-AC-40478, *Procurement of Materials*
- PRC-PRO-AC-40471, *Contract Labor Resources*
- PRC-PRO-AC-40496, *Managed Task Services*
- PRC-PRO-QA-259, *Graded Approach*
- PRC-RD-EN-1819, *CHPRC Engineering Requirements*
- PRC-PRO-AC-16405, *Submittal Management System*
- PRC-PRO-MS-40213, *Subcontractor Oversight*

# B10 Inspections and Tests

Inspection and testing of specified items, services, and processes shall be conducted using established acceptance and performance criteria. As appropriate, S&GRP and subcontractor personnel shall use maintained and calibrated equipment for inspections and tests.

## B10.1 Instrument/Equipment Testing, Inspection, and Maintenance

Instrument and equipment testing, inspection, and maintenance of S&GRP plant equipment are controlled per PRC-PRO-WKM-12115. Instrumentation used in the field for measuring groundwater levels and groundwater quality is controlled by SGRP-PRO-SMP-52126, *Control of Monitoring Instruments*,

Calibration of analytical equipment (e.g., gas chromatograph, spectrophotometer, and pH meter) is performed in accordance with HASQARD (DOE/RL-96-68), Volumes 3 and 4, the DoD/DOE QSM and the manufacturer's procedures for calibration.

The Industrial Hygiene Equipment Laboratory (IHEL) is responsible for the industrial hygiene sampling and monitoring equipment used in support of the S&GRP and is controlled by PRC-STD-SH-54164, *Management of Industrial Hygiene Instruments*. IHEL is responsible for the following specific activities:

- Procuring and maintaining an inventory of sampling and monitoring equipment and associated consumables and to ensure critical spare parts are available

- Calibrating and repairing sampling and monitoring equipment

## B10.2 Acceptance

At the conclusion of well construction tasks, a final acceptance walk down is performed and documented per SGRP-PRO-EN-50030. If QA participates in the walk down, a work site assessment report is issued. Field activity reports, geologic logs, and other well specific records are reviewed and approved prior to publication in a borehole summary report or in IDMS. At the conclusion of construction projects that support operations, the completed or modified system is tested and inspected as directed by project design and procurement documents.

## B10.3 Measuring and Test Equipment

M&TE used by S&GRP includes but is not limited to data collection equipment such as water level pressure transducers, e-tapes, steel measuring tapes, and water quality instrumentation (pH, conductivity,

turbidity, and dissolved oxygen). This equipment is addressed in SGRP-PRO-SMP-52126. M&TE used for activities affecting quality are controlled and calibrated, and/or adjusted at specific intervals, to maintain precision and accuracy within prescribed limits in accordance with PRC-PRO-MN-490, *Calibration Management Program*, or HASQARD (DOE/RL-96-68) Volumes 3 and 4, as appropriate. Procurement activities for M&TE are governed by PRC-PRO-QA-268.

The following requirements are further discussed in PRC-PRO-MN-490:

- Periodic preventive and corrective maintenance of measurement and testing equipment shall be performed to ensure availability and satisfactory performance of the systems
- Routine inspections recommended by the manufacturer are performed before instrument operations. The frequency/interval of these inspections is established based on the manufacturer's recommendations.
- Instrument maintenance shall be performed and documented (i.e., including the date and signatures [or initials] of personnel who performed the maintenance).

Radiological instrumentation is purchased, maintained, and calibrated by MSA through the contract requisition process.

The equipment will be uniquely identified and traceable to its calibration data. Equipment will be maintained using a documented process to ensure continuing data quality and process capability.

## B11 Management Assessment

Managers shall assess their management processes. Problems that hinder the organization from achieving its objectives shall be identified and corrected.

Management assessments will be conducted in accordance with the process described in PRC-PRO-QA-246, *Management Assessment*, and will focus on compliance with documented requirements and procedures. S&GRP shall conduct a minimum of one management assessment annually in accordance with HASQARD, Volume 1. The following status reports are prepared:

- Management assessment results are prepared by the Operational Assurance group in accordance with PRC-PRO-QA-246.
- Quarterly trending analysis reports of corrective action data and monthly indicators are prepared by Issues Management per PRC-PRO-QA-052.
- Nonconformance reports trended by QA Programs are in accordance with PRC-PRO-QA-24741, *Performance Analysis Process*.

## B12 Independent Assessment

Independent assessments will be conducted periodically by or under direction of the EC&QA organization. S&GRP shall perform a minimum of one technical assessment (surveillance) annually in accordance with HASQARD, Volume 1 (DOE/RL-96-68).

DUAs are performed by or at the direction of the Task Lead, once a discrete body of data has been validated based on EPA/240/R-02/004. DUAs are subject to independent review by the QAE.

QA reports to management through the following methods:

- QA surveillances are scheduled by the S&GRP QAE annually.
- In a typical year, unscheduled surveillances are performed by the S&GRP QAE. These surveillances examine programmatic and technical aspects of the S&GRP work scope. The cognizant S&GRP manager is provided with the results of such surveillances.
- When QA is assigned to verify completion of corrective actions, the verification is documented on a surveillance report transmitted to cognizant management.
- Company-wide independent assessments and surveillances are performed that examine aspects of the QA program.
- Findings and opportunities for improvement, are reported to management for corrective action through implementation of PRC-PRO-QA-052.

Management and technical assessments performed by S&GRP provide input to CRRS. CRRS data are analyzed quarterly by CHPRC Quality and Performance Assurance and fed back to management.

## B13 References

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# Supporting Information B-1

# QA Requirements Specific to Onsite Measurement

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## B-1.1 QA Requirements Specific to Onsite Measurement

DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*, Volume 3 together with Volume 1, along with PRC-MP-QA-599, *Quality Assurance Program*, and this Environmental Quality Assurance Plan, set forth the quality assurance and quality control requirements that govern analytical work performed in the field. Field analytical techniques are often qualitative or semi-quantitative analytical methods that can be used to provide a quick determination of the presence, magnitude, or absence of a contaminant. This minimizes the expense and extended turnaround time required to analyze samples in a laboratory. The quality control and analytical sophistication of field measurements may, therefore, not need to be controlled to the same extent as for laboratory analyses.

The measurement of samples in the field may be performed by field screening techniques, process monitoring techniques, or field testing techniques. The data quality objective or other type of planning process should dictate the type of measurement system that will be used. A graded approach is recommended to determine the specific field analytical method and applicable quality control requirements based on time and cost considerations and the decision risk associated with use of the data.

### B-1.1.1 Field Screening/Process Monitoring

Field screening/process monitoring procedures are performed directly on the sample or media in the field or in the process facility (e.g., pump and treat facility). A variety of field screening/process monitoring methods are available and the project must clearly define and control the use of any data generated.

Adequate quality control must be demonstrated for field screening measurements to ensure acceptance of the data for use by the decision maker or regulatory authority. Measurements are usually acceptable, as long as the method detection limit is below the action levels or regulatory threshold limits. The best results for field screening methods are obtained when the contaminant is known and the measurement technique is acceptable for use under the environmental conditions that exist at the site.

Process monitoring typically involves the sampling of critical points within a treatment system to assess system performance and equipment change out requirements. Process monitoring procedures, similar to field screening procedures, are performed directly on the sample in the facility. Process monitoring methods have the same requirements as field screening methods described above. Method detection limits must be sufficiently low such that system performance can be ascertained.

### B-1.1.2 Field Testing

Field testing is performed on samples collected in the field and generally analyzed in a field laboratory located at or near the sample collection point. Field analytical measurements may be conducted using the same analytical methods used in a fixed-site laboratory. Data generated may be used to demonstrate compliance with requirements and must meet similar quality control standards as a fixed-site laboratory to ensure that data comparability is based on test conditions similar to those for the fixed-site laboratory. The required level of quality and quantity of the data is determined by the project using the data quality objective process or other planning process.

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# Supporting Information B-2

# Equations Routinely Used to Calculate Quality Control Parameters

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## B-2.1 Equations

The following equations are routinely used to calculate accuracy, precision, and methods detection limits.

**Precision**. If precision is calculated from duplicate measurements, the following equation is used:

$$RPD = \frac{|C_1 - C_2| \times 100}{(C_1 + C_2)/2}$$

where:

| | | |
|---|---|---|
| RPD | = | relative percent difference |
| $C_1$ | = | first observed values |
| $C_2$ | = | duplicate observed values. |

If precision is calculated from three or more replicates, the relative standard deviation (RSD) is used rather than RPD:

$$RSD = \frac{S}{\bar{y}} \times 100$$

where:

| | | |
|---|---|---|
| RSD | = | relative standard deviation |
| s | = | standard deviation |
| $\bar{y}$ | = | mean of replicate analyses. |

Standard deviation, s, is defined as follows:

$$S = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \bar{y})^2}{n-1}}$$

where:

| | | |
|---|---|---|
| s | = | standard deviation |
| $y_i$ | = | measured valued of the $i^{th}$ replicate |
| $\bar{y}$ | = | mean of replicate measurements |
| n | = | number of replicates. |

**Accuracy**. For measurements where matrix spikes are used to determine the accuracy:

$$\%R = 100x\left[\frac{S-U}{C_{sa}}\right]$$

where:

| | | |
|---|---|---|
| %R | = | percent recovery |
| S | = | measured concentration in spiked aliquot |
| U | = | measured concentration in unspiked aliquot |
| $C_{sa}$ | = | actual concentration of spike added. |

For situations where a standard reference material (SRM) is used instead of or in addition to matrix spikes:

$$\%R = 100x\left[\frac{C_m}{C_{srm}}\right]$$

where:

| | | |
|---|---|---|
| %R | = | percent recovery |
| $C_m$ | = | measured concentration of SRM |
| $C_{srm}$ | = | actual concentration of SRM. |

**Method Detection Limits (Sensitivity)**. 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants," provides the determination of method detection limits for non-radioanalytes.

**Minimum Detectable Activity and Concentration (Sensitivity).** The minimum detectable activity (MDA) has been defined as a level of activity that is practically achievable by a measurement system. The MDA is calculated using the following equation when the counting time in the sample is the same as in the background.

$$\mathrm{MDA} = [(\frac{2.71}{\mathrm{T}}) + (4.65 * \mathrm{S_b})] / \mathrm{K}$$

where:

| | | |
|---|---|---|
| T | = | sample count time |
| K | = | detector conversion factor (e.g., count rate/disintegration rate) |
| $S_b$ | = | standard deviation of background count rate for the counting time (T). |

When $T_b$ is not equal to T, minimum detectable activity is calculated as shown below.

$$MDA = \frac{\frac{2.71}{T} + 3.3 * \sqrt{\frac{R_b}{T} + \frac{R_b}{T_b}}}{\xi * b * k}$$

where:

| | | |
|---|---|---|
| $R_b$ | = | background count rate |
| $T_b$ | = | background count time |
| T | = | sample count time |
| $\xi$ | = | counting efficiency |
| b | = | abundance |
| k | = | conversion factor to convert to desired units. |

The minimum detectable concentration (MDA) is calculated as:

$$MDC = \frac{MDA}{q * Y * decay}$$

where:

| | | |
|---|---|---|
| q | = | sample quantity (e.g., g or ml) |
| Y | = | chemical yield |
| decay | = | decay factor (correction for radioactive decay to reference date). |

## B-2.2 Reference

40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants," *Code of Federal Regulations*. Available at: https://www.govinfo.gov/content/pkg/CFR-2010-title40-vol22/pdf/CFR-2010-title40-vol22-part136.pdf.

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# Supporting Information B-3

# Matrix of Implementing Procedures

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## B-3.1 Matrix of Implementing Procedures

### S&GRP QAP Implementation Matrix

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| **SECTION 1 PROGRAM** | | |
| Quality Assurance Program Plans | CHPRC-00189, *CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan* | SGW-56624, *Soil & Groundwater Remediation Project Conduct of Operations Matrix-Previously Numbered GRP-TI-001* |
| QA Requirements Flowdown | PRC-MP-MS-19361, *CH2M HILL Plateau Remediation Company Project Execution Plan*<br>PRC-MP-MS-003, *Integrated Safety Management System/Environmental Management System Description (ISMSD)*<br>PRC-PRO-MS-40117, *Requirements Management Process* | |
| Quality Planning | | |
| Organization, Responsibilities, and Interfaces | PRC-MP-AC-40500, *Acquisition Management Plan* | SGRP-POL-PM-50123, *S&GRP Integrated Environment, Safety, and Health Management Roles, Responsibilities, and Functions* |
| Readiness Reviews | PRC-PRO-OP-055, *Startup Readiness* | SGRP-PRO-EN-50030, *Drilling, Remediating and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings*<br>SGRP-PRO-EN-52125, *Geoprobe, Casing Driving, and Push Technology Installations* |
| Stop Work Authority | PRC-PRO-SH-7085, *Safety Responsibilities* | SGRP-PRO-PM-50137 (GRP-PRO-046), *S&GRP Stop Work and Shift Office Notifications* |
| Graded Application of QA Program | PRC-PRO-QA-259, *Graded Approach*<br>PRC-PRO-NS-8317, *Safety Basis Implementation and Maintenance*<br>PRC-PRO-NS-700, *Safety Basis Development* | |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| **SECTION 2, PERSONNEL TRAINING AND QUALIFICATION**<br>Training and Qualification Program | CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*<br>PRC-MP-TQ-011, *CH2M HILL Plateau Remediation Company (CHPRC) Qualification and Training Plan*<br>PRC-PRO-TQ-164, *Integrated Training Electronic Matrix*<br>PRC-PRO-TQ-175, *Training Program Administration*<br>PRC-PRO-TQ-40165, *Training Program Administration*<br>MSC-PRO-QA-263, *Qualification and Certification of QA/QC Inspection and Test Personnel*<br>PRC-PRO-TQ-459, *Environmental Training*<br>PRC-PRO-TQ-40164, *Personnel Training and Qualification*<br>PRC-PRO-QA-40102, *Quality Assurance Engineer Training and Qualification Program* | PRC-STD-TQ-40234, *Soil and Groundwater Remediation Project Accumulation Areas Dangerous Waste Training Plan* |
| Training and Indoctrination | PRC-STD-TQ-40179, *Nuclear Facility Operations Training Program Description*<br>PRC-PRO-TQ-164, *Integrated Training Electronic Matrix*<br>PRC-PRO-TP-166, *Transportation and Packaging Training*<br>PRC-PRO-TQ-179, *Obtaining Training Equivalencies, Waivers, and Extensions*<br>MSC-PRO-QA-263, *Qualification and Certification of QA/QC Inspection and Test Personnel*<br>PRC-PRO-TQ-459, *Environmental Training*<br>PRC-MP-TQ-011, *CH2M HILL Plateau Remediation Company (CHPRC) Qualification and Training Plan*<br>PRC-PRO-TQ-175, *Training Program Descriptions*<br>PRC-PRO-TQ-40165, *Training Program Administration*<br>CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*<br>PRC-PRO-TQ-40164, *Personnel Training and Qualification* | |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| Qualification and Certification | HNF-42887, *Qualification of Welders and Welding Operators*<br>PRC-PRO-TQ-40165, *Training Program Administration*<br>MSC-PRO-QA-263, *Qualification and Certification of QA/QC Inspection and Test Personnel*<br>CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*<br>PRC-PRO-TQ-40164, *Personnel Training and Qualification* | |
| Training and Qualification Records | PRC-PRO-TQ-249, *Training Records Administration*<br>MSC-PRO-QA-263, *Qualification and Certification of QA/QC Inspection and Test Personnel*<br>PRC-PRO-TQ-459, *Environmental Training*<br>PRC-PRO-TQ-40164, *Personnel Training and Qualification* | |
| **SECTION 3 QUALITY IMPROVEMENT**<br>Deficiency Identification | PRC-PRO-QA-052, *Issues Management*<br>PRC-PRO-EM-060, *Reporting Occurrences and Processing Operations Information*<br>PRC-PRO-QA-298, *Nonconforming Items*<br>CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*<br>PRC-PRO-QA-246, *Management Assessment*<br>PRC-PRO-EP-15333, *Environment Protection Processes* | SGRP-PRO-SMP-50015, *Sample Management and Reporting Sample Issue Resolution and Problem and Discrepancy Process*<br>HNF-28242, *Software Management Plan* |
| Corrective Action Management | PRC-PRO-QA-052, *Issues Management*<br>PRC-PRO-QA-298, *Nonconforming Items*<br>CHPRC-00073, *CHPRC Radiological Control Manual*<br>PRC-PRO-QA-246, *Management Assessment* | |
| Nonconformance Control | PRC-PRO-EM-058, *Event Initials Investigation and Critique Meeting Process*<br>PRC-PRO-QA-298, *Nonconforming Items* | SGRP-PRO-SMP-50015, *Sample Management and Reporting Sample Issue Resolution and Problem and Discrepancy Process*<br>SGRP-PRO-SMP-50016, *Sample Management and Reporting – Request for Data Review* |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| Performance Data Analysis | PRC-PRO-QA-052, *Issues Management*<br>PRC-PRO-QA-298, *Nonconforming Items*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-QA-24741, *Performance Analysis Process* | PRC-PRP-SMP-53095, *Data Quality Objectives Planning Process* |
| Control of Suspect/ Counterfeit Items | PRC-PRO-QA-301, *Control of Suspect/Counterfeit and Defective Items* | |
| **SECTION 4, DOCUMENTS AND RECORDS**<br>Documents | PRC-PRO-IRM-112, *Forms Control*<br>MSC-PRO-211, *Administrative Record File and Public Information Repositories*<br>PRC-PRO-IRM-10588, *Records Management Processes*<br>PRC-PRO-EN-440, *Engineering Documentation Preparation and Control*<br>PRC-PRO-EN-2001, *Facility Modification Package Process*<br>PRC-PRO-MS-589, *CH2M HILL Plateau Remediation Company Procedures*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-EN-8016, *Design Change Notice Process*<br>PRC-PRO-IRM-8310, *Document Control Processes* | SGRP-PRO-EN-50002, *Descriptions of Work for Well Drilling and Decommissioning*<br>SGRP-PRO-OP-50010, *Sample Management and Reporting - Sample Documentation Processing*<br>SGRP-PRO-SMP-50011, *Sample Management and Reporting Data Deliverable Receipt, Control, and Verification* |
| Records | PRC-PRO-IRM-10588, *Records Management Process*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements* | SGRP-PRO-OP-50006, *Sample Management and Reporting - Sampling Documentation Preparation and Control*<br>SGRP-PRO-SMP-50011, *Sample Management and Reporting Data Deliverable Receipt, Control, and Verification*<br>SGRP-PRO-SMP-50013, *Sample Management and Reporting Data Package Validation Process*<br>SGRP-PRO-OP-50014, *Sample Management and Reporting Records Management*<br>SGRP-PRO-SMP-50015, *Sample Management and Reporting Sample Issue Resolution and Problem and Discrepancy Process*<br>SGRP-GD-SMP-50117, *Data Validation for Chemical Analyses* |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| | | SGRP-GD-SMP-50116, *Data Validation for Radiochemical Analyses*<br>SGRP-PRO-EN-50025, *Geologic Logging*<br>SGRP-PRO-EN-50030, *Drilling, Remediating and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings*<br>SGRP-PRO-EN-52125, *Geoprobe, Casing Driving and Push Technology Installations.*<br>CP-15383, *Common Requirements of the Format for Electronic Analytical Data (FEAD)*<br>SGRP-PRO-OP-54082, *Well Maintenance Well Development, Investigation, Repair, and/or Redevelopment* |
| **SECTION 5, WORK PROCESSES**<br><br>Work Process Documents | PRC-PRO-MN-19304, *Periodic Maintenance Process*<br>PRC-PRO-WKM-079, *Job Hazard Analysis*<br>PRC-PRO-TP-156, *Onsite Hazardous Material Shipments*<br>PRC-PRO-TP-157, *Offsite Hazardous Material Shipments*<br>PRC-PRO-RP-379, *External Dosimetry Program*<br>PRC-PRO-RP-380, *Internal Dosimetry Program*<br>MSC-RD-SEC-11440, *Physical Protection of Property and Facilities*<br>PRC-PRO-MS-589, *CH2M HILL Plateau Remediation Project Company Procedures*<br>PRC-PRO-NS-700, *Safety Basis Development*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-NS-8317, *Safety Basis Implementation and Maintenance*<br>PRC-PRO-EP-52798, *CERCLA Removal Action Procedure* | SGRP-PRO-EN-50003, *Assignment of Well ID and Well Naming for Wells Utilized by Hanford Site*<br>SGRP-PRO-OP-50006, *Sample Management and Reporting –Sampling Documentation Preparation and Control*<br>SGRP-PRO-OP-50018, *Sample Management and Reporting Group Operations Plan*<br>SGRP-PRO-SMP-50019, *Sample Management and Reporting-Groundwater Monitoring Sample Event Scheduling and Sample Document Preparation, Reprinting and Management*<br>SGRP-PRO-OP-50021, *Environmental and IH Sample Preparation and Shipping Authorization*<br>SGRP-PRO-OP-50022, *Test Pit Excavation in Contaminated Areas*<br>SGRP-PRO-RP-50023, *Field Cleaning and/or Decontamination of Geoprobe and Drilling Equipment*<br>SGRP-PRO-OP-50024, *Well Development and Testing*<br>SGRP-PRO-EN-50025, *Geologic Logging* |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| | PRC-PRO-SH-409, *Industrial Hygiene Monitoring, Reporting and Records Management*<br>PRC-PRO-OP-40126, *Equipment and Piping Labeling*<br>PRC-MP-MS-19361, *Project Execution Plan* | SGRP-PRO-EP-50026, *Requirements for Use of Hydrogeologic Field Measurement and Monitoring Equipment*<br>SGRP-PRO-SMP-50043, *Operational Monitoring Groundwater Sampling*<br>SGRP-PRO-SMP-52126, *Control of Monitoring Instruments*<br>SGRP-PRO-SMP-50047, *Sample Packaging, Transportation and Shipping*<br>SGRP-PRO-SMP-50048, *Laboratory Cleaning of Sampling Equipment*<br>SGRP-PRO-SMP-50049, *Measurement of Groundwater Levels*<br>SGRP-PRO-SMP-50050, *Bottle Preservation*<br>SGRP-PRO-SMP-50051, *Chain of Custody/Sample Analysis Request*<br>SGRP-PRO-SMP-50053, *Portable Grundfos Pump Decontamination*<br>SGRP-PRO-OP-50054, *Sample Storage Units*<br>SGRP-PRO-OP-50056, *Container Sampling*<br>SGRP-PRO-OP-50057, *Collecting PCB Wipe Samples*<br>SGRP-PRO-SMP-50058, *Millipore Water System*<br>SGRP-PRO-SMP-50060, *Field Characterization and Treatment Monitoring Activities Groundwater Sampling*<br>SGRP-PRO-SMP-50061, *Non-VOC Soil and Sediment Sampling*<br>SGRP-PRO-SMP-50062, *VOC Soil and Sediment Sampling*<br>SGRP-PRO-OP-50063, *Sample Compositing*<br>SGRP-PRO-OP-50064, *Routine and Non-Routine Soil-Gas Sampling*<br>SGRP-PRO-SMP-50065, *Field Decontamination of Sampling Equipment* |
| | PRC-MP-TP-40476, *Transportation Program Management Plan* | SGRP-PRO-OP-50007, *Data Quality Assessment*<br>SGRP-PRO-EN-50030, *Drilling, Remediating and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings*<br>SGRP-PRO-EN-52125, *Geoprobe, Casing Driving and Push Technology Installations.* |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| | | SGRP-PRO-OP-54082, *Well Maintenance Well Development, Investigation, Repair, and/or Redevelopment*<br>SGRP-PRO-OP-X-XXX-XXX, *Unit Specific Groundwater Operations Operating Procedures*<br>2WPT-PRO-OP-XXXX, *Unit Specific Groundwater Operations Operating Procedures (200 West Pump & Treat)* |
| Identification and Control of Items | DOE-0336, *Hanford Site Lockout/Tagout Procedure*<br>PRC-PRO-PMT-52772, *Property Management*<br>MSC-PRO-140, *Utilizing General Supplies, Spare Parts, and Convenience Storage* Inventories<br>PRC-PRO-QA-297, *Inspection, Test and Operating Status*<br>PRC-PRO-AC-335, *Use and Control of Purchasing Card*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-QA-5432, *Hold Point Application in Technical Work Documents*<br>PRO-PRO-OP-40126, *Equipment and Piping Labeling* | SGRP-PRO-EP-50026, *Requirements for Use of Hydrogeologic Field Measurement & Monitoring Equipment*<br>SGRP-PRO-SMP-50051, *Chain of Custody/Sample Analysis Request* |
| Handling, Shipping, and Storing | PRC-PRO-SH-40481, *Storing, Using and Handling Compressed Gases*<br>PRC-PRO-EN-129, *Controlling Spare Parts Inventory*<br>PRC-PRO-PMT-52772, *Property Management*<br>MSC-PRO-140, *Utilizing General Supplies, Spare Parts, and Convenience Storage Inventories*<br>PRC-PRO-TP-156, *Onsite Hazardous Material Shipments*<br>PRC-PRO-TP-157, *Offsite Hazardous Material Shipments*<br>PRC-PRO-EP-15333, *Environmental Protection Processes*<br>MSC-PRO-FM-375, *Management of Central Warehouse Facilities and Stored Material*<br>PRC-PRO-SH-40516, *Chemical Management Program* | SGRP-PRO-OP-50021, *Environmental and IH Sample Preparation and Shipping Authorization*<br>SGRP-PRO-SMP-50047, *Sample Packaging, Transporting and Shipping*<br>SGRP-PRO-OP-50004, *Purgewater Management*<br>SGRP-PRO-OP-50120, *Waste Packaging and Handling at S&GRP*<br>SGRP-PRO-OP-50054, *Sample Storage Units* |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| | PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-EN-8323, *Management of HEPA Filter Systems*<br>PRC-PRO-AC-52750, *Control of Materials in the Field* | |
| Process Monitoring or Data Collection Instruments | CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*<br>PRC-PRO-MN-490, *Calibration Management Program*<br>DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*<br>PRC-STD-SH-54164, *Management of Industrial Hygiene Instruments* | SGRP-PRO-EP-50026, *Requirements for Use of Hydrogeologic Field Measurement and Monitoring Equipment*<br>SGRP-PRO-SMP-52126, *Control of Monitoring Instruments*<br>PRC-PRO-RP-40063, *Radiation Protection Instrument Program* |
| Control of Computer Systems | PRC-PRO-IRM-309, *Controlled Software Management* | HNF-28242, *Software Management Plan* |
| **SECTION 6, DESIGN** | PRC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)* | SGRP-PRO-EN-50002, *Descriptions of Work for Well Drilling and Decommissioning* |
| Design Input | PRC-PRO-IRM-309, *Controlled Software Management*<br>PRC-PRO-EN-440, *Engineering Documentation Preparation and Control*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-EN-2001, *Facility Modification Package Process*<br>PRC-PRO-NS-8317, *Safety Basis Implementation and Maintenance*<br>PRC-PRO-NS-700, *Safety Basis Development* | |
| Design Process | PRC-MP-MS-19361, *CH2M HILL Project Execution Plan*<br>PRC-PRO-IRM-309, *Controlled Software Management*<br>PRC-PRO-EN-440, *Engineering Documentation Preparation and Control* | |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| | PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issue*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-EN-2001, *Facility Modification Package Process*<br>PRC-PRO-EN-8016, *Design Change Notice Process*<br>PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issue* | |
| Design Verification | PRC-PRO-EN-8336, *Design Verification*<br>PRC-PRO-IRM-309, *Controlled Software Management*<br>PRC-PRO-EN-440, *Engineering Documentation Preparation and Control*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-EN-2001, *Facility Modification Package Process*<br>PRC-PRO-EN-8016, *Design Change Notice Process*<br>PRC-PRO-EP-52798, *CERCLA Removal Action Procedure* | |
| Design Changes | PRC-PRO-IRM-309, *Controlled Software Management*<br>PRC-PRO-EN-440, *Engineering Documentation Preparation and Control*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-EN-2001, *Facility Modification Package Process*<br>PRC-PRO-EN-8016, *Design Change Notice Process* | PRC-PRO-EN-40271, *Engineering Design Process* |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| Design Documentation and Records | PRC-PRO-IRM-309, *Controlled Software Management*<br>PRC-PRO-EN-440, *Engineering Documentation Preparation and Control*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-EN-2001, *Facility Modification Package Process*<br>PRC-PRO-EN-8016, *Design Change Notice Process*<br>PRC-PRO-EP-52798, *CERCLA Removal Action Procedure*<br>PRC-STD-EN-40259, *Engineering Calculations*<br>PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issue* | |
| Computer Software | PRC-PRO-IRM-309, *Controlled Software Management*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements* | HNF-28242, *Software Management Plan* |
| **SECTION 7, PROCUREMENT**<br>Procurement Planning | PRC-PRO-AC-40478, *Procurement of Materials*<br>PRC-PRO-EN-129, *Controlling Spare Parts Inventory*<br>PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*<br>PRC-PRO-AC-335, *Use and Control of Purchasing Card*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management* | |
| Content of Procurement Documents | PRC-PRO-AC-40478, *Procurement of Materials*<br>PRC-PRO-EN-129, *Controlling Spare Parts Inventory*<br>PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*<br>PRC-PRO-EN-301, *Control of Suspect/Counterfeit and Defective Items* | SGRP-PRO-EN-50002, *Descriptions of Work for Well Drilling and Decommissioning* |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| | PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management* | |
| Supplier Evaluation and Selection | PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*<br>PRC-PRO-AC-335, *Use and Control of Purchasing Card*<br>PRC-PRO-QA-3144, *Supplier Quality Assurance Program Evaluation*<br>MSC-PRO-QA-3144, *Supplier Quality Assurance Program Evaluation* | |
| Control of Supplier Nonconformance | PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*<br>PRC-PRO-CN-14990, *Construction Management* | |
| Acceptance of Items and Services | PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*<br>PRC-PRO-QA-283, *Control of Inspections*<br>PRC-PRO-EN-286, *Testing of Equipment and Systems*<br>PRC-PRO-QA-297, *Inspection, Test, and Operating Status*<br>PRC-PRO-AC-335, *Use and Control of Purchasing Card*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-EN-8323, *Management of HEPA Filter Systems* | SGRP-PRO-EN-50030, *Drilling, Remediating and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings*<br>SGRP-PRO-EN-52125, *Geoprobe, Driving and Push Technology Installations.* |
| Commercial Grade Items | PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements* | |
| Control of Supplier-Generated Documents | PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements* | |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| Control of Suspect/Counterfeit Items | PRC-PRO-EM-060, *Reporting Occurrences and Processing Operations Information*<br>PRC-PRO-QA-268, *Control of Purchased/Acquired Items and Services*<br>PRC-PRO-QA-301, *Control of Suspect/Counterfeit and Defective Items* | |
| **SECTION 8, INSPECTION AND ACCEPTANCE TESTING**<br>Inspection and Acceptance Testing | PRC-PRO-QA-283, *Control of Inspections*<br>PRC-PRO-EN-286, *Testing of Equipment and Systems*<br>HNF-54260, *Visual Weld Inspection - Performance and Documentation*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-QA-5432, *Hold Point Application in Technical Work Documents* | |
| Inspection and Acceptance Process | MSC-PRO-QA-263, *Qualification and Certification of QA/QC Inspection and Test Personnel*<br>PRC-PRO-QA-283, *Control of Inspections*<br>PRC-PRO-EN-286, *Testing of Equipment and Systems*<br>HNF-54260, *Visual Weld Inspection - Performance and Documentation*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-CN-14990, *Construction Management*<br>PRC-PRO-QA-5432, *Hold Point Application in Technical Work Documents* | |

**S&GRP QAP Implementation Matrix**

| CHPRC QAP | PROJECT PROCEDURES | |
|---|---|---|
| | **CHPRC-Wide Procedures** | **S&GRP Procedures** |
| Inspection and Acceptance Testing Results | PRC-PRO-QA-283, *Control of Inspections*<br>PRC-PRO-EN-286, *Testing of Equipment and Systems*<br>HNF-54260, *Visual Weld Inspection - Performance and Documentation*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements*<br>PRC-PRO-QA-5432, *Hold Point Application in Technical Work Documents* | |
| Inspection and Testing Status | PRC-PRO-QA-283, *Control of Inspections*<br>PRC-PRO-EN-286, *Testing of Equipment and Systems*<br>PRC-PRO-QA-297, *Inspection, Test, and Operating Status*<br>HNF-54260, *Visual Weld Inspection - Performance and Documentation*<br>PRC-RD-EN-1819, *CHPRC Engineering Requirements* | |
| Calibration of Measuring and Test Equipment | PRC-PRO-MN-490, *Calibration Management Program* | SGRP-PRO-EP-50026, *Requirements for Use of Hydrogeologic Field Measurement & Monitoring Equipment*<br>SGRP-PRO-SMP-52126, *Control of Monitoring Instruments* |
| **SECTION 9, MANAGEMENT ASSESSMENT** | PRC-PRO-QA-246, *Management Assessment*<br>CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual*<br>PRC-PRO-SH-40499, *Safety and Health Inspections* | |
| Management Assessments | | |
| Corrective Action | PRC-PRO-QA-052, *Issues Management*<br>PRC-PRO-QA-246, *Management Assessment*<br>CHPRC-00073, *CH2M HILL Plateau Remediation Company Radiological Control Manual* | |

Note: Complete reference citations are provided in Chapter B13 in this appendix.

CHPRC = CH2M HILL Plateau Remediation Company

S&GRP = Soil and Groundwater Group

QAP = Quality Assurance Plan

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# Supporting Information B-4

# Safety Classification and Quality Level for S&GRP

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## B-4.1 Safety Classification and Quality Level for S&GRP

There is currently no Quality Level 1 or 2 structures, systems, or components under the purview of the Soil and Groundwater Group (S&GRP). Procurement of Environmental Analytical Laboratory Services is Quality Level 1. S&GRP also performs work and procures goods and services that are Quality Level 3, as defined in PRC-PRO-QA-259, *Graded Approach*. The following are required to be at least Quality Level 3 per PRC-PRO-QA-259:

- Items, work activities, and services where special processes, or regulatory code (welding, special coatings, and special permitting), are called out and/or when independent verification/review/ examination/inspection is required by a national consensus standard (e.g., American Welding Society, [AWS D1.1, *Structural Welding Code—Steel*; American Society of Mechanical Engineers [ASME B31.3, *Process Piping*, and ASME BPVC, *ASME Boiler and Pressure Vessel Code*, Section VIII, "Rules for Construction of Pressure Vessels"), which have not been designated as Quality Level 1 or 2 items or services with the potential to cause radiological harm
- Items and services that require additional controls beyond commercial practices based upon engineering evaluation
- Items or services that perform a safety function (defense in depth)
- Items or services that minimize impact to the environment
- Items or services that perform a function to minimize damage to a facility or its critical equipment

The following additional S&GRP items and services are Quality Level 3:

- Design and construction of critical elements of in situ groundwater barriers
- Testing of instruments used to demonstrate regulatory compliance
- Procurement of services or standards used to calibrate instruments for collecting environmental data
- Self-performance or procurement of services for well drilling, well construction, well decommissioning, geotechnical test borings, environmental investigation wells, and geophysical logging
- Well maintenance (maintenance where well modification is involved requiring the filing of a resource protection well report)
- Procurement of selected materials used in self performed well construction (permanent well screens and casing)
- Procurement of services related to analytical laboratory work such as data validation or geochemical/geotechnical properties of soil
- Procurement of services related to groundwater/vadose modeling
- Procurement of services related to acquisition of geophysical data
- Procurement of items or services that could directly impact data quality (e.g., sample bottles)

- Procurement of services to develop *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and *Resource Conservation and Recovery Act of 197* (RCRA) response action documents that include tasks requiring the use of computational and analytical software, including spreadsheets (such tasks would include, but not be limited to, vadose zone and groundwater contaminant fate and transport modeling and the conduct of human health, ecological, and protection of groundwater risk assessments; CERCLA and RCRA response action documents include the administrative and technical plans and reports developed to support the selection and implementation of removal and/or remedial actions)
- Procurement of selected items that are susceptible to counterfeiting as described in DOE G 414.1-2B, *Quality Assurance Program Guide*, and DOE O 414.1D, *Quality Assurance* (e.g., graded fasteners, circuit breakers, ratchet type tie downs and other items as determined by quality assurance); purchase orders for such items shall include clauses or statements regarding procurement of potentially suspect or counterfeit items and shall require receipt inspection

## B-4.2 References

ANSI/ASME B31.3-2008, 2008, *Process Piping*, American Society of Mechanical Engineers, New York, New York.

ASME BPVC, 2007, *ASME Boiler and Pressure Vessel Code*, Section VIII, "Rules for Construction of Pressure Vessels," Division 1, "Design and Fabrication of Pressure Vessels," American Society of Mechanical Engineers, New York, New York.

AWS D1.1, 2008, *Structural Welding Code—Steel*, American Welding Society, New York, New York.

*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, Pub. L. 107-377 as amended, 42 USC 9601 et seq., December 31, 2002. Available at: https://www.csu.edu/cerc/researchreports/documents/CERCLASummary1980.pdf.

DOE G 414.1-2B Chg 2 (Admin Chg), 2011, *Quality Assurance Program Guide*, U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives-documents/400-series/0414.1-EGuide-2b-admchg2.

DOE O 414.1D, Chg 1 (Admin Chg), 2013, *Quality Assurance*, U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives-documents/400-series/0414.1-BOrder-d-admchg1.

PRC-PRO-QA-259, *Graded Approach*, CH2M HILL Plateau Remediation Company, Richland, Washington.

*Resource Conservation and Recovery Act of 1976*, Pub. L. 94-850, 42 USC 6901 et seq. Available at: https://www.govinfo.gov/content/pkg/STATUTE-90/pdf/STATUTE-90-Pg2795.pdf.

# Appendix C

# National Emission Standards for Hazardous Air Pollutants; Radionuclides Quality Assurance Project Plan

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# Terms

The following terms are used in the main text of this appendix as well as the supporting information.

| | |
|---|---|
| ABCASH | Automated Bar Coding of All Samples at Hanford 2 |
| AMP | air monitoring plan |
| ASME | American Society of Mechanical Engineers |
| ATD | alpha track detectors |
| BMP | best management practice |
| CAM | continuous air monitor |
| CHPRC | CH2M HILL Plateau Remediation Company |
| CSB | Canister Storage Building |
| DCG | Derived Concentration Guide |
| DoD | U.S. Department of Defense |
| DOE | U.S. Department of Energy |
| DOECAP | U.S. Department of Energy Consolidated Audit Program |
| DOE-RL | U.S. Department of Energy, Richland Operations Office |
| DQO | data quality objective |
| EC&QA | Environmental Compliance & Quality Assurance |
| ECO | Environmental Compliance Officer |
| EDP | electronic data processing |
| EIS | Environmental Integration Services |
| ENFMN | Effluent and Near Facility Monitoring Network |
| EPA | U.S. Environmental Protection Agency |
| EQAPP | Environmental Quality Assurance Program |
| ERS | Environmental Reporting System |
| Ge(Li) | lithium-drifted geranium detector |
| HASQARD | *Hanford Analytical Services Quality Assurance Requirements Documents* |
| HEPA | high-efficiency particulate air |
| HPGe | high-purity geranium detector |
| IDMS | Integrated Document Management System |
| MAPEP | Mixed Analyte Performance Evaluation Program |

| | |
|---|---|
| MCA | multichannel analyzer |
| MDC | minimum detectable concentration |
| MEI | maximally exposed individual |
| MSA | Mission Support Alliance |
| NBS | National Bureau of Standards |
| NESHAP | "National Emission Standards for Hazardous Air Pollutants" |
| NFM | Near-Field Monitoring |
| ORP | Office of River Protection |
| PCM | periodic confirmatory measurement |
| PIC | potential impact category |
| PNNL | Pacific Northwest National Laboratory |
| PUREX | Plutonium-Uranium Extraction |
| QA | quality assurance |
| QAO | quality assurance objective |
| QAP | Quality Assurance Program |
| QAPjP | Quality Assurance Project Plan |
| QC | quality control |
| QSM | Quality Systems Manual |
| RAWP | removal action work plan |
| REDOX | Reduction-Oxidation Facility |
| SME | subject matter expert |
| V&B | Ventilation and Balance |
| WESF | Waste Encapsulation and Storage Facility |
| WDOH | Washington State Department of Health |

# C1 Management of Air Emissions Measurement

This Quality Assurance Project Plan (QAPjP) documents the quality assurance (QA) requirements necessary to meet state and regulatory requirements, to describe the process of monitoring and reporting radioactive air emissions from stacks and vents and from fugitive or diffuse sources, and to ensure data collected is of sufficient quality to ensure permit compliance. DE-AC06-08RL14788, *CH2M HILL Plateau Remediation Company Plateau Remediation Contract*, requires CH2M HILL Plateau Remediation Company (CHPRC) to comply with all environmental laws, regulations, U.S. Department of Energy (DOE) orders, and procedures applicable to the work being performed under the contract. The requirement for CHPRC to conduct a "National Emission Standards for Hazardous Air Pollutants" (NESHAP; 40 CFR 61) Quality Assurance Program (QAP) is specified in the following regulations listed in Section J.2 of the contract:

- 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants." Appendix B, Method 114, *Test Methods for Measuring Radionuclide Emissions from Stationary Sources*, Section 4.11 states, "The quality assurance program should be documented in a quality assurance project plan."
- WAC 246-247-075(6), "Radiation Protection—Air Emissions," "Monitoring, Testing, and Quality Assurance," states: "Licensed facilities shall conduct and document a quality assurance program."

