West Valley Demonstration Project

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Characterization Management Plan for the Facility Characterization Project

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Table of Contents

Table of Contents (Continued)

References

WVDP Documents and Departmental Procedures

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ACM-2706, Alpha Spectral Analysis
ACM-2707, Actinide Analysis
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ACM-3103, Preparation of Samples for Gamma Spectroscopy
ACM-3104, Gamma spectrometric Analysis
ACM-4001, Purifying and Counting 99Tc
ACP-7.3, Control of Samples
ACP-8.6, ACP Data Approval
ACP-9.1, Analytical and Process Chemistry Laboratory Assessment Program
QM-2, Quality Assurance Program
QM-7, Control of Purchased Items and Services
WVDP-002, Quality Management Manual
WVDP-010, WVDP Radiological Controls Manual
WVDP-011, Industrial Hygiene and Safety Manual
WVDP-099, Environmental Compliance Manual
WVDP-111, Quality Assurance Program (QAP)
WVDP-123, Laboratory Quality Assurance Program Manual
WVDP-124, Laboratory Quality Assurance Methods Manual
WVDP-126, Performance-Based Training Program Manual
WVDP-127, West Valley Nuclear Services Company (WVNS) Procurement Manual
WVDP-131, Radiological Control Procedures Manual
WVDP-163, WVDP ALARA Program Manual
WVDP-200, West Valley Demonstration Project (WVDP) Waste Acceptance Manual
WVDP-241, Site Specific Health and Safety Plan (HASP)
WVDP-257, WVNS Manual for the Preparation, Review, Approval, Distribution, and Revision of Controlled Documents
WVDP-262, WVNS Manual for Records Management and Storage
WVDP-293, Radiological Protection Record Keeping and Reporting Program Manual
WVDP-318, Radiological Instrumentation Calibration and Maintenance Program Manual
WVDP-EIS-014, Characterization of Reactor Fuel Reprocessed at West Valley
WM-230, Determining Radioactivity in a Waste Package
WM-260, Data Verification and Validation

Policies and Procedures from WVDP-117, Policies and Procedures Manual

WV-108, Preventative Maintenance Recall Tracking System and Component Information Input
WV-109, Instrument Data and Recall Tracking System
WV-538, Employee Indoctrination and Training
WV-902, Data Quality Objectives
WV-921, Hazards Identification and Analysis

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SOP 300-24, Sample Storage and Packaging Facility Operation

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NUREG-1575, Revision 1, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)
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NUREG-1757, Consolidated NMSS Decommissioning Guidance, Volume 1 (draft for comment)

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No. 224, November 20, 1997.

West Valley Nuclear Services Company (WVNSCO) Internal Memorandum, FD:2002:0003, Regulatory Programs to Distribution, "Key Radionuclides for Performance Assessment," dated January 14, 2002.

West Valley Nuclear Services Company (WVNSCO), Project Implementation Plan for the Facility Characterization Project, dated February 28, 2002.

Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), December 1997, NUREG-1575, EPA 402-R-97-016.