Note: 10 CFR 830.121(a), "Nuclear Safety Management," states:

> Contractors conducting activities, including providing items or services, that affect, or may affect, the nuclear safety or DOE nuclear facilities must conduct work in accordance with the Quality Assurance criteria in Section 820.122.

The QAP this statement is referring to is the CHPRC PRC-MP-QA-599, *Quality Assurance Program*. This QAPjP complies with the main document (CHPRC-00189, Environmental Quality Assurance Program Plan [EQAPP]), which supports and complies with the CHPRC QAP.

In addition, CHPRC has elected to incorporate best management practices (BMPs) into the QA practices to increase the 'compliance margin' associated with each emission unit. These BMPs are internal to CHPRC and are considered to be the point of procedural compliance but not the point of regulatory compliance.

The individual CHPRC project offices, with support from the environmental and QA organizations within the CHPRC are responsible for conducting all air emissions measurement and related QA and maintenance activities associated with air emissions sample collection, sample handling, and chain of custody. The organizations implementing the measurement program are described in the QAP (PRC-MP-QA-599), and the EQAPP (CHPRC-00189). The QAP states:

> PRC-MP-MS-19361, *CH2M HILL Plateau Remediation Company Project Execution Plan*, contains the official CHPRC organizational chart; PRC-MP-MS-19361 is the official source for CHPRC roles and responsibilities.

PRC-MP-EP-40220, *Environmental Program and Strategic Planning Roles, Responsibilities, and Functions* documents additional roles, responsibilities, and functions. PRC-MP-PM-53011, *CHPRC Project Management Plan*, further defines the organizational alignments and the roles and responsibilities for the implementation of the CHPRC mission.

CHPRC responsibility for chain of custody extends through transport of the required samples to the delivery location for the analytical laboratory contracted by the Mission Support Alliance (MSA) contractor under contract with the U.S. Department of Energy, Richland Operations Office (DOE-RL). When custody of the air emissions samples is taken by the laboratory, the MSA's Effluent and Near Facility Monitoring Network (ENFMN) program assumes responsibility for laboratory analysis of the samples, and management of the resulting data, providing applicable QA for the analysis process and associated estimates of emissions for annual reporting of emissions (MSC-PLN-EI-23333, latest revision, *Environmental Quality Assurance Program Plan*). The CHPRC project offices and environmental support organizations participate in the verification and validation of the sample data as part of final approval before reporting. The objective of this QAPjP is to describe the elements of monitoring and reporting radioactive air emissions from stacks and vents (referred to only as stacks in the balance of this QAPjP) and from fugitive or diffuse sources which will ensure data collected is of sufficient quality to ensure permit compliance.

## C1.1 CHPRC Projects

CHPRC projects are responsible for design, procurement, inspection, calibration, and maintenance of systems used for collecting stack emission samples, associated sampling information, and stack flow rate measurements at facilities they manage. Stack samples are submitted to the MSA-managed Contract Laboratory for analysis, and the flow rate measurements are provided to MSA Environmental Integration Services (EIS), which is the group responsible for reviewing various information and reports cited in this QAPjP and retaining required records. CHPRC stack emission monitoring activities, such as sample collection, are addressed in this CHPRC QAPjP and procedures.

## C1.2 Environmental Compliance Officers

CHPRC Environmental Compliance Officers (ECOs) or their delegates have responsibility for project environmental compliance; however, technical and engineering aspects are delegated to project engineers. ECOs or their delegates review the stack flow data from measurements performed by MSA's Ventilation and Balance (V&B) personnel. ECOs are responsible for monitoring stack emissions data for their facilities and assisting in evaluating concerns over elevated emissions, which might require notification to regulators as well as corrective actions. They also review the MSA internal statement of work issued annually by MSA EIS that lists laboratory analytical services and sampling schedules. As changes in operating conditions and/or source terms at facilities occur, ECOs may, in consultation with and with approval of CHPRC technical and project engineering, direct the addition or deletion of specific radionuclides identified for sampling and analysis.

## C1.3 Health Physics Personnel

CHPRC Health Physics personnel perform the sampling of radionuclide air emissions under the technical direction of the project ECO or their delegate(s). The Automated Bar Coding of All Samples at Hanford 2 (ABCASH 2, or more commonly, ABCASH as described in MSC-PRO-EI-15334, Section 5.6) computer program affords users automated data acquisition and tracking of air filter sampling information. Collection, tracking, and handling requirements for effluent samples are specified in PRC-PRO-EP-15334, *Effluent and Environmental Monitoring for Radionuclide Airborne Emissions*. CHPRC projects maintain procedures for sample collection and the sample tracking system used by the health physics organizations. Sampling activities are performed in accordance with stack monitoring and sampling requirements of 40 CFR 61, Appendix B, Method 114. In accordance with their own procedures, CHPRC projects collect and send the radioactive air emission samples to the MSA-managed Contract Laboratory.

## C1.4 Ventilation and Balance

MSA V&B personnel measure stack flow rates and are responsible for ensuring that stack flow measurement equipment is adequate and appropriately calibrated in accordance with PRC-PRO-EN-8323, *Management of HEPA Filter Systems*. V&B is responsible to ensure that Pitot tubes used for measuring stack flows are either calibrated to a National Bureau of Standards (NBS)-traceable standard or are designed and constructed in accordance with Method 2 specifications of 40 CFR 60, "Standards of Performance for New Stationary Sources," Appendices A-1 through A-8 test methods, to ensure appropriate coefficients are applied when calculating stack flow. Generally, Pitot tubes that are used on the Hanford Site are Dwyer® 160 series, manufactured to an American Society of Mechanical Engineers (ASME) design that meets ANSI/ASHRAE 51-1999 (ANSI/AMCA 210-99), *Laboratory Methods of Testing Fans for Aerodynamic Performance Rating* codes and complies with 40 CFR 60, Appendix A-1, Method 2 construction specifications. Dwyer 160-series Pitot tubes have baseline coefficients of 1.0 for standard Pitot tubes and 0.84 for type S Pitot tubes. Measurements are made on a periodic schedule established by the facilities.

## C1.5 Instrumentation and Control Technicians

CHPRC instrumentation and control technician personnel perform the inspection and calibration of instrumentation that measures stack flow, sample flow, stack and sample flow temperature, and the mass flow controllers that maintain sample flow at a constant preselected value.

## C1.6 MSA Environmental Integration Services

The MSA EIS group manages the radioactive air emissions sample analysis and compliance reporting for facilities managed by CHPRC and for facilities managed by other prime contractors to DOE-RL and DOE, Office of River Protection (ORP). Responsibilities include managing radioactive air emissions data, advising on engineering and regulatory matters, and submitting required reports to the U.S. Environmental Protection Agency (EPA), Washington State Department of Health (WDOH), and DOE. EIS is responsible for assuring the required QA-related to the sample analysis and reporting aspects.

The MSA EIS group works with the CHPRC points of contact to address identification of known or suspected elevated emissions from normal or unplanned operations, as well as any further emissions sample or data analyses supporting investigation of the elevated emissions. The CHPRC Environmental Compliance and Quality Assurance (EC&QA) group is responsible for independent assessments of the CHPRC radioactive air emissions monitoring program in adherence to CHPRC-00189.

# C2 Radioactive Air Emissions Data Generation and Acquisition

CHPRC projects operate and maintain required air monitoring equipment at CHPRC facilities, and transport the resulting air samples to MSA's sample receiving station, then MSA transports the air samples to the analytical laboratory using chain-of-custody procedures. CHPRC supports the verification and validation of sample data and input to the required reporting and certification, for annual reporting of emissions to EPA, WDOH, and DOE-RL. These actions are carried out by implementing the requirements listed in the internal procedure on effluent and environmental monitoring, PRC-PRO-EP-15334, for radioactive air emissions measurement and sampling systems. The project identifies sample analytes of

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interest, required minimum detectable quantities, and ensures performance of required compliance assessments of radioactive air emissions sampling and measurement equipment and records.

The CHPRC projects and Environmental Protection support group address concerns over known or suspected elevated emissions from normal or unplanned operations. To ensure an appropriate and prompt response to such situations, CHPRC relies on subject matter experts and internal procedures such as PRC-PRO-EP-15333, *Environmental Protection Processes* and PRC-PRO-EP-15334. Prompt response is also supported by CHPRC radiation protection procedures, which require immediate field surveys of the collected samples using hand held instruments, with any abnormal results being identified to management. Responses to any indications of unplanned elevated emissions may include such actions as notifications to regulatory agencies, testing, and repair of emissions control or monitoring equipment, or review of operations producing the emissions.

The MSA Contract Laboratory conducts the sample analyses, sample data compilation, internal reporting, and overall sample and data QA.

The MSA EIS group validates the radioactive air emissions sample analyses, compiles stack flow-rate data, performs as-needed final emission release calculations, oversees radiological dose calculations, and prepares the annual radionuclide air emissions report for the Hanford Site. CHPRC contributes descriptive content and data review as part of the reporting effort. In support of CHPRC, the MSA EIS group establishes sampling schedules and identifies the analytical laboratory technical requirements for radioactive air sample analyses, including identifying specific radionuclides to be analyzed and limits of analytical detection. CHPRC cooperates with MSA to assist with field sample data and verification and validation of laboratory data results. MSA portions of the activities are performed in accordance with MSC-PRO-EI-15334. CHPRC portions of the activities are performed in accordance with the PRC-PRO-EP-15334 and this QAPjP.

## C2.1 Radioactive Air Emissions Measurement Program

CHPRC is responsible for implementing the requirements listed in its internal procedure on effluent and environmental monitoring, PRC-PRO-EP-15334 for radioactive air emissions monitoring and sampling systems. Additional CHPRC responsibilities include providing the MSA with laboratory analysis needs for each emissions sample, including analytes of interest and required minimum detectable quantities. The CHPRC is responsible for conducting the required compliance assessments of radioactive air emissions sampling and monitoring equipment and records.

Responsibilities assigned for sampling, analysis, data compilation, reporting, and oversight are described in the following sections within this appendix, as required by 40 CFR 61, Method 114, Section 4.1.

Sampling, sample collection, and stack monitoring procedures are described in Method 114 Section 2, *Stack Monitoring and Sample Collection Methods.*

Table C-1 lists the major stacks managed by CHPRC and the supporting information that describe the monitoring methods for each relative to requirements in Method 114, Section 4. Supporting information is located within the various sections after the references. Supporting information C-9, “ Minor Stack and General Permit Required Monitoring Locations,” describes the monitoring methods relative to the requirements in Method 114, Section 4 for nonstack Permit required locations (e.g., Liquid Effluent Retention Facility Basin, Central Waste Complex).

**Table C-1. Major Stacks Index**

| Major Stack | Supporting Information | Hanford Site Radioactive Air Emissions License #FF-01[a], Emission Unit ID |
|---|---|---|
| 105-KW Air Sparger | C-1, "105-KW Air Sparger" | [b] |
| 291-A-1 (PUREX) | C-2, "291-A-1 (PUREX) Stack" | 369 |
| 291-T-1 (T Plant) | C-3, "291-T-1 (T Plant)" | 314 |
| 291-S-1 (REDOX) | C-4, "291-S-1 (REDOX)" | [c] |
| 296-B-1 (B Plant) | C-5, "291-B-1 (B Plant)" | 402 |
| 296-B-10 (WESF) | C-6, "296-B-10 (Waste Encapsulation & Storage Facility)" | 340 |
| 296-H-212 (CSB) | C-7, "296-H-212 (Canister Storage Building)" | 435 |
| 296-W-4 (WRAP) | C-8, "296-W-4 (Waste Receiving and Packaging Facility)" | 193 |
| General Permit Required Monitoring Locations | C-9, "Minor Stack and General Permit Required Monitoring Locations" | -- |
| EP-324-01-S | C-10, "EP-324-01-S" | [d] |

a. WDOH, 2017, *Radioactive Air Emissions License for the Department of Energy Richland Office Hanford Site*.

b. Operating under CERCLA authority. See Letter AIR 09-1003, "Transition of the Plutonium Finishing Plant (PFP) to Regulation Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)."

c. Operating under CERCLA authority (letter 19-ESQ-0086, "Transition of the Reduction-Oxidation Facility (REDOX) and Stack P-291S001-001 to Regulation Under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)"). Authority under CERCLA was initiated in May 2019, after the documentation indicating implementation of applicable or relevant and appropriate requirements was agreed upon.

d. Operating under CERCLA authority (letter CHPRC-1903855, "Withdrawal of 324/327 Stacks from Hanford Air Operating Permit").

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

CSB = Canister Storage Building

PUREX = Plutonium Uranium Extraction Plant

REDOX = Reduction-Oxidation Facility

WESF = Waste Encapsulation and Storage Facility

WRAP = Waste Receiving and Processing Facility

## C2.2 Radioactive Air Emissions Monitoring Data Management

MSA's ENFMN program has responsibility for verifying and validating radioactive air emissions data, compiling stack flow-rate data, performing as-needed final calculations, and preparing the annual radionuclide air emissions report for the Hanford Site, with contribution by CHPRC. For CHPRC, the MSA ENFM establishes sampling schedules and identifies the analytical laboratory technical requirements for radioactive air sample analyses, including identifying specific radionuclides to be analyzed and limits of analytical detection. CHPRC cooperates with the MSA ENFM to assist with field sample data and laboratory data results validation and verification. The MSA portions of the activities are performed in accordance with MSC-PRO-EI-15334. The CHPRC portions for the activities are performed in accordance with the PRC-PRO-EP-15334 and this QAPjP.

The MSA ENFM has responsibility for compiling site-wide radioactive air emissions sampling and stack flow data for regulatory reports. Additional responsibilities include verifying sample analysis parameters

received from laboratories and providing sampling schedules. The MSA ENFM assigns electronic data processing (EDP) codes (also known as location codes) for tracking samples and in support of CHPRC sampling activities, and with CHPRC input stipulates to the Contract Laboratory the number and types of samples it should receive annually and analyses to perform. In addition, MSA ENFM provides projected yearly sampling requirements (e.g., numbers of samples and needed analyses) and data quality objectives (DQOs) for types of analyses as part of the laboratory contract. CHPRC participates in verification and validation of the laboratory analysis data and assists with correcting and/or explaining sample errors or anomalies identified.

MSA manages the number and kind of radiological analyses performed by the Contract Laboratory in accordance with a statement of work, which addresses sample media collected from stacks managed by CHPRC. Specific radionuclides to be analyzed are determined with the assistance of CHPRC environmental and facility or project technical authorities. The MSA ENFM coordinates the transferring of laboratory analytical data into the ABCASH computerized system for retrieval by the MSA EIS group and CHPRC environmental and facility management and support staff. The Contract Laboratory maintains a QA plan and analytical procedures that meet the requirements of 40 CFR 61, Method 114.

### C2.2.1 Reporting of Airborne Releases

Radioactive air emissions data are used to support the reporting of releases of airborne radioactivity from the Hanford Site and the corresponding dose to the maximally exposed member of the public. This reporting is conducted annually in accordance with 40 CFR 61, Subpart H, “National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities” and WAC 246-247, as well as the DOE O 458.1, *Radiation Protection of the Public and the Environment*. Collection, compilation, calculation, verification, and validation of radioactive air emissions data are the primary steps in a process by which samples are collected from selected stacks and ambient air locations, analyzed in a laboratory to detect amounts of specified radioactive materials, and the results validated and documented in the reports. Quantified data on releases from ongoing activities obtained through the use of structured data collection and trending are periodically provided to management via annual emission and environmental reports.

The MSA contractor has primary responsibility for preparing all reports of point-source radioactive air emissions data for submission to the EPA, WDOH, and DOE-RL.

The activities specific to radioactive air emissions sample measurements and reporting include the following:

- Completion and recording of laboratory analyses performed to detect the presence of radioactive materials on particulate filter media, silver-zeolite cartridges, or other sampling media appropriate to the material to be sampled as well as compatible with analytical methods available at the Contract Laboratory
- Calculation of releases and average concentrations of radioactivity based on the laboratory analysis data of sampled emissions and the measured stack flow data or maximum stack flow rates (or in some cases as rated by exhauster manufacturers)
- Calculation of quantities of radionuclides released and average concentrations for a calendar year for a specific discharge point or the general ambient area of the Hanford Site
- Validation of acquired data
- Preparation and release of reports identified above

### C2.2.2 MSA Contract Laboratory

The Contract Laboratory personnel perform radiochemical analyses, pursuant to a statement of work, on sample media collected from stacks managed by CHPRC as well as other site contractors. Specific radionuclides to be analyzed are determined by MSA EIS with the assistance of ECOs and facility or project stack engineers. The Contract Laboratory maintains a QA plan and analytical procedures that meet the requirements of 40 CFR 61, Appendix B, Method 114.

### C2.2.3 Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) has been designated by DOE-RL to perform dose modeling for the Hanford Site, including compliance dose modeling for stacks operated by CHPRC. PNNL derives effective dose equivalents using an EPA-approved dose model (e.g., CAP88 PC). Dose modeling results supplied by PNNL are included in the annual Radionuclide Air Emission Report for the Hanford Site (e.g., DOE/RL-2011-13, *Portable/Temporary Radionuclide Air Emission Units and High-Efficiency Particulate Air-Filtered Vacuum Radioactive Air Emission Units Annual Report Calendar Year 2010*) prepared for EPA, WDOH, and DOE, and in the annual Hanford Site Environmental Report prepared by PNNL for DOE (e.g., PNNL-19455, *Hanford Site Environmental Surveillance Data Report for Calendar Year 2009*).

MSA and PNNL also maintain DOE/RL-2007-53, *Methods for Calculating Doses to Demonstrate Compliance with Air Pathway Radiation Dose Standards at the Hanford Site*, which describes the methods and procedures used annually for determining the Hanford Site maximally exposed individual (MEI) and assessing DOE Hanford Site dose standard compliance. It also serves somewhat as a history of the sources and development of Hanford Site methods.

## C3 Assessment and Oversight

In addition to the federal and state documents referenced above, this QAPjP also conforms to the requirements in the latest revisions of the QAP (PRC-MP-QA-599) and the EQAPP (CHPRC-00189). Where appropriate, this QAPjP applies to monitoring and reporting of radioactive air emissions from licensed major and minor stacks managed by CHPRC, as well as fugitive and diffuse sources. The implementing procedures, plans, and instructions are appropriate for the control of radioactive air emissions data, as required by 40 CFR 61, Method 114 and applicable DOE orders.

Distribution and control of this QAPjP are in compliance with PRC-PRO-IRM-8310, *Document Control Processes*. This QAPjP is typically reviewed and updated annually or whenever significant changes are made to the program. A reduced set of quality actions has been imposed on licensed minor stacks (i.e., reduced compared to quality actions required for major stacks) via Section 4.0 of WDOH (2017). Those actions are intended to ensure and confirm the quality of periodic measurements of emissions from minor point source emission units that use sample extraction as the approved form of periodic confirmatory measurement. Such measurements are required to confirm that emissions from such sources have remained low. Those reduced quality actions are summarized in the following:

- Implementation of quality checks supporting the periodic confirmatory measurements. These checks shall ensure that the emissions measurements are sufficient to verify low emissions.
- Stack flow measurements shall be conducted annually.
- An annual calibration will be performed on the existing sample flow meter or an annual function check will be performed if the flow meter is replaced by either a rotameter or a magnehelic gauge.

- Effluent samples shall be collected on standard (i.e., very high efficiency particulate air) sample filters and other media as determined in the permit.
- Laboratory sample analysis will meet the requirements of 40 CFR 61, Appendix B, Method 114(3).
- The following items as documented in this NESHAP QAPjP or other documents:
  - The sample collection and analysis procedures which refer to facility-specific procedures.
  - The quality control (QC) program for evaluating and tracking the quality of the periodic confirmatory measurement data against preset criteria (as identified in MSC-PLN-EI-23333). The QC program includes, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks (as identified in MSC-PLN-EI-23333 and in contractual documents.
  - A sample tracking system providing positive identification of samples and data through all phases of the sample collection, analysis, and reporting system (refer to Chapter C2). Sample handling and preservation procedures maintain the integrity of the samples during collection, storage, and analysis (refer to Chapter C2; PRC-PRO-EP-15334; MSC-PRO-EI-15334, *Effluent and Environmental Monitoring*.

CHPRC is responsible for collecting stack emission samples, associated sampling information, and stack flow rate measurements at facilities it manages (Table C-2). Stack samples are submitted to the Contract Laboratory for analysis, and the flow rate measurements are provided to MSA EIS. CHPRC also is responsible for reviewing various information and reports cited in this QAPjP and retaining required records.

**Table C-2. Responsibility for Quality Assurance Activities**

| Item | Task | Performed by MSA EIS with Review/ Concurrence by CHPRC | Performed by CHPRC |
|---|---|---|---|
| 1 | Provide analytical criteria and detection limits for radioanalysis | X | |
| 2 | Annual documenting of Contract Laboratory analytical services, which includes sampling and analytical requirements and sampling schedules | X | |
| 3 | Collect samples of radioactive air emissions from sample locations and record information on sample envelope data and/or into ABCASH via handheld barcode scanners | | X |
| 4 | Transport samples from sampled stacks to the MSA receiving station utilizing chain of custody procedures. | | X |
| 5 | Analyze samples at the Contract Laboratory | X | |
| 6 | Audit laboratory QA/QC | X | |
| 7 | Prepare radioactive air emissions sampling and monitoring data compilation and reporting procedures | X | |
| 8 | Verify measured stack flow data from V&B and transmit to MSA EIS for annual reporting | | X |
| 9 | Verify sample analyses | X | |
| 10 | Compile sampling results, flow data, and data on duration of operation into annual releases in curie quantities and annual average concentrations | X | |

**Table C-2. Responsibility for Quality Assurance Activities**

| Item | Task | Performed by MSA EIS with Review/ Concurrence by CHPRC | Performed by CHPRC |
|---|---|---|---|
| 11 | Prepare annual emissions and releases reports | X | |
| 12 | Compute annual effective dose equivalent to maximally exposed member of the public from Hanford Site radioactive emissions | X | |
| 13 | Conduct programmatic audits of emissions sample handling | X | X |
| 14 | Conduct compliance assessments on radiological air sampling and monitoring systems | | X |
| 15 | Conduct Tracking and Trending of Air Emissions Abatement System | | X |

| | | | | | |
|---|---|---|---|---|---|
| ABCASH | = | Automated Bar Coding of All Samples at Hanford 2 | MSA | = | Mission Support Alliance |
| CHPRC | = | CH2M HILL Plateau Remediation Company | QA/QC | = | quality assurance/quality control |
| EIS | = | Environmental Integration Services | V&B | = | ventilation and balance |

## C3.1 NESHAP Quality Assurance Requirements

The QA sub-elements of 40 CFR 61, Appendix B, Method 114, Section 4.0 are listed below in bold italicized text, followed in each case with a description of how they are addressed by the program:

- Section 4.1 ***The organizational structure, functional responsibilities, levels of authority, and lines of communication for all activities related to the emissions monitoring program shall be identified and documented***: refer to Chapter C1 of this QAPjP. Additional roles, responsibilities, and functions are documented in PRC-MP-EP-40220.

- Section 4.2 ***Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations***: refer to Section C1.2 and Chapters C2 and C4 in this QAPjP.

- Section 4.3 ***The sample collection and analysis procedures used in measuring the emissions shall be described***: refer to the supplemental information.

- Section 4.4 ***The objectives of the QA program shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data including a description of the procedures used to assess these parameters:***

  a. Specific to the laboratory analysis of samples, refer to Chapters C3 and C4 of this QAPjP.

  b. The quantitative QA parameters are precision, accuracy, and completeness (defined in 40 CFR 61, Appendix B, Method 114, Section 4.4). Accuracy is the degree of agreement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of valid data obtained compared to the amount expected under normal conditions.

  c. Specific to the measurement of effluent flow, accurate measurements of the flow in stacks and ducts must be provided because the accuracy of any emissions estimate is directly related to the accuracy of flow measurements. The flow rate of air exhausted through each stack or duct is periodically measured and may be continuously monitored if there is a potential for significant variation in flow rate (i.e., >20% during a year, based upon guidance of ANSI/HPS N13.1-1999,

*Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities*). If historical data are available, the 20% variability may be approximated by the standard deviation of the measurements. If the variability of flow rate is based on engineering judgment, such factors as fan maintenance, the opening of doors, and the variations in the number of fans shall be taken into account. For stacks and ducts that must be continuously monitored for effluent flow, flow calibration tolerances ensure the flow measurement and recording system shall be capable of determining the mass flow rate of the effluent stream with an accuracy that is within ±10% of that measured with the Reference Method (per guidance of ANSI/HPS N13.1. Where only annual measurements of flow rate are performed, these shall be performed following the applicable requirement of 40 CFR 60, Appendix A-1, Methods 1 or 2, or other alternative methods that have been approved as providing acceptable accuracy.

Taking into account the variables affecting stack flow, such as those discussed in the preceding paragraph, precision of the flow measurements is addressed by limited indirect data indicating reasonable precision of air effluent flow measurements is achieved. Flow measurements will have sufficient precision to ensure emissions limits for each stack are not exceeded. Calibration of continuous flow measurement devices per manufacturers or approved specifications provides adequate check for comparable readings. Use of comparative multiple traverses as part of the procedure for annual flow measurements, along with comparison with National Institute of Science and Technology-traceable standards, provides adequate indication of agreement among individual measurements (Section C1.4). For stacks approved for use of maximum system flow capacity as an agency approved alternative method for stack emissions measurement, precision has been adequately addressed.

Within the context of the 40 CFR 61, Subpart H and referenced 40 CFR 61, Appendix B, Method 114, completeness of effluent flow measurement is addressed by utilizing a completeness criterion of no <80% operational coverage during periods of powered stack flow for continuous measurement devices. For the annual flow measurement methods, completeness is satisfied by a minimum of one measurement per calendar year by the approved method, with no >18-month duration between any two measurements.

Applying the criteria above in combination with the quality parameters addressed during stack sample analytical measurements, validation and verification conducted as part of the development of the annual report of emissions, and the data quality activities and objectives described in the supporting document MSC-PRO-EI-15334 provides adequate assurance of the precision, accuracy and completeness of the effluent flow measurements. The annual reported emissions calculations developed for compliance reporting purposes shall address the applicable uncertainty parameters for the emission measurement data, including the annual effluent flow and sample analysis data.

- Section 4.5 ***A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include where applicable a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified:*** The Contract Laboratory contractual documents and MSC-PLN-EI-23333.Tracking and trending of indication devices at the emission unit is conducted per PRC-PRO-EP-15333, Section 5.14. Periodic independent assessments provide an additional review to evaluate and track the quality of emissions measurement data against preset criteria.

- Section 4.6 ***A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during***

***collection, storage, and transport:*** Refer to PRC-PRO-EP-15334, Chapter C2 of this QAPjP, and ABCASH. Sample tracking is also required by PRC-PRO-EP-15334, Section 5.6.

- Section 4.7 ***Regular maintenance, calibration, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table 2 – Maintenance, Calibration and Field Check Requirements***: Maintenance, Calibration, and Field Check Requirements are addressed in Supporting Information C-1 through C-10. Other documents are listed in Chapter C2 of this QAPjP and facility-specific procedures.
- Section 4.8 ***Periodic internal and external audits shall be performed to monitor compliance with the QA program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited***: refer to Chapter C3 of this QAPjP.
- Section 4.9 ***A corrective action program shall be established including criteria for when corrective action is needed, what corrective actions will be taken and who is responsible for taking the corrective action***: refer to Chapter C3 of this QAPjP and to PRC-PRO-QA-052, *Issues Management*.
- Section 4.10 ***Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and description of corrective actions***: refer to Chapter C3 of this QAPjP. Also, notification requirements are contained in PRC-PRO-15333, Section 5.57. A review of emissions measurement data quality is included as a line of inquiry for assessment of NESHAP (40 CFR 61) major radioactive air emission sources managed by CHPRC.
- Section 4.11 ***The QA program should be documented in a quality assurance project plan (QAPjP) that should address each of the above requirements***: refer to the purpose of this QAPjP (Section C1.1).

## C3.2 Organizations Responsible for QA

QA oversight of the radioactive air emissions monitoring responsibilities carried out by CHPRC is performed by the CHPRC EC&QA organization. On a periodic basis, the CHPRC EC&QA group conducts internal and external audits of the radioactive air emissions monitoring activities of the CHPRC program.

The CHPRC EC&QA group is responsible for the following CHPRC radioactive air emissions QA oversight activities:

- Scheduling and conducting QA surveillances of air emissions activities in accordance with PRC-PRO-QA-9769, *Surveillance Process*
- Reviewing documents to ensure data quality and QA objectives are met
- Verifying resolution of nonconforming items
- Reviewing sample system design, operation, sample collection, and sample chain of custody
- Verifying use of qualified analytical laboratories for sample analysis
- Serving as interpretative authority for environmental QA requirements
- Assessing and evaluating the effectiveness of implementation of this QAPjP
- Serving as the focal point for EC&QA-related issues
- Approval of this QAPjP

MSA is responsible for the following:

- Reviewing and approving sample analysis and data transfer deliverables as applied to the Contract Laboratory while implementing contractual and regulatory QA requirements
- Reviewing and approving Contract Laboratory procedures specific to radioactive air emission sample chain of custody, sample analysis, and data and records management
- Scheduling and conducting QA or QC surveillances or inspections of Contract Laboratory analysis of air emissions samples, generally conducted internally by MSA QA personnel

### C3.2.1 MSA, Environmental Integration Services

The MSA EIS group manages the radioactive air emissions sample analysis and compliance reporting for facilities managed by CHPRC, and for other prime contractors. Responsibilities include managing radioactive air emissions data, advising on engineering and regulatory matters, and submitting required reports to EPA, WDOH, and DOE-RL. The EIS group is also responsible for ensuring the required QA-related to the sample analysis and reporting.

The EIS group works with CHPRC points of contact to address any concerns over known or suspected elevated emissions from normal or unplanned operations. To ensure an appropriate and prompt response to such situations, the CHPRC projects, with assistance from CHPRC Environmental Protection, relies on their subject matter expert (SME) and following of internal procedures such as PRC-PRO-EP-15333 and PRC-PRO-EP-15334.

The CHPRC EC&QA group is responsible for independent assessments of the CHPRC radioactive air emissions monitoring program in adherence to CHPRC-00189.

### C3.2.2 CHPRC Environmental Compliance Officers

Section C1.2 delineates the responsibilities of the CHPRC Environmental Compliance Officers.

## C4 Data Verification and Validation

MSA EIS, in consultation with CHPRC ECOs and SMEs, verifies and validates effluent and environmental data for reporting and decision-making. The data are verified by ensuring that the quantity and type of samples collected and analyses performed are adequate to meet regulatory requirements (e.g., sampling, and analytical). The data are also validated by ensuring that they are of the type and quality suitable for the intended use.

Verification and validation of effluent and environmental sampling and analysis data are important quality assurance objective (QAO) activities that are performed by qualified laboratory, facility, and environmental support personnel. When properly done, these two comprehensive QAO activities increase the probability of acquiring quality data having a high degree of accuracy (WAC 246-247-075(13)). The following definitions of validation and verification are from EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5):

- Validation. Confirmation by examination and provision of objective evidence that particular requirements for a specified use are fulfilled. In design and development, validation concerns the process of examining a product or result to determine conformance to user needs. To supplement this is another definition of data validation, from EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation* (EPA QA/G-8): It is an analyte-specific and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set.

- Verification. Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. In design and development, verification concerns the process of examining a result of a given activity to determine conformance to the stated requirements for that activity. To supplement this is another definition of data verification, from EPA/240/R-02/004: It is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against method, procedural, and/or contractual requirements.

To varying degrees, all parties involved in the sampling, analysis, and reporting program perform verification and validation on samples, effluent flow measurements, and resulting analytical data, which are the central elements of the entire program. For example, field sample collectors follow procedures and sampling schedules to ensure samples are properly handled, exchanged on time, and, if possible, are of nominal volume; technical support specialists measure effluent flow rates. MSA Contract Laboratory personnel adhere to analytical procedures in accordance with national standards and the laboratory QAP; and MSA EIS personnel evaluate the sample data for completeness and for representativeness to expected as well as historical and regulatory values before approving them to be of adequate quality and sufficiently verified and validated for their intended use, which is usually to comply with federal and state reporting requirements. With regard to stack emissions data, for instance, the data evaluations include comparing those data against laboratory minimum detectable concentrations (MDCs) (e.g., 8.8E-15 µCi/L for gross alpha and 1.8E-14 µCi/L for gross beta), concentration guides (e.g., DOE Derived Concentration Guides [DCGs] and Table 2 Appendix E of 40 CFR 61), and multi-year concentration trends of each stack (typically in the range of 5.0E-14 µCi/L to 5.1E-16 µCi/L for gross alpha, and 8.3E-14 µCi/L and 2.0E-16 µCi/L for gross beta [these ranges vary within approximately a factor of 10 according to the facility source terms]). These evaluations help keep in view the relative position stack concentrations have to MDCs, DCGs, and Table 2 concentrations.

Those stack concentrations, and respective yearly releases, are also roughly projected to a potential annual radiological dose to an MEI member of the public, which is then compared with the MEI dose limit of 10 mrem/yr effective dose equivalent.

To borrow further from EPA/240/R-02/004: “Data verification is primarily an evaluation of performance against pre-determined (and often generic) requirements given in a document such as an analytical method procedure or a contract. Data validation, on the other hand, focuses on particular data needs for a project, as stated in a project-specific document such as a QAPjP. Furthermore, data verification and data validation are typically sequential steps performed by different parties” and “data validation begins with the outputs from data verification. The definitions and approaches described in this guidance are not intended to be prescriptive or necessarily to be applied rigidly across all programs, organizations, and circumstances.”

Laboratories analyze effluent and environmental samples; technical support and facility groups measure effluent flows, collect samples, and record operating and sampling information. These organizations supply MSA EIS with all pertinent operating, sampling, and analytical data needed to perform effluent and environmental compliance calculations, evaluations, and reports.

The facility support personnel, laboratory personnel, and MSA EIS generally follow these types of steps during the verification phase of data review:

- Confirming the equipment operates such that the quantity of sample meets requirements, which includes sampling periods, sample volume, and number of samples (i.e., completeness)

- Confirming an appropriate sampling medium was used to collect the sample

- Confirming the sample analyses performed meet requirements and are appropriate to the sample medium
- Confirming that chain of custody and physical integrity of the samples were acceptably maintained
- Confirming that sample data are handled properly and available within time constraints

Contract Laboratory personnel and MSA EIS personnel in consultation with CHPRC ECOs and environmental support SMEs generally follow as applicable some or all of these types of steps during the validation phase of data review:

- Identifying values acquired under significant deviations from standard operating procedures and possibly correcting or removing them
- Identifying and correcting mistakes and errors during data transfer
- Identifying periods during which baselines or calibrations deviated from tolerable limits, and then identifying, denoting, correcting, or removing data acquired during those periods
- Checking the internal consistency of simultaneous measurements, making corrections when possible, and denoting when corrections are not possible
- Checking outlying values to determine whether a measurement process error was responsible
- Checking consistency of measurements with expectations

Once these verification and validation steps have been completed, the data may still exhibit indications of a statistically significant anomalous event or the appearance of a measurement error that has not been satisfactorily explained. At this point, the data evaluator traces the path of the measurement to establish whether a measurement error is involved. If that explanation is reasonably eliminated, the data may be used as indicative of a real event.

The data management activities further include ABCASH data downloading and effluent flow data entry into the MSA-managed Environmental Reporting System (ERS), release and flow calculations, and data formatting for reports. Most laboratory analytical data are formatted for direct electronic downloading from ABCASH into ERS, but some data, such as flow measurements, currently are not and must be loaded using separately created files. MSA EIS staff who verify and validate effluent and environmental data are experienced with the mathematical methods described in this document and with commonly used units of measure.

The majority of the data calculations are performed within ABCASH and ERS. For instance, ABCASH calculates sample concentrations in µCi/mL by dividing the amount of radioactivity (in either µCi or pCi) per sample by the volume of sampled emissions. ERS performs calculations by multiplying laboratory analytical data (e.g., concentrations in µCi/mL) by stack emission or liquid effluent volumes to yield total releases of analytes, usually in curies. These calculations also render average concentrations of analytes, weighted over the selected time range of reporting. These data are presented in ERS-generated release reports. Individual sample and flow data, including actual sampling periods, are presented in ERS-generated trend reports. The resulting release and trend data are verified and validated through:

- Evaluation by cognizant MSA EIS staff members and CHPRC ECOs and support SMEs who compare the data for reasonableness against historical data of generally the past 5 years or more years if indicated; this evaluation is an ongoing process throughout each calendar year as effluent data for that year accumulate in ABCASH and ERS.

- Periodic evaluation throughout the calendar year by MSA EIS and CHPRC ECOs and support SMEs and qualified representatives of facilities that generated the air emissions.
- Further in-depth evaluation by MSA EIS staff and qualified CHPRC facility representatives during the yearly review cycle required before annual reports of air emission and liquid effluent data are published.
- An ERS anomaly program that identifies data lying outside preset control ranges based on compliance levels and degree of increase, or decrease, of release in relation to historical trends; if suspect data are identified, they and any identified underlying causes are investigated until determined to be genuine, erroneous, or perpetually suspect (i.e., no definitive explanation found). Suspect data are corrected to the fullest extent possible. For cases in which no complete resolution can be further developed, prudently applied scientific judgment is the only recourse for resolving as much as practicable any questionable data.

  Dispositions of data may include the primary option of retaining and reporting the data as is, or keeping the data in the databases but not reporting them. Nonreporting of questionable data should be supported by adequate scientific reasoning, such as a "measured" radionuclide having too short a half-life to reasonably exist in measurable amounts in the emissions of a particular source term. The potential impact of questionable data to the dose standard for the Hanford Site is also considered when dispositioning questionable data. If, for instance, based upon historical measurements, the ostensible presence of a short-lived radionuclide in a sample result were not expected and its dose impact were inconsequential, the inclination would generally be to not report that value.

Sampling and analysis of radionuclide air emissions are performed in accordance with the schedule in the latest revision of the Contract Laboratory statement of work document. The resulting sampling and analytical data are available in ABCASH for the vast majority of stacks. MSA EIS effluent scientists and engineers, and CHPRC scientists and health physicists evaluate those analytical results throughout each year. Normally this evaluation, a key part of the verification and validation process, is done in concert with cognizant CHPRC facility personnel who participate in the evaluation by reviewing periodic data packages compiled by MSA EIS. The data are evaluated for consistency with historically expected concentrations for each emission source; sufficient sampling times and/or volumes; anomalies in timer, totalizer, rotameter, and/or vacuum gauge readings; and laboratory analytical uncertainties, being mindful of contractually stipulated MDCs. Eventually, after the data are validated within ABCASH, they are transferred to ERS, which has a built-in anomaly detection program. This program identifies potential statistical discrepancies in the data, usually involving sampling time overlaps and concentrations that may indicate a deviation two- to three-sigma higher than historical averages.

Essential to verifying and validating emissions data is reviewing basic and typical sampling parameter information associated with nearly every sample. Table C-3 provides the sampling parameter information.

**Table C-3. Sampling Parameter Information**

| | |
|---|---|
| **Date On** | Date sample filter installed in record sampler (should match date off of previous sample collected) |
| **Time On** | Time sample filter installed in recorded sampler (typically should be within 30 minutes of the time off of the previous sample) |
| **Date Off** | Date sample filter collected |
| **Time Off** | Time sample filter removed from record sampler |
| **Timer hours** | Total hours sample collected (value taken from the timer may differ from actual elapsed sampling time, in which case, the timer value is normally less) |

**Table C-3. Sampling Parameter Information**

| | |
|---|---|
| **Vacuum On** | Measure of suction pressure through stack sampling system with sampling media |
| **Vacuum Off** | Measure of suction pressure through stack sampling system just prior to sampling media removal |
| **Rotameter On** | Measure of flow rate through sampling line with sampling media installed; flow rate is typically at or near 2 cfm or as appropriate for the particular stack sampling system for near-isokinetic collection of stack particulate emission sample |
| **Rotameter Off** | Measure of flow rate through sampling line with sampling media removed |

MSA EIS and Contract Laboratory personnel, with input from CHPRC ECOs and SMEs, perform the following when anomalies are noted between the data received from Contract Laboratory and the sampling information:

- When dates or times are missing, contact the point-of-contact at the facility from which the emission sample originated and request documented information on the sample in question from the respective sample logbook or other source of reliable information. If the date on or time on are not available, enter the date off and time off of the immediately preceding sample if such an example exists. If the date off or time off is missing, enter the date on and time on from the sample of the immediately succeeding week, if such an example exists.
- Document all corrections in ABCASH to maintain an audit trail.

## C5 References

The following references are cited in the main text of this appendix as well as in the supporting information.

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# Supporting Information C-1

# 105-KW Air Sparger

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**Compliance Document Contents:**

1. 40 CFR 61, Subpart H (revised as of July 1, 1998)
2. DOE/RL-98-02, *Radioactive Air Emissions Notice of Construction for 105-KW Filter Vessel Sparging Vent* (Integrated Document Management System [IDMS] Accession #D198040486)
3. Letter AIR 98-307, "Notice of Construction for the 105 K West Filter Vessel Sparging Vent" (IDMS Accession #DA03908661)
4. Letter EPA, 1998, "98-EAP-448 dated August 21, 1998" (IDMS Accession #D8195755)
5. Letter 99-SFD-190, "Contract No. DE-AC06-96RL13200 – Signed Record of Decision (ROD) for the K Basins Interim Remedial Action" (IDMS Accession #D8100132)
6. Letter 00-SFO-076, "Contract No. DE-AC06-96RL13200 – Implementation of K Basins Interim Remedial Action Record of Decision (ROD)" (IDMS Accession #D8209343)
7. Meeting Minutes FH-0005889, "Routine Technical Assistance Meeting – WDOH/DOE-RL/ DOE-ORP/PHMC/PNNL/BHI" (IDMS Accession #D8467852)

## C-1 Alternative Monitoring Method Per 40 CFR 61.93(b)(3)

In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the Air Sparger at the 105-KW Basin with the radionuclide emission requirements defined in the alternative monitoring method that was submitted and approved by EPA per 40 CFR 61.93(b)(3), "Emission Monitoring and Test Procedures" (revised as of July 1, 1998), which is applicable to this emission unit which transitioned into CERCLA per References 6 and 7 above and the QA Program elements described below. This stack has been assigned an EDP code of Y249.

### C-1-1.0 Purpose and Background

This section provides the following requirements associated with the alternative monitoring method:

- Stack sample collection methods appropriate for radionuclides
- Radiochemical methods that are used to determine the amounts of radionuclides collected by the stack sampling
- QA methods that are conducted in conjunction with these measurements.

The entire effluent stream from this stack passes through two 12 by 12 in. high proficiency particulate air (HEPA) filters in series. The approved alternate stack monitoring method includes a destructive test of downstream filter that is used for the characterization of emissions. This involves the coring of the HEPA filter and chemically digesting it for subsequent radiochemical analyses.

Many different types of facilities release radionuclides into air. These radionuclides differ in the chemical and physical forms, half-lives, and type of radiation emitted. The appropriate combination of sample extraction, collection, and analysis for an individual radionuclide is dependent upon many interrelated factors including the mixture of other radionuclides present. Because of this wide range of conditions, no single method for monitoring or sample collection and analysis of a radionuclide is applicable to all types of facilities. Therefore, a series of methods based on "principles of measurement" is described for monitoring and sample collection and analysis that are applicable to the measurement of radionuclides found in effluent streams at stationary sources. This approach provides the user with the flexibility to

choose the most appropriate combination of monitoring and sample collection and analysis methods that are applicable to the effluent stream to be measured.

**C-1-2.0 Stack Monitoring and Sample Collection Methods**

Monitoring and sample collection methods are described based on "principles of monitoring and sample collection" that are applicable to the measurement of radionuclides from effluent streams at stationary sources. Radionuclides of most elements will be in the particulate form in these effluent streams and can be readily collected using suitable filter media. Radionuclides of hydrogen, oxygen, carbon, nitrogen, the noble gases, and in some circumstances, iodine will be in the gaseous form. Radionuclides of these elements in a gaseous form are not required to be monitored at this stack.

**C-1-2.1 Radionuclides as Particulates**

*Response*: The entire effluent stream from the processes that either vent passively or actively through this stack passed through two HEPA filters in series to remove the particulates. The HEPA filter has a high efficiency for removal of sub-micron particles and is designed in accordance with ASME AG-1, *Code on Nuclear Air and Gas Treatment*.

**C-1-3.0 Radionuclide Analysis Methods**

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in the contractual documents.

**C-1-4.0 Quality Assurance Methods**

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative and are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-1-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Refer to Chapter C1 in this QAPjP. The Organization Chart is located on the CHPRC Environmental Protection website. Chapter C1 documents most of the roles and responsibilities associated with these activities. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220.

**C-1-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: Refer to Section C1.2 and Chapter C2 in this QAPjP. Administrative controls are also in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-1-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including where applicable:

**C-1-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: The sample site is the second of two HEPA filters in series which filters 100% of the air being exhausted out the stack. The sample is assigned EDP code Y249. As a result, one sampling site with one selected sample point exists as an approved alternative.

**C-1-4.3.2** A description of the sampling probe and representativeness of the samples.

*Response*: The approved alternate monitoring method involves the destructive analysis of a 12 by 12 in. HEPA filter that is removed from the system for characterization. Through it passes 100% of the air that is either passively or actively emitted from the system. This HEPA filter is the second HEPA filter of two in series used to filter the particulate emissions from this stack. From this HEPA filter, core samples are taken and then transferred to the delivery location where they will be sent to the laboratory to be chemically digested in preparation for radiochemical analysis..

**C-1-4.3.3** A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: This requirement is not applicable. Compliance is demonstrated by the continuous sampling of emissions (see next section).

**C-1-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: The approved alternate monitoring method involves the destructive analysis of a 12 by 12 in. HEPA filter that is removed from the system for characterization. Through it passes 100% of the air that is either passively or actively emitted from the system. This HEPA filter is the second HEPA filter of two in series used to filter the particulate emissions from this stack. From this HEPA filter, core samples are taken and then transferred to the MSA Contract Laboratory where they will be chemically digested in preparation for radiochemical analysis. Removing the HEPA filter and characterizing it is done every 3 months in the event sparging is performed. In the case where sparging is not performed and the stack only acts as a passive vent to the system, the removal and characterization of the HEPA filter shall be done annually. The second stage HEPA filter is assigned EDP code Y249. There are no calibration requirements associated with this alternative monitoring method other than those associated with the radiochemical analyses conducted by the laboratory in accordance with the latest revision of Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-1-4.3.5** A description of the Contract Laboratory analytical procedures used for each radionuclide measured, including frequency of analysis, calibration procedures and frequency of calibration.

*Response*: The radionuclides which are required to be measured and laboratory analysis procedures are included as requirements in contractual documents.

**C-1-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: Per the approved alternate method of monitoring that has been approved by EPA, sample flow measurements are not required.

**C-1-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: Per the approved alternate method of monitoring that has been approved by EPA, effluent flow rate measurements are not required.

**C-1-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 in this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-1-4.5** A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-1-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to the main body of this QAPjP, PRC-PRO-EP-15334, and ABCASH.

**C-1-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-1-1, “Maintenance, Calibration, and Field Check Requirements.”

*Response*: Per the approved alternate method of monitoring that has been approved by EPA, the maintenance, calibrations, and field checks found in 40 CFR 61, Method 114 Table 2 are not applicable.

**C-1-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-1-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**Table C-1-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | N/A |
| Inspect Pitot tubes for contaminant deposits | N/A |
| Inspect Pitot tube systems for leaks | N/A |
| Inspect sharp-edged nozzles for damage | N/A |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | N/A |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | N/A |
| Clean transport lines | N/A |
| Inspect or test the sample system for leaks | N/A |
| Check mass flow meters of sampling systems with a secondary or transfer standard | N/A |
| Check sampling flow rate through critical flow venturis | N/A |
| Inspect rotameters of sampling systems for presence of foreign matter | N/A |
| Check response of stack flow rate systems | N/A |
| Calibration of flow meters of sampling systems | N/A |
| Calibration of effluent flow measurement devices | N/A |
| Calibration of timing devices | N/A |

HEPA = high efficiency particulate air
N/A = not applicable

**C-1-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and descriptions of corrective actions.

*Response*: Refer to Sections C2.2 in this QAPjP.

**C-1-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

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# Supporting Information C-2

# 291-A-1 (PUREX) Stack

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# C-2 Method 114 Comparison for 291-A-1 Stack

In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the 291-A-1 Stack at the Plutonium-Uranium Extraction (PUREX) Plant with the radionuclide emission requirements defined in 40 CFR 61, Appendix B, Method 114. Requirements from Method 114 are directly quoted by section number. Responses that detail the state of compliance immediately follow the requirements.

### C-2-2.1 Radionuclides as Particulates

The extracted effluent stream is passed through a filter to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, "Filter Media") shall be followed in using filter media to collect particulates (incorporated by reference—see 40 CFR 61, Subpart H, Section 61.18).

*Response:* Particles from sampled stack emissions are collected on a 47 mm-diameter Versapor® 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric. This filter is rated in ANSI/HPS N13.1–1999, Table D.1 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

### C-2-2.2 Radionuclides as Gases

The following sections provide guidance for radionuclides as gases.

#### C-2-2.2.1 Tritium (H-3)

Tritium in the form of water vapor is collected from the extracted effluent sample by sorption, condensation, or dissolution techniques. Appropriate collectors may include silica gel, molecular sieves, and ethylene glycol or water bubblers.

Tritium in the gaseous form may be measured directly in the sample stream using Method B-1, collected as a gas sample, or may be oxidized to tritiated water using a metal catalyst and collected as described above.

*Response:* Irradiated fuel has not been introduced into PUREX for many years. No dissolutions have been performed since late 1989. Gaseous sampling systems have shown that the levels of tritium have fallen to levels at or below analytical detection limits, which are also well below environmental release and monitoring limits. Consequently, sampling for tritium is no longer required or performed.

#### C-2-2.2.2 Iodine

Iodine is collected from an extracted sample by sorption or dissolution techniques. Appropriate collectors may include charcoal, impregnated charcoal, metal zeolite, and caustic solutions.

*Response:* Irradiated fuel has not been introduced into PUREX for many years. No dissolutions have been performed since late 1989. Iodine-131 has decayed to essentially zero, leaving only the longer-lived iodine-129 (I-129). Despite the low activity and low dose potential of I-129, sampling and analysis for iodine (using silver-zeolite cartridges) continues, since I-129 emissions remain the largest contributor of actual emissions doses from the 291-A-1 Stack, and the results have value in tracking offsite radionuclides emitted from Hanford Site stacks. Iodine sampling at the 291-A-1 Stack is not required by 40 CFR 61 or WAC 246-247.

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® Versapor is a registered trademark of the Pall Corporation, Port Washington, New York.

#### C-2-2.2.3 Argon, Krypton, and Xenon

Radionuclides of these elements are either measured directly by an in-line or off-line monitor, or are collected from the extracted sample by low-temperature sorption techniques. Appropriate sorpers may include charcoal or metal zeolite.

*Response*: Irradiated fuel has not been introduced into PUREX for many years. No dissolutions have been performed since late 1989. Sampling for these gaseous radionuclides is no longer required or performed. The release of other radioactive gases decreased even more rapidly than for these nuclides. No 40 CFR 61 requirement, WAC 246-247 requirement, or FF-01 license requirement (WDOH 2017) exists requiring sampling for these gaseous radionuclides.

#### C-2-2.2.4 Oxygen, Carbon, Nitrogen, and Radon

Radionuclides of these elements are measured directly using an in line or off line monitor. Radionuclides of carbon in the form of $CO_2$ may be collected by dissolution in caustic solutions.

*Response*: Irradiated fuel has not been introduced into PUREX for many years. No dissolutions have been performed since late 1989. Gaseous sampling systems have shown that the levels of 14C have fallen to levels at or below analytical detection limits, which are also well below environmental release and monitoring limits. Consequently, sampling for this radionuclide is no longer required or performed.

### C-2-3.0 Radionuclide Analysis Methods

*Response:* The analysis methods have been evaluated by cognizant MSA personnel and are included in contractual documents.

### C-2-4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative and are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-2-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Chapter C1 in this QAPjP documents most of the roles and responsibilities associated with these activities. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220. Project-specific roles and responsibilities are located in PRC-MP-MS-003, *Integrated Safety Management System/Environmental Management System Description (ISMSD)*.

**C-2-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: The facility is shut down and processing has ceased; therefore, unplanned operations resulting in increased emissions are unlikely. Administrative controls are in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-2-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including where applicable:

**C-2-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: The sample collection system was constructed to meet the ANSI-N13.1-1969 standard and no modifications have been performed that would require upgrading the sample collection system to the ANSI/HPS-N13.1-1999 standard requirements. Only one sampling site is currently being used for obtaining samples from the PUREX 291-A-1 Stack. The elevation of the active sampling site is 22.6 m (74 ft) abovegrade. The location was chosen to ensure a well-mixed, fully developed flow, in compliance with the criteria of ANSI-N13.1-1969 (Section 4.2.1.2: "The sampling point should be a minimum of five diameters downstream from abrupt changes in flow direction or prominent transitions") and of 40 CFR 60, Appendix A-1, Method 1 (Section 11.1.1: "Sampling and/or velocity measurements are performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance").

The 291-A-1 Stack is 2.1 m (7 ft) in diameter, based on the dimension of a steel liner inside the concrete stack. The last major disturbance in the air flow is at the connection of the underground effluent tunnel to the stack where the air is redirected up the stack. This transition is at grade level; therefore, the sampling site is more than 10 times the diameter downstream from the last major disturbance.

The 291-A-1 Stack is 61 m (200 ft) high, or more than 28 times the diameter abovegrade. The active sampling site is therefore approximately 18 diameters from the top of the stack.

The continuous sampling involves particulate collection on a record filter (EDP code A006), and iodine gas collection on a silver-zeolite cartridge (EDP code A007). To ensure representative particulate sampling, the sample is withdrawn from the stack via a Kurz® six-nozzle multipoint probe. The number and position of nozzles were designed to comply with ANSI N13.1-1969 to provide representative sampling of stack emissions.

**C-2-4.3.2** A description of the sampling probe and representativeness of the samples.

*Response*: To ensure representative particulate sampling, the sample probe is located, designed, and operated in accordance with ANSI N13.1-1969. The probe is located over five diameters downstream from abrupt changes in accordance with ANSI N13.1-1969, Section 4.2.1.2. The Kurz probe (identified as SSP-V18-2) has six nozzles, located at centers of equal annular areas, in accordance with ANSI/HPS N13.1-1999, Appendix A3. The sample is withdrawn continuously from the stack at a near-isokinetic flow rate in accordance with ANSI N13.1-1969, Section 4.2.2.3. The probe and sample line are made entirely of stainless steel. The probe design and operation comply with the required standards for representative sampling of stack emissions.

**C-2-4.3.3** A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

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® Kurz is a registered trademark of Kurz Instruments, Inc., Monterey, California.

*Response*: This requirement is not applicable as the 40 CFR 61.93(b)(2)(ii) references the applicability of the ANSI N13.1-1969 standard which does not require continuous monitoring. Compliance is demonstrated by the continuous sampling of emissions (see next section).

**C-2-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: Sample air is withdrawn continuously from the stack effluent stream by the probe as described in Section C-2-4.3.2.

The sample is collected in two stages. The first stage is a record filter (EDP code A006) for particulate collection. The second is a silver-zeolite cartridge (EDP code A007) for iodine gas collection. The particulate filter and silver zeolite cartridge are exchanged routinely and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the FF-01 license (EU369; WDOH 2017). Iodine 129 is also analyzed for based on the rationale outlined in Section C-2-2.2.2. Sample collectors are not amenable to calibration; however, sample flow rate measurement instruments are calibrated as discussed in Section C-2-4.3.6.

**C-2-4.3.5** A description of the Contract Laboratory analytical procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: References to the laboratory analytical requirements are included in contractual documents.

**C-2-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: The sample flow rate measurement system consists of a rotameter and vacuum gauge. The sampling systems are inspected routinely and flow rate adjusted by a manual flow control valve to maintain a constant flow. Calibrations are performed annually in accordance with PRC-PRO-EP-15333, PRC-PRO-MN-490, *Calibration Management Program*, and with Table C-2-1. Precision, accuracy and completeness are met for stack flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-2-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: The stack flow is relatively constant, so the emissions flow rate is measured annually by traverses with a standard Pitot tube in the rectangular duct upstream of the base of the stack using a variant of the Pitot traverse method described in 40 CFR 60, Appendix A-1, Method 2. This variant Pitot traverse procedure was approved by EPA (EPA 9501426) because it was used in certifying the stack flow meter to 40 CFR 52, “Approval and Promulgation of Implementation Plans,” Appendix E, “Performance Specifications and Specification Test Procedures for Monitoring Systems for Effluent Stream Gas Volumetric Flow Rate”). Flow measurement Pitot traverses are performed by V&B personnel. Calibration of V&B equipment is discussed in Section 1.5 in the main text of this EQAPP. Precision, accuracy and completeness are met for stack flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**Table C-2-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | N/A. There is no thermal anemometer. This is not a component of the approved sampling system; therefore, no cleaning is conducted. |
| Inspect Pitot tubes for contaminant deposits | N/A. There are no Pitot tubes. This is not a component of the approved sampling system; therefore, no cleaning is conducted. |
| Inspect Pitot tube systems for leaks | N/A. There are no Pitot tubes. This is not a component of the approved sampling system; therefore, no cleaning is conducted. |
| Inspect sharp-edged nozzles for damage | At least annually or after maintenance that could cause damage. See Section 4.3.4 of CPSM-PRO-OP-50660. |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | Annually. See Section 4.3.3 of CPSM-PRO-OP-50660. |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | Annually. See Section 4.4.3 of CPSM-PRO-OP-50660. |
| Clean transport lines | Visible deposits for HEPA-filtered applications; surface density of 1 g/cm$^2$ for other applications. This is an "as required" activity in the event that the inspection of the rotameter shows any visible deposits. |
| Inspect or test the sample system for leaks | At least annually. See Section 4.2.1 of CPSM-PRO-EP-54292. |
| Check mass flow meters of sampling systems with a secondary or transfer standard | N/A. There are no stack mass flow meters. This is not a component of the approved sampling system; therefore, no check is conducted. |
| Inspect rotameters of sampling systems for presence of foreign matter | At the start of each sampling period. See Section 4.2.1 of CPSM-PRO-EP-54292. |
| Check response of stack flow rate systems | N/A. There are no effluent flow measurement devices at PUREX. This is not a component of the approved sampling system. The Vent & Balance team, employed from a separate DOE contractor, measures the effluent flow annually. |
| Calibration of flow meters of sampling systems | |
| Calibration of effluent flow measurement devices | N/A. An installed effluent flow measurement device is not a component of the approved sampling system. The Vent & Balance team, employed from a separate DOE contractor, measures the effluent flow annually using a calibrated pitot tube. |
| Calibration of timing devices | N/A. Timing devices are not a component of the approved sampling system; therefore, no calibration is conducted. |

References: CPSM-PRO-EP-54292, *Central Plateau Risk Management (CPRM) PUREX Stack Sampling.*
CPSM-PRO-OP-50660, *NESHAPS Stack Inspection and Cleaning*.

DOE = U.S. Department of Energy
HEPA = high efficiency particulate air
N/A = not applicable
PUREX = Plutonium Uranium Extraction Facility

**C-2-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 of this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-2-4.5** A QAP shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-2-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to the main body of this QAPjP, PRC-PRO-EP-15334, and ABCASH.

**C-2-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-2-1, "Maintenance, Calibration, and Field Check Requirements."

*Response*: Refer to Table C-2-1, PRC-PRO-EP-15334, and to facility-specific procedures.

**C-2-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-2-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-2-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and descriptions of corrective actions.

*Response*: Refer to Section C2.2 in this QAPjP.

**C-2-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

**C-2-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-2-2, "CHPRC Best Management Practice Requirements."

*Response*: Refer to Table C-2-2, PRC-PRO-EP-15333, and facility-specific procedures.

**Table C-2-2. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | Weekly |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps) | Weekly |

CHPRC = CH2M HILL Plateau Remediation Company
HEPA = high efficiency particulate air

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# Supporting InformationC-3

# 291-T-1 (T Plant)

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**Compliance Document Contents:**

Letter AIR 17-206 dated February 21, 2017.

## C-3 Method 114 Comparison for Stack 291-T-1

### C-3-2.1 Radionuclides as Particulates

The extracted effluent stream is passed through filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, "Filter Media") shall be followed in using filter media to collect particulates (incorporated by reference—see 10 CFR 61, Subpart H, Section 18).

*Response*: Particles from sampled stack emissions are collected on a 47 mm-diameter Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric. This filter is rated in Table D.1 of ANSI/HPS N13.1–1999 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm. The sample filter is exchanged biweekly for gross alpha and gross beta analysis and the filters composited quarterly for analysis of specified particulate radionuclides.

### C-3-2.2 Radionuclides as Gases

*Response*: There is no requirement to perform gaseous radionuclide sampling because T Plant is no longer processing radioactive materials that might cause gaseous radionuclide emissions.

### C-3-3.0 Radionuclide Analysis Methods

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in contractual documents.

### C-3-4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative, are of known precisian and accuracy, and include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-3-4.1** The organizational structure functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Responsibilities for radioactive air emissions sampling activities are described in Chapter C1 in this QAPjP. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220. The T Plant facility-specific organization charts and roles and responsibilities policy are located on the Waste & Fuels Management Project website.

**C-3-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: Refer to Section C1.2, and Chapters C2 and C4 in this QAPjP. Administrative controls are also in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-3-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including, where applicable:

**C-3-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: Refer to 06-AMCP-0153, specifically the *291-T-1 Stack Equivalency Demonstration to ANSI N13.1-1999* attachment.

**C-3-4.3.2** A description of sampling probes and representativeness of the samples.

*Response:* Refer to the attachments within 06-AMCP-0153 for a description of the sampling probes.

**C-3-4.3.3** A description of any continuous monitoring systems used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: The 291-T-1 Stack monitoring requirements are governed by the ANSI/HPS N13.1-1999 standard as a result of a significant modification made in 2004. The unabated potential to emit submitted in DOE/RL-2004-50, *Radioactive Air Emissions Notice of Construction for Consolidated T Plant Operations*, is in excess of 5 mrem/year thereby making this stack a potential impact category (PIC) 1 per the ANSI/HPS N13.1-1999 standard. A PIC 1 stack requires the use of continuous sampling of record emissions and in-line, realtime monitoring with alarm capability (continuous air monitor [CAM]). Compliance is demonstrated by the continuous sampling of emissions (see next section) and operation of collocated alpha and beta/gamma CAMs. The CAM detection sensitivity for alpha is 2.0E-11 µCi/mL (plutonium-239 [Pu-239]) and beta/gamma is 1.0E-11 µCi/mL (strontium-90 [Sr-90]). Calibrations are performed annually in accordance with PRC-PRO-EP-15333, PRC-PRO-MN-490, and T Plant specific work package instructions.

**C-3-4.3.4** A description of the sample collection systems for each radionuclide measured including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: Sample air is withdrawn continuously from the stack emissions stream by the probe as described in Section C-3-4.3.2 (refer to the attachments within 06-AMCP-0153). This air flows through the sample line, and particulate radionuclides are collected on a sample filter. The sample filters are exchanged routinely and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the FF-01 license (WDOH 2017). Sample collectors are not amenable to calibration; however, sample flow rate measurement instruments are calibrated as discussed in Section C-3-4.3.6.

Radionuclide particulate sampling is described in project specific Radiological Control procedures.

**C-3-4.3.5** A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: The laboratory analytical requirements are included in contractual documents.

**C-3-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: The sample flow rate measurement system consists of a flow meter that accounts for the total flow volume and instantaneous flow rate. The sampling systems are inspected routinely and flow rate adjusted by a manual flow control valve to maintain a constant flow. Calibrations are performed annually in accordance with PRC-PRO-EP-15333, PRC-PRO-MN-490, and Table C-3-1. Precision, accuracy and completeness are met for sample flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**Table C-3-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | N/A. Not a component of the approved sampling system; therefore, no inspection is conducted |
| Inspect Pitot tubes for contaminant deposits | |
| Inspect Pitot tube systems for leaks | |
| Inspect sharp-edged nozzles for damage | At least annually or after maintenance that could cause damage and documented in a PM/S |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | Annually and documented in a PM/S |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | |
| Clean transport lines | Visible deposits for HEPA-filtered applications; surface density of 1 g/cm$^2$ for other applications and documented in a PM/S (cleaning performed only if deposits are found) |
| Inspect or test the sample system for leaks | At least annually and documented in a PM/S |
| Check mass flow meters of sampling systems with a secondary or transfer standard | |
| Inspect rotameters of sampling systems for presence of foreign matter | N/A. Not a component of the approved sampling system; therefore, no inspection is conducted |
| Check response of stack flow rate systems | N/A. Alternate Method approved for effluent flow measurement) (Alternate Method request number 03-RCA-0163 and EPA 0401888) |
| Calibration of flow meters of sampling systems | At least quarterly and documented in a PM/S |
| Calibration of effluent flow measurement devices | N/A. Alternative Method approved for effluent flow measurement (Alternate Method request number 03-RCA-0163 and EPA 0401888) |
| Calibration of timing devices | N/A. Not a component of the approved sampling system; therefore, no calibration is conducted |

References: 03-RCA-0163, "National Emission Standards for Hazardous Air Pollutants: Request for Approval of an Alternate Method for Flow Measurements for the 291-T-1 Stack."

EPA 0401888, Re: Approval of an Alternate Method for Flow Measurement in the 291-T-1 Stack.

HEPA = high-efficiency particulate air

N/A = not applicable

PM/S = Periodic Maintenance and Surveillance

**C-3-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: An alternative method has been approved by EPA and WDOH (EPA 0401888 and AIR 03-601). Precision, accuracy and completeness are met as described in Section C3.1, bullet 4.4 in this QAPjP for approved alternative methods.

**C-3-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements at the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 in this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-3-4.5** A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-3-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to PRC-PRO-EP-15334 and ABCASH.

**C-3-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-3-1, “Maintenance, Calibration, and Field Check Requirements.”

*Response*: Refer to Table C-3-1, PRC-PRO-EP-15334, and facility-specific procedures.

**C-3-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-3-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-3-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and descriptions of corrective actions.

*Response*: Refer to Section C2.2 in this QAPjP.

**C-3-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

**C-3-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-3-2, "CHPRC Best Management Practice Requirements."

*Response*: Refer to Table C-3-2, PRC-PRO-EP-15333, and to facility-specific procedures.

**Table C-3-2. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | Weekly |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps, CAMs, mass flow controllers) | Weekly |

CAM = continuous air monitor
CHPRC = CH2M HILL Plateau Remediation Company
HEPA = high efficiency particulate air

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# Supporting Information C-4

# 291-S-1 (REDOX)

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# C-4 Method 114 Comparison for 291-S-1 Stack

In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the 291-S-1 Stack at the Reduction-Oxidation (REDOX) Facility with the radionuclide emission requirements defined in 40 CFR 61, Appendix B, Method 114. Requirements from Method 114 are directly quoted by section number. Responses that detail the state of compliance immediately follow the requirements.

**C-4-2.1 Radionuclides as Particulates**

The extracted effluent stream is passed through a filter to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, "Filter Media") shall be followed in using filter media to collect particulates (incorporated by reference—see 40 CFR 61, Subpart H, Section 61.18).

*Response*: Particles from sampled stack emissions are collected on a 47 mm diameter Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric. This filter is rated in ANSI/HPS N13.1–1999, Table D.1 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

**C-4-2.2 Radionuclides as Gases**

*Response*: There is no requirement to perform gaseous radionuclide sampling because REDOX is no longer separating radioactive materials that might cause gaseous radionuclide emissions.

**C-4-3.0 Radionuclide Analysis Methods**

*Response:* The analysis methods have been evaluated by cognizant MSA personnel and are included in contractual documents.

**C-4-4.0 Quality Assurance Methods**

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative and are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

*Response*: The entirety of Section 4.0 details the QAP instituted for the 291-S-1 Stack.

**C-4-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Chapter C1 in this QAPjP documents most of the roles and responsibilities associated with these activities. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220. Project-specific roles and responsibilities are located in PRC-MP-MS-003.

**C-4-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: The facility is shut down and processing has ceased; therefore, unplanned operations resulting in increased emissions are unlikely. Administrative controls are in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-4-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including where applicable.

**C-4-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: The sample collection system had recently gone through a modification from a minor to a major stack when it was transferred from the Air Operating Permit (AOP) to CERCLA (letter 19-ESQ-0086). As a result, the sample collection system was upgraded to the ANSI/HPS-N13.1-1999 standard with some approved alternatives. Only one sampling site is currently being used for obtaining samples from the REDOX 291-S-1 Stack. The probe that is sampling the effluent in the stack is a rake probe that has five nozzles used to sample the effluent.

The elevation of the active sampling site is approximately 15.24 m (50 ft) abovegrade. The sample location meets the location requirement of 40 CFR 60, Appendix A-1, Method 1 (Section 11.1.1: "Sampling and/or velocity measurements are performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance"). The 291-S-1 Stack diameter is not confirmed due to the inability to remove the rake probe. Good engineering judgement has shown that it is approximately 1.83 m (6 ft) based on the length of the rake probe in drawing H-2-95383, *291-S-1 Probe Assembly Stack Sampler/Monitor*. The last major disturbance in the air flow is where the connection of the underground effluent tunnel is redirected up the stack. With the rake probe at the 15.24 m (50 ft) level the sampling location is approximately eight duct diameters upstream of the last flow disturbance. The 291-S-1 Stack is 61 m (200 ft) high, or more than 28 times the diameter above grade.

No ports exist at this location to verify cyclonic flow, velocity coefficient of variation, and tracer gas concentration profiles. This location cannot be verified as meeting the ANSI/HPS N13.1-1999 standard. This alternative was accepted during the transition to CERCLA through the removal action work plan (RAWP) and the air monitoring plan (AMP).

**C-4-4.3.2** A description of the sampling probe and representativeness of the samples.

*Response*: The continuous sampling involves particulate collection on a record filter (EDP code S006). The probe is a rake with five nozzles and has not been aerosol tested. The probe cannot be removed for inspection without potentially affecting the structural integrity of the stack masonry shell. The probe has been cemented into place. All other applicable inspections can be performed.

Although the stack was upgraded as a part of the modification, the sample location predates the ANSI/HPS N13.1-1999 standard (and ANSI/HPS N13.1-1969 standard) and was established in accordance with DOE protocols. The sample location is based on the original design criteria and the use of the rake-style probe was accepted as an alternative in the RAWP and AMP. A rake-style probe has already been approved for use at other Hanford Site facilities (e.g., T Plant, WESF, Waste Receiving and Processing Facility, PUREX).

A review of the REDOX sample results over the past 10 years indicates consistent low-level emissions consistent with the surveillance and maintenance status of the facility and demonstrates the ability of the probe to collect a precise, accurate, and complete sample over time.

**C-4-4.3.3** A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: After the recent modification from regulation under the AOP to regulation under CERCLA the REDOX Stack is now a "major" point source. The modification means that the stack is now a PIC 2, per the ANSI/HPS N13.1-1999 standard, and requires continuous monitoring for record emissions and retrospective, offline periodic analysis. Compliance is demonstrated through the continuous measurement of emissions using a rotameter and a vacuum pump. Flows have proven to be within 20% and sensitivity is not applicable. Calibrations are performed annually in accordance with PRC-PRO-EP-15333, PRC-PRO-MN-490, and REDOX-specific work package instructions.

**C-4-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: Sample air is withdrawn continuously from the stack effluent stream by the probe as described in Section C-4-4.3.2.

The sample is collected with a record filter (EDP code S006) for particulate collection. The particulate filter is exchanged routinely and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the RAWP and AMP. Sample collectors are not amenable to calibration; however, sample flow rate measurement instruments are calibrated as discussed in Section C-4-4.3.6.

**C-4-4.3.5** A description of the Contract Laboratory analytical procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: References to the laboratory analytical requirements are included in contractual documents.

**C-4-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: The sample flow rate measurement system consists of a rotameter and vacuum gauge. The sampling systems are inspected routinely and flow rate adjusted by a manual flow control valve to maintain a constant flow. Calibrations are performed annually in accordance with PRC-PRO-EP-15333, PRC-PRO-MN-490, and with Table C-4-1. Precision, accuracy and completeness are met for stack flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**Table C-4-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | N/A. There is no thermal anemometer. This is not a component of the approved sampling system; therefore, no cleaning is conducted. |
| Inspect Pitot tubes for contaminant deposits | N/A. This is not a component of the approved sampling system; therefore, no cleaning is conducted. |
| Inspect Pitot tube systems for leaks | N/A. This is not a component of the approved sampling system; therefore, no cleaning is conducted. |

**Table C-4-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Inspect sharp-edged nozzles for damage | N/A. This is an approved alternative in the DOE/RL-2017-06, *Removal Action Work Plan for the REDOX Complex*, Rev. 0 REDOX RAWP. The probe cannot be removed for inspection without affecting the structural integrity of the stack masonry shell. The probe has been cemented into place. A quarterly evaluation of 291S-001 Stack bi-weekly record sample with comparison to interior workplace air monitoring (adjusted for the sand filter removal efficiency) and bi-weekly NFM data will be qualitatively performed as an alternative to the annual inspection. |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | N/A. This is an approved alternative in the REDOX RAWP. The probe cannot be removed for inspection without affecting the structural integrity of the stack masonry shell. The probe has been cemented into place. A quarterly evaluation of 291S-001 Stack bi-weekly record sample with comparison to interior workplace air monitoring (adjusted for the sand filter removal efficiency) and bi-weekly NFM data will be qualitatively performed as an alternative to the annual inspection. |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | Annually. See Section 4.4 of CPSM-PRO-OP-50660. |
| Clean transport lines | Visible deposits for HEPA-filtered applications; surface density of 1 $g/cm^2$ for other applications. This is an "as required" activity in the event that the inspection of the rotameter shows any visible deposits. |
| Inspect or test the sample system for leaks | At least annually. See Section 4.5 of CPSM-PRO-OP-50660.<br>*NOTE: The probe cannot be removed for inspection without affecting the structural integrity of the stack masonry shell. The probe has been cemented into place.* |
| Check mass flow meters of sampling systems with a secondary or transfer standard | N/A. This is not a component of the approved sampling system; therefore, no check is conducted. |
| Inspect rotameters of sampling systems for presence of foreign matter | At the start of each sampling period. See Appendix B of CPSM-PRO-OP-50659. |
| Check response of stack flow rate systems | N/A. This is not a component of the approved sampling system. Periodic effluent flow rate measurements are conducted as the flow rate varies by less than 20% during the year at an alternative location to that prescribed by Method 1. |
| Calibration of flow meters of sampling systems | |
| Calibration of effluent flow measurement devices | N/A. An installed effluent flow measurement device is not a component of the approved sampling system. Stack flow rates are not measured; instead, an alternative method of using maximum fan capacity per 40 CFR 61.93(b)(3) and periodic effluent flow rate measurements are conducted as effluent flow rates vary less than 20%. |
| Calibration of timing devices | N/A. Timing devices are not a component of the approved sampling system; therefore, no calibration is conducted. |

References: 40 CFR 61.93, "National Emission Standards for Hazardous Air Pollutants."
CPSM-PRO-OP-50660, *NESHAPS Stack Inspection and Cleaning*.
DOE/RL-2017-06, *Removal Action Work Plan for the REDOX Complex*, Rev. 0

| | | | | | |
|---|---|---|---|---|---|
| DOE | = | U.S. Department of Energy | NFM | = | near-field monitoring |
| HEPA | = | high efficiency particulate air | PUREX | = | Plutonium Uranium Extraction Facility |
| N/A | = | not applicable | RAWP | = | Removal Action Work Plan |

**C-4-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: Stack flow rates are tested annually at an alternative location to that prescribed by Method 1. Environmentally, an alternative method of using maximum fan capacity (21,250 cfm) per 40 CFR 61.93(b)(3) was accepted as effluent flow rates vary less than 20%. This was a conservative measure to ensure emissions are captured year to year. A review of the REDOX sample results over the previous 10 years indicates consistent low-level emissions consistent with the surveillance and maintenance status of the facility and demonstrates the ability of the stack sampling system to produce precise, accurate, and complete results. Precision, accuracy, and completeness are met for stack flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-4-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 of this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-4-4.5** A QAP shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-4-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to the main body of this QAPjP, PRC-PRO-EP-15334, and ABCASH.

**C-4-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-2-1, “Maintenance, Calibration, and Field Check Requirements.”

*Response*: Refer to Table C-2-1, PRC-PRO-EP-15334, and to facility-specific procedures.

**C-4-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-4-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-4-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and descriptions of corrective actions.

*Response*: Refer to Section C2.2 in this QAPjP.

**C-4-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

**C-4-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-4-2, "CHPRC Best Management Practice Requirements."

*Response*: Refer to Table C-2-2, PRC-PRO-EP-15333, and facility-specific procedures.

**Table C-4-2. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | Weekly (During Winter Months) |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | Weekly |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps) | Weekly |

CHPRC = CH2M HILL Plateau Remediation Company
HEPA = high efficiency particulate air

# Supporting Information C-5

# 291-B-1 (B Plant)

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**Compliance Document Contents:**

Letter AIR 06-1010 (IDMS Accession #DA03877552)

## C-5 Method 114 Comparison for the 296-B-1 Stack

In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the 296-B-1 Stack at the B Plant complex with the radionuclide emission requirements defined in 40 CFR 61, Appendix B, Method 114. Requirements from Method 114 are directly quoted by section number. Responses that detail the state of compliance immediately follow the requirements.

The B Plant facility and the original 291-B-1 Stack were built in the 1940s, and the stack was used to support two missions: the bismuth-phosphate plutonium/uranium recovery mission, and the recovery of cesium and strontium from the fission product waste stream. When the stack was taken out of service in 1997, it was isolated from B Plant, along with associated filters and fans. The stack has been deregistered with the regulators and will not be addressed further in point-by-point evaluations. A new stack was built to replace the original stack and began operation in 1998 when the deactivation of the facility was completed and placed in surveillance and maintenance status. The replacement system has its own fans, two banks of dual-stage HEPA filters, and a stack sampling system.

### C-5-2.1 Radionuclides as Particulates

The extracted effluent stream is passed through a filter to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, “Filter Media”) shall be followed in using filter media to collect particulates (incorporated by reference—see 10 CFR 61, Subpart H, Section 18).

*Response*: Particles from sampled stack emissions are collected on a 47 mm-diameter Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric. This filter is rated in Table D.1 of ANSI/HPS N13.1–1999 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

### C-5-2.2 Radionuclides as Gases

*Response*: There is no requirement to perform gaseous radionuclide sampling because the B Plant is no longer processing radioactive materials that might cause gaseous radionuclide emissions. Irradiated fuel is no longer being introduced into B Plant because its first primary mission was completed in the early 1950s. No dissolutions have been performed since late 1952, and the separation of cesium and strontium ended in 1984. Following the bismuth-phosphate and cesium-strontium missions, the facility was cleaned out and no processing performed. Consequently, there is no need for gaseous radionuclide sampling, and the 296-B-1 Stack is not equipped for gaseous radionuclide sampling.

### C-5-3.0 Radionuclide Analysis Methods

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in contractual documents.

**C-5-4.0 Quality Assurance Methods**

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative, are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-5-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Roles and responsibilities are discussed in Chapter C1. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220.

**C-5-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: The facility is shut down and processing has ceased; therefore, unplanned operations resulting in increased emissions are unlikely. Refer to Section C1.2, and Chapters C2 and C4 in this QAPjP. Administrative controls are also in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-5-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including, where applicable:

**C-5-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: The stack is cylindrical and approximately 27 m (88.5 ft) tall. The sampling location is at an elevation of 13.1 m (43 ft). The sampling nozzle inlet is about 7.4 m (24.4 ft) above the top of the duct, which enters the stack at a 45º upward angle. The internal diameter of the stack is 31.25 in. The nozzle of the sampling probe is about 9.4 stack diameters from the inlet duct. The sampling location qualification criteria are described in PNNL-12017, *Airborne Effluent Monitoring System Certification for New B-Plant Ventilation Exhaust Stack*. The sampling probe (an Anderson Model RF-2-111) has a single shrouded nozzle. The sampling probe, tubing, and filter holder are all stainless-steel. The sampling system meets the criteria of 40 CFR 61, Subpart H, and the requirements of ANSI/HPS N13.1 -1969. The 296-B-1 Stack sampling location is identified by EDP code B001.

**C-5-4.3.2** A description of the sampling probe and representativeness of the samples.

*Response*: Particles in emissions from the 296-B-l Stack are continuously withdrawn with a single-point shrouded probe at a location in the stack emission stream where contaminants are of a uniform distribution. The sampling equipment meets the ANSI/HPS N13.1-1969 standard. Sampling location criteria, sampling nozzle, and sampling tube are described in PNNL-12017. The EPA approved the DOE alternative-method petition that allows the use of a sampling probe with a single shrouded nozzle in place of a probe with several isokinetic nozzles. This single-point sampling-extraction approach is applicable when the potential contaminants in the emission stream are of uniform concentration at the sampling location (PNNL-12017).

**C-5-4.3.3** A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: This requirement is not applicable as the 40 CFR 61.93(b)(2)(ii) references the applicability of the ANSI N13.1-1969 standard which does not require continuous monitoring. Compliance is demonstrated by the continuous sampling of emissions (Section C-5-4.3.4).

**C-5-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: Sample air is withdrawn continuously from the stack emissions stream by the probe as described in Section C-5-4.3.2. This air flows through the sample line, and particulate radionuclides are collected on a sample filter. The sample filters are exchanged routinely and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the FF-01 license (WDOH 2017). Sample collectors are not calibrated; however, sample flow rate measurement instruments are calibrated as discussed in Section C-5-4.3.6.

**C-5-4.3.5** A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: The laboratory analytical requirements are included in contractual documents.