Acronyms and Abbreviations

ACM	Analytical Chemistry Method
ALARA	As Low As Reasonably Achievable
A&PC	Analytical and Process Chemistry
AR	Analytical Request
ASR	Analytical Sample Report
BNFL	British Nuclear Fuels Limited
CCTV	Closed-Circuit Television
CdTe	Cadmium Telluride
CFR	Code of Federal Regulations
CMP	Characterization Management Plan
D&D	Decontamination and Decommissioning
DAP	Data Collection and Analysis Plan
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
DQO	Data Quality Objective
EPA	Environmental Protection Agency
FCP	Facility Characterization Project
FOV	Field of View
GPC	General Purpose Cell
HASP	Health and Safety Plan
HLW	High-Level Waste
ISMS	Integrated Safety Management System
ISOCS	In Situ Object Counting System
IWP	Industrial Work Permit
LCS	Laboratory Control Samples
LTR	License Termination Rule
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCA	Multi-Channel Analyzer
MDA	Minimum Detectable Activities
MDC	Minimum Detectable Concentrations
NORM	Naturally Occurring Radioactive Material
NRC	Nuclear Regulatory Commission
NYSASDA	New York State Atomic Space and Development Authority
NYSERDA	New York State Energy Research and Development Authority
NYSDEC	New York Stated Department of Environmental Conservation
PMC	Process Mechanical Cell
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RIDS	Record Inventory and Disposition Schedule
SAIC	Scientific Applications International Corporation
SCA	Single-Channel Analyzer
STS	Supernatant Treatment System
SOP	Standard Operating Procedure
TEDE	Total Effective Dose Equivalent
VAST	Vitrification Analytical Sample Tracking
WNYNSC	Western New York Nuclear Service Center
WTF	Waste Tank Farm
WVDP	West Valley Demonstration Project
WVNSCO	West Valley Nuclear Services Company

Executive Summary

The key objective of the West Valley Demonstration Project (WVDP) through December 2004 is to demonstrate that the facilities on the North Plateau meet the criteria for license termination in accordance with correspondence from the Nuclear Regulatory Commission (NRC). West Valley Nuclear Services Company (WVNSCO)as the prime contractor for the Department of Energy (DOE), will perform activities, including characterization, that will ultimately support this objective. This Facility Characterization Management Plan (CMP) details the characterization approach to be used to generate radionuclide source term estimates for the Waste Tank Farm (excluding Tanks 8D-1 and 8D-2), the Vitrification Facility, and the Process Building. This plan has been reviewed by an external peer review panel who have provided comments. The plan was subsequently revised to incorporate the external peer review panel's comments and recommendations.

In general, the technical approach for characterization is to use validated information, either historical or newly collected data, to generate conservatively bounded radionuclide source terms typically by conducting dose-to-curie modeling. All calculations and computer modeling are peer reviewed and documented in the project files. The inventory reports are issued as documents that can be referenced by the performance assessment modeler as part of the Long Term Stewardship Environmental Impact Statement for the site and to demonstrate that the license termination rule (LTR) criteria have been met.

The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) was used as guidance in developing this characterization approach. Specifically, Sections 4.8.4, 5.3, 6.0, and Appendix E of the MARSSIM were incorporated into this plan.

1.0 Project Management

1.1 Background

Site History

In 1959, the State of New York acquired 3,345 acres of land in the town of Ashford, near West Valley, which is located some 30 miles south of Buffalo, for use as an atomic industrial area. That year, the State Office of Atomic Development established the Western New York Nuclear Service Center (WNYNSC) on the property.

In 1962, Nuclear Fuels Services, Inc. leased the WNYNSC from the state. In 1966, Nuclear Fuels Services began operations at the plant, which covers some 190 acres of the WNYNSC property. The state retained ownership of the facility through the New York State Atomic Space and Development Authority (NYSASDA), which was recreated in 1975 as the New York State Energy Research and Development Authority (NYSERDA).

The plant was initially licensed by the Atomic Energy Commission and later by the Nuclear Regulatory Commission (NRC) under authority of the Atomic Energy Act. The license authorized Nuclear Fuel Services as the operator of the facility and the NYSERDA as owner of the facility to: (a) store irradiated fuel elements and radioactive waste (including high-level waste); (b) reprocess spent nuclear fuel; and (c) dispose of solid radioactive waste generated at the facility by burial in soil on the property.

The plant operated as a nuclear fuel reprocessing center from 1966 to 1972. During the operation of the plant, 640 metric tons of spent reactor fuel were processed, resulting in 660,000 gallons of highly radioactive liquid waste. The liquid waste was stored in the underground high-level waste tanks.

Nuclear Fuel Services shutdown the plant in 1972 for modifications to increase its seismic capability and to expand its capacity. The company withdrew from the reprocessing business in 1976, without restarting the operation and turned control of the facilities to the site owner, NYSERDA.