**C-5-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: The sample flow rate measurement system consists of a rotameter and vacuum gauge. The sampling systems are inspected routinely and the flow rate is adjusted by a manual flow control valve to maintain a constant flow. Calibrations are performed annually in accordance with PRC-PRO-EP-15333 and PRC-PRO-MN-490. Precision, accuracy and completeness are met for stack flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-5-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: The stack flow is relatively constant, so the flow rate is measured annually in accordance with 40 CFR 61.93. The flow is measured by standard Pitot traverses in accordance with 40 CFR 60, Appendix A-1, Method 2. The traverse ports are tangential and located on the horizontal 30-in. duct between the HEPA filters and the exhaust fans. Traverse points are located at centers of equal area annuli. Flow measurement Pitot traverses are performed by V&B personnel. Calibration of V&B equipment is discussed in Section C1.4 in this QAPjP. Precision, accuracy, and completeness are met for stack flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-5-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 in this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-5-4.5** A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-5-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to PRC-PRO-EP-15334 and ABCASH.

**C-5-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-5-1, "Maintenance, Calibration, and Field Check Requirements."

*Response*: Refer to Table C-5-1, PRC-PRO-EP-15334, and B Plant-specific procedures.

**Table C-5-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | N/A. This is not a component of the approved sampling system; therefore, no cleaning is conducted. |
| Inspect Pitot tubes for contaminant deposits | |
| Inspect Pitot tube systems for leaks | |
| Inspect sharp-edged nozzles for damage | At least annually or after maintenance that could cause damage. See Section 4.3.4 of CPSM-PRO-OP-50660. |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | Annually. See Section 4.3.3 of CPSM-PRO-OP-50660. |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | Annually. See Section 4.4.3 of CPSM-PRO-OP-50660. |
| Clean transport lines | Visible deposits for HEPA-filtered applications; surface density of 1 $g/cm^2$ for other applications. This is an "as required" activity in the event that the inspection of the rotameter shows any visible deposits. |
| Inspect or test the sample system for leaks | At least annually. See Section 4.7 of CPSM-PRO-OP-50660. |
| Check mass flow meters of sampling systems with a secondary or transfer standard | N/A. This is not a component of the approved sampling system; therefore, no check is conducted. |
| Inspect rotameters of sampling systems for presence of foreign matter | At the start of each sampling period. See Section 4.2.1 of CPSM-PRO-EP-54282. |
| Check response of stack flow rate systems | There are no effluent flow measurement devices at B Plant. This is not a component of the approved sampling system. The Vent & Balance team, employed from a separate DOE contractor, measures the effluent flow annually. |
| Calibration of flow meters of sampling systems | N/A. This is not a component of the approved sampling system; therefore, no check is conducted. |

**Table C-5-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Calibration of effluent flow measurement devices | N/A. Effluent flow measurement devices at B Plant are not an installed component of the approved sampling system. The Vent & Balance team, employed from a separate DOE contractor, measures the effluent flow annually using a calibrated Pitot tube. |
| Calibration of timing devices | N/A. There are no timing devices at B Plant. This is not a component of the approved sampling system; therefore, no calibration is conducted. |

References: CPSM-PRO-EP-54282, *Central Plateau Risk Management (CPRM) B-Plant Stack Sampling*.
CPSM-PRO-OP-50660, *NESHAPS Stack Inspection and Cleaning*.
DOE = U.S. Department of Energy
HEPA = high efficiency particulate air
N/A = not applicable

**C-5-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-5-4.9** A corrective action program shall be established, including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-5-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and description of corrective actions.

*Response*: Refer to Section C2.2 in this QAPjP.

**C-5-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

**C-5-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-5-2, “CHPRC Best Management Practice Requirements.”

*Response*: Refer to Table C-5-2, PRC-PRO-EP-15333, and to facility-specific procedures.

**Table C-5-2. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | Weekly |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps) | Weekly |

CHPRC = CH2M HILL Plateau Remediation Company

HEPA = high efficiency particulate air

# Supporting Information C-6

# 296-B-10 (Waste Encapsulation & Storage Facility)

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**Compliance Document Contents:**

Letter AIR 16-309 dated March 4, 2016

## C-6 Method 114 Comparison for the 296-B-10 Stack

In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the 296-B-10 Stack at the Waste Encapsulation and Storage Facility (WESF) with the radionuclide emission requirements defined in 40 CFR 61, Appendix B, Method 114. Requirements from Method 114 are directly quoted by section number. Responses that detail the state of compliance immediately follow the requirements.

### C-6-2.1 Radionuclides as Particulates

The extracted effluent stream is passed through a filter to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, "Filter Media") shall be followed in using filter media to collect particulates (incorporated by reference—see 40 CFR 61, Subpart H, Section 61.18).

*Response*: Particles from sampled stack emissions are collected on a 47 mm-diameter Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric. This filter is rated in Table D.1 of ANSI/HPS N13.1–1999 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

### C-6-2.2 Radionuclides as Gases

*Response*: The 296-B-10 Stack does not exhaust radionuclide gases; therefore, this section is not applicable.

### C-6-3.0 Radionuclide Analysis Methods

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in contractual documents.

### C-6-4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative, are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-6-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Roles and responsibilities are discussed in Chapter C1 in this QAPjP. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220.

**C-6-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: Refer to Section C1.2, and Chapters C2 and C4 in this QAPjP. Administrative controls are also in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-6-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including the following elements where applicable.

**C-6-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: The W-130 Project required modification of the WESF hot cells, which required the transitioning of the monitoring requirements from the ANSI N13.1-1969 to the ANSI/HPS N13.1-1999 standard. The installed rake-type probe is an approved alternate to the ANSI/HPS N13.1-1999 required shrouded-type probe style (WDOH approval letter AIR 16-309 references the WESF Stack approval among others). The 296-B-10 Stack has an inside diameter of 1.1 m (42 in.) and the probe location is approximately 17.4 m (57 ft) from the base. There are five nozzles supplying the record sampler. ANSI N13.1-1969, Section A3.2 recommends a minimum of five nozzles on a stack that has the diameter of the 296-B-10 Stack.

The procedure in 40 CFR 60, Appendix A-1, Method 1 requires sampling to be performed at least eight stack diameters downstream and two diameters upstream of any flow disturbances. Eight stack diameters correspond to 8.5 m (28 ft,) and two stack diameters correspond to 2.1m (7 ft). The 296-B-10 Stack complies with this criterion.

**C-6-4.3.2** A description of sampling probes and representativeness of the samples.

*Response*: The sampling probe consists of five nozzles. The five nozzle inlets are 0.38 in. in diameter. The stack flow is fully turbulent (Reynolds number approximately 7.4E+03) and, as stated in Section A.3.3.2 of ANSI N13.1-1969, ". . . as the flow becomes more turbulent, the velocity becomes more nearly uniform across the duct."

**C-6-4.3.3** A description of any continuous monitoring systems used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: This requirement is not applicable because ANSI/HPS N13.1-1999 does not require near-realtime monitoring to demonstrate compliance for this emission unit.

**C-6-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: The sample is collected with a record filter (EDP code B748) for particulate collection. The particulate filter is exchanged routinely and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the FF-01 license. Sample collectors are not amenable to calibration; however, sample flow rate measurement instruments are calibrated as discussed in Section C-4-4.3.6.

**C-6-4.3.5** A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: The analytes of interest for the 296-B-10 Stack are identified in the FF-01 license (WDOH 2017). The laboratory analytical requirements are included in contractual documents.

**C-6-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: Two vacuum pumps draw air through the sample transport lines at 1.9E -03 $m^3/s$ (4 cfm), while the record sampler operates at 9.4E-04 $m^3/s$ (2.0 cfm). The sample transport line drops with almost a 90° bend from the 17.4 m (57 ft) level on the stack to the sample cabinet located at the base of the stack. The sample transport line is heat-traced and insulated to inhibit condensation. The sample transport lines were installed with a minimum number of bends.

The sample passes through a 47 mm diameter Versapor 3000 or equal filter paper in the record sampler. The filter paper is changed monthly and evaluated for gross alpha and gross beta activity. The samples are analyzed monthly to provide isotopic radionuclide concentrations. The record sampler results provide the basis for reporting the amount and concentrations of radionuclides released to the environment. These reports are forwarded to all appropriate organizations and agencies. Downstream of the filter, the sampled air passes through a flow meter, a flow totalizer, a flow regulator, and a vacuum pump. In the event of a low flow in the record sampler line, a local alarm and a remote alarm are activated. Precision, accuracy and completeness are met for sample flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-6-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: Because of physical constraints of the K-1 system, the flow in the K-1 duct cannot be measured per 40 CFR 60, Appendix A-1, Methods 1, 1A, 2, and 2C. The approved use of an alternate effluent flow rate methodology (DOE/RL-2015-50, *Radioactive Air Notice of Construction Application for the Waste Encapsulation and Storage Facility (WESF) Ventilation Upgrade*) uses a maximum exhaust flow capacity of 24,390 cfm instead. Precision, accuracy and completeness are met as described in Section C3.1, bullet 4.4 in this QAPjP for approved alternative methods.

**C-6-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 in this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-6-4.5** A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Refer to Chapter C3 in this QAPjP and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*.

**C-6-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to PRC-PRO-EP-15334, Section 5.6 and ABCASH.

**C-6-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-6-1, "Maintenance, Calibration, and Field Check Requirements."

*Response*: Refer to Table C-6-1, PRC-PRO-EP-15334, and WESF-specific procedures.

**Table C-6-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | N/A. This is not a component of the approved sampling system; therefore, no cleaning is conducted. |
| Inspect Pitot tubes for contaminant deposits | N/A. WESF does not have a flow measurement pitot tube and transport line. This is not a component of the approved sampling system. Instead, a WDOH approval is in place allowing for an alternative flow measurement method using the maximum exhaust fan capacity. |
| Inspect Pitot tube systems for leaks | N/A. WESF does not have a flow measurement pitot tube and transport line. This is not a component of the approved sampling system; therefore, no inspection is conducted. Instead, a WDOH approval (98-EAP-175) is in place allowing for alternative flow measurement using the maximum exhaust fan capacity. |
| Inspect sharp-edged nozzles for damage | At least annually or after maintenance that could cause damage. See procedure WESF-PRO-MN-51849, Step 4.1.1. |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | Annually. See procedure WESF-PRO-MN-51849, Steps 4.2.22 and 4.2.27. |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | Annually. See procedure WESF-PRO-MN-51849, Step 4.2.33. |
| Clean transport lines | Visible deposits for HEPA-filtered applications; surface density of 1 $g/cm^2$ for other applications. This is an "as required" activity in the event that the inspection of the rotameter shows any visible deposits. |
| Inspect or test the sample system for leaks | At least annually. See procedure WESF-PRO-MN-51849, Step 4.3. |
| Check mass flow meters of sampling systems with a secondary or transfer standard | N/A. There are no mass flow meters in use at WESF. This is not a component of the approved sampling system. Instead, a rotameter is used. |
| Inspect rotameters of sampling systems for presence of foreign matter | At the start of each sampling period. |
| Check response of stack flow rate systems | N/A. WESF does not measure stack flow rate using any component installed in the stack. EPA has approved (98-EAP-175) the use of maximum exhaust fan capacity as an alternative flow measurement method. |
| Calibration of flow meters of sampling systems | N/A. This is not a component of the approved sampling system. Instead, a rotameter is used. |
| Calibration of effluent flow measurement devices | N/A. An effluent flow measurement device is not a component of the approved sampling system. The WDOH permit allows use of the maximum effluent flow value provided from the fan curve. |

**Table C-6-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Calibration of timing devices | At least annually. |

Reference: WESF-PRO-MN-51849, *Inspect and/or Change-Out 296B-10 Stack Probe and Sample Line*.

EPA = U.S. Environmental Protection Agency
HEPA = high efficiency particulate air
N/A = not applicable
WDOH = Washington State Department of Health
WESF = Waste Encapsulation Storage Facility

**C-6-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-6-4.9** A corrective action program shall be established, including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-6-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and description of corrective actions.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-6-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

**C-6-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-6-2, “CHPRC Best Management Practice Requirements.”

*Response*: Refer to Table C-6-2, PRC-PRO-EP-15333, and to facility-specific procedures.

**Table C-6-2. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | Weekly |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps, CAMs) | Weekly |

CAM = continuous air monitor
CHPRC = CH2M HILL Plateau Remediation Company
HEPA = high efficiency particulate air

# Supporting Information C-7

# 296-H-212 (Canister Storage Building)

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**Compliance Document Contents:**

Letter AIR 17-916 dated September 8, 2017(IDMS Accession #0901280267)

## C-7 Method 114 Comparison for the 296-H-212

In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the 296-H-212 Stack at the Canister Storage Building (CSB) with the radionuclide emission requirements defined in 40 CFR 60, Appendix B, Method 114. Requirements from Method 114 are directly quoted by section number. Responses that detail the state of compliance immediately follow the requirements.

### C-7-2.1 Radionuclides as Particulates

The extracted effluent stream is passed through a filter to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, “Filter Media”) shall be followed in using filter media to collect particulates (incorporated by reference—see 40 CFR 61, Subpart H, Section 61.18).

*Response*: Particles from sampled stack emissions are collected on a 47 mm diameter Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric. This filter is rated in Table D.1 of ANSI/HPS N13.1–1999, to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

### C-7-3.0 Radionuclide Analysis Methods

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in contractual documents.

### C-7-4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative and are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-7-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Refer to Chapter C1 in this QAPjP, which documents most of the roles and responsibilities associated with these activities. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220.

**C-7-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: Administrative controls are in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-7-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including where applicable:

**C-7-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: Only one sampling site is currently being used for obtaining samples from the 296-H-212 Stack. The 296-H-212 Stack is 0.70 m (2.30 ft) in diameter and 22.86 m (75.00 ft) high. The exhaust fan inlet to the stack is at 2.4 m (7.38 ft) abovegrade. The elevation of the active sampling site is 7.85 m (25.75 ft) abovegrade. An alternative methodology for use of a single point shrouded probe at this location in the stack was approved by EPA in 1994 (HNF-7880, *Radioactive Air Emissions Notice of Construction Canister Storage Building, Building 212-H*, Appendix F, "Letter from U.S. Environmental Protection Agency to R.F. Pelletier").

**C-7-4.3.2** A description of the sampling probe and representativeness of the samples.

*Response*: The sampling probe consists of a shrouded probe. Per PNNL-12166, *Airborne Effluent Monitoring System Certification for New Canister Storage Building Ventilation Exhaust Stack*, testing has shown the sample system to provide 91% penetration for a stack flowrate of 9,300 cfm.

**C-7-4.3.3** A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: This requirement is not applicable because the ANSI N13.1-1969 standard does not require near-realtime monitoring to demonstrate compliance for this emission unit.

**C-7-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: The sample is collected with a record filter (EDP code B748) for particulate collection. The particulate filter is exchanged routinely and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the FF-01 license. Sample collectors are not amenable to calibration; however, sample flow rate measurement instruments are calibrated as discussed in Section C-4-4.3.6.

**C-7-4.3.5** A description of the Contract Laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: The analytes of interest for the 296-H-212 Stack are identified in the FF-01 license (WDOH 2017). And the laboratory analytical requirements are found in contractual documents.

**C-7-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: Two vacuum pumps draw air through the sample transport line at 9.5E-03 $m^3/s$ (2 cfm), while the record sampler operates at 4.7E-04 $m^3/s$ (1.0 cfm). The sample transport line drops with a 90º bend from the 14.0 m (46 ft) level on the stack to the sample cabinet located at the base of the stack. The sample transport lines were installed with a minimum number of bends.

The sample passes through a 47 mm diameter Versapor 3000 or equal filter paper in the record sampler. The filter paper is changed monthly and evaluated for gross alpha and gross beta activity. The samples are analyzed monthly to provide isotopic radionuclide concentrations. The record sampler results provide the basis for reporting the amount and concentrations of radionuclides released to the environment. These reports are forwarded to all appropriate organizations and agencies. Downstream of the filter, the sampled air passes through a flow meter, a flow totalizer, a flow regulator, and a vacuum pump. In the event of a low flow in the record sampler line, a local alarm and a remote alarm are activated.

**C-7-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: The flow rate is measured continuously with the GEMS™ Sensors system. The flow meter is calibrated annually per procedure SP-10-002 (CSB-PRO-MN-51340), *Stack Monitor Periodic Calibration*.

**C-7-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 in this QAPjP.

**C-7-4.5** A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Refer to Chapter C3 in this QAPjP. Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-7-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to PRC-PRO-EP-15334, Section 5.6.

**C-7-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-7-1, “Maintenance, Calibration, and Field Check Requirements.”

*Response*: Refer to Table C-7-1, PRC-PRO-EP-15334, and WESF-specific procedures.

™ GEMS is a trademark of MSC Industrial Supply Co., Melville, New York.

**Table C-7-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | N/A. This is not a component of the approved sampling system; therefore, no cleaning is conducted at CSB. |
| Inspect Pitot tubes for contaminant deposits | At least annually. |
| Inspect Pitot tube systems for leaks | |
| Inspect sharp-edged nozzles for damage | At least annually or after maintenance that could cause damage. |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | Annually. |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | |
| Clean transport lines | Visible deposits for HEPA-filtered applications; surface density of 1 g/cm$^2$ for other applications. This is an "as required" activity in the event that the inspection shows any visible deposits. |
| Inspect or test the sample system for leaks | At least annually. |
| Check mass flow meters of sampling systems with a secondary or transfer standard | At least quarterly |
| Inspect rotameters of sampling systems for presence of foreign matter | N/A. This is not a component of the approved sampling system; therefore, no inspection is conducted. |
| Check response of stack flow rate systems | At least quarterly. |
| Calibration of flow meters of sampling systems | At least annually. |
| Calibration of effluent flow measurement devices | |
| Calibration of timing devices | |

CSB = Canister Storage Building
HEPA = high efficiency particulate air
N/A = not applicable

**C-7-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response:* Refer to Chapter C3 in this QAPjP.

**C-7-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-7-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and descriptions of corrective actions.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-7-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

**C-7-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-7-2, "CHPRC Best Management Practice Requirements."

*Response*: Refer to Table C-7-2, PRC-PRO-EP-15333, and to facility-specific procedures.

**Table C-7-2. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | Weekly |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps, CAMs) | Weekly |

CAM = continuous air monitor
CHPRC = CH2M HILL Plateau Remediation Company
HEPA = high efficiency particulate air

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# Supporting Information

# C-8. 296-W-4 (Waste Receiving and Packaging Facility)

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**Compliance Document Contents:**

WDOH Approval Letter, AIR 12-343, dated February 2, 2012

# Method 114 Comparison for the 296-W-4 (Waste Receiving and Packaging Facility)

In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the 296-W-4 Stack at the Waste Receiving and Packaging Facility with the radionuclide emission requirements defined in 40 CFR 60, Appendix B, Method 114. Requirements from Method 114 are directly quoted by section number. Responses that detail the state of compliance immediately follow the requirements.

### C-8-2.1 Radionuclides as Particulates

The extracted effluent stream is passed through a filter to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, "Filter Media") shall be followed in using filter media to collect particulates (incorporated by reference—see 40 CFR 61, Subpart H, Section 61.18).

*Response*: Particles from sampled stack emissions are collected on a 47 mm diameter Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric. This filter is rated in ANSI/HPS N13.1–1999, Table D.1 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

### C-8-2.2 Radionuclides as Gases

*Response*: The 296-W-4 Stack does not exhaust radionuclide gases; therefore, this section is not applicable.

### C-8-3.0 Radionuclide Analysis Methods

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in contractual documents.

### C-8-4.0 Quality Assurance Methods

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative and are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-8-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Refer to Chapter C1 in this QAPjP, which documents most of the roles and responsibilities associated with these activities. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220.

**C-8-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: Refer to Section C1.2, and Chapters C2 and C4 in this QAPjP. Administrative controls are also in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-8-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including where applicable:

**C-8-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: The top of the 296-W-4 Stack is 46 ft above the base. The record sampling port is located at a height of 11.73 m, (38.5 ft) above the base. The sample port is approximately 6.4 duct diameters downstream of the last disturbance.

The sample location was determined through testing with the results reported in WHC-SD-W026-ATR-011, *W-026, Acceptance Test Report Isokinetic Stack Effluent Monitor Sys. (Submittal # 2018)*. The site was chosen to provide representative sampling of the effluent and to comply with ANSI N13.1-1969. The sample port was chosen to minimize the length of sample line in accordance with ANSI N13.1-1969. There are five nozzles supplying the record sampler.

**C-8-4.3.2** A description of the sampling probe and representativeness of the samples.

*Response*: The sampling probe consists of five nozzles branching from a single delivery line and is made entirely of 304 stainless steel tubing. At the inlet, each port is tapered to a knife edge with a 15° angle. The probe nozzles have an inside diameter of 4.0 mm (0.156 in.). Entrance into the manifold is at 45°. The use of a near isokinetic five-point probe located more than 6.4 duct diameters downstream of the last major flow disturbance is believed to achieve representative sampling (sample flow rates are checked daily to ensure near isokineises of ±20%).

**C-8-4.3.3** A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: This requirement is not applicable because the ANSI N13.1-1969 standard does not require near-realtime monitoring to demonstrate compliance for this emission unit. Compliance is demonstrated by the continuous sampling of emissions (see next section).

**C-8-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: Sample air is withdrawn continuously from the stack effluent stream by the probe as described in Section C-8-4.3.2.

The sample is collected on a record filter (EDP code W-123) for particulate collection. The particulate filter is exchanged routinely (biweekly) and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the FF-01 license (WDOH 2017). Sample collectors are not amenable to calibration; however, sample flow rate measurement instruments are calibrated as discussed in Section C-8-4.3.6.

**C-8-4.3.5** A description of the Contract Laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: The laboratory analytical requirements are included in contractual documents.

**C-8-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: The sample flow rate measurement system consists of a mass flow meter, flow regulator (flow control valve, a vacuum gauge, and a vacuum pump. The flow transmitter sends information through a data logger to the plant control system. The flow rate regulator is provided to maintain a constant flow rate through the sample collection. At least once a day, personnel ensure proper sample flow rates are near isokinetic (±20%). The audible and visible alarm signals that indicate low flow rates for the record sampler are provided remotely in the dispatch office. The data logger inputs data from the flow transmitter and outputs data to the facility annunciator panel (including and flow alarms).

Calibration of the mass flow meters is performed off site on two identical mass flow meters in accordance with PRC-PRO-MN-490. These flow meters are swapped out every 6 months on a rotating basis. Every quarter the operating mass flow meter is either checked against a secondary standard or checked and swapped out with the other transmitter.

Alternative vacuum pumps are provided for the system. Failure annunciation (low flow rate) is provided and checked periodically in the dispatcher's office to demonstrate operability.

Precision, accuracy, and completeness are met for sample flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-8-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: The 296-W-4 Stack flow is relatively constant; therefore, the emissions flow rate is measured annually by traverses with a standard Pitot tube using the test ports located 33 ft 6 in. above the base of the stack using the Pitot traverse method described in 40 CFR 60, Appendix A-1, Method 2. Flow measurement Pitot traverses are performed by V&B personnel. Calibration of V&B equipment is discussed in Section C1.5 in this QAPjP.

The 296-W-4 Stack does have a stack flow probe and transmitter that is not calibrated and is considered process instrumentation. For information purposes, the value from the stack transmitter is compared to the value obtained by the Pitot tube method described above but is not used for reporting values for emissions. There are no alarms associated with the stack flow value.

Precision, accuracy, and completeness are met as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-8-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 in this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-8-4.5** A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-8-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to the main body in this QAPjP, PRC-PRO-EP-15334, and ABCASH.

**C-8-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-8-1, "Maintenance, Calibration, and Field Check Requirements."

*Response*: Refer to Table C-8-1, PRC-PRO-EP-15334, and to facility-specific procedures.

**Table C-8-1. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | Not used. |
| Inspect Pitot tubes for contaminant deposits | |
| Inspect Pitot tube systems for leaks | |
| Inspect sharp-edged nozzles for damage | Performed during annual stack inspection. |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | |
| Clean transport lines | Performed as needed during annual stack inspection. |
| Inspect or test the sample system for leaks | Performed during annual stack inspection. |
| Check mass flow meters of sampling systems with a secondary or transfer standard | Checked or checked and swapped with calibrated instrument quarterly. |
| Inspect rotameters of sampling systems for presence of foreign matter | Not used. |
| Check response of stack flow rate systems | N/A per 40 CFR 61.93(b)(1)(iii), Subpart H. For relatively constant flow rates only periodic measurements are necessary. WRAP runs at a relatively constant flow and the period of the measurement is annually. |
| Calibration of flow meters of sampling systems | Two instruments are calibrated annually and installed alternately every 6 months. |
| Calibration of effluent flow measurement devices | Not used. The WRAP effluent flow meter is reference only. It is checked against the annual stack flow measurement performed by vent and balance personnel. |
| Calibration of timing devices | Not used. |

Reference: 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants."
HEPA = high efficiency particulate air
N/A = not applicable
WRAP = Waste Receiving and Processing Facility

**C-8-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-8-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-8-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and descriptions of corrective actions.

*Response*: Refer to Section C2.2 in this QAPjP.

**C-8-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

**C-8-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-8-2, "CHPRC Best Management Practice Requirements."

*Response*: Refer to Table C-8-2, PRC-PRO-EP-15333, and to facility-specific procedures.

**Table C-8-2. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | Weekly |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps, CAMs) | Weekly |

CAM = continuous air monitor
CHPRC = CH2M HILL Plateau Remediation Company
HEPA = high efficiency particulate air

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# Supporting Information

## C-9. Minor Stack and General Permit Required Monitoring Locations

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The QAOs for measurements applicable to Minor Stack and General Permit Required monitoring locations are related primarily to the following:

- Defining the appropriate methods for sampling and analysis for the required analytes of interest.
- Defining quantitative limits and values for analytical precision and accuracy appropriate for the sampling locations.
- Defining data representativeness, completeness, and comparability in terms applicable to the sampling locations.

The CHPRC responsibilities will generally be limited to sample collection and monitoring equipment maintenance and calibration. The analytical and data reduction responsibilities will be generally performed by a Contract Laboratory and MSA, respectively. In some cases, the monitoring, analysis, and data reduction for a location will be performed by MSA as contracted work.

A Minor Stack is a source of emissions from a powered point source with a potential to emit below 0.1 mrem/yr (i.e., 2706T, Maintenance and Storage Facility). Minor Stack (minor point source) emissions sampling is generally conducted using an existing stack probe, sample transport line, and record sampler to extract a representative sample from the stack exhaust as a means of verifying low emissions (periodic confirmatory measurement [PCM]). Where extractive sampling equipment is used to collect a representative sample as PCM from a minor point source WDOH has provided clarification on the application of 40 CFR 61, Appendix B, Method 114 in letter AIR 05-303.

Actions to assure quality of periodic confirmatory measurement shall be as follows:

(1) Implementation of quality checks supporting the periodic confirmatory measurements. These checks shall assure that the emissions measurements are sufficient to verify low emissions;

(2) Stack flow measurements will be conducted annually;

(3) An annual calibration will be performed on the existing sample flow meter or annual function check will be performed if the flow meter is replaced by either a rotameter or magnehelic gauge;

(4) Effluent samples will be collected on standard (very high efficiency particulate air) sample filters;

(5) The laboratory sample analysis will meet the requirements of Appendix B, Method 114(3); and

(6) The following items will be documented in a NESHAP Quality Assurance Project Plan or other documents:

(i) Sample collection and analysis procedures used;

(ii) The quality control program for evaluating and tracking the quality of the periodic confirmatory measurement data against preset criteria. The quality control program should include, where applicable, a system of replicates, spiked samples, split samples, blanks and control charts. The number and frequency of such quality control checks shall be identified; and

(iii) The sample tracking system to provide positive identification of samples and data through all phases of the sample collection, analysis, and reporting system, Sample

handling and preservation procedures to maintain the integrity of the samples during collection, storage, and analysis.

Air samples collected in support of the minor point source monitoring locations meet the quality assurance requirements of Method 114 used to report air emissions in accordance with 40 CFR 61, Subpart H. The sample collection frequency and analytes of interest are specified in the license requirements for each minor point source monitoring location. Sample collection procedures will generally be in the form of radioactive work tasks or plans. The chain-of-custody process will comply with Method 114 requirements. The analytical method for the sample is prescribed in Method 114 (3) and is specified in the contract requirements for the Contract Laboratory. The contract requirements contain EPA-established methods and analyte specific quantitation limits and ranges for precision and accuracy. The Contract Laboratory will provide data packages to MSA that meet the requirements of SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition; Final Update V*. MSA will validate and analyze the data as provided for in MSC-PLN-EI-23333. Preventive maintenance and calibration of field monitoring equipment will be performed in accordance with facility procedures following the applicable BMPs outlined in Table C-9-1. The AIR 05-303 guidance does not specify what Appendix B Method 114 Table 2 maintenance and test requirements must be met to *assure that the emissions measurements are sufficient to verify low emissions*. Following the Table C-9-1 practices will provide the requisite assurance given the lack of specificity provided in AIR 05-303 but may exceed the practices needed for a specific system. Each Project must evaluate their minor point source sampling system and associated maintenance practices as not all portions of Table C-9-1 may be applicable. This should be codified in facility specific procedures or work instructions.

**Table C-9-1. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | If present, weekly. |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required. |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps) | If present, weekly. |
| Cleaning of thermal anemometer | If present, inspect every 3 years. |
| Inspect Pitot tubes for contaminant deposits | |
| Inspect Pitot tube systems for leaks | |
| Inspect sharp-edged nozzles for damage | |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | If present, this is an “as required” activity in the event that the inspection shows any visible deposits. |
| Check response of stack flow rate systems | If present, inspect every 3 years. |
| Calibration of effluent flow measurement devices | |

**Table C-9-1. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Calibration of timing devices | |
| Check mass flow meters of sampling systems with a secondary or transfer standard | |
| Inspect rotameters of sampling systems for presence of foreign matter | If present, performed each time samples are collected. |
| Calibration of flow meters of sampling systems | If present, inspect every 3 years. |

CHPRC = CH2M HILL Plateau Remediation Company
HEPA = high efficiency particulate air

General Permit Required monitoring is conducted at nonpowered point sources or area sources (diffuse and fugitive) using a variety of collection methods (e.g., fixed head sampler, swipes, nondestructive examination, deposition sampling). Air samples collected in support of the General Permit Required monitoring locations meet the QA requirements of Method 114 used to report air emissions in accordance with 40 CFR 61, Subpart H. The sample collection frequency and analytes of interest are specified in the license requirements for each General Permit Required monitoring location. Sample collection procedures will generally be in the form of a radioactive work tasks or plans. The chain-of-custody process will comply with Method 114 requirements. The analytical method for the sample is prescribed in Method 114 (3) and is specified in the contract requirements for the Contract Laboratory. The contract requirements contain EPA-established methods and analyte specific quantitation limits and ranges for precision and accuracy. The Contract Laboratory will provide data packages to MSA that meet the requirements of SW-846. MSA will validate and analyze the data as provided for in MSC-PLN-EI-23333. Preventive maintenance and calibration of field monitoring equipment will be performed in accordance with facility procedures.

## Method 114 Comparison for Minor Stack Monitoring Locations

40 CFR 61, Appendix B, Method 114 provides requirements for stack (point source) monitoring at stationary sources. The minor point source radioactive air licenses contained in the FF-01 license (WDOH 2017) utilize select portions of Method 114 as compliance requirements for minor point source emissions. In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the minor point source monitoring locations for nonpoint source emissions monitoring with the radionuclide emission requirements defined in Method 114. Requirements from Method 114 are directly quoted by section number. Responses that detail the state of compliance immediately follow the requirements.

### C-9-2.1 Radionuclides as Particulates

The extracted effluent stream is passed through a filter to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, “Filter Media”) shall be followed in using filter media to collect particulates (incorporated by reference—see 40 CFR 61 Subpart H, Section 61.18).

*Response*: Particles from sampled emissions are collected on a 47 mm diameter Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric or equal. This filter is rated in ANSI/HPS N13.1–1999, Table D.1 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

**C-9-2.2 Radionuclides as Gases**

*Response*: For minor point source monitoring locations, radionuclide gases are not considered analytes of interest; therefore, this section is not applicable.

**C-9-3.0 Radionuclide Analysis Methods**

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in MSC-PLN-EI-23333 and Contract Laboratory contractual documents.

**C-9-4.0 Quality Assurance Methods**

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative and are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-9-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Refer to Chapter C1 in this QAPjP, which documents most of the roles and responsibilities associated with these activities. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220.

**C-9-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: Refer to Section C1.2, and Chapters C2 and C4 in this QAPjP. Administrative controls are also in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-9-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including where applicable:

**C-9-4.3.1** Identification of sampling sites and number of sampling points, including rationale for the selections.

*Response*: DOE established the PCM extractive sampling locations prior to issuance of the ANSI N13.1-1969 standard and consist of a single point. WDOH accepted these locations as representative upon issuance of the FF-01 (WDOH 2017) license for the minor point source.

**C-9-4.3.2** A description of the sampling probe and representativeness of the samples.

*Response*: PCM is an alternate method for determining compliance where emissions are expected to result in a dose of 0.1 mrem/yr or less. For locations that are stacks or vents either a rake probe or a shrouded

probe will be used to collect the PCM sample such that the sample extracted is representative of the stack or vent effluent. The use of a rake type probe meeting the ANSI N13.1-1969 requirements is considered capable of collecting a representative sample for pre-ANSI N13.1-1999, and ANSI N13.1-1969 stacks. In the event of a modification or transition to CERCLA, a rake type probe may be used as an approved alternate to a shrouded probe for ANSI/HPS N13.1-1999 stacks.

**C-9-4.3.3** A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: This requirement is not applicable. Compliance is demonstrated by the PCM of low-level emissions for historical monitoring (see next section).

**C-9-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: Sample air is withdrawn from stack effluent by a probe, transmitted through a sample transmission line to a record sampler and onto a filter for laboratory analysis. The particulate filter is collected by Project personnel and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the location specific license of the FF-01 license (WDOH 2017). Sample flow rate measurement instruments are calibrated as discussed in Section C-9-4.3.6.

**C-9-4.3.5** A description of the Contract Laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: The laboratory analytical requirements are included in MSC-PLN-EI-23333 and the Contract Laboratory scope of work.

**C-9-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: The sample flow rate measurement system may consist of a mass flow meter or rotameter, flow regulator (flow control valve, a vacuum gauge, and a vacuum pump). The flow rate regulator is provided to maintain a constant flow rate throughout the sample collection period.

Calibration of any mass flow meters is performed in accordance with PRC-PRO-MN-490. Rotameters are function tested in accordance with facility specific procedures or work instructions

Precision, accuracy, and completeness are met for sample flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-9-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: PCM is an alternate method for determining compliance where emissions are expected to result in a dose of 0.1 mrem/yr or less. As such the Method 114 requirements are applicable to the analyses performed in the Contract Laboratory. For locations that are stacks or vents either V&B or an in situ flow measurement system will be used to determine the flow rate of the stack or vent effluent. Where the stack flow is relatively constant, the emissions flow rate is measured annually by traverses with a standard Pitot tube using the test ports in the stack using the Pitot traverse method described in 40 CFR 60 Appendix A-1, Method 2. Flow measurement Pitot traverses are performed by V&B personnel. Calibration of V&B equipment is discussed in Section C1.5 in this QAPjP. Where in situ measurements

are conducted, refer to Table C-9-1, PRC-PRO-EP-15334, and Facility-specific procedures or work instructions.

**C-9-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 in this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-9-4.5** A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-9-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to the main body of this QAPjP, PRC-PRO-EP-15334, and ABCASH.

**C-9-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-9-2, “Maintenance, Calibration, and Field Check Requirements.”

*Response*: Refer to Table C-9-1, PRC-PRO-EP-15334, and to facility-specific procedures.

**C-9-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-9-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-9-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and descriptions of corrective actions.

*Response*: Refer to Section C2.2 in this QAPjP.

**Table C-9-2. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | Not used. |
| Inspect Pitot tubes for contaminant deposits | |
| Inspect Pitot tube systems for leaks | |
| Inspect sharp-edged nozzles for damage | |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | |
| Clean transport lines | Performed as needed. |
| Inspect or test the sample system for leaks | Performed during annual inspection. |
| Check mass flow meters of sampling systems with a secondary or transfer standard | If present, checked or checked and swapped with calibrated instrument quarterly. |
| Inspect rotameters of sampling systems for presence of foreign matter | If present, performed each time samples are collected. |
| Check response of stack flow rate systems | Not used. |
| Calibration of flow meters of sampling systems | If present, performed annually. |
| Calibration of effluent flow measurement devices | Not used. |
| Calibration of timing devices | |

HEPA = high efficiency particulate air

## Method 114 Comparison for General Permit Required Monitoring Locations

The radioactive air licenses contained in the FF-01 license (WDOH 2017) utilize select portions of 40 CFR 60, Appendix B, Method 114 as compliance requirements for nonpoint source emissions. In this supporting information, a requirement-by-requirement recitation and response is given, which describes the state of compliance of the General Permit Required Monitoring Locations for nonpoint source emissions monitoring with the radionuclide emission requirements defined in Method 114. Requirements from Method 114 are directly quoted by section number. Responses that detail the state of compliance immediately follow the requirements.

### C-9-2.1 Radionuclides as Particulates

The extracted effluent stream is passed through a filter to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI/HPS N13.1-1999 (Section 6.6.2, “Filter Media”) shall be followed in using filter media to collect particulates (incorporated by reference—see 40 CFR 61, Subpart H, Section 61.18).

*Response*: Particles from sampled emissions are collected on a 47 mm diameter Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric or equal. This filter is rated in ANSI/HPS N13.1–1999, Table D.1 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

**C-9-2.2 Radionuclides as Gases**

*Response*: For General Permit Required monitoring locations, radionuclide gases are not considered analytes of interest; therefore, this section is not applicable.

**C-9-3.0 Radionuclide Analysis Methods**

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in MSC-PLN-EI-23333 and Contract Laboratory contractual documents.

**C-9-4.0 Quality Assurance Methods**

Each facility required to measure their radionuclide emissions shall conduct a QAP in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative and are of known precision and accuracy, and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written procedures, data quality specifications, audits, corrective actions, and reports. This QAP shall include the program elements that follow.

**C-9-4.1** The organizational structure, functional responsibilities, levels of authority, and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Refer to Chapter C1 in this QAPjP, which documents most of the roles and responsibilities associated with these activities. Additional Environmental Program and Strategic Planning Roles, Responsibilities, and Functions are documented in PRC-MP-EP-40220.

**C-9-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: Refer to Section C1.2 and Chapters C2 and C4 in this QAPjP. Administrative controls are also in place for trending emissions data in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-9-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described, including where applicable:

**C-9-4.3.1** Identification of sampling sites and number of sampling points, including the rationale for site selections.

*Response*: The monitoring locations are dictated in the license conditions and generally consist of a single point low volume particulate sampler.

**C-9-4.3.2** A description of the sampling probe and representativeness of the samples.

*Response*: PCM is an alternate method for determining compliance where emissions are expected to result in a dose of 0.1 mrem/yr or less. As such the Method 114 requirements are applicable to the analyses performed in the Contract Laboratory. This requirement is not applicable where locations are not stacks or vents and the use of a sample probe to obtain a representative sample is not required. For locations that are stacks or vents either a rake probe or a shrouded probe will be used to collect the PCM sample such that the sample extracted is representative of the stack or vent effluent.

**C-9-4.3.3** A description of any continuous monitoring system used to measure emissions, including the sensitivity of the system, calibration procedures, and frequency of calibration.

*Response*: This requirement is not applicable. Compliance is demonstrated by the continuous sampling of emissions for historical monitoring (see next section).

**C-9-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures, and frequency of calibration.

*Response*: Sample air is withdrawn continuously from ambient atmosphere by a sampler onto a filter for laboratory analysis.

The sample is collected on a record filter for particulate collection. The particulate filter is exchanged routinely (biweekly) and analyzed at the Contract Laboratory. The frequency of collection and the specific radionuclides analyzed are identified in the location specific license of the FF-01 license (WDOH 2017). Sample collectors are not amenable to calibration; however, sample flow rate measurement instruments are calibrated as discussed in Section C-9-4.3.6.

**C-9-4.3.5** A description of the Contract Laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: The laboratory analytical requirements are included in MSC-PLN-EI-23333 and the Contract Laboratory scope of work.

**C-9-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: The sample flow rate measurement system consists of a mass flow meter, flow regulator (flow control valve, a vacuum gauge, and a vacuum pump. The flow rate regulator is provided to maintain a constant flow rate throughout the sample collection period.

Calibration of any mass flow meters is performed in accordance with PRC-PRO-MN-490.

Precision, accuracy, and completeness are met for sample flow as described in Section C3.1, bullet 4.4 in this QAPjP.

**C-9-4.3.7** A description of the effluent flow rate measurement procedures, including frequency of measurements, calibration procedures, and frequency of calibration.

*Response*: PCM is an alternate method for determining compliance where emissions are expected to result in a dose of 0.1 mrem/yr or less. As such the 40 CFR 61, Appendix B, Method 114 requirements are applicable to the analyses performed in the Contract Laboratory. This requirement is not applicable where locations are not stacks or vents and the determination of flow rate is not required. For locations that are stacks or vents either V&B or an in situ flow measurement system will be used to determine the flow rate of the stack or vent effluent. Where the stack flow is relatively constant, the emissions flow rate is measured annually by traverses with a standard Pitot tube using the test ports in the stack using the Pitot traverse method described in 40 CFR 60, Appendix A-1, Method 2. Flow measurement Pitot traverses are performed by V&B personnel. Calibration of V&B equipment is discussed in Section C1.5 in this QAPjP. Where in situ measurements are conducted, refer to Table C-9-2, PRC-PRO-EP-15334, and facility-specific procedures.

**C-9-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data, including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known

value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of data obtained compared to the amount expected under normal conditions.

*Response*: Refer to Chapters C3 and C4 in this QAPjP, and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-9-4.5** A QC program shall be established to evaluate and track the quality of the emissions measurement data against preset criteria. The program should include, where applicable, a system of replicates, spiked samples, split samples, blanks, and control charts. The number and frequency of such QC checks shall be identified.

*Response*: Laboratory requirements are presented in MSC-PLN-EI-23333 and Contract Laboratory *Statement of Work for Services Provided for the Effluent and Environmental Monitoring Program*, which is updated yearly.

**C-9-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sample collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain the integrity of samples during collection, storage, and analysis.

*Response*: Refer to the main body of this QAPjP, PRC-PRO-EP-15334, and ABCASH.

**C-9-4.7** Regular maintenance, calibrations, and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-9-2, “Maintenance, Calibration, and Field Check Requirements.”

*Response*: Refer to Table C-9-2, PRC-PRO-EP-15334, and to facility-specific procedures.

**C-9-4.8** Periodic internal and external audits shall be performed to monitor compliance with the QAP. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Chapter C3 in this QAPjP.

**C-9-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken, and who is responsible for taking the corrective action.

*Response*: Refer to PRC-PRO-QA-052.

**C-9-4.10** Periodic reports to responsible management shall be prepared on the performance of the emissions measurements program. These reports should include assessment of the quality of the data, results of audits, and descriptions of corrective actions.

*Response*: Refer to Section C2.2 in this QAPjP.

**C-9-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: Refer to this QAPjP as a whole.

**C-9-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-9-1, “CHPRC Best Management Practice Requirements.”

*Response*: Refer to Table C-9-1, PRC-PRO-EP-15333, and to facility-specific procedures.

# Supporting Information

# C-10. EP-324-01-S

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**Compliance Document Contents:**

DOE/RL-2004-77, *Removal Action Work Plan for 300 Area Facilities*

## Method 114 Comparison for EP-324-01-S Stack

**C-10-2.1 Radionuclides as Particulates**

The extracted effluent stream is passed through a filter media to remove the particulates. The filter must have a high efficiency for removal of sub-micron particles. The guidance in ANSI N13.1-1999 (Section 6.6.2, "Filter Media") shall be followed in using filter media to collect particulates (incorporated by reference—see 40 CFR 61, Subpart H, Section 61.18).

*Response*: Particles from sampled stack emissions are collected on a 47 mm diameter. Versapor 3000 or equal filter, an acrylic copolymer membrane supported by a nonwoven polyester or nylon fabric. This filter is rated in Table D.1 of ANSI/HPS-N13.1-1999 to be from 99.7% to >99.99% efficient for particles in the range of 0.035 to 1 µm.

**C-10-2.2 Radionuclides as Gases**

**C-10-2.2.1 The Radionuclide Tritium (H-3)**. Tritium in the form of water vapor is collected from the extracted effluent sample by sorption, condensation or dissolution techniques. Appropriate collectors may include silica gel, molecular sieves, and ethylene glycol or water bubblers.

Tritium in the gaseous form may be measured directly in the sample stream using Method B-1, collected as a gas sample or may be oxidized using a metal catalyst to tritiated water and collected as described above.

*Response*: The EP-324-01-S stack is not sampled for gaseous radionuclides. Tritium sampling has been discontinued because no further tritium projects are planned.

**C-10-2.2.2 Radionuclides of Iodine.** Iodine is collected from an extracted sample by sorption or dissolution techniques. Appropriate collectors may include charcoal, impregnated charcoal, metal zeolite, and caustic solutions.

*Response*: The EP-324-01-S stack is not sampled for gaseous radionuclides.

**C-10-2.2.3 Radionuclides of Argon, Krypton, and Xenon.** Radionuclides of these elements are either measured directly by an in-line or off-line monitor, or are collected from the extracted sample by low temperature sorption techniques. Appropriate sorbers may include charcoal or metal zeolite.

*Response*: The EP-324-01-S stack is not sampled for gaseous radionuclides.

**C-10-2.2.4 Radionuclides of Oxygen, Carbon, Nitrogen and Radon.** Radionuclides of these elements are measured directly using an in-line or off-line monitor. Radionuclides of carbon in the form of carbon dioxide may be collected by dissolution in caustic solutions.

*Response*: The EP-324-01-S stack is not sampled for gaseous radionuclides.

**C-10-3.0 Radionuclide Analysis Methods**

*Response*: The analysis methods have been evaluated by cognizant MSA personnel and are included in MSC-PLN-EI-23333 and Contract Laboratory contractual documents.

A series of methods based on "principles of measurement" are described which are applicable to the analysis of radionuclides collected from airborne effluent streams at stationary sources. These methods are applicable only under the conditions stated and within the limitations described. Some methods specify that only a single radionuclide be present in the sample or the chemically separated sample. This condition should be interpreted to mean that no other radionuclides are present in quantities which would interfere with the measurement.

Also identified (Table C-10-1) are methods for a selected list of radionuclides. The listed radionuclides are those which are most commonly used and which have the greatest potential for causing dose to members of the public. Use of methods based on principles of measurement other than those described in this section must be approved in advance of use by the Administrator. For radionuclides not listed in Table C-10-1, any of the described methods may be used provided the user can demonstrate that the applicability conditions of the method have been met.

The type of method applicable to the analysis of a radionuclide is dependent upon the type of radiation emitted (i.e., alpha, beta or gamma). Therefore, the methods described below are grouped according to principles of measurements for the analysis of alpha, beta and gamma emitting radionuclides.

**C-10-3.1 Methods for Alpha Emitting Radionuclides**

**C-10-3.1.1 Method A-1, Radiochemistry-Alpha Spectrometry**.

Principle: The element of interest is separated from other elements, and from the sample matrix using radiochemical techniques. The procedure may involve precipitation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet in a very thin film by electrodeposition or by coprecipitation on a very small amount of carrier, such as lanthanum fluoride. The deposited element is then counted with an alpha spectrometer. The activity of the nuclide of interest is measured by the number of alpha counts in the appropriate energy region. A correction for chemical yield and counting efficiency is made using a standardized radioactive nuclide (tracer) of the same element. If a radioactive tracer is not available for the element of interest, a predetermined chemical yield factor may be used.

Applicability: This method is applicable for determining the activity of any alpha-emitting radionuclide, regardless of what other radionuclides are present in the sample provided the chemical separation step produces a very thin sample and removes all other radionuclides which could interfere in the spectral region of interest. APHA-605, *Methods of Air Sampling*, Method 605, "Tentative Method of Analysis for Plutonium Content of Atmospheric Particulate Matter"; ASTM D 3972:2009, *Test Method for Isotopic Uranium in Water by Radiochemistry*.

*Response 324 Stack*: The alpha-emitting radionuclides of interest are Pu-239/240, Pu-238, and Am-241. The laboratories use element-specific chemical separation/purification followed by deposition to a planchet in a form minimizing self-absorption of alpha emissions. Activities are determined using alpha energy analysis (alpha spectrometry). The laboratories use high-resolution solid-state spectrometers for analysis. The high-resolution detectors are connected to a computer-controlled multichannel analyzer (MCA) for discrimination and quantification of isotope-specific alpha emissions. The methods all use radiochemical tracers to correct for chemical yields. Laboratory methodologies are compatible and appropriate to perform analyses within the scope of Method A-1.

*Response Near-Field Monitoring (NFM)*: Same as the above except the alpha-emitting radionuclides of interest are Pu-239/240, Pu-238, U-234, U-235, U-238, and Am-241.

**C-10-3.1.2 Method A-2, Radiochemistry-Alpha Counting**.

Principle: The element of interest is separated from other elements, and from the sample matrix using radiochemistry. The procedure may involve precipitation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet in a thin film and counted with an alpha counter. A correction for chemical yield (if necessary) is made. The alpha count rate measures the total activity of all emitting radionuclides of the separated element.

Applicability: This method is applicable for the measurement of any alpha-emitting radionuclide, provided no other alpha emitting radionuclide is present in the separated sample. It may also be applicable for determining compliance, when other radionuclides of the separated element are present, provided that the calculated emission rate is assigned to the radionuclide which could be present in the sample that has the highest dose conversion factor. IDO-12096, *RESL Analytical Chemistry Branch Procedures Manual*.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.1.3 Method A-3, Direct Alpha Spectrometry**.

Principle: The sample, collected on a suitable filter, is counted directly on an alpha spectrometer. The sample must be thin enough and collected on the surface of the filter so that any absorption of alpha particle energy in the sample or the filter, which would degrade the spectrum, is minimal.

Applicability: This method is applicable to simple mixtures of alpha emitting radionuclides and only when the amount of particulates collected on the filter paper are relatively small and the alpha spectra is adequately resolved. Resolutions should be 50 keV (Full width half maximum) or better, ASTM D3084-05, *Standard Practice for Alpha-Particle Spectrometry of Water*.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.1.4 Method A-4, Direct Alpha Counting (Gross alpha determination)**.

Principle: The sample, collected on a suitable filter, is counted with an alpha counter. The sample must be thin enough so that self-absorption is not significant and the filter must be of such a nature that the particles are retained on the surface.

Applicability*:* Gross alpha determinations may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, or the identity and isotopic ratio of the radionuclides in the sample are well-known, and (2) measurements using either Methods A-1, A-2, or A-5 have shown that this method provides a reasonably accurate measurement of the emission rate. Gross alpha measurements are applicable to unidentified mixtures of radionuclides only for the purposes and under the conditions described in Section C-10-3.7. APHA-601, *Methods of Air Sampling*, Method 601, “Tentative Method of Analysis for Gross Alpha Radioactivity Content of the Atmosphere”; ASTM D1943-05, *Standard Test Method for Alpha Particle Radioactivity of Water*.

*Response*: Gross alpha analysis will not be used to report activities of specific radionuclides. No analytical preparation is required for the requested analysis. The laboratories use a low background, thin window, gas-flow proportional counter with a guard detector operated in coincidence mode and pulse-height discrimination to separate alpha and beta activity. Laboratory methodologies are compatible and appropriate to perform analyses within the scope of Method A-4.

**C-10-3.1.5 Method A-5, Chemical Determination of Uranium**.

Principle: Uranium may be measured chemically by either colorimetry or fluorometry. In both procedures, the sample is dissolved, the uranium is oxidized to the hexavalent form and extracted into a suitable solvent. Impurities are removed from the solvent layer. For colorimetry, dibenzoylmethane is added, and the uranium is measured by the absorbance in a colorimeter. For fluorometry, a portion of the solution is fused with a sodium fluoride-lithium fluoride flux and the uranium is determined by the ultraviolet activated fluorescence of the fused disk in a fluorometer.

Applicability: This method is applicable to the measurements of emission rates of uranium when the isotopic ratio of the uranium radionuclides is well known. ASTM E1118, *Standard Practice for Acoustic Emission Examination of Reinforced Thermosetting Resin Pipe (RTRP)*; ASTM D2907-97, *Standard Test Methods for Microquantities of Uranium in Water by Fluorometry*.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.1.6 Method A-6, Radon-222—Continuous Gas Monitor**.

Principle: Radon-222 is measured directly in a continuously extracted sample stream by passing the air stream through a calibrated scintillation cell. Prior to the scintillation cell, the air stream is treated to remove particulates and excess moisture. The alpha particles from radon-222 and its decay products strike a zinc sulfide coating on the inside of the scintillation cell producing light pulses. The light pulses are detected by a photomultiplier tube which generates electrical pulses. These pulses are processed by the system electronics and the read out is in pCi/L of radon-222.

Applicability: This method is applicable to the measurement of radon-222 in effluent streams which do not contain significant quantities of radon-220. Users of this method should calibrate the monitor in a radon calibration chamber at least twice per year. The background of the monitor should also be checked periodically by operating the instrument in a low radon environment. EPA 520/1-89-009, *Indoor Radon and Radon Decay Product Measurement Protocols*.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.1.7 Method A-7, Radon-222-Alpha Track Detectors**.

Principle: Radon-222 is measured directly in the effluent stream using alpha track detectors (ATDs). The alpha particles emitted by radon-222 and its decay products strike a small plastic strip and produce submicron damage tracks. The plastic strip is placed in a caustic solution that accentuates the damage tracks which are counted using a microscope or automatic counting system. The number of tracks per unit area is correlated to the radon concentration in air using a conversion factor derived from data generated in a radon calibration facility.

Applicability: Prior approval from EPA is required for use of this method. This method is only applicable to effluent streams which do not contain significant quantities of radon-220, unless special detectors are used to discriminate against radon-220. This method may be used only when ATDs have been demonstrated to produce data comparable to data obtained with Method A-6. Such data should be submitted to EPA when requesting approval for the use of this method. EPA 520/1-89-009.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.2 Methods for Gaseous Beta Emitting Radionuclides**.

**C-10-3.2.1 Method B-1, Direct Counting in Flow-Through Ionization Chambers**.

Principle: An ionization chamber containing a specific volume of gas which flows at a given flow rate through the chamber is used. The sample (effluent stream sample) acts as the counting gas for the chamber. The activity of the radionuclide is determined from the current measured in the ionization chamber.

Applicability: This method is applicable for measuring the activity of a gaseous beta-emitting radionuclide in an effluent stream that is suitable as a counting gas, when no other beta-emitting nuclides are present. DOE/EP-0096, *A Guide for Effluent Radiological Measurements at DOE Installations*; NCRP-58, "A Handbook of Radioactivity Measurement Procedures."

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.2.2 Method B-2, Direct Counting with In-line or Off-line Beta Detectors**.

Principle: The beta detector is placed directly in the effluent stream (in-line) or an extracted sample of the effluent stream is passed through a chamber containing a beta detector (off-line). The activities of the radionuclides present in the effluent stream are determined from the beta count rate, and a knowledge of the radionuclides present and the relationship of the gross beta count rate and the specific radionuclide concentration.

Applicability: This method is applicable only to radionuclides with maximum beta particle energies >0.2 MeV. This method may be used to measure emissions of specific radionuclides only when it is known that the sample contains only a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. Specific radionuclide analysis of periodic grab samples may be used to identify the types and quantities of radionuclides present and to establish the relationship between specific radionuclide analyses and gross beta count rates.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.3 Methods for Non-Gaseous Beta Emitting Radionuclides**.

**C-10-3.3.1 Method B-3, Radiochemistry-Beta Counting**.

Principle: The element of interest is separated from other elements, and from the sample matrix by radiochemistry. This may involve precipitation, distillation, ion exchange, or solvent extraction. Carriers (elements chemically similar to the element of interest) may be used. The element is deposited on a planchet, and counted with a beta counter. Corrections for chemical yield, and decay (if necessary) are made. The beta count rate determines the total activity of all radionuclides of the separated element. This method may also involve the radiochemical separation and counting of a daughter element, after a suitable period of ingrowth, in which case it is specific for the parent nuclide.

Applicability: This method is applicable for measuring the activity of any beta-emitting radionuclide, with a maximum energy >0.2 MeV, provided no other radionuclide is present in the separated sample. APHA-608, *Methods of Air Sampling*, Method 608, "Tentative Method of Analysis for Strontium-90 Content of Atmospheric Particulate Matter."

*Response*: The beta-emitting radionuclide of interest is Sr-90. The laboratories use element-specific chemical separation/purification followed by deposition to a planchet. Activities are determined using gas proportional counting. The laboratories use a low background, thin window, gas-flow proportional counter with a guard detector operated in coincidence mode and pulse-height discrimination to separate alpha and beta activity. The methods may use a radiochemical tracer (Sr-85) or a chemical carrier to

correct for chemical yields. Laboratory methodologies are compatible and appropriate to perform analyses within the scope of Method B-3.

**C-10-3.3.2 Method B-4, Direct Beta Counting (Gross beta determination)**.

Principle: The sample, collected on a suitable filter, is counted with a beta counter. The sample must be thin enough so that self-absorption corrections can be made.

Applicability: Gross beta measurements are applicable only to radionuclides with maximum beta particle energies >0.2 MeV. Gross beta measurements may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, and (2) measurements made using Method B-3 show reasonable agreement with the gross beta measurement. Gross beta measurements are applicable to mixtures of radionuclides only for the purposes and under the conditions described in Section C-10-3.7. APHA-602, *Methods of Air Sampling*, Method 602, "Tentative Method of the Analysis for Gross Beta Radioactivity Content of the Atmosphere"; ASTM D1890-51, *Standard Test Method for Beta Particle Radioactivity of Water*.

*Response*: Gross beta analysis will not be used to report activities of specific radionuclides. No analytical preparation is required for the requested analysis. The laboratories use a low background, thin window, gas-flow proportional counter with a guard detector operated in coincidence mode and pulse-height discrimination to separate alpha and beta activity. Laboratory methodologies are compatible and appropriate to perform analyses within the scope of Method B-4.

**C-10-3.3.3 Method B-5, Liquid Scintillation Spectrometry**.

Principle: An aliquot of a collected sample or the result of some other chemical separation or processing technique is added to a liquid scintillation "cocktail" which is viewed by photomultiplier tubes in a liquid scintillation spectrometer. The spectrometer is adjusted to establish a channel or "window" for the pulse energy appropriate to the nuclide of interest. The activity of the nuclide of interest is measured by the counting rate in the appropriate energy channel. Corrections are made for chemical yield where separations are made.

Applicability: This method is applicable to any beta-emitting nuclide when no other radionuclide is present in the sample or the separated sample provided that it can be incorporated in the scintillation cocktail. This method is also applicable for samples that contain more than one radionuclide but only when the energies of the beta particles are sufficiently separated so that they can be resolved by the spectrometer. This method is most applicable to the measurement of low-energy beta emitters such as tritium and carbon-14. APHA-609, *Methods of Air Sampling*, Method 609, "Tentative Method of Analysis for Tritium Content of the Atmosphere"; EML-LV-0539-17, *Radiochemical Analytical Procedures for Analysis of Environmental Samples*.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.4 Gamma Emitting Radionuclides**

**C-10-3.4.1 Method G-1, High Resolution Gamma Spectrometry**.

Principle: The sample is counted with a high resolution gamma detector, usually either a lithium-drifted [Ge(Li)] or high-purity geranium detector (HPGe), connected to a multichannel analyzer or computer. The gamma emitting radionuclides in the sample are measured from the gamma count rates in the energy regions characteristic of the individual radionuclide. Corrections are made for counts contributed by other radionuclides to the spectral regions of the radionuclides of interest. Radiochemical separations may be made prior to counting but are usually not necessary.

Applicability: This method is applicable to the measurement of any gamma emitting radionuclide with gamma energies >20 keV. It can be applied to complex mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gases. The method may also be applied to the analysis of gaseous gamma emitting radionuclides directly in an effluent stream by passing the stream through a chamber or cell containing the detector. ASTM D3649-85, *Standard Practice for High Resolution Gamma Spectrometry*; IDO-12096.

*Response 324 Stack*: The primary gamma-emitting radionuclide of interest is Cs-137; however, the analysis will also reveal Co-60, Cs-134, Eu-152, Eu-154, Eu-155, Ru-106, and Sb-125. No analytical preparation is required; composites are generated by direct counting of multiple filters. The laboratories use high-resolution spectrometers to analyze the composited air filters. The high-resolution detectors are connected to an MCA for discrimination and quantification of isotope-specific gamma emissions. Laboratory methodologies are compatible and appropriate to perform analyses within the scope of Method G-1.

*Response NFM*: Same as above except the gamma-emitting radionuclides of interest are Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Eu-155, Ru-106, and Sb-125.

**C-10-3.4.2 Method G-2, Low Resolution Gamma Spectrometry**.

Principle: The sample is counted with a low resolution gamma detector, a thallium activated sodium iodide crystal. The detector is coupled to a photomultiplier tube and connected to a multichannel analyzer. The gamma emitting radionuclides in the sample are measured from the gamma count rates in the energy regions characteristic of the individual radionuclides. Corrections are made for counts contributed by other radionuclides to the spectral regions of the radionuclides of interest. Radiochemical separation may be used prior to counting to obtain less complex gamma spectra if needed.

Applicability: This method is applicable to the measurement of gamma emitting radionuclides with energies >100 keV. It can be applied only to relatively simple mixtures of gamma emitting radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream by passing the gas stream through a chamber or cell containing the detector (EMSL-LV-0539-17).

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.4.3** Method G-3, Single Channel Gamma Spectrometry.

Principle: The sample is counted with a thallium activated sodium iodide crystal. The detector is coupled to a photomultiplier tube connected to a single channel analyzer. The activity of a gamma emitting radionuclide is determined from the gamma counts in the energy range for which the counter is set.

Applicability: This method is applicable to the measurement of a single gamma emitting radionuclide. It is not applicable to mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream by passing the gas stream through a chamber or cell containing the detector.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.4.3 Method G-4, Gross Gamma Counting**.

Principle: The sample is counted with a gamma detector usually a thallium activated sodium iodine crystal. The detector is coupled to a photomultiplier tube and gamma rays above a specific threshold energy level are counted.

Applicability: Gross gamma measurements may be used to measure emissions of specific radionuclides only when it is known that the sample contains a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. When gross gamma measurements are used to determine emissions of specific radionuclides periodic measurements using Methods G-1 or G-2 should be made to demonstrate that the gross gamma measurements provide reliable emission data. This method may be applied to analysis of gaseous radionuclides directly in an effluent stream by placing the detector directly in or adjacent to the effluent stream or passing an extracted sample of the effluent stream through a chamber or cell containing the detector.

*Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.5 Counting Methods**. All of the above methods with the exception of Method A-5 involve counting the radiation emitted by the radionuclide. Counting methods applicable to the measurement of alpha, beta and gamma radiations are listed below. The equipment needed and the counting principles involved are described in detail in ASTM D3648-78, *Standard Practices for the Measurement of Radioactivity*.

**C-10-3.5.1 Alpha Counting**.

- *Gas Flow Proportional Counters*. The alpha particles cause ionization in the counting gas and the resulting electrical pulses are counted. These counters may be windowless or have very thin windows.

  *Response*: The laboratories use a low background, thin window, gas-flow proportional counter with a guard detector operated in coincidence mode and pulse-height discrimination to separate alpha and beta activity. Laboratory detectors are compatible and appropriate to perform analyses within the scope of the identified methodology.

- *Scintillation Counters*. The alpha particles transfer energy to a scintillator resulting in a production of light photons which strike a photomultiplier tube converting the light photons to electrical pulses which are counted. The counters may involve the use of solid scintillation materials such as zinc sulfide or liquid scintillation solutions.

  *Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

- *Solid-State Counters*. Semiconductor materials, such as silicon surface-barrier p-n junctions, act as solid ionization chambers. The alpha particles interact which the detector producing electron hole pairs. The charged pair is collected by an applied electrical field and the resulting electrical pulses are counted.

  *Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

- *Alpha Spectrometers*. Semiconductor detectors used in conjunction with multichannel analyzers for energy discrimination.

*Response*: The laboratories use high-resolution, solid-state spectrometers for analysis after chemical separation/purification. The high-resolution detectors are connected to an MCA for discrimination and quantification of isotope-specific alpha emissions. Laboratory detectors are compatible and appropriate to perform analyses within the scope of the identified methodology.

**C-10-3.5.2 Beta Counting**

- *Ionization Chambers*. These chambers contain the beta-emitting nuclide in gaseous form. The ionization current produced is measured.

  *Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

- *Geiger-Muller Counters-or Gas Flow Proportional Counters*. The beta particles cause ionization in the counting gas and the resulting electrical pulses are counted. Proportional gas flow counters which are heavily shielded by lead or other metal, and provided with an anti-coincidence shield to reject cosmic rays, are called low background beta counters.

  *Response*: The laboratories use a low background, thin window, gas-flow proportional counter with a guard detector operated in coincidence mode and pulse-height discrimination to separate alpha and beta activity. Laboratory detectors are compatible and appropriate to perform analyses within the scope of the identified methodology.

- *Scintillation Counters*. The beta particles transfer energy to a scintillator resulting in a production of light photons, which strike a photomultiplier tube converting the light photon to electrical pulses which are counted. This may involve the use of anthracene crystals, plastic scintillator, or liquid scintillation solutions with organic phosphors.

  *Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

- *Liquid Scintillation Spectrometers*. Liquid scintillation counters which use two photomultiplier tubes in coincidence to reduce background counts. This counter may also electronically discriminate among pulses of a given range of energy.

  *Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.5.3 Gamma Counting**

- *Low-Resolution Gamma Spectrometers*. The gamma rays interact with thallium activated sodium iodide or cesium iodide crystal resulting in the release of light photons which strike a photomultiplier tube converting the light pulses to electrical pulses proportional to the energy of the gamma ray. Multi-channel analyzers are used to separate and store the pulses according to the energy absorbed in the crystal.

  *Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

- *High-Resolution Gamma Spectrometers*. Gamma rays interact with a Ge(Li) or HPGe semiconductor detectors resulting in a production of electron-hole pairs. The charged pair is collected by an applied electrical field. A very stable low noise preamplifier amplifies the pulses of electrical charge resulting

from the gamma photon interactions. Multichannel analyzers or computers are used to separate and store the pulses according to the energy absorbed in the crystal.

*Response*: The laboratories use high-resolution spectrometers for analysis of composite air filters. The high-resolution detectors are connected to an MCA for discrimination and quantification of isotope-specific gamma emissions. Laboratory detectors are compatible and appropriate to perform analyses within the scope of the identified methodology.

- *Single Channel Analyzers*. Thallium activated sodium iodide crystals used with a single window analyzer. Pulses from the photomultiplier tubes are separated in a single predetermined energy range.

  *Response*: Not applicable. This methodology will not be requested of the laboratories providing analysis.

**C-10-3.5.4 Calibration of Counters**. Counters are calibrated for specific radionuclide measurements using a standard of the radionuclide under either identical or very similar conditions as the sample to be counted. For gamma spectrometers a series of standards covering the energy range of interest may be used to construct a calibration curve relating gamma energy to counting efficiency.

In those cases where a standard is not available for a radionuclide, counters may be calibrated using a standard with energy characteristics as similar as possible to the radionuclide to be measured. For gross alpha and beta measurements of the unidentified mixtures of radionuclides, alpha counters are calibrated with a natural uranium standard and beta counters with a cesium-137 standard. The standard must contain the same weight and distribution of solids as the samples, and be mounted in an identical manner. If the samples contain variable amounts of solids, calibration curves relating weight of solids present to counting efficiency are prepared. Standards other than those prescribed may be used provided it can be shown that such standards are more applicable to the radionuclide mixture measured.

*Response*: The laboratories providing analytical services are required to be able to comply (where applicable) with the DOE/U.S. Department of Defense (DoD) Quality Systems Manual (QSM; DoD/DOE 2013) for Environmental Laboratories and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD). Both the HASQARD and the QSM programs require establishment of robust detector calibration programs. DOE QSM requirements are integrated into the DoD/DOE QSM. All counters are calibrated using National Institute of Standards and Technology traceable materials.

- For gamma energy spectral counting, a mixed-gamma standard that emits various gamma rays ranging from 59 to 1,850 keV is used. Vendor-supplied calibration software is used to construct efficiency-versus-energy calibration curves for different geometrical configurations used in gamma analysis.

- Alpha spectral counters are calibrated with the isotopes of interest for each element requested, again using vendor-supplied calibration software to construct efficiency and energy calibrations.

- For the determination of radiostrontium, 90Sr/90Y is used for calibration of beta proportional counters over the range of potential residual solids on the counting planchets.

- For gross alpha and gross beta counting, detectors are calibrated with isotopes known to be common in Hanford-generated samples. Because of technical difficulties, calibration curves relating weight of solids present to counting efficiencies are not established in direct alpha-beta counting of air filter samples.

- Laboratory calibration of detectors is compatible and appropriate to perform analyses within the scope of the identified methodology.

**C-10-3.6 Radiochemical Methods for Selected Radionuclides**. Methods for a selected list of radionuclides are listed in Table C-10-1. The radionuclides listed are those which are most commonly used and which have the greatest potential for causing doses to members of the public. For radionuclides not listed in Table C-10-1, methods based on any of the applicable "principles of measurement" described in Sections C-10-3.1 through C-10-3.4 may be used.

*Response*: The sampling points associated with this analytical work are part of an established and long running air monitoring program. The radionuclides of interest were established by first performing an assessment of building inventory and potential to emit, as documented in DOE/RL-2004-77. Then the following criteria were applied:

- 40 CFR 61.93(b)(4)(i) requires measurement of all radionuclides from a release point that could contribute >10% of the potential effective dose equivalent (to a member of the public), which means specific radionuclide analyses are required (e.g., isotopic analysis of quarterly composite samples). The 324 Building stack potential-to-emit is assessed in CERCLA document DOE/RL-2004-77, Appendix C.

- DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (invoked by reference from DOE O 458.1), Table 3-1 requires measurement of all radionuclides from a release point that contribute >10% of the dose (interpreted as actual emissions dose rather than potential dose). Note, however, that exact quantities cannot be determined for low emissions that are below MDCs.

- In order to ensure both of the above criteria are met, radionuclides that are near but <10% of the potential effective dose equivalent are included in the analytes of interest..

Analysis and analytes include the following:

- Evaluation of gross alpha (Method A-4) and gross beta (Method B-4) activities directly on air filters.

- Composite analysis for beta emitter (Method B-3); Sr-90.

- Composite analysis for alpha emitters (Method A-1); plutonium isotopic (Pu-238, Pu-239/240), uranium isotopic (U-234, U-235, U-238), and Am-241.

- Composite analysis for gamma emitters (Method G-1); Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Eu-155, Ru-106, and Sb-125.

  Note: Gamma emitters Eu-152, Eu-154, Eu-155, Ru-106, and Sb-125 are not identified in Table C-10-1 but are part of the routine reporting suite analyzed via Method G-1.

  Laboratory methodologies are compatible and appropriate to perform analyses within the scope of identified methods.

**C-10-3.7 Applicability of Gross Alpha and Beta Measurements to Unidentified Mixtures of Radionuclides**.

Gross alpha and beta measurements may be used as a screening measurement as a part of an emission measurement program to identify the need to do specific radionuclide analyses or to confirm or verify that unexpected radionuclides are not being released in significant quantities.

Gross alpha (Method A-4) or gross beta (Methods B-2 or B-4) measurements may also be used for the purpose of comparing the measured concentrations in the effluent stream with the limiting "Concentration Levels for Environmental Compliance" in 40 CFR 61, Appendix E, Table 2. For unidentified mixtures, the measured concentration value shall be compared with the lowest environmental concentration limit for any radionuclide which is not known to be absent from the effluent stream.

*Response*: The sampling points associated with this analytical work are part of an established and long running air monitoring program. The composition of the radionuclide contamination at any location is not expected to change significantly over time. Gross alpha and gross beta analysis is performed to provide overall trending and to monitor for unexpected emission excursions.

**Table C-10-1. List of Approved Methods for Specific Radionuclides**

| Radionuclide | Approved Methods of Analysis |
|---|---|
| Am-241 | A-1, A-2, A-3, A-4 |
| Ar-41 | B-1, B-2, G-1, G-2, G-3, G-4 |
| Ba-140 | G-1, G-2, G-3, G-4 |
| Br-82 | G-1, G-2, G-3, G-4 |
| C-11 | B-1, B-2, G-1, G-2, G-3, G-4 |
| C-14 | B-5 |
| Ca-45 | B-3, B-4, B-5 |
| Ce-144 | G-1, G-2, G-3, G-4 |
| Cm-244 | A-1, A-2, A-3, A-4 |
| Co-60 | G-1, G-2, G-3, G-4 |
| Cr-51 | G-1, G-2, G-3, G-4 |
| Cs-134 | G-1, G-2, G-3, G-4 |
| Cs-137 | G-1, G-2, G-3, G-4 |
| Fe-55 | B-5, G-1 |
| Fe-59 | G-1, G-2, G-3, G-4 |
| Ga-67 | G-1, G-2, G-3, G-4 |
| H-3 ($H_2O$) | B-5 |
| H-3 (gas) | B-1 |
| I-123 | G-1, G-2, G-3, G-4 |
| I-125 | G-1 |
| I-131 | G-1, G-2, G-3, G-4 |
| In-113m | G-1, G-2, G-3, G-4 |
| Ir-192 | G-1, G-2, G-3, G-4 |
| Kr-85 | B-1, B-2, B-5, G-1, G-2, G-3, G-4 |
| Kr-87 | B-1, B-2, G-1, G-2, G-3, G-4 |

**Table C-10-1. List of Approved Methods for Specific Radionuclides**

| Radionuclide | Approved Methods of Analysis |
|---|---|
| Kr-88 | B-1, B-2, G-1, G-2, G-3, G-4 |
| Mn-54 | G-1, G-2, G-3, G-4 |
| Mo-99 | G-1, G-2, G-3, G-4 |
| N-13 | B-1, B-2, G-1, G-2, G-3, G-4 |
| O-15 | B-1, B-2, G-1, G-2, G-3, G-4 |
| P-32 | B-3, B-4, B-5 |
| Pm-147 | B-3, B-4, B-5 |
| Po-210 | A-1, A-2, A-3, A-4 |
| Pu-238 | A-1, A-2, A-3, A-4 |
| Pu-239 | A-1, A-2, A-3, A-4 |
| Pu-240 | A-1, A-2, A-3, A-4 |
| Ra-226 | A-1, A-2, G-1, G-2 |
| S-35 | B-5 |
| Se-75 | G-1, G-2, G-3, G-4 |
| Sr-90 | B-3, B-4, B-5 |
| Tc-99 | B-3, B-4, B-5 |
| Te-201 | G-1, G-2, G-3, G-4 |
| Uranium (total | A-1, A-2, A-3, A-4 |
| Uranium (Isotopic) | A-1, A-3 |
| Uranium (Natural) | A-5 |
| Xe-133 | G-1 |
| Yb-169 | G-1, G-2, G-3, G-4 |
| Zn-65 | G-1, G-2, G-3, G-4 |

*Response*: The analytical methods used for specific radionuclides are identified in Section C-10-3.6.

**C-10-4.0 Quality Assurance Methods**

Each facility required to measure their radionuclide emissions shall conduct a quality assurance program in conjunction with the radionuclide emission measurements. This program shall ensure that the emission measurements are representative, and are of known precision and accuracy and shall include administrative controls to ensure prompt response when emission measurements indicate unexpectedly large emissions. The program shall consist of a system of policies, organizational responsibilities, written

procedures, data quality specifications, audits, corrective actions and reports. This quality assurance program shall include the following program elements:

**C-10-4.1** The organizational structure, functional responsibilities, levels of authority and lines of communications for all activities related to the emissions measurement program shall be identified and documented.

*Response*: Responsibilities for radioactive air emissions sampling activities are described in Chapters C1 and C2 in this QAPjP.

Both the HASQARD and the QSM programs require definition of a robust organizational structure and functional responsibilities including identification of levels of authority and lines of communications appropriate for analysis of all environmental samples.

**C-10-4.2** Administrative controls shall be prescribed to ensure prompt response in the event that emission levels increase due to unplanned operations.

*Response*: Administrative controls for trending emission data are implemented by Section C3.1 in this QAPjP, in accordance with procedure PRC-PRO-EP-15333, Section 5.14, and notification in accordance with procedure PRC-PRO-EP-15333, Section 5.57.

**C-10-4.3** The sample collection and analysis procedures used in measuring the emissions shall be described including where applicable:

*Response*: Sample Collection is addressed in the following sections.

Sample Analysis. Both the HASQARD and the QSM programs require that the laboratories operate to defined and controlled analytical procedures. Laboratory programs ensure that only the most recent revisions of analytical procedures are used. Controlled copies of laboratory procedures are provided to MSA as part of the analytical services contracts. The analytical procedures have been reviewed to ensure that the methodology meets the suggested approaches specifically identified in Methods A-1, A-4, B-3, B-4, and G-1.

**C-10-4.3.1** Identification of sampling sites and number of sampling points, including the rational for site selection.

*Response*: The top of the EP-324-01-S Stack is 45.7 m (150 ft) aboveground level. The record sampling probe is located at a height of 26.8 m (88 ft) aboveground. The stack diameter is 3.15 m (10.3 ft) at the sampling location. These dimensions are identified on drawing H-3-307632, Sheet 2, *Stack Sampling System*. The sample probe is approximately 9 duct diameters downstream of the last major disturbance and 6 duct diameters upstream of the stack exit.

The location was chosen to ensure a well-mixed, fully-developed flow in compliance with the criteria of ANSI-N13.1-1969 (i.e., Section 4.2.1.2: “The sampling point should be a minimum of five diameters downstream from abrupt changes in flow direction or prominent transitions”) and of 40 CFR 60, Appendix A-1, Method 1 (i.e., Section 2.1: “Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend.”).

**C-10-4.3.2** A description of the sampling probes and representativeness of the samples.

*Response*: To ensure representative particulate sampling, the sample probe is located, designed, and operated in accordance with ANSI N13.1-1969. The probe is located over 5 duct diameters downstream from abrupt changes in accordance with ANSI N13.1-1969, Section 4.2.1.2. The Kurz probe has six

nozzles located at centers of equal annular areas, as identified in Kurz Instruments drawing 1497D7003 as part of CVI 31553, in accordance with ANSI N13.1-1969 Appendix A3. The sample is withdrawn continuously from the stack at near-isokinetic flow rate in accordance with ANSI N13.1-1969, Section 4.2.2.3, as ensured by PRC-PRO-EP-15333 or PRC-PRO-EP-15334. The probe and sample line are made entirely of stainless steel; thus, the probe design and operation comply with the required standards for representative sampling of stack emissions.

**C-10-4.3.3** A description of any continuous monitoring systems used to measure emissions, including the sensitivity of the system, calibration procedures and frequency of calibration.

*Response*: This requirement is not applicable. Compliance is demonstrated by the continuous sampling of emissions (see Section C-10-4.3.4 of this supplemental information).

**C-10-4.3.4** A description of the sample collection systems for each radionuclide measured, including frequency of collection, calibration procedures and frequency of calibration.

*Response*: Sample air is withdrawn continuously from the stack emissions stream by the probe as described in Section C-10-4.3.2 of this supplemental information. This air flows through the sample line and particulate radionuclides are collected on a sample filter. The sample filters are exchanged routinely and analyzed at the MSA Contract-approved laboratory. The frequency of collection and the specific radionuclides analyzed are identified in location-specific sampling authorization forms, which are updated periodically to reflect changes. The current frequency is monthly for stack samples and biweekly for NFM filters. Sample collectors cannot be calibrated; however, sample flow rate measurement instruments are calibrated as discussed in Section C-10-4.3.6 of this supplemental information.

**C-10-4.3.5** A description of the laboratory analysis procedures used for each radionuclide measured, including frequency of analysis, calibration procedures, and frequency of calibration.

*Response*: This analytical work is part of an established and long running air monitoring program. Samples are obtained biweekly for NFM sources and monthly for the 324 Stack. Individual filters are analyzed for gross alpha and gross beta after receipt at the laboratory. Individual filters are archived by site location and composited on a biannual basis for NFM sources and quarterly for the stack. Composites are analyzed for gamma- emitting radionuclides, Sr-90, Pu-isotopic, U-isotopic (as specified by site), and Am-241 (as specified by site).

Both the HASQARD and the QSM programs require that the laboratories only operate detectors after calibration has been documented. Neither HASQARD nor QSM specify calibration frequency, but the laboratories identify periodic calibration in their documentation. HASQARD, QSM, and laboratory procedures require recalibration in the event of: (1) major repairs or adjustments to the power supply or detector, or (2) significant calibration shift as indicated by routine analysis of instrument control standards.

Both the HASQARD and the QSM programs require that the laboratories operate to defined and controlled analytical procedures. Laboratory programs ensure that only the most recent revisions of analytical procedures are used. Controlled copies of laboratory analytical procedures are provided to MSA as part of the analytical services contracts. These procedures have been reviewed to ensure that the methodology meets the suggested approaches specifically identified in methods A-1 (Pu-isotopic, U-isotopic, and Am-241), A-4 (gross alpha, B-3 [Sr-90]), B-4 (gross beta), and G-1 (gamma-emitting radionuclides) above.

**C-10-4.3.6** A description of the sample flow rate measurement systems or procedures, including calibration procedures and frequency of calibration.

*Response*: The sample flow rate measurement system consists of a rotameter and vacuum gauge. The sampling systems are inspected routinely and flow rate adjusted by a manual flow control valve to maintain a constant flow per 31M-SOP-ENV-001 (324-PRO-D4-53664), *Perform Stack Emissions Particulate Sampling*. Calibrations are performed annually in accordance with procedures identified in PRC-PRO-EP-15333 or PRC-PRO-EP-15334.

**C-10-4.3.7** A description of effluent flow rate measurement procedures, including frequency of measurements, calibration procedures and frequency of calibration.