Beginning of the West Valley Demonstration Project

In 1980, Congress passed Public Law 96-368, the West Valley Demonstration Project (WVDP) Act, which authorized the DOE to conduct a technology demonstration project for the safe solidification of the high-level waste and cleanup of associated facilities used during the solidification. This demonstration project is currently underway, with vitrification of the high-level liquid waste, a process begun in 1996, being recently completed.

Following passage of the WVDP Act, NRC amended the plant license to terminate the responsibility and authority of Nuclear Fuel Services as the operational licensee of the facility, leaving NYSERDA as the sole licensee. The NRC suspended this license in 1981 following creation of the WVDP to allow DOE to carry out the demonstration project without NRC license authority.

Although NRC suspended the license covering the site until completion of the WVDP, NRC retained certain authorities under the WVDP Act. These include prescribing decommissioning criteria for:

- The tanks and other facilities in which the high-level waste solidified under the project was stored,
- The facilities used in the solidification of the waste, and
- Any material and hardware used in connection with the WVDP.

DOE is not an NRC licensee under this arrangement, and the Department's decommissioning activities are conducted under the WVDP Act and not the Atomic Energy Act.

In 1996, DOE and NYSERDA issued for public comment a Draft Environmental Impact Statement (DEIS) for completing the West Valley Demonstration Project and closure or long-term management of the facilities at the site. Upon completion of the demonstration project, the WVDP Act requires NYSERDA to reacquire and possess the facilities under license to NRC to ensure the license conforms to NRC regulations, including those regulations associated with license termination.

Following public discussion and regulatory review, DOE in 2002, divided the EIS into two separate EIS actions: (1) one addressing waste management and (2) another addressing decommissioning, long-term monitoring, and stewardship of the site. The Characterization Management Plan (CMP) was prepared to support preparation of this latter EIS. The Record of Decision for the Decommissioning EIS is expected to be completed in calendar year 2005 under an aggressive schedule.

Performance Assessments

Under contract to DOE and NYSERDA, in connection with the EIS process, SAIC developed a set of site-specific computer codes to assess the performance of an in-place closure design. These codes model radionuclide release, transport, and related dose from groundwater and erosion releases.

An updated performance assessment utilizing data from the Facility Characterization Project is forecast to be completed by September 2004 in support of the decommissioning EIS Record of Decision.

License Termination Criteria and NRC Involvement

On February 1, 2002, the NRC issued a notice in the Federal Register indicating that the Commission will apply its License Termination Rule to the site. Found in the Code of Federal Regulations 10 CFR 20 Subpart E, the rule provides for a range of criteria for license termination. It specifies that release for unrestricted use will be considered when a dose criterion of 25 millirem per year total effective dose equivalent (TEDE) to the average member of the critical group is not exceeded, and when residual radioactivity has been reduced as low as reasonable achievable (ALARA) (10 CFR 20.1402).

The License Termination Rule specifies restricted release for a site when the individual dose criterion of 25 millirem per year TEDE can be attained using legally-enforceable institutional controls established after a public participatory process, including ALARA considerations (10 CFR 20.1404). The Commission itself must approve use of the alternate criteria, after coordination with the Environmental Protection Agency (EPA).

An NRC (Richard A. Meserve) letter to NYSERDA (Paul L. Piciulo) dated June 20, 2002 outlined NRC involvement as a cooperating agency for the decommissioning EIS, indicating that NRC will be reviewing key documents such as characterization studies, engineering studies, and performance assessment modeling, with the same rigor that NRC reviews license applications under the Atomic Energy Act. The letter noted that applicable NRC guidance appears in the following documents:

- NUREG-1727, NMSS Decommission Standard Review Plan
- NUREG/BR-0241, NMSS Handbook for Decommissioning Fuel Cycle and Material Licensees
- NUREG-1575, Revision 1 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)
- NUREG-1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs
- NUREG-1757, Consolidated NMSS Decommissioning Guidance (a three-volume decommissioning manual, of which only the first volume is available in draft form)

The Final Site End Condition

Until the EIS process culminates with the Record of Decision, the final end state of the plant will remain undefined.