*Response*: The stack flow is relatively constant, so the flow rate is measured annually in accordance with 40 CFR 61.93. The flow is measured by Type-S Pitot tube traverse in accordance with 40 CFR 60, Appendix A-1, Method 2. There are four ports spaced $90^{o}$ apart located just below the sampling probe location on the stack. Traverse points are located at centers of equal area annuli. Flow measurement pitot traverses are performed by V&B personnel who are also responsible for ensuring that all stack flow measurement equipment is adequate and appropriately calibrated in accordance with PRC-PRO-EP-15334. V&B is responsible to ensure that pitot tubes used for measuring stack flows are either calibrated to an NBS-traceable standard or are designed and constructed in accordance with Method 2 specifications of 40 CFR 60, Appendix A, to ensure appropriate coefficients are applied when calculating stack flow. Generally, Pitot tubes that are used on the Hanford Site are Dwyer 160 series, manufactured to an American Society of Mechanical Engineers design that meets ANSI/AMCA 210-99 and ANSI/ASHRAE 51-1999 codes and complies with 40 CFR 60, Appendix A-1, Method 2, construction specifications. Dwyer 160 series Pitot tubes have baseline coefficients of 1.0 for standard pitot tubes and 0.84 for Type-S Pitot tubes. 324 Facility measurements are made on a periodic schedule and by procedures identified in PRC-PRO-EP-15334.

**C-10-4.4** The objectives of the QAP shall be documented and shall state the required precision, accuracy, and completeness of the emission measurement data including a description of the procedures used to assess these parameters. Accuracy is the degree of agreement of a measurement with a true or known value. Precision is a measure of the agreement among individual measurements of the same parameters under similar conditions. Completeness is a measure of the amount of valid data obtained compared to the amount expected under normal conditions

*Response*: The objectives of the Quality Assurance program are documented in Section 1.3.2 of the main text in this document, PRC-MP-EP-40220, and detailed below.

Both the HASQARD and the QSM require that the laboratories have in place fully documented and robust QAPs to ensure that results are reported to known precision, accuracy, comparability, and completeness levels. For the analysis of air filter samples, the laboratories will be instructed to develop project-specific criteria to meet the following limits:

The requirements for precision, accuracy, and completeness are as follows:

- Precision requirements for measurements are met when replicate samples fall within a relative percent difference of ±30% for activities ≥5 times the minimum detectable activity values or when the analytical uncertainty is ≤20%.

  Note: Splitting stack sample filters is not feasible for making analytical replicates. Typically, the low gross alpha and gross beta activities found on air filters result in a high rate of counting uncertainty, which render filter recounts unsuitable for evaluation as replicates. Precision evaluation will not be required routinely for gross alpha, gross beta and gamma spectral analysis unless field replicate samples are provided to the laboratory.

- Accuracy requirements shall be met when 95% of the results from performance-check standards of laboratory control samples (for radiochemical separations) fall within 100% ±25%.
- Completeness requirements shall be met when the laboratory produces a minimum of 90% reportable data for requested analyses on all submitted samples.

**C-10-4.5** The QC program shall be established to evaluate and track the quality of the emission measurement data against preset criteria. The program should include, where applicable, a system of replicates; spiked samples; split samples; blanks; and control charts. The number and frequency of such quality control checks shall be identified.

*Response*: Both the HASQARD and the QSM require that the laboratories have in place fully documented and robust QAPs to ensure that long-term stability of the analytical procedures is maintained. The programs routinely track and evaluate laboratory quality control materials including batch blanks, laboratory control samples, and laboratory replicates (as applicable). Matrix spike samples are not required for the radioanalytical methods identified. All laboratory control materials are included with a maximum of 20 samples, or per analytical batch, whichever is more frequent. Control limits for laboratory control samples and replicates are defined in the comments for C-10-4.4. The acceptance criteria for batch blanks are less than minimum detectable activity (i.e., nondetected) or <5% sample isotope concentration.

For all samples and quality control materials, the laboratory evaluates and tracks tracer/carrier recoveries (tracers/carriers are not required for gross alpha, gross beta, and gamma spectrometry analyses). Recovery criterion is 30% to 110%.

The laboratory also tracks and evaluates detector performance using calibration standards and background counts. Control criteria are based on statistical evaluations of multiple measurements. Limits are ±2 sigma warning limits with ±3 sigma control limits.

All QC parameter data are maintained within the electronic laboratory information management system. The laboratory information management system generates control charts, as necessary, and the information is reviewed periodically for trends.

Note: Each sample collection point produces only one record sample filter that is sent to the laboratory for analysis; no duplicate samples are available. The program does not provide externally-spiked or split-sample materials.

The laboratory is also required to participate in the DOE Mixed Analyte Performance Evaluation Program (MAPEP). MAPEP includes analysis of air filter media for all of the methods identified for this scope of work. MAPEP performance is reviewed by the U.S. Department of Energy Consolidated Audit Program (DOECAP). MAPEP failures and associated corrective actions are monitored at least annually by DOECAP. Sequential failures of a MAPEP parameter require immediate corrective actions documented through DOECAP and distributed to all DOE users of the laboratory.

**C-10-4.6** A sample tracking system shall be established to provide for positive identification of samples and data through all phases of the sampling collection, analysis, and reporting system. Sample handling and preservation procedures shall be established to maintain integrity of the samples during collection, storage, and analysis.

*Response*: Samples are assigned unique identification numbers and transferred to the laboratory under formal chain-of-custody documentation. Sample tracking is provided through sampling collection, analysis, and reporting as identified in Section C-1-4.6.

Both the HASQARD and the QSM require that the laboratories have in place fully documented and robust sample receipt, storage, and internal chain-of-custody processes. Specific preservation (other than storage to minimize potential contamination) is not required for the analyses requested.

Both the HASQARD and the QSM require that all results be fully traceable to the sample number provided by the client.

**C-10-4.7** Regular maintenance, calibration and field checks shall be performed for each sampling system in use by satisfying the requirements found in Table C-10-2, "Maintenance, Calibration, and Field Check Requirements."

*Response*: The following maintenance frequency and procedures are identified in PRC-PRO-EP-15334 (using Table 2 from Method 114 with an additional column to show "EP-324-01-S Applicability and Compliance Status").

**Table C-10-2. Maintenance, Calibration, and Field Check Requirements**

| Sampling System Components | Frequency of Activity |
|---|---|
| Cleaning of thermal anemometer | N/A. The thermal anemometer element of the continuous stack flow instrument is not scheduled for cleaning because it is not used for record purposes. |
| Inspect Pitot tubes for contaminant deposits | N/A. There are no pitot tubes installed in the stack. |
| Inspect Pitot tube systems for leaks | N/A. There are no pitot tubes installed in the stack. |
| Inspect sharp-edged nozzles for damage | At least annually or after maintenance that could cause damage. |
| Check nozzles for alignment, presence of deposits, or other potentially degrading factors | Annually. |
| Check transport lines of HEPA-filtered applications to determine if cleaning is required | Annually. |
| Clean transport lines | Visible deposits for HEPA-filtered applications; surface density of 1 $g/cm^2$ for other applications. Performed as needed during annual stack inspection. |
| Inspect or test the sample system for leaks | At least annually. |
| Check mass flow meters of sampling systems with a secondary or transfer standard | N/A. Mass flowmeters are not relied upon for record information. |
| Inspect rotameters of sampling systems for presence of foreign matter | At the start of each sampling period. |
| Check response of stack flow rate systems | N/A. The continuous stack flow instrument is not scheduled for testing because it is not used for record purposes. |
| Calibration of flow meters of sampling systems | At least annually. |
| Calibration of effluent flow measurement devices | N/A. The continuous stack flow instrument is not scheduled for calibration because it is not used for record purposes. |
| Calibration of timing devices | N/A. The stack does not utilize timing devices. |

HEPA = high-efficiency particulate air
N/A = not applicable

**C-10-4.8** Periodic internal and external audits shall be performed to monitor compliance with the quality assurance program. These audits shall be performed in accordance with written procedures and conducted by personnel who do not have responsibility for performing any of the operations being audited.

*Response*: Refer to Section C3.1 in this QAPjP.

Both the HASQARD and the QSM require documented periodic internal audits of laboratories by individuals independent of the operations being audited. The laboratory is assessed annually to the QSM via onsite DOECAP audits.

**C-10-4.9** A corrective action program shall be established including criteria for when corrective action is needed, what corrective action will be taken and who is responsible for taking the corrective action.

*Response*: Refer to Section C3.1 in this QAPjP.

Both the HASQARD and the QSM require that laboratories have in place fully documented and robust corrective action programs. Laboratory corrective active programs are described in laboratory quality assurance program documents and specific laboratory procedures. Controlled copies of laboratory quality assurance program documents and procedures are provided to MSA as part of the analytical services contracts.

**C-10-4.10** Periodic reports to responsible management shall be prepared on the performance of the emission measurements program. These reports should include assessment of the quality of the data, results of audits, and description of corrective actions.

*Response*: The "periodic reports" that describe and/or characterize the levels of performance related to the "assessment of the quality of data, results of data, and description of corrective actions" comprise such documents as:

- Routine (usually weekly) programmatic activity reports by MSA
- Management assessments, independent assessments, and audits by Washington Closure Hanford to CHPRC only
- Regulatory agency inspections
- Periodic data reviews of ABCASH conducted by contractors and orchestrated by MSA
- National intercomparative laboratory testing
- Laboratory accreditation
- Annual effluent monitoring and data and effluent monitoring reports (e.g., the Radionuclide Air Emissions Report and the Hanford Site Environmental Report)
- Documented corrective action management actions on findings and opportunities for improvement.

**C-10-4.11** The QAP should be documented in a QAPjP that should address each of the above requirements.

*Response*: This QAPjP was prepared to perform this function.

**C-10-4.12** CHPRC BMPs for sample and abatement system readiness shall be performed for each emission unit in use by satisfying the requirements found in Table C-10-3, "CHPRC Best Management Practice Requirements."

*Response*: Refer to Table C-10-3, PRC-PRO-EP-15333, and to facility-specific procedures.

**Table C-10-3. CHPRC Best Management Practice Requirements**

| Emission Unit Components | Frequency of Activity |
|---|---|
| Inspect heat traces sample line operation | Weekly |
| Determine availability of redundant abatement equipment (e.g., fans, drive motors, dampers [inlet, backflow and exhaust], HEPA filtration) | |
| Maintenance scheduled and performed in a manner equivalent to Vital Safety Systems | As required |
| Determine availability of redundant sampling system equipment (e.g., vacuum pumps) | Weekly |

CHPRC = CH2M HILL Plateau Remediation Company
HEPA = high efficiency particulate air

# Appendix D

# CHPRC Environmental Management System Assessment Program

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# Terms

| | |
|---|---|
| CHPRC | CH2M HILL Plateau Remediation Company |
| CRD | Contractor Requirements Document |
| EC&QA | Environmental Compliance and Quality Assurance |
| EMS | Environmental Management System |
| EP&SP | Environmental Program and Strategic Planning |
| ISMS | Integrated Safety Management System |

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# D1 Introduction

PRC-MP-EP-40182, *Environmental Management System Manual* (hereinafter called the EMS Manual), provides an overview of the Environmental Management System (EMS), which was developed to satisfy the specifications of DE-AC06-08RL14788, *CH2M HILL Plateau Remediation Company Plateau Remediation Contract*. This contract states that the Integrated Safety Management System (ISMS) shall include an integrated EMS developed pursuant to DOE O 436.1 (Supplemented Rev. 0), *Departmental Sustainability*, and will include supplemental requirements for spill prevention, reporting, and response (Attachment 1, "Contractor Requirements Document"; hereinafter called CRD O 436.1). Section J.2 of the contract has been modified to include the Contractor Requirements Document (CRD) for DOE O 436.1.

The EMS Manual describes the elements and framework of ISO 14001:2015, *Environmental Management Systems–Requirements with Guidance for Use*, and incorporates the additional provisions of CRD O 436.1. This system follows the basic format of plan-do-check-act philosophy. The EMS has categorized these requirements into the following seven Core Elements:

1. Context of the Organization
2. Leadership
3. Planning
4. Support
5. Operation
6. Performance Evaluation
7. Improvement

These Core Elements align with the ISMS Core Functions and guiding principles.

The ISMS Guiding Principles establish the organizational culture for doing work safely. ISMS Core Functions and EMS Core Elements establish organizational processes to identify and control human and environmental hazards. When the culture and processes function together, the outcome is a balance between compliance and operational excellence designed to protect the worker, public, and environment.

The EMS Manual describes the scope of the EMS and how it relates to the ISMS and existing systems. It is largely a referencing document pointing to existing CH2M HILL Plateau Remediation Company (CHPRC) programs and procedures that demonstrate conformance to ISO 14001:2015; however, the manual also provides direction for implementing ISO 14001:2015 requirements in some instances.

Under the EMS, CHPRC has developed and implemented an environmental policy, identifies its environmental aspects (activities, products, or services that can interact with the environment), and ensures that significant environmental impacts are appropriately managed.

EMS is a systematic approach to work that is designed to:

- Ensure protection of human health and the environment while complying with environmental requirements
- Identify and focus on activities that could have an impact on the environment

- Ensure that employees working on such activities are properly trained
- Ensure that proper controls are developed and implemented to minimize environmental impacts
- Facilitate the monitoring of environmental performance over time

A component of the EMS program is the CHPRC Environmental Assessment Program, which is documented in this appendix.

# D2 Purpose, Scope, and Applicability

## D2.1 Purpose

The purpose of this document is to establish the requirements for the CHPRC EMS internal audit program, including the process, roles and responsibilities, and auditor qualifications. EMS internal audits are planned, scheduled, and performed to determine whether the CHPRC Environmental Management System conforms to ISO 14001:2015 and CRD O 436.1, and has been properly implemented, maintained, and continually improved.

## D2.2 Scope and Applicability

This document applies to the CHPRC EMS Program.

Note 1: The term “assessment” is understood to be “independent assessments,” which are used synonymously with audits in this document.

Note 2: Terms specific to this document are defined in ISO 14001:2015 and ISO 19011:2002, *Guidelines for Auditing Management Systems*.

The scope of internal audits are determined by the Environmental Compliance and Quality Assurance (EC&QA) Assessment Program and are based on elements of the ISO 14001:2105 standard and CHPRC’s EMS Manual. EMS internal audits are not evaluations of compliance with CHPRC’s legal and other environmental requirements.

# D3 Implementation

This document is effective upon publication.

# D4 Frequency of EMS Internal Audit

Internal EMS audits shall be planned and scheduled. All elements of the EMS Program will be audited at least once every 3 years to ensure the CHPRC conforms to ISO 14001:2015 and to the requirements of the CHPRC EMS Manual. Environmental Program and Strategic Planning (EP&SP) management will decide on the strategy to be pursued to accomplish this requirement. An individual audit may be limited to a sampling of EMS elements or areas and can be both random and/or focused on certain activities based on their importance and/or results of previous audits. The environmental importance of the processes concerned, changes affecting the organization and the results of previous audits will be considered when establishing internal audits.

# D5 Auditor Evaluation

## D5.1 Auditors

CHPRC will select auditors and conduct audits to ensure objectivity and the impartiality of the audit process. The evaluation of auditors shall be in accordance with Table D-1 and shall occur at the following different stages:

- The initial evaluation of auditor candidates
- Maintenance of evaluation of auditors
- The continual evaluation of auditor performance to identify needs for maintenance and improvement of knowledge and skills

**Table D-1. Auditor and Lead Auditor Qualification Criteria**

| Parameter | Auditor | Lead Auditor |
|---|---|---|
| Education | Bachelor's Degree | Bachelor's Degree |
| Total Work Experience | 5 years | 5 years |
| Work Experience in Quality or Environmental Management Field | 2 years | 2 years |
| Auditor Training | CHPRC Assessment Fundamentals, course 604010 | ISO 14001:2015 EMS Lead Auditor Training |
| Audit Experience | Four complete audits for a total of at least 20 days of audit experience as an auditor-in-training under the direction and guidance of an auditor competent as a Lead Auditor | Three complete audits for a total of at least 15 days of audit experience acting in the role of a Lead Auditor under the direction and guidance of an auditor competent as a lead auditor. The audits should be completed within the last two consecutive years |

Reference: ISO 14001:2015, *Environmental Management Systems–Requirements with Guidance for Use*.

EMS = Environmental Management System

In accordance with ISO 19011:2002, Section 7.2, auditors shall demonstrate competence based on the following personal attributes:

- Ethical (i.e., fair, truthful, sincere, honest, and discreet)
- Open minded (i.e., willing to consider alternative ideas or points of view)
- Diplomatic (i.e., tactful in dealing with people)
- Observant (i.e., actively aware of physical surroundings and activities)
- Perceptive (i.e., instinctively aware of and able to understand situations)
- Versatile (i.e., adjusts readily to different situations)
- Tenacious (i.e., persistent, focused on achieving objectives)
- Decisive (i.e., reaches timely conclusions based on logical reasoning and analysis)
- Self-reliant (i.e., acts and functions independently while interacting effectively with others)

Section 7.3 of ISO 19011:2002 states auditors should also have the ability to apply the knowledge and skills in the following areas:

1. Audit principles, procedure, and techniques. An auditor should be able to:
    a. Apply audit principles, procedures, and techniques
    b. Plan and organize the work effectively
    c. Conduct the audit within the agreed time schedule
    d. Prioritize and focus on matters of significance
    e. Collect information through effective interviewing, listening, observing, and reviewing documents, records, and data
    f. Understand the appropriateness and consequences of using sampling techniques for auditing
    g. Verify the accuracy of collected information
    h. Confirm the sufficiency and appropriateness of audit evidence to support audit findings and conclusions
    i. Assess those factors that can affect the reliability of the audit findings and conclusions
    j. Use work documents to record audit activities
    k. Prepare audit reports
    l. Maintain the confidentiality and security of information
    m. Communicate effectively, either through personal linguistic skills or through an interpreter
2. Management system and reference documents to enable the auditor to comprehend the scope of the audit and apply audit criteria. Knowledge and skills in this area should cover:
    a. Application of management systems to different organizations
    b. Interaction between the components of the management system
    b. Quality or environmental management system standards, applicable procedures, or other management system documents used as audit criteria
    c. Recognize differences between and priority of the reference documents
    d. Application of the reference documents to different audit situations
    e. Information systems and technology for authorization, security, distribution, and control of documents, data, and records
3. Organizational situations to enable the auditor to comprehend the organization’s operational context, such as:
    a. Organizational size, structure, functions, and relationships
    b. General business processes and related terminology
    c. Cultural and social customs of the auditee

4. Applicable laws, regulations, and other requirements relevant to the discipline to enable the auditor to work within, and be aware of, the requirements that apply to the organization being audited. Knowledge and skills in this area should cover:

    a. Local, regional, and national codes, laws, and regulations
    b. Contracts and agreements
    b. International treaties and conventions
    c. Other requirements to which the organization subscribes

EMS auditors should have knowledge and skills in the following areas:

1. Environmental management methods and techniques to enable the auditor to examine environmental management systems and to generate appropriate audit findings and conclusions. Knowledge and skills in this area should cover:

    a. Environmental terminology

    b. Environmental management principles and their application

    b. Environmental management tools (such as environmental aspect/impact evaluation, life-cycle assessment, environmental performance evaluation, etc.)

2. Environmental science and technology to enable the auditor to comprehend the fundamental relationships between human activities and the environment. Knowledge and skills in this area should cover:

    a. The impact of human activities on the environment
    b. Interaction of ecosystems
    b. Environmental media (e.g., air, water, land)
    c. Management of natural resources (e.g., fossil fuels, water, flora, and fauna)
    d. General methods of environmental protection

3. Technical and environmental aspects of operations to enable the auditor to comprehend the interaction of the auditee's activities, products, services, and operations with the environment. Knowledge and skills in this area should cover:

    a. Sector-specific terminology
    b. Environmental aspects and impacts
    b. Methods for evaluating the significance of environmental aspects
    c. Critical characteristics of operational processes, products, and services
    d. Monitoring and measurement techniques
    e. Technologies for the prevention of pollution

Auditors should have the education, work experience, auditor training, and audit experience listed in Table D-1 and their work experience should be in a technical, managerial, or professional position involving the exercise of judgment, problem solving, and communication with other managerial or professional personnel, peers, customers, and/or other interested parties.

Part of the work experience should be in a position where the activities undertaken contribute to the development of knowledge and skills in the environmental management field.

Note: An individual with a current certificate from an Exemplar Global-certified ISO 14001:2015 EMS Lead Auditor training course, and objective evidence to support maintenance of their proficiency as an auditor, is qualified to lead a CHPRC EMS audit.

## D5.2 Lead Auditors

Lead auditors should have the qualifications shown in Table D-1 and should have additional knowledge and skills in audit leadership to facilitate the efficient and effective conduct of the audit. A lead auditor should be able to:

- Plan the audit and make effective use of resources during the audit
- Represent the audit team in communications with the audit client and auditee
- Organize and direct audit team members
- Provide direction and guidance to auditors-in-training
- Lead the audit team to reach the audit conclusions
- Prevent and resolve conflicts
- Prepare and complete the audit report

This additional experience should have been gained while acting in the role of lead auditor under the direction and guidance of another auditor who is competent as a lead auditor.

## D5.3 Maintenance and Improvement of Competence Continual Professional Development

Continual professional development is concerned with the maintenance and improvement of knowledge, skills, and personal attributes. This can be achieved through means such as additional work experience, training, private study, coaching, attendance at meetings, seminars and conferences, or other relevant activities. Auditors should demonstrate their continual professional development. The continual professional development activities should take into account changes in the needs of the individual and the organization, the practice of auditing, standards, availability of financial resources, and other requirements.

Auditors should maintain and demonstrate their auditing ability through regular participation in audits of compliance with legal and other environmental requirements and/or environmental management systems.

# D6 Roles and Responsibilities

## D6.1 Lead Auditor

The Lead Auditor is responsible for all phases of the audit including but not limited to the following:

- Pre-audit planning, which includes the following:
  - Selecting the audit team
  - Verifying all team members are qualified (Section D5)
  - Obtaining any background information necessary to achieve the audit objectives
  - Preparing the audit plan
- Assigning work to the audit team
- Conducting an opening meeting

- Conducting the audit
- Communication during the audit with the audit team and the auditee
  - Notifying auditee when findings of critical nonconformities are discovered
- Conducting a closing meeting
  - Making recommendations for improvements to the EMS
- Performing post-audit activities
  - Report audit findings and noteworthy practices

The Lead Auditor provides leadership to ensure that the audit is conducted efficiently and effectively in accordance with the audit scope and plan.

### D6.2 Auditor

The Auditor follows the directions of the Lead Auditor and supports the audit. The Auditor plans and carries out assigned responsibilities effectively and efficiently. The Auditor complies with applicable audit requirements.

During the audit, the Auditor identifies and documents nonconformities (audit findings), opportunities for improvement, and noteworthy practices.

The Auditor assists the Lead Auditor in preparing the audit report.

### D6.3 Auditee

The person or group audited is referred to as the auditee. It is the responsibility of the auditee to:

- Coordinate the date and visit logistics of the audit, which includes finding a conference room or office where the audit can be held
- Provide access to the facilities and documents requested by the auditors
- Cooperate with the auditors, to provide any information requested by the auditors
- Determine and initiate any corrective actions based on the audit findings

## D7 Internal Audit Process

EMS internal audits are planned and conducted to measure the effectiveness of CHPRC's overall EMS, or to determine the conformity or nonconformity with criteria defined in the international standard ISO 14001:2015. EC&QA performs internal audits on CHPRC organizations, functions, or persons in accordance with PRC-PRO-EP-53109, *Environmental Audit Management*, and the following process defined in Table D-2, which generally follows processes described in PRC-PRO-QA-9662, *Independent Assessment Process*.

**Table D-2. Internal Audit Process**

| Actionee | Action |
|---|---|
| EC&QA Representative with signature authority | Schedules the EMS internal audit. Although ISO 14001:2015 does not specify an audit frequency, the schedule is based on evaluating each of the EMS elements at least once every 3 years. Every 3 years, an external independent audit shall be conducted in accordance with the EMS Manual (PRC-MP-EP-40182). If certified to the ISO 14001:2015 standard, the external audits will be conducted annually by a certified ISO 14001 registrar.<br>The assessment schedules shall be reviewed periodically and modified as new information on the facility or organization is obtained that changes the estimated complexity or available resources. Some considerations in scheduling include:<br>• Previous assessment results and their dispositions<br>• Independent information (e.g., experiences from other DOE contractors, peer organizations, and regulatory organizations)<br>• Changes in responsibilities, resources, or management |
| EC&QA Representative with signature authority | Responsible for planning the EMS audits.<br>The determination of criteria to be assessed and the degree to which ISMS/EMS core functions/core elements are demonstrated within each work level depends on the consequence and likelihood of failure or risk of the work activity and or the scope of the specific assessment. Programs, systems, and processes that contribute a higher risk to quality, safety, and mission accomplishment are assessed with greater rigor or frequency. Assessment criteria are tailored during the planning phase of an assessment in order to embrace the vision set forth for each assessment and answer the question, "What do we want to accomplish?" |
| **Qualification of Auditor** | |
| Prospective Lead Auditor | Provide the following to the EC&QA Representative:<br>• Certification records<br>• Records of previous audit/assessment participation<br>• Record of successfully completed ISO 14001 training<br>• Resume |
| EC&QA Representative with signature authority | • Verifies EMS Auditors and Lead Auditors are qualified and impartial.<br>• Reviews the prospective Lead's training and experience, determines if any additional training is required and if not:<br>– Completes Site form #A-6005-401, EMS Lead Auditor Qualification/Certification Record. This form documents the requirements for an EMS Lead Auditor.<br>• Approves qualification/certification by signing and dating form #A-6005-401 when complete.<br>• Verifies this form has been completed, signed, dated, and is current.<br>• Verifies this form is maintained as a record in accordance with PRC-PRO-IRM-10588.<br>• Ensures all the EMS auditors are qualified in accordance with Chapter D5 of this appendix and is impartial.<br>• Approve all assessors and Lead assessors. This approval will be documented by signature on the assessment plan, which includes the names of the audit team.<br>• Verify other team members have a strong technical background in the elements they will be auditing.<br>Note: To ensure impartiality, the Lead Auditor and audit team members shall not be responsible for developing or implementing the activity being audited. |

**Table D-2. Internal Audit Process**

| Actionee | Action |
|---|---|
| | • Annually evaluates the EMS Lead Auditor's proficiency by verifying regular and active participation in one or more of the following, that contribute to the development of their knowledge and skills described in Section D5.2 of this appendix:<br>– Participation in assessment activities since the date of last evaluation<br>– Participation EMS, QA, or other pertinent training programs<br>• Documented review and study of codes, standards, procedures, and other documents related to the EMS, QA Program, and program auditing. |
| Lead Auditor | Prior to the audit, the Lead Auditor notifies the respective operations being assessed of the upcoming audit. |
| Lead Auditor | Develops the EMS Internal Audit Plan, which may include:<br>• Assessment Criteria. Checklists or lines of inquiry; significant issues from previous occurrences, assessments or nonconformities; performance measures; and best management practices; include reference documents<br>• Audit Scope, including a listing of auditees<br>• Assessment Team. Members and respective qualifications or technical expertise<br>• Assessment Strategy (e.g., interviews, document reviews, surveillances, verification testing)<br>• Schedule. Dates and coordination activities with affected staff (opening/closing meetings, debriefings, interview schedules) and dates when draft and final reports will be provided.<br>**Note**: If the audit is being used to verify the effectiveness of previous corrective/preventive actions, the audit plan should state this explicitly.<br>Sends the audit plan to the organization being audited before the audit activities begin. Any objections by the auditee should be resolved and a revised audit plan written, if applicable, before continuing the audit. |
| **Conducting an EMS Assessment** | |
| Lead Auditor | • Conduct an entrance meeting with the assessment team and appropriate management and staff of the assessed organization to discuss the assessment scope, determine the status of work to be assessed, and meet counterparts.<br>• Document the assessment scope, individuals in attendance, and the meeting date. |
| Lead Auditor/Assessment Team | Review documents related to the EMS and the elements/activities that are the subject of the audit before and during the assessment to gain an understanding of the organization's activities before the assessment.<br>Examples of documents that can be reviewed include:<br>• Previous EMS internal and external audit reports<br>• Environmental policies<br>• Environmental aspects list including significant environmental aspects<br>• Training records<br>• Communication records<br>• Operational procedures and records<br>• Documents that specify legal and other environmental requirements<br>• Nonconformance and corrective and preventive action records<br>• Effluent and emission monitoring records<br>• Performance measure records and data<br>• Other EMS documents relevant to the elements that are within the scope of the audit, such as objectives and targets, management review documentation, etc. |

**Table D-2. Internal Audit Process**

| Actionee | Action |
|---|---|
| Lead Auditor/Assessment Team | Conducts the audit by performing the following tasks, as applicable:<br>• Evaluates procedures, EMS program implementation, previous EMS assessment results, and corrective and preventive actions taken; obtains objective evidence, including staff interviews, records, or direct observation of facility operations or functional processes. (Includes titles of documents or records that provide objective evidence of conformance on audit checklist or in audit report)<br>• Evaluates applicability and implementation for all persons who work for, or on behalf of, CHPRC.<br>Immediately addresses any unacceptable conditions, including possible safety or regulatory noncompliance issues, by notifying the responsible manager and/or the EC&QA Representative.<br>Completes the assessment checklist.<br>Analyzes data from the assessment to provide useful information for the organization's management. The Assessor shares data, objective evidence, and preliminary analyses and identifies the strengths and weaknesses associated with the element and activities being assessed. Findings shall be clear, accurate and actionable.<br>The Assessor/Assessment Team concludes the assessment by briefing the EMS VP EP&SP and the EC&QA Representative and other auditees and/or their management as appropriate, of the assessment findings. |
| Lead Auditor | • Conducts periodic (daily recommended) meetings with the assessment team to discuss the progress of the assessment and any potentially adverse condition.<br>• Conduct periodic (daily recommended) meetings with management of the assessed organization, as appropriate, to report the progress and status of the assessment, and to coordinate required interfaces involved in the assessment.<br>• Conduct an exit meeting to present the results of the assessment to appropriate management of the assessed organization.<br>• Document the exit meeting scope, and the date and the meeting attendees. |
| Lead Auditor | Identifies audit findings and categorizes them as one of the following:<br>Nonconformity: Objective evidence exists that a requirement has not been addressed (intent), a practice differs from the defined system (implementation), or the system is not effective.<br>Major nonconformity: A system element is missing, or there is evidence that a system element is not implemented or not effective. Multiple minor nonconformities may be grouped together as a major if they are all examples of the same type of nonconformity.<br>Minor nonconformity: A single observed discrepancy in the system, with evidence that the overall system is defined, implemented, and effective.<br>Observation: Not a nonconformity, but something that could lead to a nonconformity if allowed to continue uncorrected, or an existing condition without adequate supporting evidence to verify that it constitutes a nonconformity.<br>Opportunity for Improvement/Recommendation: A suggested means of accomplishing an activity, fulfilling the intent of a procedural requirement, or improving the efficiency or effectiveness of the EMS. It is not a nonconformity or observation. A recommendation involves an element that meets the minimum ISO 14001 requirements, but could bring that element of the EMS to the next level, as part of continual improvement.<br>Noteworthy Practice: Performance that exceeds expectations in terms of efficiency and/or effectiveness and provides a model for others to follow. |

**Table D-2. Internal Audit Process**

| Actionee | Action |
|---|---|
| **Preparing the EMS Assessment Report** | |
| Lead Auditor | Prepares the draft assessment report including:<br>• Audit Objectives<br>• Scope<br>• Identification of Lead Auditor and audit team members<br>• Dates and places where audit activities were conducted<br>• Audit criteria<br>• Audit findings including Major and Minor nonconformities, observations, opportunities for improvement and noteworthy practices and a statement of the effectiveness of the EMS Program elements which were evaluated.<br>• Audit conclusions<br>• Attachments to the report, if any, may include:<br>– Lines of inquiry and audit results<br>– Personnel contacted during the assessment<br>– Procedures and documents reviewed<br>Forwards the draft assessment report, for technical and factual accuracy review, as applicable, to the responsible assessed manager(s) of the assessed organization(s) and resolve any issues from this review.<br>Enters the findings, nonconformities and opportunities for improvement into the CRRS per PRC-PRO-QA-052.<br>Prepares the transmittal letter and ensure distribution of the final assessment report the responsible managers.<br>Ensures final report is entered into the IEP.<br>Distribute approved report within 30 days of final report issuance. |
| EC&QA Representative with signature authority | Reviews and approves all audit/assessment reports. Retains the audit records, in accordance with PRC-MP-QA-599 and PRC-PRO-IRM-10588.<br>Note: Completion and effectiveness of corrective action is verified as part of a subsequent audit. It is the responsibility of the EC&QA Representative to ensure this occurs. |

References: ISO 14001:2015, *Environmental Management Systems–Requirements with Guidance for Use*.

PRC-MP-EP-40182, *Environmental Management System Manual*.

PRC-PRO-IRM-10588, *Records Management Processes*.

PRC-PRO-QA-052, *Issues Management*.

PRC-MP-QA-599, *Quality Assurance Program*.

| | | | | | |
|---|---|---|---|---|---|
| CRRS | = | Condition Report and Resolution System | IEP | = | Integrated Evaluation Plan |
| DOE | = | U.S. Department of Energy | ISMS | = | Integrated Management System |
| EC&QA | = | Environmental Compliance and Quality Assurance | QA | = | Quality Assurance |
| EMS | = | Environmental Management System | VP | = | Vice President |
| EP&SP | = | Environmental Program and Strategic Planning | | | |

## D8 EMS Assessment Report

The EMS Assessment Report will be written in a timely manner upon completion of the assessment. The report will include major and minor nonconformities, observations, opportunities for improvement, and also document noteworthy practices. The report may also include the assessment scope, the executive summary, and a statement of the effectiveness of the program elements that were evaluated, as applicable. The report will include the identification of the assessment team members, areas reviewed, personnel contacted and interviewed during the assessment, and the documents reviewed.

The report must be reviewed and approved by the EMS EC&QA Representative with signature authority. Results of the internal audit shall be provided to affected management. Results of the EMS internal audit will be included in the management review per PRC-MP-EP-40182, Section 9.3, "Management Review."

## D9 Review

EC&QA is responsible for administering this EQAPP. The EQAPP will be reviewed, and updated as necessary, at a minimum of every 3 years.

## D10 Required Records

All records are generated, processed, and maintained in accordance with PRC-PRO-IRM-10588, *Records Management Processes*, and PRC-PRO-IRM-8310, *Document Control Processes*.

## D11 References

DOE O 436.1, 2011, *Departmental Sustainability*, Rev. 0, Attachment 1, "Contractor Requirements Document," U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives/0436.1-BOrder/view.

ISO 14001:2015, *Environmental Management Systems – Requirements with Guidance for Use*, International Organization for Standardization, Geneva, Switzerland.

ISO 19011:2002, *Guidelines for Quality and/or Environmental Management Systems Auditing*, International Organization for Standardization, Geneva, Switzerland.

PRC-MP-EP-40182, *Environmental Management System Manual*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-MP-QA-599, *Quality Assurance Program*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-EP-53109, *Environmental Audit Management*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-IRM-8310, *Document Control Processes*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-IRM-10588, *Records Management Processes*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-052, *Issues Management*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-9662, *Independent Assessment Process*, CH2M HILL Plateau Remediation Company, Richland, Washington.

# Appendix E

# Quality Assurance Project Plan for Modeling

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# Terms

| | |
|---|---|
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| CHPRC | CH2M HILL Plateau Remediation Company |
| DOE | U.S. Department of Energy |
| DQO | data quality objective |
| ECF | Environmental Calculation File |
| EC&QA | Environmental Compliance and Quality Assurance |
| EMDT | Environmental Modeling Data Transmittal |
| EMMA | Environmental Model Management Archive |
| EPA | U.S. Environmental Protection Agency |
| EP&SP | Environmental Programs and Strategic Planning |
| HISI | Hanford Information System Inventory |
| HLAN | Hanford Local Area Network |
| IDMS | Integrated Document Management System |
| MKS Integrity™ | Software configuration management system used at the Hanford Site (MKS Integrity is a trademark of Parametric Technology Corporation [formerly MKS Integrity], Boston, Massachusetts) |
| QAPjP | Quality Assurance Project Plan |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| SMP | Software Management Plan |
| STP | Software Test Plan |

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# E1 Introduction

CHPRC-00189, *CH2M HILL Plateau Remediation Company Quality Assurance Program Plan*, requires that planning for modeling projects invoke the use of the EPA's guidance document for environmental modeling (EPA/240/R-02/007, *Guidance for Quality Assurance Project Plans for Modeling* [EPA QA/G-5M]). This Quality Assurance Project Plan (QAPjP) is developed following the guidance found in EPA/240/R-02/007. All nine "Group A" elements presented in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), are relevant and important and are addressed in this QAPjP for modeling work. The scope of this QAPjP addresses both numerical fate and transport simulation models as well as related models. Related models include inventory models, waste form release models, and geoframework models.

This QAPjP also addresses model documentation requirements that provide for compliance with U.S. Department of Energy (DOE) management expectations listed in EM-QA-001, *Office of Environmental Management Quality Assurance Program*, Attachment H, "Model Development, Use, and Validation."

This plan provides the process under which compliant modeling work can be performed to meet the QA requirements of DOE-STD-5002-2017, *Disposal Authorization Statement and Tank Closure Documentation for DOE O 435.1* assessments, including Performance Assessments and Composite Analyses. This technical standard requires that development and use of models for such analyses is documented, verified, under configuration control, and archived in accordance with DOE G 414.1-4, *Safety Software Guide for Use with 10 CFR 830, Subpart A, Quality Assurance Requirements, and DOE O 414.1C, Quality Assurance*, and DOE O 414.1D, *Quality Assurance*.

The guidance has been tailored under a graded approach to meet the ongoing need of the CH2M HILL Plateau Remediation Company (CHPRC) Modeling Team to provide timely model development and application to meet project needs in an environment where model development and application activities are not managed as a standalone project. The Modeling Team functions as a support organization, providing technical expertise and product delivery to support CHPRC projects and occasionally other Hanford Site Contractors as well. Thus, the guidance has been adapted to support quality model development and application as an ongoing service function that supports multiple model development and application efforts.

# E2 Project/Task Organization

Modeling tasks performed by the Modeling Team are an ongoing effort in support of CHPRC projects. As such, multiple models are expected to be under concurrent development and use at any given time and must be managed to meet aggressive schedules. The roles and relations of the modeling team are identified in the organization chart shown in Figure E-1.

The organizations involved and their responsibilities are summarized as follows:

- CHPRC Environmental Programs and Strategic Planning – line organization for the Modeling Team. Provide technical resources, coordinate modeling work, perform modeling work, and ensure quality of the modeling work. Fund model development. Also, the Environmental Compliance and Quality Assurance group provides support in performing reviews of quality planning documents, software lifecycle documents, and in conducting surveillances.

- CHPRC Projects – define modeling work needed to support projects and review modeling work performed. Fund model application.

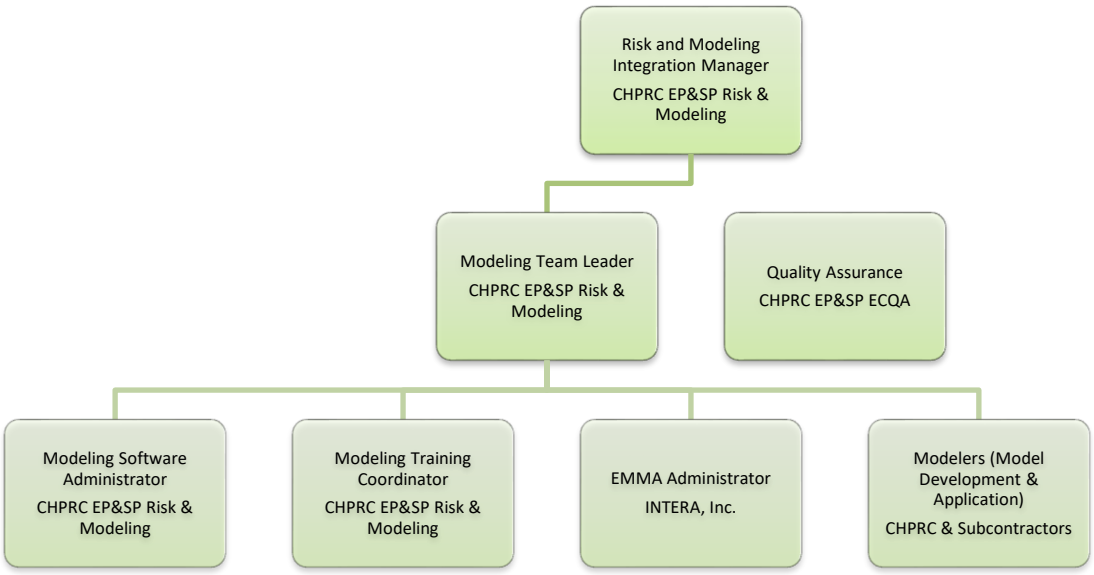



**Figure E-1. Modeling Team Organization Chart**

Responsibilities listed in Table E-1 are assigned to staff in the CHPRC Environmental Program and Strategic Planning (EP&SP) organization's Risk and Modeling Integration Group and as well as to staff members of CHPRC's pre-selected modeling subcontractor INTERA.