1.2 Project Definition and Introduction

The purpose of the Facility Characterization Project is to reduce the overall risk or likelihood of underestimating the long-term impacts from the radiological sources in the Vitrification Facility, Process Building, and select units in the Waste Tank Farm for any of the closure options considered. High-Level Waste (HLW) Tanks 8D-1 and 8D-2 are specifically excluded from this scope of work as they are covered by a preexisting characterization program documented in WVDP-364, "Data Collection and Analysis Plan (DAP) for Tanks 8D-1 and 8D-2 as Part of the Waste Tank Farm (WTF) Project."

Long-term impacts are determined by a performance assessment. Specifically, the performance assessment is a computer model that estimates the future radiological doses to off-site receptors and on-site intruders when specific closure engineering features are implemented for in-place closure. Radiological inventories (source terms) were previously developed to use with the DEIS performance assessment models. Based on an evaluation of the earlier inventory estimates and associated performance assessment results for the DEIS, the scope of the Facility Characterization Project quickly focused on those key facilities and radionuclides that impact the outcome of the performance assessment results. The key dose contributors to the performance assessment are the Waste Tank Farm, Vitrification Facility, and the Process Building.

The Facility Characterization Project will evaluate the prior estimates and determine whether they represent a conservatively bounded radionuclide source term for a given unit. If it is determined that additional data is necessary to defend a radionuclide source term or to generate a source term, WVNSCO shall employ a graded approach to data collection to meet the project data quality objectives documented in Appendix A.

A review of prior source term estimates and computer performance assessment simulations suggests that some amount of source term reduction (decontamination) is needed in parts of the

Process Building (e.g., the GPC and PMC) to demonstrate radiological doses below the currently targeted dose criteria. This assessment data was evaluated from two different simulations; the groundwater release scenario and the erosion release scenario (see Tables 1-1 and 1-2). In both cases, the GPC is the dominant cell representing greater than half of the collective dose for the Process Building. These tables also reflect the predominant radionuclides for the Process Building based on the existing performance assessment. The predominant radionuclides include U-233, U-234, Np-237, Pu-239, Pu-240, and Am-241.

1.3 Project Organization and Responsibility

The project organization that will carry out this CMP is shown in Figure 1. Key project roles and responsibilities are defined below.

Facility Characterization Project Manager - has responsibility for all phases of the Facility Characterization Project and communicating project direction to the project team. The Facility Characterization Project Manager will provide top level oversight for the project planning, reporting, scheduling, and specifications. The Facility Characterization Project Manager, in conjunction with the Technical Review and Approval Panel, will determine whether the data collected per this CMP is adequate to support the goals and objectives of this project or whether additional data is necessary. The Facility Characterization Project Manager has day-to-day responsibility for ensuring that the requirements of this CMP, including quality of deliverables, are implemented. The Facility Characterization Project Manager, in conjunction with the Technical Review and Approval Panel, will determine whether the data collected per this CMP is adequate to support the goals and objectives of this project or whether additional data is necessary. Key supporting organizations are coordinated by the Facility Characterization Project Manager to ensure project integration.

The Facility Characterization Project Manager is responsible for developing and maintaining the scope, schedule, and budget of the project.

Facility Characterization Project Lead - responsible for developing and maintaining the integrity of the unit assessment process in accordance with this plan, and coordinating and providing direction to all support personnel. In addition, the Project Lead supports the preparation and maintenance of the project scope, schedule, and budget. The Project Lead also participates in Technical Review and Approval Panel activities.

Facility Characterization Project Unit Leads - responsible for performing the technical assessment for assigned units, developing characterization approaches, following day-to-day unit characterization activities, and ensuring that the field work performed meets the requirements of the technical approach. Unit Leads are responsible for maintaining associated project schedules and also participate in the Technical Review and Approval Panel activities.

Facility Manager - in keeping with the Integrated Safety Management System (ISMS) principles, the Facility Manager is responsible for ensuring safe implementation of field collection of samples and physical measurements in their facilities.

Analytical and Process Chemistry (A&PC) Manager - responsible for the data that is produced and reported by the laboratory and will be responsible for initiating corrective actions within the laboratory.

Table 1-1

Summary of Dose Analysis for Groundwater Release Scenarios

Room	Long-Lived Curies Inventory (Ci)	Peak Annual Dose (mrem/yr)	Time of Peak Dose (year)	Controlling Radionuclides
Process Mechanical Cell	6.3E+02	53	7800	U-233, Np-237
General Purpose Cell	2.1E+03	452	4700	U-233, Np-237
Chemical Process Cell	6.0E+01	7	6700	U-233, U-234, Np-237
Extraction Cell 1	2.6E+02	27	6900	U-233
Extraction Cell 2	2.1E+02	22	6400	U-233
Liquid Waste Cell	1.2E+01	4	3900	Np-237
Off Gas Cell	3.3E-01	0.2	3900	Np-237
Hot Cells 1 - 5	2.3E+01	0.9	3100	Np-237

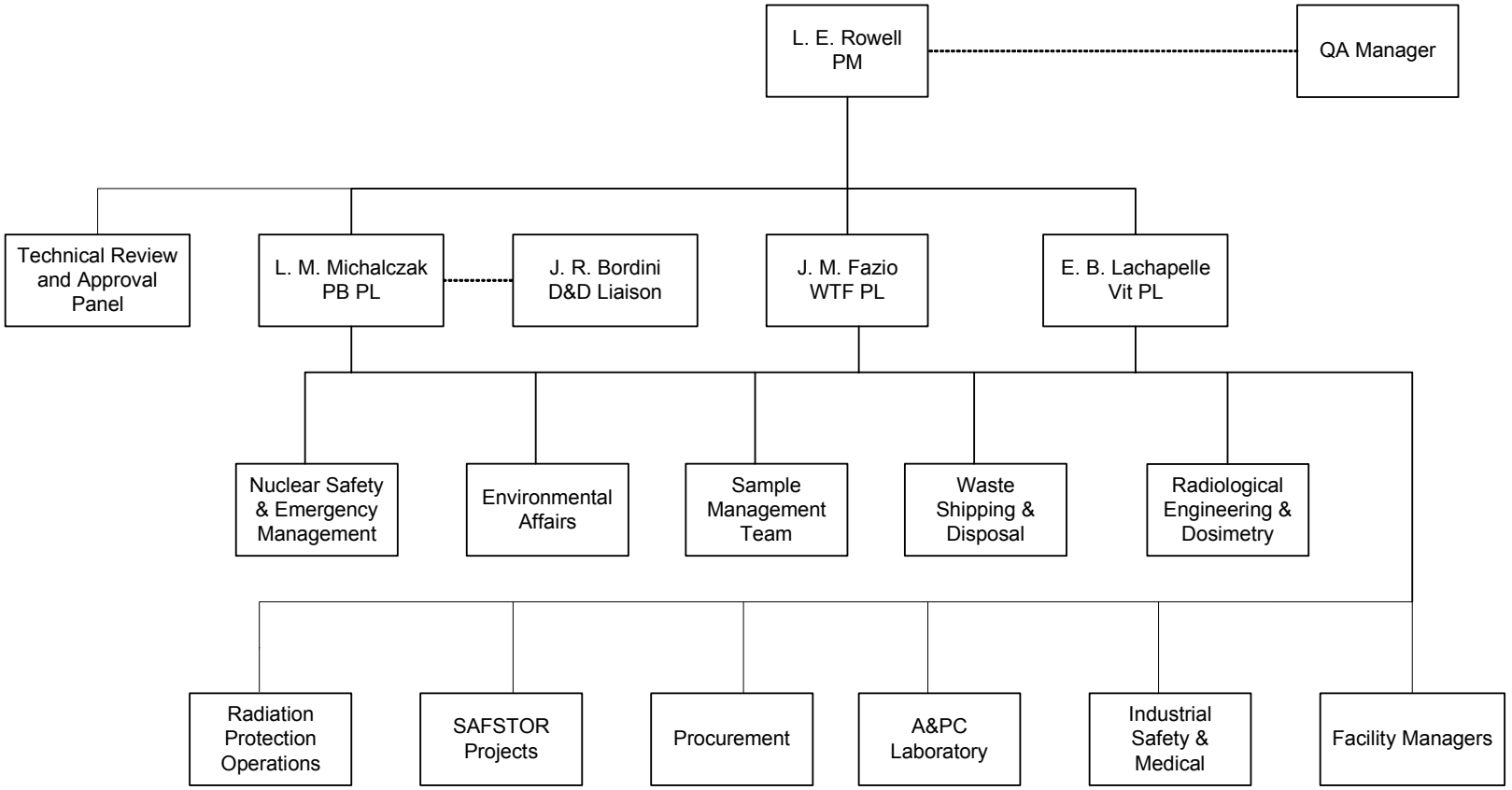
Table 1-2

Summary of Dose Analysis for Erosion Release Scenarios

Room	Long-Lived Curies Inventory (Ci)	Peak Annual Dose (mrem/yr)	Time of Peak Dose (year)	Controlling Radionuclide
Process Mechanical Cell	6.3E+02	12.7	2040	Pu-239, Pu-240
General Purpose Cell	2.1E+03	34.6	3370	Pu-239, Pu-240
Chemical Process Cell	6.0E+01	1.2	2040	Pu-239, Pu-240
Extraction Cell 1	2.6E+02	5.5	2040	Pu-239, Pu-240
Extraction Cell 2	2.1E+02	4.2	2040	Pu-239, Pu-240
Liquid Waste Cell	1.2E+01	0.13	2440	Pu-239, Pu-240, Am-241
Off Gas Cell	3.3E-01	0.06	2040	Pu-239, Pu-240
Hot Cells 1 - 5	2.3E+01	1.2	2040	Pu-239, Pu-240
Sample Storage Cell	4.9E+01	0.6	2040	Pu-239, Pu-240

Figure 1

Facility Characterization Project



Sample Management Team - responsible for conducting data validation per this CMP.