**Table E-1. Modeling Team Roles and Responsibilities**

| Role | Organization | Responsibilities |
|---|---|---|
| Risk and Modeling Integration Manager | CHPRC EP&SP | Responsible for performance of quality technical work, line management responsibility for modeling staff, assignment of responsibilities, final approval of modeling work products, and management assessments (roles and responsibilities are defined in PRC-MP-EP-40220 and PRC-PRO-EP-40253) |
| Modeling Team Leader | CHPRC EP&SP | Responsible for technical work definition and direction, and compliance by modeling staff with the requirements of this QAPjP |
| Modeling Training Coordinator | CHPRC EP&SP | Issue training assignments to modelers, track modeler training, ensure evidence of modeler training assignment completion is placed in records |
| Modeling Software Administrator | CHPRC EP&SP | Software owner for all modeling software (roles and responsibilities are defined in PRC-PRO-IRM-309) |
| EMMA Administrator | INTERA | Setup, maintenance, and access control to EMMA |
| Environmental Compliance and Quality Assurance | CHPRC EP&SP | Review of this QAPjP and software lifecycle documents; plan and conduct surveillances and support assessments |
| Modelers | CHPRC and subcontractors | Perform model development and model application work consistent with the requirements of this QAPjP and relevant CHPRC procedures |

References: PRC-MP-EP-40220, *Environmental Program and Strategic Planning Roles, Responsibilities, and Functions*.
PRC-PRO-EP-40253, *Risk Assessment and Modeling Integration*.
PRC-PRO-IRM-309, *Controlled Software Management*.

CHPRC = CH2M HILL Plateau Remediation Company
EP&SP = Environmental Programs and Strategic Planning
EMMA = Environmental Model Management Archive
QAPjP = Quality Assurance Project Plan

# E3 Problem Definition/Background

Groundwater and vadose zone modeling is needed to support *Resource Conservation and Recovery Act of 1976* (RCRA) and *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), document preparation, aid in design of remedies, prepare documents for compliance with DOE O 435.1, *Radioactive Waste Management*, and to meet other environmental subsurface predictive needs. Such models are to be developed and applied following a graded approach that tailors the sophistication and quality assurance efforts to the quality demands driven by specific model needs.

Specific problems to be solved, or decisions to be made, or outcomes to be achieved through model development and application are not documented here. Rather, specification of modeling objectives is accomplished for each model development and/or application effort through communication between project personnel requiring modeling support and the Modeling Team. A template for documenting specific modeling objectives, schedule for work, assumptions, and concurrences is provided in Supporting Information E-1, "Modeling Support Work Plan Template," and shall be completed to define the work and approved before each modeling activity commences.

U.S. Environmental Protection Agency (EPA) guidance directs that modeling objectives should address the following:

- What is the specific problem? What are the goals and objectives of this project that will address this problem?
- Why should a modeling approach be used to address the problem? Is there a regulatory requirement for a modeling analysis?
- What specifically will this project produce to address this problem (e.g., a new predictive tool, modeling results for a new scenario)?
- What types of decisions regarding the problem may be made as a result of this project? Who will be responsible for making these decisions?
- Will any aspect of the problem not be addressed in this modeling work?
- What other types of problems may this modeling work address?

It is important to place the problem in historical perspective to give a sense of the purpose and position of this modeling work relative to other project and program phases and initiatives. Such information also indicates the importance of generating new information and suggests tools that may be available to do this. Therefore, sufficient background information may be provided where appropriate in the work plan or in the *Model Package Report* (Section E7.4) to answer the following types of questions, as applicable:

- Why is this modeling work important, and how may it support proposed or existing research, programs, initiatives, regulations, or other legal directives?
- How may this project "fit in" with other ongoing, broader efforts?
- What types of conflicts or uncertainties currently exist that will be resolved by this work?
- What information, previous work, or previous data may currently exist that this work can use?

- Given that the problem is best solved by a modeling approach, what models currently exist (if any) that can be used to achieve this project's goals and objectives? If multiple models exist, how is one determined to be better than the others for this application?

The completed modeling objectives statement in the Model Support Work Plan should be included in the Model Package Report when the full model is documented (Section E7.4).

## E4 Project/Task Description and Schedule

Modeling work performed under this QAPjP is not managed as a distinct project, but rather as a support function for other projects. Thus, task and schedules for this work is developed cooperatively with Projects (ideally with input from the Modeling Team). The optional Model Support Work Plan (template found in Supplemental Information E-1) includes a section to plan a detailed work breakdown because model development and application is often not planned to sufficient detail in Field Estimate Schedules to allow for Modeling Team work planning. The detailed work planning shall map to the Field Estimate Schedule to permit reporting on status back to projects.

Examples of tasks that can be addressed in the detailed work planning include the following:

- How the conceptual model of the problem or site will be developed
- How the structural model and data processing software will be obtained
- How data may be acquired for model development, calibration, and testing
- The criteria used to decide whether probabilistic model output or point estimates are needed
- Assessments relative to associated project-specific quality requirements

This element of the Model Support Plan shall also list the products, deliverables, and milestones to be completed in the various stages of the project, along with a schedule of anticipated start and completion dates for the milestones and deliverables, and the persons responsible for them.

## E5 Quality Objectives and Criteria for Model Inputs/Outputs

This element of the QAPjP for Modeling introduces the quality criteria that the expected components and outcomes of each specific modeling effort needs to achieve in order to meet the needs of the user of modeling results. These criteria are specified within *performance or acceptance criteria* that are developed in a *systematic planning process*. The systematic planning process invoked by the Modeling Team identifies the expected outcome of the modeling project, its technical goals, cost and schedule, and the criteria for determining whether the inputs and outputs of the various intermediate stages of the project, as well as the project's final product, are acceptable. This is usually an iterative process involving at least modelers and users of model results. The goal is to ensure that the project will produce the right type, quality, and quantity of data to meet the user's needs.

The systematic planning process can be applied to any type of data-generating project. The seven basic steps of the systematic planning process are illustrated in Figure E-2. The first three steps can be considered preliminary aspects of scoping and defining the modeling effort, while the last four steps relate closely to the establishment of performance criteria or acceptance criteria that will help ensure the quality of the model outputs and conclusions. While both are measures of data quality, *performance criteria* are used to judge the adequacy of information that is newly collected or generated on the project, while *acceptance criteria* are used to judge the adequacy of existing information that is drawn from sources that are outside of the current project. Generally, performance criteria are used when data quality is under the project's control, while acceptance criteria focus on whether data generated outside of the project are acceptable for their intended use on the project (e.g., as input to a model).

The systematic planning approach under this QAPjP is based on the intent of PRC-PRO-QA-259, *Graded Approach*. This means that the extent of systematic planning and the approach to be taken should match the general importance of the project and the intended use of the data. For example, when modeling is to be used on a project that generates data to be used either for decision making (i.e., hypothesis testing) or to determine compliance with a standard, EPA recommends that the systematic planning process take the form of the data quality objective (DQO) process that is explained in detail within EPA/240/B-06/001, *Guidance for the Data Quality Objectives Process* (EPA QA/G-4). It is noted here that the DQO Process is undertaken by the project the Modeling Team supports, and is not commonly managed by the Modeling Team although its members often participate in that process.

The performance or acceptance criteria developed by the model planning team will address the following types of components for modeling projects:

- The particular type of task being addressed and the intended use of the output (e.g., predictions) of the modeling project to achieve this task
- The type of output needed to address the specific regulatory decision (if relevant), including whether probabilistic or point estimates are needed
- The statistical criteria (e.g., limits on decision error) to be used in the model-building process to identify those variables considered statistically important to the prediction process and included as input to the model
- Desired limits placed on the probability of making a certain type of decision error due to the uncertainty associated with the model output (if a decision is to be made) and/or criteria to demonstrate the model performs adequately (e.g., as well or better than a previously accepted model for a given situation)
- How the parameter, input, calibration, and test data necessary for this project are acquired and evaluated for use in model development and/or in producing output
- Requirements associated with the hardware/software configuration (e.g., run time or processing capabilities) for those studies involving software evaluation

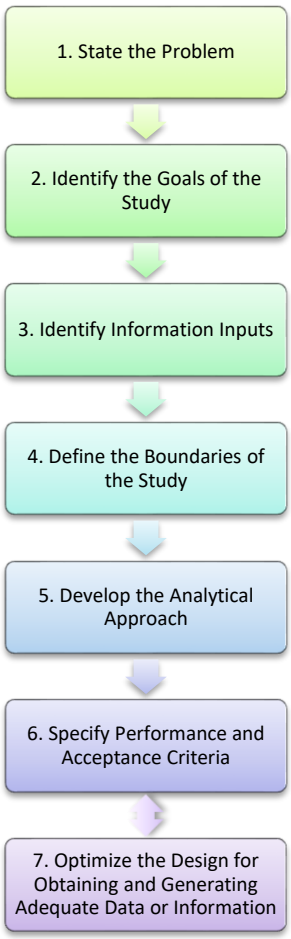



**Figure E-2. Systematic Planning Process**

While DQOs state the user's data needs relative to a given decision, corresponding criteria need to be placed on the data to determine whether the data have satisfied these needs. For modeling projects, such quality criteria can be placed on outcomes such as software performance (e.g., run time or processing capabilities) and model prediction (e.g., acceptable level of uncertainty associated with model prediction, relative to decision error). For this QAPjP, no qualities criteria are placed on run time or processing capabilities. This is because the nature of the models involved always involve tradeoffs between resolution (e.g., temporal, spatial) and processing capability (e.g., model size, run time). The appropriate balance of resolution and processing capability is found iteratively for each modeling effort and cannot be stipulated in advance. Similarly, model prediction criteria are seldom established in advance due to the variable quality and sparseness of data to support modeling input parameters. Rather, sensitivity studies and uncertainty analyses are used to interpret model predictions in light of the limitations of available data used to develop the model. The level of rigor needed in sensitivity studies and uncertainty analyses will be determined using a graded approach based on modeling objectives.

PRC-PRO-EP-40253, *Risk Assessment and Modeling Integration*, establishes the requirements and processes to assure consistent, timely, and high quality risk assessments and modeling in support of

CHPRC projects and DOE's decision-making process. The main objective of this procedure is to ensure that all risk assessments conducted for the Central Plateau:

- Are based on a common set of assumptions and datasets.
- Use comparable procedures, models, and analysis methods.
- Provide comparable results, and provide compatible conclusions that contribute to the overall mission of the Central Plateau cleanup and closure efforts and Hanford Site cleanup strategy.

PRC-PRO-EP-40253 identifies steps for sufficient planning, staffing, communication and coordination during implementation, review, and quality assurance that shall be used for risk assessment and modeling activities conducted in support of CHPRC projects.

# E6 Special Training Requirements/Certification

Modeling Team members are selected and hired specifically for their academic training and professional work experience that provides the expertise necessary to develop and apply numerical simulation models for subsurface flow and transport modeling. There are no specific certification requirements. Section E6.1 identifies the training requirements for Modelers.

## E6.1 Indoctrination and Training Program for Modelers

The indoctrination program for Modelers is established here and provides personnel performing environmental modeling work with an understanding of their job responsibilities and authority, general criteria including applicable codes and standards, regulatory commitments, CHPRC procedures, and quality assurance program requirements.

Modelers shall be trained and qualified to ensure they are capable of performing assigned work and shall have continuing training to ensure that job proficiency is maintained. This section describes the requirements and responsibilities established by the Risk & Modeling Integration Group to ensure that personnel performing modeling work are properly trained and qualified for their assigned tasks.

The Risk and Modeling Integration Group training and qualification program shall meet the requirements of PRC-MP-QA-599, *CHPRC Quality Assurance Program*, Section 2, "Personnel Training and Qualifications"; CHPRC-00189, Chapter 3, "Personnel Qualification and Training"; and this training plan. The Modeling Team Leader assigns a Training Coordinator to ensure that Modelers receive the required training and maintain their qualification. The Risk and Modeling Integration Group shall require personnel training and qualification in accordance with the procedures identified in PRC-MP-QA-599, Appendix B.

### E6.1.1 Required Reading

The following DOE and CHPRC level 1 or level 2 procedures are required reading for all Modelers, and individuals serving in role of Checker or Senior Reviewer of environmental calculation files (ECFs) reporting environmental model applications prepared under PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issues*, or model package reports (defined in Section E7.4 of this plan):

- CHPRC-00189, *CH2M HILL Plateau Remediation Company Quality Assurance Program Plan*
- PRC-PRO-EP-40253, *Risk Assessment and Modeling Integration*
- PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issue*
- PRC-PRO-IRM-309, *Controlled Software Management*

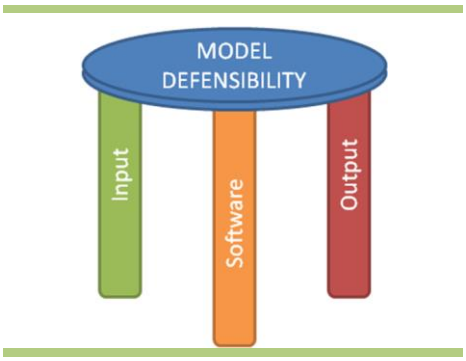
The following software quality assurance documents are also required reading for all Modelers:

- Software Management Plans (SMPs) and Software Test Plans (STPs) (or equivalent) for each CHPRC controlled software element used by a Modeler to perform modeling work

In addition to the above, the Modeling Team Leader is required to read the following procedure:

- PRC-PRO-QA-40090, *Work Site Assessment*

The Modeling Training Coordinator is responsible for issuing and tracking training assignments to all Modelers, Checkers, and Senior Reviewers performing work under the direction of the EP&SP organization and ensuring that evidence of training assignment completion is placed in records consistent with PRC-PRO-IRM-10588, *Records Management Process*. The Responsible Manager retains responsibility for confirming that completed modeling work products meet all CHPRC requirements.




*"Model defensibility requires traceability and reproducibility, which are achieved by change control and version preservation of three general model components: inputs, software, and outputs."*

Training assignments for the above required reading list will be made and completion recorded as follows:

- For Modelers, Checkers, and Senior Reviewers, the Modeling Training Coordinator will use Form A-6004-943, *Required Reading Acknowledgement Sheet*, to assign and record completion of all of the documents listed as required reading above.
- All completed *Required Reading Acknowledgement Sheets* will be submitted to electronic records in the Integrated Document Management System (IDMS) by the Modeling Training Coordinator, consistent with requirements in PRC-PRO-IRM-10588.

The documents listed as required reading are subject to revision. To ensure training remains current, the Modeling Training Coordinator will register in *CHPRC Docs Online* to receive email notice of updates of each procedure listed in this training plan. Upon receipt of notification of a revision of any of listed procedure, a new training assignment will be issued to all subcontractor Modelers to require reading the revised procedure.

### E6.1.2 Computer-Based Training

Modelers who hold a Hanford security badge are also required to complete the following Computer-Based Training courses:

- Courses #000001 & #0000006 – Hanford General Employee Training
- Course #000030 – Official Use Only Training
- Course #004108 – Beryllium Associate Worker Training

In addition to the above, all personnel serving in a preparation, testing, or review role for modeling software quality assurance documentation under PRC-PRO-IRM-309 are required to complete the following Computer-Based Training courses:

- Course 600005 – PRC Software SME training
- Course 600006 – PRC Controlled Software Management training

Assignment of Computer-Based Training is made by the responsible CHPRC manager.

## E7 Documentation and Records

Preparing appropriate documentation for quality assurance purposes is important for all environmental data operations, but especially for modeling projects. Information on how a model was selected, developed, evaluated, and applied (as relevant) on a given project needs to be documented so that sufficient information is available for model testing and assessment, peer review, and future model application. For the purposes of modeling work that is the subject of this QAPjP, an overview of what constitutes documentation and what constitutes a record is provided in Table E-2. This table also identifies what needs to be preserved (whether it is a record or not) and where this information will be preserved. CHPRC's document approval and clearance process results in a cleared document being placed in IDMS, but this action does not in itself constitute a record; action must be taken to commit the document to electronic records space in IDMS. The Modeling Team Leader will ensure that final documents and related records are committed to electronic records space in IDMS following document clearance and release.

An Environmental Model Management Archive (EMMA) will provide the means to document all aspects of model development and application for the Modeling Team. The objective of using EMMA is to provide for the defensibility of environmental models developed and maintained for CHPRC. Model defensibility requires traceability and reproducibility, which are achieved by change control and version preservation of three general model components: inputs, software, and outputs. All documents that are identified as CHPRC records will be submitted and managed through the IDMS as required by PRC-PRO-IRM-10588.

Traceability is achieved to the degree that a reviewer with sufficient training and access to supporting information is able to follow the flow of information in a model from source data through conceptualization, parameterization, code input, code calculations, and code output, and ultimately to the results reported in released documents.

Reproducibility is achieved when it is demonstrated that a model can be restored to any check point in time during the model maintenance period when it was used to produce reported results and can be rerun to obtain the reported results.

The development of a complex simulation model of a system such as a vadose zone or aquifer represents a substantial investment. Such models are only rarely "single-use" tools, but evolve as improvements are made over time to leverage the investment: source data are added from monitoring programs; computer simulation codes are improved; conceptual understanding of the system modeled improves; and refinements are made to address new problems. Strong configuration management of complex environmental models is necessary to provide a defensible tool that can support decision making.

**Table E-2. Model Components, Documents, and Records Map**

| Model Component | Element | Preserve? | Document? | Record? |
|---|---|---|---|---|
| Training | Training evidence | Yes; IDMS Electronic Records | Required Reading Acknowledgement Sheet | Yes |
| Basis (inputs) | Electronic data transfers | Yes; EMMA | Electronic Data Transfer Package Cover Sheet | No |
| Model | Preliminary model development files | No | - | No |
| | Input files | Yes; EMMA | - | No |
| | Software files (executables, documentation, | Yes; MKS Integrity™ | Per PRC-PRO-IRM-309 | |
| | Software installation and checkout record | Yes; IDMS Electronic Records | Software Installation and Checkout form | Yes |
| | Output files* | Yes*; EMMA | - | |
| | Model documentation | Yes; IDMS Electronic Records with copy in EMMA | Model Package Report | As needed |
| Application | Application documentation | Yes; IDMS Electronic Records with copy in EMMA | Environmental Calculation File | Yes |
| | Input files | Yes | No | No |
| | Output files* | Yes* | No | No |

Reference: PRC-PRO-IRM-309, *Controlled Software Management*.

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*Output files are preserved at the discretion of the modeler with consideration to the storage requirements and ease of replication from preserved input files and software.

EMMA = Environmental Model Management Archive

IDMS = Integrated Document Management System

EPA/240/R-02/007 identifies the following three items as especially relevant to a modeling project:

- [Model] Calibration (B7): Documenting the process for calibrating the model that will perform the designated regulatory predictive task.
- Nondirect measurements (data acquisition requirements) (B9): Introducing the types and sources of existing data to be used in building and/or executing the model(s) to be considered, specifying how these data will be acquired, and documenting the quality associated with these data and their relevance in addressing project objectives.
- Data management and hardware/software configuration (B10): Documenting the data management process from data acquisition through transmission and processing, and to final use; documenting the components of the process to generate model outputs; and highlighting the quality assurance procedures associated with the configuration of the hardware and software utilized by the model.

The Model Package Report (template in Supporting Information E-2, “Model Package Report Template”) will be used to document the model development and calibration process for major models that will be utilized to support multiple model applications. The graded approach will be applied to determine the

need for a separate Model Package Report: if a model is relatively simple, has a narrow model objective (such as hypothesis testing or scoping evaluation), and/or will be used only once then the document requirements of the Model Package Report can be included in the ECF. The purpose of a separate Model Package Report is to document major models that support multiple calculations in a single location and thereby avoid duplication of model development and management information across multiple ECFs.

Nondirect measurements and data management will be documented using the Electronic Model Data Transmittal (EMDT) (Hanford Site Form A-6007-714, "Environmental Modeling Data Transmittal Cover Page") to record the source of data used to derive input parameters, the date these data were obtained, and if a database query was used, a copy of the query used.

Software configuration management is based on PRC-PRO-IRM-309. Figure E-3 illustrates the relationship this procedure to the requirements it implements. The configuration management of software used for environmental models is adopted as a supporting activity for environmental model configuration management. That is, it is recognized that software used for environmental models is already well managed to meet the objectives of traceability and reproducibility as far as the software itself is concerned. Thus, all that is required to uniquely link software to the model package is to fully identify the version of all managed software used. This will enable recovery of that version of the software, when needed, from the software configuration management system used by CHPRC (MKS Integrity™).

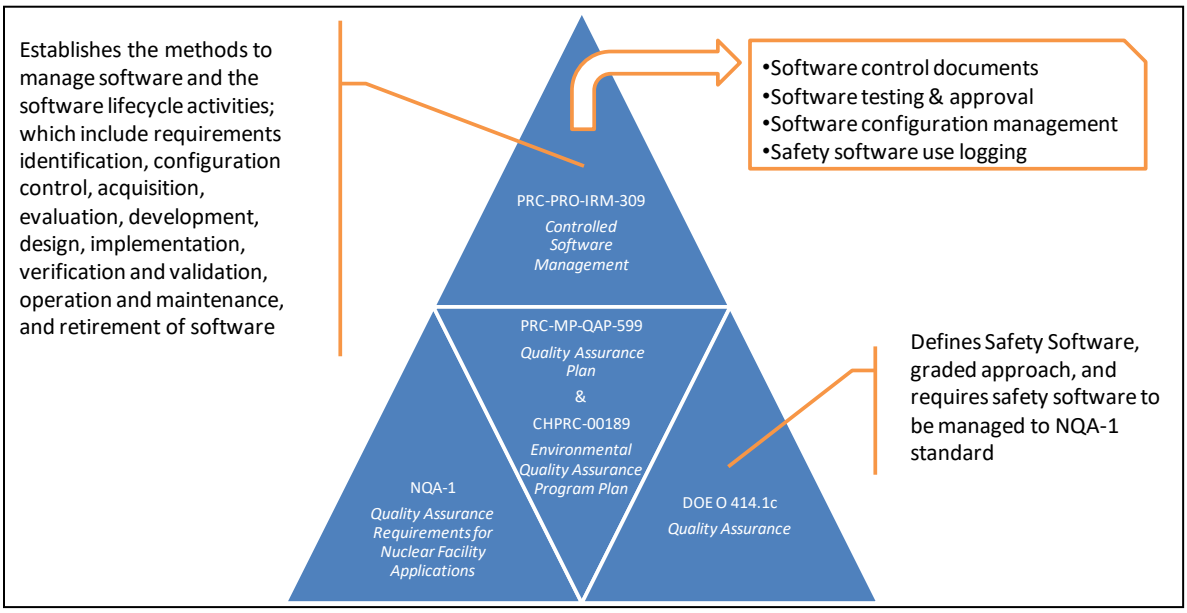


**Figure E-3. CHPRC Software Quality Assurance Requirement, Procedure, and Documentation Relationships**

Figure E-4 illustrates how this QAPjP relates the most important CHPRC quality assurance procedures for modeling, document products, simulation software, and archive systems. Note from this illustration that EMMA serves to capture and retain numerical model parameter basis and information, simulation inputs, and simulation outputs while MKS Integrity is the repository for software.

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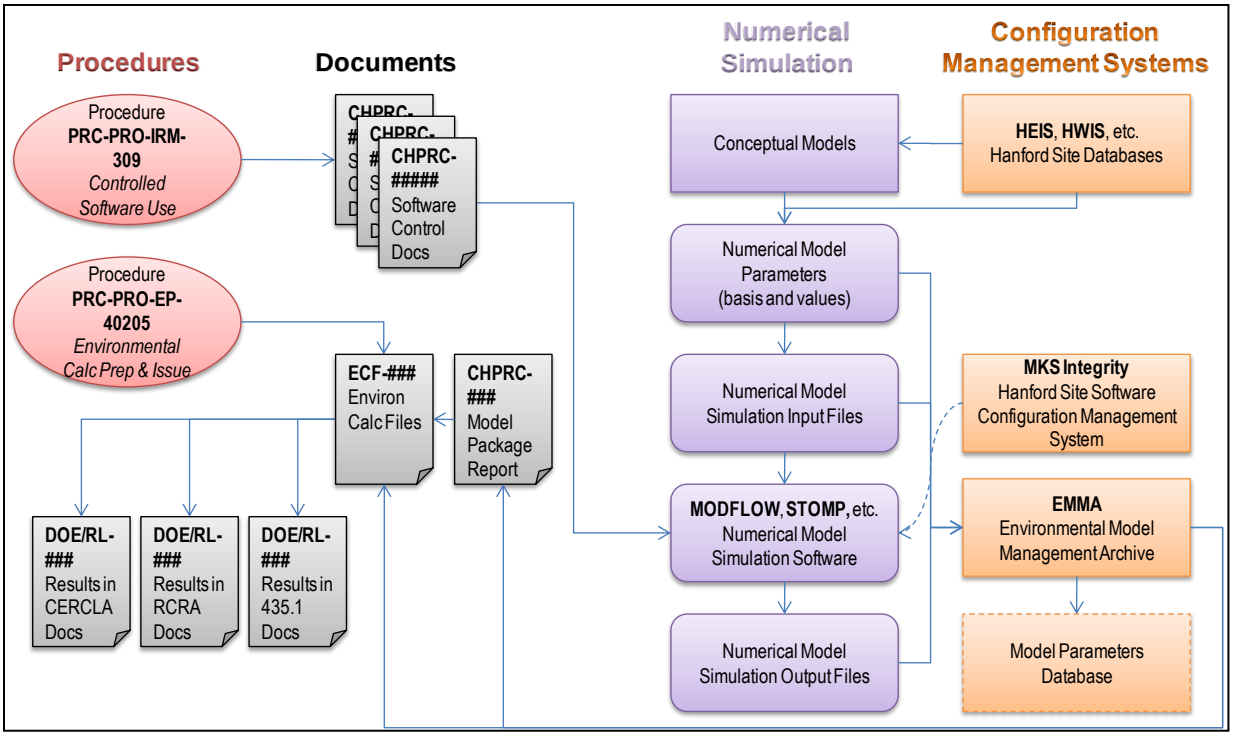


**Figure E-4. Relationship of EMMA to CHPRC Quality Control Components for Modeling**

## E7.1 Model Components Subject to Configuration Management

Configuration management of environmental models requires control of three components of a model: input parameters, simulation software, and output results. If these are not preserved in a retrievable, linked fashion, then modelers cannot reliably retrieve, reproduce, or trace model simulation results. It is important to note that the objective of this model configuration management system is not to create a "records" type database (e.g., IDMS) that is unalterable with strong focus on preventing changes to past versions; rather the objective is to create a means to store clearly identifiable and traceable versions of evolving computer simulation models to provide for reproducibility and transparency.

*A simple example of how differences in model objectives can lead to different parameterizations for the same data set:*

*Consider two models that are otherwise identical except for the model objectives: one is intended to provide a conservative, bounding estimate of arrival in the aquifer for a drinking water dose calculation for a sorbing contaminant; the other is to provide a conservative, bounding estimate of soil concentration of the same contaminant in the upper soil for a dust inhalation dose calculation. The modeler in each case will examine the available data on contaminant sorption, but one could select a high value of $K_d$ to ensure that the upper soil contaminant level is overestimated (meeting the model objective for a dust inhalation dose) where the other modeler could select lower value of $K_d$ to bias the model to overpredict the concentration in groundwater.*

*Thus, the very same data are used to arrive at different parameter values due solely to different model objectives.*

### E7.1.1 Inputs

Models use input parameters that are derived from data, but are not typically directly observed data. Parameterization of model inputs from observed data involves many considerations including but not limited to: data uncertainty, data quality, data spatial variability, data scalability, qualify of observed data, and model objectives. Thus, the same collection of observed data may lead to different parameter values for different models.

To meet the objectives of traceability and reproducibility, model input parameters must be preserved, together with information that identifies sources used and decisions made to derive those parameters and evidence of input checking performed to ensure the intended inputs were correctly selected and input to the software. Due to the variety of software used, the means to accomplish this will vary. In some instances, it may be possible to include not only the input parameter values, but the source notes and checker validation certification directly in the input file (perhaps as comment fields) thus making the input file(s) fully self-contained in this respect. In other cases, this is not possible and separate documentation, such as text "readme" files that accompany the inputs, might be used to fulfill this purpose. Typically, more information than the mere numerical inputs used for a model must be preserved to document the complete basis for parameter input values. Collectively, all of this information constitutes the "basis" information that is the source of parameter values for a model or models. All such information must be archived to enable clear identification of the sources of information and decisions that result in the inputs used in a particular model. Only by preserving both the basis information and the inputs used in a given model and model application is full traceability possible. The tool to be used for tracking sources of inputs is the EMDT cover sheet (Hanford Site Form A-6007-714), discussed in Section E8.2.

### E7.1.2 Software

The governing procedure at CHPRC for software configuration management is PRC-PRO-IRM-309. The configuration management of software used for environmental models is adopted as a supporting

activity for environmental model configuration management. That is, it is recognized that software used for environmental models is already well managed to meet the objectives of traceability and reproducibility as far as the software itself is concerned. Thus, what is required to link software uniquely to the model package is to identify the version (build) of all managed (Hanford Information System Inventory [HISI]-listed) software used. This will enable recovery of that version of the software, when needed, from the software configuration management system used by CHPRC (MKS Integrity).

### E7.1.3 Outputs

Preservation of model outputs is also necessary because it documents the results originally obtained and enables direct checking of documented results to model output files. However, judgment must be exercised in deciding how much needs to be archived and what does not because model output can be very voluminous. It is not necessary to save all information recorded during any given model simulation where doing so simply fills electronic media with information of little value. Therefore, modelers are expected to identify the minimum output necessary to preserve that will allow tracing results to particular applications and reported results and checking for reproducing simulations.

## E7.2 Environmental Model Management Archive

The key implementation feature for model configuration management is the establishment, administration, and use of a model file archive that is designed to meet the objectives of this model configuration management plan. The model file archive for this purpose will be identified as EMMA. The EMMA interface tool provides a means to denote linkages between basis information, models, and applications and visualize the archive, but all file storage is by design merely a disciplined file archive arrangement that does not depend on the EMMA application. As such, the EMMA interface tool is a low risk, standalone, desktop tool, and therefore does not need to meet the requirements of PRC-PRO-IRM-309 (Section 1.2, “Scope,” parts 4 and 5).

### E7.2.1 EMMA Organization

EMMA is organized in a logical manner to support access both through a simple configuration management system as well as through direct browsing of the directory structure. The top level of the archive will include three fundamental divisions: /models, /applications, and /basis:

- /models – for files and Model Package Reports that archive all files that constitute a distinct version of a particular model and the output files obtained from runs of record (those used to report results)
- /applications – all input files necessary to repeat any given run that was used to report results using a given model, output files necessary to trace inputs to results (at minimum), and the associated ECF
- /basis – archival of the basis for input parameters used for model construction and application with associated Electronic Data Transfer Cover sheets

Maintenance of the information in these three divisions of the archive will meet the goals of model reproducibility and transparency.

The /models division will be organized by model, then by model version. For example, a subdirectory named/CPGWM would contain the Central Plateau Groundwater Model, and be further subdivided into versions; /v1.0, /v2.0, etc. Within each version directory, a Model Package Report should be placed, as well as the input files needed to run this model. The ECF will identify the specific software used (software archival is handled separate from this model file archive).

The /applications division will be organized by ECF number (which is assigned in accordance with PRC-PRO-EP-40205). For example, the ECF for the first application of the S-SX Groundwater Submodel was ECF-200UP1-10-0056, so all inputs and a copy of the ECF itself is stored in the /ECF-200UP1-10-0056/rev.0 directory.

The /basis division will be organized by EMDT number, and below that level by revision number (/rev.0, /rev.1, etc.). An electronic data transfer cover sheet will be stored with each archival to document the source and transfer of basis information.

A partial depiction of how the archive structure appears is depicted in Figure E-5.

### E7.2.2 EMMA Location

EMMA will be maintained on a server physically located and managed at the INTERA Richland Office. The model file archive will be configured to permit changes only from approved users in the INTERA office. Initially, EMMA will only be accessible from the INTERA office, but limited access by internet or changes in hosting location may be provided under later revisions of this QAPjP. Regular backups of the EMMA to a read-only Hanford Local Area Network (HLAN) disk space will be used to ensure that CHPRC modeling work is retained by, and accessible to, the prime contractor. Incremental backups will be performed under an adaptive schedule, in recognition that more frequent backups are needed when content is being frequently added to EMMA and less often when no content is being added. The frequency for performing incremental backups will be determined by the EMMA administrator. Incremental backups will be performed at least once per month. During periods where frequent content additions to EMMA occur, incremental backup will be either weekly or biweekly at the discretion of the EMMA administrator.

### E7.2.3 EMMA Change Control

Three levels of access will be used for controlling the configuration of EMMA; administrator, read/write access, and read-only access. Read-only will be available to anyone in the INTERA office. Only the EMMA administrator and an alternate administrator will be granted write access. The EMMA administrator will be responsible for establishing the archive, granting and revoking access privileges, and providing configuration management for the archive. The EMMA administrator will be responsible for loading content placed in a designated staging area into EMMA at the request of modelers submitting new content. Read-only access will be freely granted to those who need to browse and obtain copies of models, applications, and basis information without any need to commit new information.

### E7.2.4 EMMA Archival

ECFs are managed under PRC-PRO-EP-40205, and as part of that procedure will be issued and included in IDMS; these will be placed in IDMS record space.

Model Package Reports will be issued as CHPRC reports as necessary where there is a need to cite information regarding model development; these will be included in IDMS as part of the clearance process.

EMMA itself is a working archive and does not constitute a record because it is a working archive.

Incremental backups of the EMMA archive will be transferred to CHPRC at least monthly for synchronization to a read-only HLAN accessible disk space.

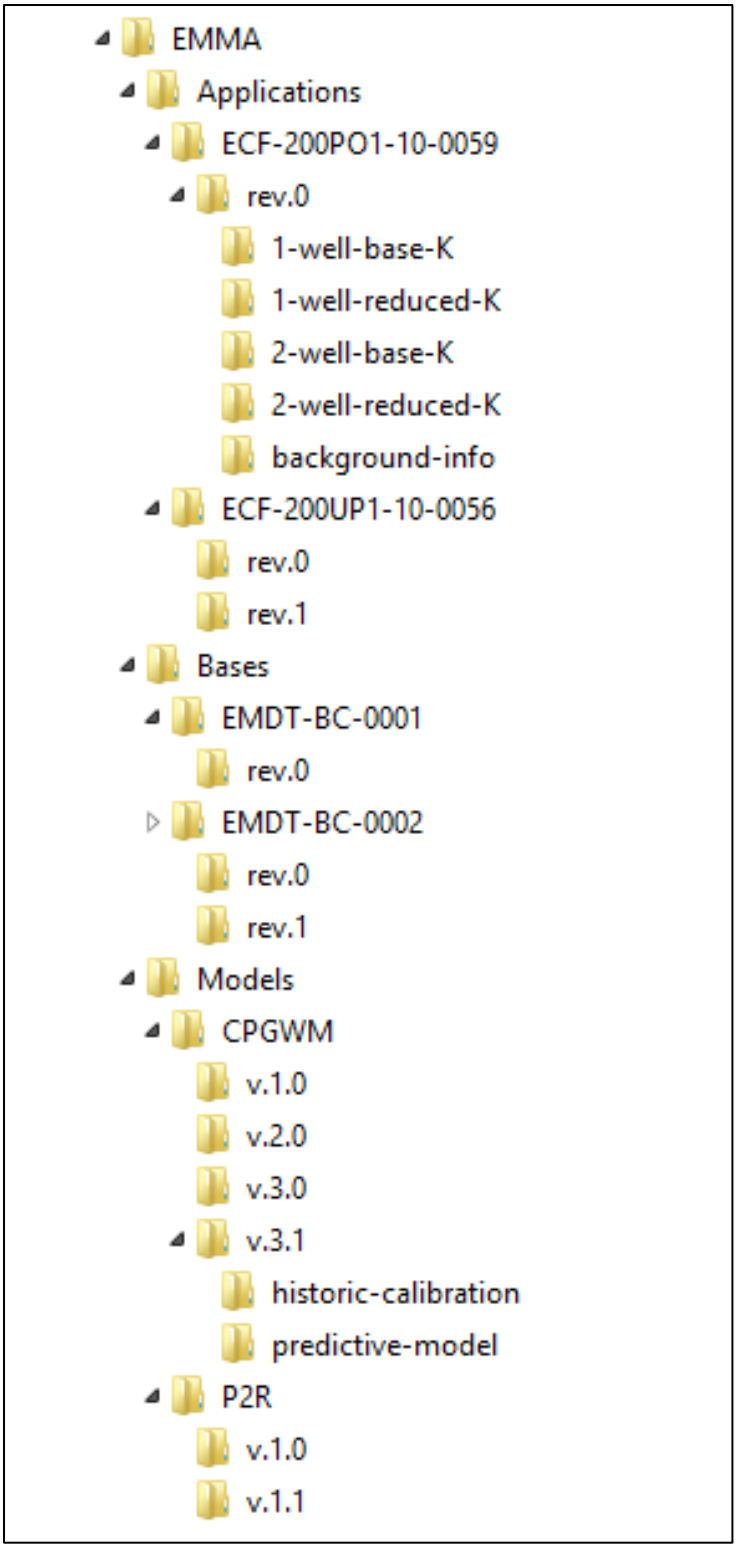


**Figure E-5. EMMA Partial File Structure**

## E7.3 Environmental Model Version Identification

For purposes of archival in EMMA, model version and simulation run numbers will be assigned to each distinct model and model version to enable complete identification and traceability.

The preferred convention for naming model versions and designating simulations will include six entries in the form:

*Model Name*, Version (N1), Simulation G(N2)_B(N3)_I(N4)_TC.CC_CN_iter

where:

| | | |
|---|---|---|
| *Model Name* | = | a descriptive character string to uniquely identify the model, e.g. "Central Plateau Groundwater Model" |
| N1 | = | Major version number (for readily identifiable distinct model); can have a decimal place (e.g., Version 1.1) |
| N2 | = | Model grid; entry is an index number |
| N3 | = | Flow boundary conditions; entry is an index number |
| N4 | = | Initial conditions; entry is an index number |
| TC | = | Transport code ("p" for particle tracking or "c" for contaminant transport) |
| CC | = | Constituent code (e.g., "H3" for tritium, "I129" for iodine-129, "Tc99" for technetium-99, etc.) |
| CN | = | Computer Name (typically a DOE Property Tag number, e.g., "WD95463") |
| iter | = | Iteration; a sequential number to distinguish between multiple runs (note that it is not necessary to save and archive all successive iterations). |

Examples:

- Central Plateau Groundwater Model, Version 1.0, Simulation G4_B2_I3_c_H3_WD95462_4 (major version 1, simulation with model grid 4, boundary condition set 2, initial condition set 3, contaminant transport of tritium, simulated on computer WD95642, iteration 4).
- S-SX Groundwater Submodel, Version 1.1, Simulation G1_B1_I1_p_flow_INTERA-0053_1 (major version 1.1, simulation with model grid 1, boundary condition set 1, initial condition set 1, particle tracking, flow only, run on computer INTERA-0053, iteration 1).

Submodels (smaller models that are extracted from a large-scale model, refined, and use boundary conditions drawn from the larger scale model) receive major version numbers that reflect the version of the larger scale number and major versions of the submodel itself. For example, S-SX Groundwater Submodel Version 2.1 is version 1 of a submodel extracted from major version 2 of the Central Plateau Groundwater Model.

## E7.4 Model Package Reports

The Model Package Report is the instrument for documenting information regarding a complete configuration managed version of an environmental model. A general template is provided in Supplemental Information E-2 that specifies the overall organization and typical content for a Model

Package Report. It is expected that a Model Package Report will be completed for each distinct major version of a model and a copy committed to EMMA with the associated model files. A Model Package Report will require the same checking, senior review, and responsible manager review as an ECF with roles and responsibilities as defined in PRC-PRO-EP-40205. A model package report cover page (Hanford Site Form A-6007-637, "Environmental Model Package Report Cover Page") shall be included in the model package report to document that these checks and reviews were completed. If appropriate, the Model Package Report may also be issued as a CHPRC document to provide a citable report.

Care must be taken not to make a Model Package Report and an ECF, which is required under procedure PRC-PRO-EP-40205, duplicative. The Model Package Report is intended to document the development of the model itself and should be written first. The ECF will be used to document the application of a specific model to perform a specific set of calculations. The ECF should cite and refer to the Model Package Report for information on the development, domain, parameterization, calibration, and other essential information regarding the model itself.

In addition, the purpose of the Model Package Report is to meet the management expectations for model development, use, and validation specified in Attachment H of EM-QA-001. Table E-3 lists these required documentation elements for models and how these will be fulfilled under this QAPjP.

**Table E-3. Fulfillment of DOE EM-QA-001 Documentation Requirements for Models**

| EM-QA-001, Attachment H<br>Required Documentation Element | Where Documented |
|---|---|
| Model development and approaches to validation are planned, controlled, and documented. Planning for model validation identifies the validation methods and the validation criteria used. If model validation activities are completed after documentation of the model (i.e., using new confirmation test data gathered in the field or laboratory), these activities are described in the work planning document. | MSWP |
| Definition of the objective (intended use) of the model | MPR Section 2, Model Objectives<br>ECF Section 1, Purpose |
| Description of conceptual model and scientific basis, as well as alternatives for the selected conceptual model. Rationale for not selecting alternatives should also be included. | MPR Section 3, Model Conceptualization |
| Results of literature searches and other applicable background information. | MPR Section 1.2, Background |
| Identification of inputs and their sources. | MPR Section 4.3, Parameterization<br>ECF Section 4, Assumptions and Inputs (specific applications) |
| Identification of, and rationale for, assumptions that are made to develop or apply the model, including model idealizations, as well as those assumptions that support the input to the model and impact model results. | MPR Section 3, Model Conceptualization<br>ECF Section 4, Assumptions and Inputs (specific applications) |
| Discussion of mathematical and numerical methods that are used in the model, including governing equations, formulas, and algorithms, and their scientific and mathematical bases. | MPR Section 4, Model Implementation |

**Table E-3. Fulfillment of DOE EM-QA-001 Documentation Requirements for Models**

| EM-QA-001, Attachment H<br>Required Documentation Element | Where Documented |
|---|---|
| Identification of any associated software used, computer calculations performed, and basis to permit traceability of inputs and outputs. | MPR Section 4.1, Software<br>MPR Section 7, Model Configuration Management<br>ECF Section 5, Software Applications (specific applications) |
| Discussion of initial and/or boundary conditions | MPR Section 4.3, Parameterization<br>ECF Section 4, Assumptions and Inputs (specific applications) |
| Discussion of model limitations (i.e., data available for model development, valid ranges of model application, spatial and temporal scaling). | MPR Section 6, Model Limitations |
| Discussion of model uncertainties (e.g., conceptual model, mathematical model, process model, abstraction model, system model, parameters) and how they affect the model. | MPR Section 5, Model Sensitivity and Uncertainty Analysis |
| Identification of the originator, reviewer, and approver. | MPR Cover Sheet (model basis and construction)<br>ECF Cover Sheet (specific applications) |
| The intended use of the model and the importance of the model is used to determine the appropriate level of confidence for a model (i.e., models of system components most relied upon are validated with the highest levels of confidence to the extent practical). | MPR Section 2, Model Objectives<br>ECF Section 1, Purpose (specific applications) |

Reference: EM-QA-001, *Office of Environmental Management Quality Assurance Program*, Attachment H, "Model Development, Use, and Validation."

ECF = Environmental Calculation File

MPR = Model Package Report (template in Supplemental Information E-2)

MSWP = Modeling Support Work Plan (template in Supplemental Information E-1)

## E7.5 Recommended Graphics Tag Convention for Model-Related Graphics

Graphics that portray model construction and the numerical results obtained with models that are included in regulatory documents, ECFs, and other reports should include a unique alphanumeric graphics identification tag to ensure results are traceable to the specific model and version used. This tag should be embedded directly in the graphic—usually in the bottom right corner—so that it is not separable from the graphic. It should also be used as the file name of the graphic file to enable rapid unique location of a specific graphic file.

To support use of the graphics tag as a file name, this alphanumeric string should not include characters that are not allowable in file naming conventions for common computer operating systems (e.g., "/" or "\" characters that denote directory levels in Linux® and Windows®, respectively). Use of spaces in the tag is also highly discouraged. Periods should be reserved for the file name extension only.

® Linux is a registered trademark of Linus Torvalds in the United States and other countries.

® Windows is a registered trademark of Microsoft Corporation, Redmond, Washington.

The variety of graphical presentations associated with presenting a model and results obtained with it preclude specifying a mandatory convention for assigning a unique alphanumeric identification tag. Instead, the following convention is provided as guidance to the graphic creator that should be adapted to specific graphic types.

It is recommended to construct the alphanumeric string to include the following elements with underscores to separate these elements:

- Model identification (e.g., CGWM)
- Model version (e.g., 3-3)
- Other codes as appropriate to distinguish unique attributes from other graphical results
- Creator's initials (e.g., JQD for John Q. Doe)
- Date the graphic was created in format yyyy-mm-dd (e.g., 2010-10-01 for October 1, 2010)

Example graphics tags and descriptions are given in Table E-4.

**Table E-4. Examples of Graphics ID Tags and Associated Descriptions**

| Graphic ID Tag | Description |
|---|---|
| CPGWM_3-3_ Head_2025_JQD_2010-10-01 | Hydraulic head contour map in year 2025 predicted with the Central Plateau Groundwater Model Version 3.3; graphic generated by John Q. Doe on October 1, 2010 |
| SSXSM_0-2_Tc99_2075_JPD_2011-01-15 | Technetium-99 concentration in year 2075 predicted with the S-SX Submodel Version 0.2; graphic generated by Jane P. Doe on January 15, 2011. |
| CPGWM_3-2_HSU1_JQD_2010-09-12 | Hydrostratigraphic Unit distribution in Model Layer 1 of the Central Plateau Groundwater Model Version 3.2; graphic generated by John Q. Doe on September 12, 2010. |
| CPGWM_3-4_Head_Well-699-24-33_TDH_2010-11-11 | Time history of hydraulic head in Well 699-24-33 predicted with the Central Plateau Groundwater Model Version 3.4; graphic generated by Tom D. Harry on Veteran's Day, 2010. |

An example of the graphics tag convention use is shown in an example plot in Figure E-6 that shows the time history of the aqueous phase concentration (Cl) of tritium (H3) in two wells predicted using the Dust Suppression Well Model for Burial Ground 618-10 (DSWM61810) Version 1.0 (1-0) for the two-well configuration (2W) and hydraulic conductivity of 100 m/d (K100); this plot was generated by William E. Nichols (WEN) on March 16, 2010 (20100316).

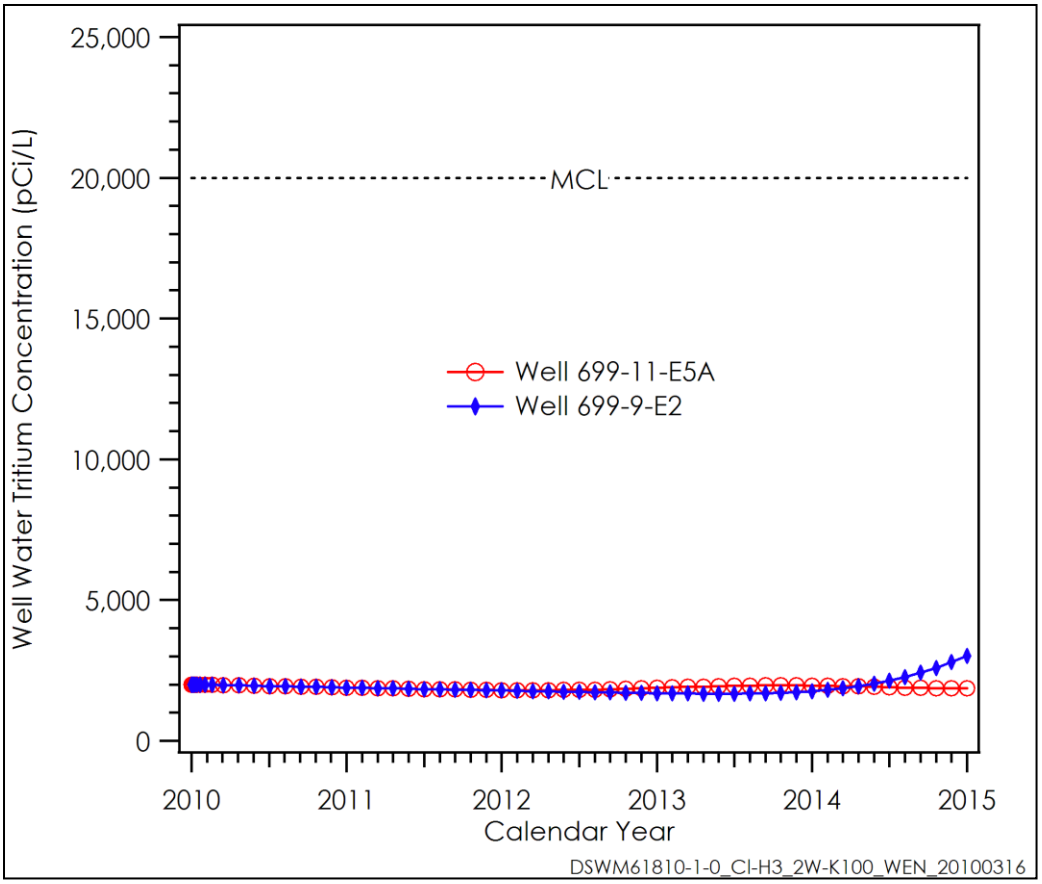


**Figure E-6. Example Graphic ID Tag**

## E8 Measurement and Data Acquisition

Input data for model development and application efforts are typically collected outside of the modeling effort or generated by other models or processing software. These data need to be properly assessed to verify that a model characterized by these data would yield predictions with an acceptable level of uncertainty. To this end, the "Group B" elements presented in EPA/240/B-01/003 address various aspects of data acquisition, the calibration of the model based on these data, management of the data, and the software/hardware configuration needed for data processing. Of the ten "Group B" elements presented in EPA/240/B-01/003, the following three are especially relevant for a modeling project:

- *[Model] Calibration (B7)*: Documenting the process for calibrating the model that will perform the designated regulatory predictive task.
- *Nondirect measurements (data acquisition requirements) (B9)*: Introducing the types and sources of existing data to be used in building and/or executing the model(s) to be considered, specifying how these data will be acquired, and documenting the quality associated with these data and their relevance in addressing project objectives.
- *Data management and hardware/software configuration (B10)*: Documenting the data management process from data acquisition through transmission and processing, and to final use; documenting the components of the process to generate model outputs; and highlighting the quality assurance procedures associated with the configuration of the hardware and software utilized by the model.

## E8.1 Model Calibration

All models, by definition, are a simplification of the environmental processes they are intended to represent. When formulating the mathematical representations of these processes one must define empirical relationships and parameters (e.g., the rate of formation or destruction of a chemical). The estimation of parameters involved in formulating these empirical relationships is called *(model) calibration*, and it is most often performed once in the model development phase.

However, some model parameters may need to be estimated for every application of the model, using site-specific field data. Similar to an analytical instrument, models are calibrated by comparing the predictions (output) for a given set of assumed conditions to observed data for the same conditions. This comparison allows the modeler to evaluate whether the model and its parameters reasonably represent the environment of interest. Statistical methods typically applied when performing model calibrations include regression analyses and goodness-of-fit methods. The details of the model calibration process, including any statistical analyses that are involved, are documented in the Model Package Report Section 4.4 (see template in Supporting Information E-1).

Most modeling work performed under this QAPjP will support regulatory decision making, so the level of detail on model calibration in the QAPjP should be sufficient to allow another modeler to duplicate the calibration method, if the modeler is given access to the model and to the actual data being used in the calibration process.

It is recognized that not every model managed under this QAPjP will be calibrated; some predictive models lack adequate data on which to base a calibration such as is often the case in vadose zone modeling. In other cases, models may be constructed using parameters obtained from previous model calibrations applicable to the same hydrostratigraphic units and scales.

Where calibration is undertaken, the features of the model calibration effort that should be documented include:

- Objectives of model calibration activities, including acceptance criteria
- Frequency of model calibration activities
- Details on the model calibration process
- Method of acquiring the input data
- Types of output generated by the model calibration
- Method of assessing the goodness-of-fit of the model calibration equation to calibration data
- Method of incorporating variability and uncertainty in the model calibration results
- Corrective actions taken if acceptance criteria were not met

Each of these items to be documented is addressed in detail in the following sections.

### E8.1.1 Objectives of Model Calibration Activities, Including Acceptance Criteria

Information related to objectives and acceptance criteria for calibration activities includes the following:

- *Objectives of the model calibration*, including what the calibration should accomplish and how the predictive quality of the model might be improved as a result of implementing the calibration process.
- *Acceptance criteria*: The specific limits, standards, goodness-of-fit, or other criteria on which a model will be judged as being properly calibrated (e.g., the percentage difference between reference data values from the field or laboratory and predicted results from the model). This includes a mention of

the types of data and other information that will be necessary to acquire in order to determine that the model is properly calibrated (e.g., field data, laboratory data, and predictions from other accepted models).

- *Justifying the calibration approach and acceptance criteria*: Each time a model is calibrated, it is potentially altered. Therefore, it is important that the different calibrations, the approaches taken (e.g., qualitative versus quantitative), and their acceptance criteria are properly justified.
  This justification can refer to the overall quality of the standards being used as a reference or of the quality of the input data (e.g., whether data are sufficient for statistical tests to achieve desired levels of accuracy).

### E8.1.2 Frequency of Model Calibration Activities

Inputs to the model calibration process can highly influence the quality of information generated by the model. Therefore, the calibration process may need to be iterative in nature, repeated whenever some key aspect of the environment changes. Each iteration utilizes data that accurately portray the changing environment and, therefore, would provide further necessary refinements to the model leading to a new version of the maintained model. The need for additional iterations is determined based on model needs established in work planning, but identification of those data that are likely to be added in the future and would provide the basis from an improved calibration is helpful.

### E8.1.3 Details on the Model Calibration Process

Provide information such as the following:

- An overview of each model or model component requiring calibration should be given, along with the various components of the calibration process, some of which may coincide with the model's components. This could be specified in text format and/or in a graphic, flow diagram-type figure. This presentation can incorporate how schedule and other time-dependent factors interplay with the various stages of the calibration process.
- Details on specific methods to be used to perform the calibration, for each portion of the model and at each stage.
- Any modification to the calibration made to accommodate data acquired for calibration purposes (see below).
- The resources necessary to conduct the model calibration, along with the individual responsible for directing the model calibration efforts.
- Where calibration records are stored to ensure that the results can be traced to the appropriate version of the model.

### E8.1.4 Method of Acquiring the Input Data

Section E8.2 provides details on how existing data are acquired and documented for use as input to model calibration and application activities. This element can document some introductory information on these data, such as the following:

- The types of data necessary at each stage of the calibration process and for each model component (or each model), along with any need for the data to represent a specific environmental situation determined by location or some other unique characteristic.
- How the data were acquired (by reference to an EMDT).

- How the quality of the data for model calibration will be determined and verified throughout the calibration process. If previous investigations on these data provide information on the quality of the data, references documenting the level of data quality should be included in the QAPjP. Otherwise, any methods used to verify data quality in the context of this project should be documented.

### E8.1.5 Types of Output Generated by the Model Calibration

The important measures and outputs that are expected to be generated upon implementing the model calibration process and that will be used to assess whether the model is properly calibrated should be documented. In addition, statistical quality control techniques to be used to process the output data for comparison to reference values or other acceptance criteria should be described. The quality assurance aspects of these analyses should also be addressed.

### E8.1.6 Method of Assessing the Goodness-of-fit of the Model Calibration Equation to Calibration Data

Statistical methods and various regression diagnostic reviews (e.g., residual plots, tests for lack of fit) are generally used when comparing the distribution of model output data that results from calibrating the model to the distribution of data measured within the particular environment that the model output is to simulate. If such methods are used on the project, they should be referenced here along with the criteria to be used in judging the "goodness-of-fit" of the model-generated distribution with the reference distribution.

### E8.1.7 Method of Incorporating Variability and Uncertainty in the Model Calibration Results

For a given environmental condition, uncertainty in the representativeness of the model input data (e.g., incompleteness, variability, and unintentional bias) will affect uncertainty in the outcome of model calibration. Deviations to the input data (reflecting the data's inherent uncertainty) or to the calibration methods and acceptance criteria can yield different model calibration outcomes.

Uncertainty in the outcome of model calibration and its potential impact on decisions being made from this outcome are addressed by documenting the following:

- The expected sources of uncertainty and variability in the model and their potential effect on the outcome of model calibration.
- The tools to be used to characterize uncertainty and variability in the outcome of model calibration (e.g., Monte Carlo techniques, sensitivity analysis).
- Acceptance criteria to be used to evaluate the level of uncertainty and variability, relative to whether the resulting uncertainty in the outcome of model calibration falls within acceptable limits.

### E8.1.8 Corrective Action Taken If Acceptance Criteria Were Not Met

Document if corrective actions were taken to deal with situations such as:

- Limits, standards, or other criteria that identify whether the model is properly calibrated were not achieved.
- Sensitivity or uncertainty analysis implied that uncertainty in the model calibration outputs exceeded pre-specified criteria.

Situations in which the model calibration process may need to be repeated after any corrective action is taken should also be specified.

## E8.2 Nondirect Measurements (Data Acquisition Requirements)

"Nondirect" measurements refer to data and other information that have been previously collected or generated under some effort outside the specific project being addressed by the QAPjP. Examples include computer databases, literature files, and software processing.

Frequently, using existing data rather than generating new data is sufficient to meet the needs of some phases of a modeling project. Because the data have already been collected and therefore, the needs of the project cannot influence how the measurements were generated, these data need special consideration. Issues regarding how relevant nondirect measurements are identified, acquired, and used on the project are addressed within this QAPjP element. The following four issues regarding how nondirect measures are acquired and used for modeling work are addressed here:

- The need and intended use of each type of data or information to be acquired.
- How the data will be identified or acquired, and expected sources of these data.
- The method of determining the underlying quality of the data.
- The criteria established for determining whether the level of quality for a given set of data is acceptable for use on the project.

Each of these items is addressed in detail below. Two key tools to be used to manage these issues is the EMDT cover sheet and the data package. The purpose of the EMDT cover sheet is to document the transmittal and acceptance of a set of data from an external source for use in modeling applications. In contrast, the data package is a document that describes how a complete data set needed for modeling input is assembled and integrated from multiple data sources.

The EMDT cover sheet is provided as Hanford Site Form A-6007-714. This form requires independent data verification by a competent reviewer who did not prepare the modeling data transmittal. When nondirect measurements are gathered for use in modeling, these are to be documented using the EMDT cover sheet to identify the need and intended use of these data, to identify the source of these data, document review of the data quality for modeling purposes by a modeler, and acceptance for use. The nature and form of data used in environmental modeling is so varied that no *a priori* standard is established in this QAPjP for acceptance or rejection of data; rather, the quality of these data will be assessed and documented in the EMDT upon receipt for later use in evaluating the resultant uncertainty in model calculations.

Review of nondirect measurements for quality consider the following criteria through the completion of the EMDT cover sheet form:

- *Representativeness*: Were the data collected from a population sufficiently similar to the population of interest and the model-specified population boundaries? Were the sampling and analytical methods used to generate the collected data acceptable to this project? How will potentially confounding effects in the data (e.g., season, time of day, location, and scale incompatibilities) be addressed so that these effects do not unduly impact the model output?
- *Bias*: Would any characteristics of the data set directly impact the model output (e.g., unduly high or low process rates)? For example, has bias in analysis results been documented? Is there sufficient information to estimate and correct bias? If using data to develop probabilistic distributions, are there adequate data in the upper and lower extremes of the tails to allow for unbiased probabilistic estimates?

- *Precision*: How is the spread in the results estimated? Is the estimate of variability sufficiently small to meet the uncertainty objectives of the modeling project as stated in Chapter E5 (e.g., adequate to provide a frequency of distribution)?
- *Qualifiers*: Have the data been evaluated in a manner that permits logical decisions on the data's applicability to the current project? Is the system of qualifying or flagging data adequately documented to allow data from different sources to be used on the same project (e.g., distinguish actual measurements from estimated values, note differences in detection limits)?
- *Summarization*: Is the data summarization process clear and sufficiently consistent with the goals of this project (e.g., distinguish averages or statistically transformed values from unaltered measurement values)? Ideally, processing and transformation equations will be made available so that their underlying assumptions can be evaluated against the objectives of the current project.

Where a data package is needed to prepare a data set from multiple information sources, it shall be prepared as a standard Central Plateau (CP-numbered) technical report. It shall be submitted for independent checking against cited data sources and senior review before issuance. Release documentation will include a cover sheet (Hanford Site Form A-6007-715, Data Package for Environmental Models Cover Page) to document the completion of checking and review.

## E8.3 Data Management and Hardware/Software Configuration

Data gathered to support modeling activities may support only one model, or multiple models. Additional data may be added over time. EMMA (Section E7.2) was designed to enable capture of linkages between model basis information (including versions reflecting changes in time), model versions, and applications of models. When new information is added to EMMA, the modeler committing the information will use the EMMA interface to provide the appropriate linkages between model basis, models, and applications. Model documentation (Model Package Reports) and application documentation (ECFs) will include reference to software used and specific versions to establish traceability to controlled software maintained in MKS Integrity.

### E8.3.1 Data Management

Data (nondirect measurements; Section E8.2) gathered and maintained to support modeling work is to be stored in EMMA (refer to Section E7.2) under the "Basis" category.

In the pre-processing stage, the input parameters are prepared for use in the modeling stage by performing processes such as data formatting, reduction, transformations, conversions, and subsetting. These data reduction and processing steps may either be documented in full in the EMDT cover sheet (Hanford Site Form A-6007-714), or in electronic format in files referenced in the EMDT cover sheet.

In the model computational stage, the mathematical equations within the model are derived and applied to the data. While a purpose of the project may not be to develop the specific mathematical processes and equations that constitute the model computational stage, this element can still highlight the primary mathematical approaches that are expected to be applied and how these approaches will ensure that the model's underlying scientific principles will be properly incorporated. This step is documented in the Model Package Report (Supporting Information E-2).

In the post-processing stage, statistical methods are applied to analyze the model output, to generate data summaries and reports, and to characterize variability and uncertainty in the model output. This step is documented in an ECF (PRC-PRO-EP-40205).

"Control mechanisms" associated with data management for modeling work includes the following:

- Data transmittals are reviewed by a modeler before inclusion in EMMA
- Model applications are checked by a verifier and reviewed by a senior reviewer before issue of an ECF
- The use of EMMA provides an audit trail, including hash numbering to uniquely identify each basis, model, or application submittal

#### E8.3.2 Hardware/Software Configuration

Hardware used by the Modeling Team includes a variety of computing equipment and operating systems (e.g., Linux and Windows). No specific platform of operating system standard is enforced so long as each platform meets installation testing criteria for all controlled modeling software installed and used on that platform. Requirements for acceptance and installation testing are specified in the pertinent software test plans. Approved computer systems and users for controlled software are tracked in the software entries in the HISI. Each software test plan requires retesting when the configuration of the hardware (such as an operating system major upgrade) changes.

Software configuration management is managed for each controlled modeling software program through lifecycle management documents as required under PRC-PRO-IRM-309. These documents usually include a Functional Requirements Document, Software Management Plan, Software Test Plan, Acceptance Test Report, and Requirements Traceability Matrix (although some of these document elements may be combined into integrated documents in some instances).

Security issues are addressed at the INTERA Richland office through the "INTERA Richland Information Security Plan." At CHPRC offices, security is addressed through adherence to CHPRC computer security requirements.

Software installation of modeling software is performed per the relevant software management plan that implements PRC-PRO-IRM-309 requirements for each modeling software package.

Documentation requirements are addressed in Chapter E7.

# E9 Assessment

This chapter identifies the types of assessments to be performed throughout the various stages of both model development and application. Findings and opportunities for improvement are reported to management for corrective action through the implementation of PRC-PRO-QA-052, *Issues Management*.

## E9.1 Management Assessment

The Responsible Manager for modeling activities may periodically assess the modeling management processes. Management assessments will be conducted in accordance with PRC-PRO-QA-246, *Management Assessment*, and will focus on compliance with documented requirements and procedures.

## E9.2 Independent Surveillance and Assessment

Independent assessments may be conducted periodically by the Environmental Compliance and Quality Assurance organization in accordance with PRC-PRO-QA-9662, *Independent Assessment Process*.

Surveillances may be conducted periodically by the Environmental Compliance and Quality Assurance organization in accordance with PRC-PRO-QA-9769, *Surveillance Process*.

## E9.3 Work Site Assessment

Work site assessments are those conducted by the Modeling Team and will follow PRC-PRO-QA-40090. These assessments are usually initiated or overseen by the Modeling Team Leader. Such assessments will address:

- Reviews of the model theory, mathematical structure, parameters, and data to ensure the objectives of the new model or application of an existing model are being met.
- Reviews of the model evaluation and hardware/software configuration testing conducted to assure the quality requirements for a new application of an existing model.
- Reviews to assess the appropriateness of data being used or considered for use in a new application of a model.

Work site assessments include senior reviews performed as part of the process of producing an ECF in accordance with PRC-PRO-EP-40205, ongoing review of model development documented in a Model Package Report (Supporting Information E-2), reviews by modelers of data receipts documented in EMDT cover sheets (Hanford Site Form A-6007-714), informal reviews conducted as part of regular (usually weekly) Modeling Team meetings, and other assessment opportunities.

# E10 Reports to Management

Reports to management are a critical part of the communication process among all participants in model development or application work. Planned reports provide a structure for notifying management of the following:

- Adherence to project schedule and budget
- Deviations from approved QAPjPs, as determined from project assessment and oversight activities (discussed in the previous chapter)
- The impact of these deviations on model prediction, application quality, and uncertainty
- The need for and results of response actions to correct the deviations
- Potential uncertainties in decisions based on model predictions and data
- Data Quality Assessment findings regarding model input data and model outputs (predictions)

Reports to management should provide an understanding of the potential effect that changes made in one segment of the model input data, the algorithms, or the development and application process may have on segments of the model algorithms, process, or predictions.

The following types of reports to management are relevant for a modeling work:

- Final version of the QAPjP for Modeling Work (submitted by the Modeling Team Leader to the Risk and Modeling Integration Manger)
- Weekly status updates for active modeling support work to project document managers (submitted by the Modeling Team Leader to the Risk and Modeling Integration Manger)

- Quarterly risk and modeling software quality assurance status reports to Risk and Modeling Integration Manager (submitted by the Modeling Team Leader to the Risk and Modeling Integration Manager)
- Final version of Model Package Reports (submitted by modeler tasked with model development to the Modeling Team Leader)
- Final version of ECFs (submitted by modeler tasked with application of a model to prepare a calculation to the Modeling Team Leader)
- Disposition of peer review comments (where peer review is used)
- Assessment reports (surveillance, management assessments)
- Corrective actions taken or planned in response to identified issues entered into the CHPRC Issues Management System (PRC-PRO-QA-052)

# E11 Data Validation and Usability

This chapter describes the process to assess the usability of the model results (whether from the first application of a new or revised model or from application of an accepted model). Therefore, these elements refer to quality procedures that occur near or at the end of model development. This section deals with "Group D" elements that describe data review, verification, and validation processes (EPA/240/B-01/003). For modeling projects, this is analogous to confirming that the steps of the modeling process were followed correctly to produce the model outputs and that the results meet modeling objectives.

Data (or information) validation and usability activities for modeling projects are represented within the following three elements:

- *Departures from Validation Criteria (D1)*: This first element documents the criteria used to evaluate how deviating from the specifications given in the QAPjP may impact the quality and usability of final results and decisions that are made based on these results.
- *Validation Methods (D2)*: This second element describes the process and methods for determining whether deviations have occurred within the model components.
- *Reconciliation with User Requirements (D3)*: This element combines the information from the previous two elements to make a final assessment of the usability of the model results.

Each element is addressed in the following sections.

## E11.1 Departures from Validation Criteria

Along with Validation Methods (Section E11.2), this element elaborates on the acceptance criteria mentioned in Chapter E5, which evaluate the model and its components based on its ability to produce results that can be used to achieve modeling objectives. For example, the acceptance criteria associated with the degree to which each model output item has met its quality specifications should be documented in the Model Package Report.

Examples of such acceptance criteria and details about how such criteria may be evaluated in the various stages of the modeling process are as follows, presented in the context of specific model applications:

- *Mathematical basis for the model*: Evaluated to the degree that the model incorporates the Features, Events, and Processes selected for representation; addressed in the Model Package Report. List possible ways in which the criteria may not be met are specified, and the effects these conditions may have on the model output.
- *Numerical models*: Confirmation that the numerical (coded) model accurately estimates the mathematical theory behind the model; achieved through code selection, in compliance with PRC-PRO-IRM-309 and typically documented in a Functional Requirements Document for the numerical code.
- *Code verification*: Achieved through adherence to PRC-PRO-IRM-309 and typically documented through an Acceptance Test Report.
- *Model evaluations*: A model can be evaluated by comparing model predictions of current conditions with similar field or laboratory data not used in the model calibration process, or with comparable predictions from accepted models or by other methods (uncertainty and sensitivity analyses); evaluations are documented in a Model Package Report.
- *Validation of input data*: For a first application of the model, where parameter values are specified and site-specific data are input into the model or subsequent applications, the input data may need to be validated for their requirements planned in Chapter E5. In addition, how the criteria were established and the possible ways in which the criteria may not be met are specified, and the effects these conditions may have on the model output are discussed in a Model Package Report and/or an ECF.
- *Model output*: The criteria used to assess the usability of the model output include its regulatory task requirements, as specified in Chapter E5. For model applications in production mode, model outputs are similarly assessed against program uncertainty and variability requirements. Comments on the process of choosing these criteria and objectives should refer to Chapter E5.

Many of the assessment approaches used to evaluate these acceptance criteria may have already been provided in Chapter E9.

## E11.2 Validation Methods

The purpose of this element is to describe, in detail, the process for making a final assessment of whether model components and their outputs satisfy the user requirements specified throughout this QAPjP. The appropriate methods of evaluation are determined by the quality objectives discussed in Chapter E5. The individuals responsible for the evaluation of the various components of the model together with the lines of authority should be shown on the organizational chart presented in Chapter E2.

Final validation of a model is achieved through review and acceptance of a Model Package Report. The following criteria are to be considered to validate a model:

- *Mathematical basis for the models*: Senior review will be used to evaluate the model's mathematical basis.
- *Numerical models*: Software acceptance tests identified in the Software Test Plans for each modeling software package are explicitly designed to test the numerical model implementation against Hanford-specific test cases.

- *Code verification*: Software installation tests identified in the Software Test Plans for each modeling software package are used to confirm correct code operation.
- *Model evaluation*: The process of specifying how and when model output will be compared with independent data to ensure that the modeling results meet project objectives will vary with each model implementation; the process used will be documented in a Model Package Report.
- *Validation of input data*: Parameter values and site-specific data that are input into the model are validated through modeler review of EMDTs.
- *Model output*: The usability of the model output is assessed by comparing it against its modeling objectives; this comparison is documented in an ECF.

### E11.3 Reconciliation with User Requirements

Modeling products are to be provided to projects for review and subject to iterative improvement by the Modeling Team to ensure these products meet the needs of users of model output.

## E12 References

### E12.1 Internal Plans and Procedures

CHPRC-00189, *CH2M HILL Plateau Remediation Company Quality Assurance Program Plan*, as revised, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-MP-EP-40220, *Environmental Program and Strategic Planning Roles, Responsibilities, and Functions*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-MP-QA-599, *Quality Assurance Program*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-EP-40205, *CHPRC Environmental Calculation Preparation and Issue*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-EP-40253, *Risk Assessment and Modeling Integration*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-IRM-309, *Controlled Software Management*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-IRM-10588, *Records Management Processes*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-052, *Issues Management*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-246, *Management Assessments*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-259, *Graded Approach*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-9662, *Independent Assessment Process*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-9769, *Surveillance Process*, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-40090, *Work Site Assessment*, CH2M HILL Plateau Remediation Company, Richland, Washington.

## E12.2 External Laws, Guidance, and Direction

*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, Pub. L. 107-377 as amended, 42 USC 9601 et seq., December 31, 2002. Available at: https://www.csu.edu/cerc/researchreports/documents/CERCLASummary1980.pdf.

DOE G 414.1-4, *Safety Software Guide for Use with 10 CFR 830, Subpart A, Quality Assurance Requirements, and DOE O 414.1C, Quality Assurance*, U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives/0414.1-EGuide-4/view.

DOE-STD-5002-2017, 2017, *Disposal Authorization Statement and Tank Closure Documentation*, U.S. Department of Energy, Washington, D.C. Available at: https://www.standards.doe.gov/standards-documents/5000/5002-astd-2017.

DOE O 414.1D Chg 1 (Admin Chg), 2013, *Quality Assurance*, U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives-documents/400-series/0414.1-BOrder-d-admchg1.

DOE O 435.1 Chg 1 (PgChg), 2007, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives-documents/400-series/0435.1-BOrder-chg1-PgChg.

EM-QA-001, 2012, *Office of Environmental Management Quality Assurance Program*, Rev. 1, Office of Environmental Management, U.S. Department of Energy, Washington, D.C. Available at: https://energy.gov/sites/prod/files/em/EMQualityAssuranceProgram(EM-QA-001Revision1).pdf.

EPA/240/B-01/003, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2016-06/documents/r5-final_0.pdf.

EPA/240/B-06/001, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/documents/guidance_systematic_planning_dqo_process.pdf.

EPA/240/R-02/007, 2002, *Guidance for Quality Assurance Project Plans for Modeling*, EPA QA/G-5M, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=200144KR.PDF.

*Resource Conservation and Recovery Act of 1976*, Pub. L. 94-850, 42 USC 6901 et seq. Available at: https://www.govinfo.gov/content/pkg/STATUTE-90/pdf/STATUTE-90-Pg2795.pdf.

# Supporting Information E-1

# Modeling Support Work Plan Template

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# Modeling Support Work Plan for [Identify Project]

## 1. Modeling Objectives

Include a clear and concise statement of the objectives this work will support and the calculations required; address the following where appropriate:

- What is the specific problem? What are the goals and objectives of this project that will address this problem?
- Why should a modeling approach be used to address the problem? Is there a regulatory requirement for a modeling analysis?
- What specifically will this project produce to address this problem (e.g., a new predictive tool, modeling results for a new scenario)?
- What types of decisions regarding the problem may be made as a result of this project? Who will be responsible for making these decisions?
- Will any aspect of the problem not be addressed in this modeling work?
- What other types of problems may this modeling work address?

## 2. Model Development & Application Schedule

| Activity ID | Work Element | Start | Finish | Status |
|---|---|---|---|---|
| | 1. Task 1 description | | | |
| | 2. Task 2 description | | | |
| | 3. Task 3 description | | | |

## 3. Assumptions

Include a list of limiting assumptions regarding the work elements and schedule above:

1. Assumption 1
2. Assumption 2
3. Assumption N

## 4. Anticipated Staff Responsibilities

| Team Member | Responsibility |
|---|---|
| | |
| | |
| | |

## 5. Communication

Detail how often, in what form, and to whom the status of work will be reported.

## 6. Change Management

Project risks include exceeding authorized budgets or not maintaining the schedule. Proactive identification, communication, management, and documentation of change are critical to the success of a project. Project risks include exceeding authorized budgets, not maintaining the schedule, and performing work outside the scope of work. Each team member is responsible for reviewing and understanding the scope of work, and communicating any issues that may involve changes in scope, schedule or level of effort to the Project Manager or Technical Leader in a timely manner. Work outside the project scope of work should not be performed by any team member without prior authorization of the Project Manager. If you have questions about your work activities as they pertain to the scope of work, please contact the Project Manager or Technical Leader.

## 7. Concurrence

Risk/Modeling
Team Leader

Name, Title
CHPRC

Date

Risk and Modeling
Integration Manager

Name, Title
CHPRC

Date

Project Lead

Name, Title
CHPRC

Date

# Supporting Information E-2

# Model Package Report Template

# Model Package Report: [Model Name]

Version #.#

This template identifies the required structure and content for documenting an environmental fate and transport simulation model used for CHPRC work in support of remedial activities at the Hanford Site. This structure may be expanded (through addition of appropriate sub-sections) as necessary to describe more complex simulation models, but all content identified must be included using the basic structure provided to ensure consistent presentation of simulation models and support integration of modeling efforts at the Hanford Site. The objective of the model package is to concisely describe the modeling objectives, conceptualization, implementation, uncertainty and sensitivity, configuration control, and limitations of a specific model.

The model package documents the model itself, not a specific calculation. The use of the model to perform specific calculations is to be documented in an ECF as required by PRC-PRO-EP-40205, *Environmental Calculation Preparation and Issue*), including inputs and results. Control of all software used to implement the model is directed by the requirements of PRC-PRO-IRM-309, *Controlled Software Management*.

## Title

Include document number (if released as a CHPRC-##### document) and model title, e.g., “Model Package Report: Central Plateau Groundwater Model, Version 1.1”.

## Approval

Use Hanford Site Form A-6007-637 to record checking, senior review, and responsible manager review of the model package report.

## Executive Summary

Summarize the model purpose and objectives, system conceptualization, and numerical results. Identify how model is uniquely identified for model configuration management purposes.

## 1 Introduction

State the purpose of the model and decisions to be supported.

### 1.1 Need

Describe why modeling is necessary, regulatory context, and relevant prior modeling work.

### 1.2 Background

Summarize the physical setting, site infrastructure, and process and operational history of the model setting. Summarize previous modeling efforts that pertain to the domain included in this effort.

## 1.3 Document Organization

Describe the organization of this model package.

# 2 Model Objectives

Comprehensively identify the objectives of the model, including the results that must be provided (quantities, locations, times); how uncertainty (conceptual and parameter) must be addressed; and validation required. Reference any documents that identified objectives and metrics established for this model prior to the start of model development.

The intended use of the model and the importance of the model is used to determine the appropriate level of confidence for a model (i.e., models of system components most relied upon are validated with the highest levels of confidence to the extent practical).

# 3 Model Conceptualization

Introduce conceptual model development.

Provide a description of the conceptual model and scientific basis, as well as alternatives for the selected conceptual model. Rationale for not selecting alternatives should also be included.

Provide identification of, and rationale for, assumptions that are made to develop or apply the model, including model idealizations, as well as those assumptions that support the input to the model and impact model results.

## 3.1 Features, Events, and Processes (FEPs)

Introduce features, events, and processes (FEPs) included and excluded.

Identify relevant features, which may include but are not limited to: geologic setting; stratigraphic and structural controls; recharge; boundary controls, spatial variability. Identify uncertainties.

Identify relevant events, which may include but is not limited to: climate change and associated consequences; anthropogenic changes to boundary conditions (e.g., surface cover changes with associated recharge modification; changes in groundwater flow resulting from construction of a reservoir that influences the system), remediation actions (e.g., pump and treat systems). Identify uncertainties.

Identify relevant processes, which may include but is not limited to river/aquifer interaction and exchange flow (e.g., bank storage effects for near-river settings); fast path mechanisms (flow through unsealed boreholes); sorption; reactive transport; waste chemistry impacts on sorption.

Formulate and present conceptualization(s) of the system consistent with available data. [Note: this may include alternative conceptual models if more than one conceptual model can be proposed that is consistent with data and observations.] Identify dimensionality for model components consistent with included FEPs.

## 3.2 Nature and Extent of Contamination

Describe current understanding of the nature and extent of contamination in the system for contaminants of concern and/or contaminants of potential concern. Identify supporting data. Discuss potential contaminant migration into model domain from out-of-domain sources (e.g., vadose zone continuing sources for a groundwater model).

# 4 Model Implementation

Introduce model implementation.

Discuss the mathematical and numerical methods that are used in the model, including governing equations, formulas, and algorithms, and their scientific and mathematical bases.

## 4.1 Software

Describe basis for selection of numerical software used to implement the model. Map software features to included FEPs and note limitations in this regard.

Demonstrate compliance with PRC-PRO-IRM-309, *Controlled Software Management*, by citing CHPRC software control documents (e.g., Functional Requirements Document, Software Management Plan, Software Test Plan, Requirements Traceability Matrix, and Acceptance Test Report), user authorization and training, and Software Checkout and Installation record.

## 4.2 Discretization

Summarize spatial and temporal discretization, including historic and future model setup(s). Identify sensitivity studies performed to confirm validity of these discretizations and associated results.

## 4.3 Parameterization

Identify model parameters, values assigned, and how derived. Identify data sources, data quality, and traceability. Describe assignment of boundary and initial conditions. Identify temporal and spatial changes in parameters and boundary conditions.

## 4.4 Calibration

Summarize calibration process and results, if applicable (or reason if calibration is not applicable). Address the following:

- Objectives of model calibration activities, including acceptance criteria
- Frequency of model calibration activities needed to maintain the model in future revisions
- Details on the model calibration process
- Method of acquiring the input data (reference Environmental Model Data Transfers)
- Types of output generated by the model calibration
- Method of assessing the goodness-of-fit of the model calibration equation to calibration data
- Method of incorporating variability and uncertainty in the model calibration results
- Corrective actions taken if acceptance criteria were not met

# 5 Model Sensitivity and Uncertainty Analyses

Discuss modeling assumptions and calibration results. Highlight their potential impacts on model results.

## 5.1 Sensitivity Analysis

Describe method used and relevant software implementation (PEST, SENSAN, etc.), e.g., Monte Carlo, LHS. Provide as many sub-sections as necessary to document the analysis. Provide recommendations/ guidance for calibration improvement.

## 5.2 Uncertainty Analysis

Describe method(s) used and metrics chosen. Provide as many sub-sections as necessary to document the analysis. Provide recommendations for model improvement.

# 6 Model Limitations

Identify and discuss limitations of this model in terms of model objectives, implementation, and software limitations.

# 7 Model Configuration Management

Identify how this model is uniquely identifiable and where the inputs, software, and outputs are configuration managed to assure reproducibility.

# 8 Data Needs

Include any data needs that can be identified, based on model development and application, for which acquisition has the potential to significantly improve the predictive ability of this model.

# 9 Model Recommendations

Include any recommendations for further refinement, expansion, or improvement to this model and benefit that might be derived from each change.

# 10 References

List all cited publications.

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