Decontamination and Decommissioning (D&D) Liaison - responsible for coordinating D&D Engineering support for field activities as determined to be required by the Facility Characterization Project Unit Lead and the Technical Review and Approval Panel.

Quality Assurance (QA) Department - The QA Department, under the direction of the QA Manager, is involved and interacts with all WVDP projects (see Figure 1) including this characterization project. Initial involvement by the QA Department is in the project's planning phase where, in accordance with the grading process in QM-2, determinations are jointly made as to the extent of involvement of the QA Department. Prior to any actual work, QA reviews implementing documents, including this CMP, for inclusion of appropriate and adequate QA Department activities. As the project progresses, QA and Project Planning regularly assess the extent and focus of involvement by QA oversight to assure its beneficial impact on the project and confirm compliance with WVDP-200, "West Valley Demonstration Project (WVDP) Waste Acceptance Manual."

Additionally, the QA Department reviews work documents to determine the adequacy of the identified surveillance and inspection requirements. This is in addition to the independent oversight program developed by QA as described in Section 4.1 of this CMP.

Technical Review and Approval Panel - reviews the technical approaches for each of the units and provides feedback on whether or not additional data must be collected to support a conservatively bounded curie estimate that can be technically defended to the NRC and the DOE.

1.4 Project Description

Quantify through sampling, process knowledge, or bounding assumptions specific radionuclides that remain in select portions of the Waste Tank Farm, Vitrification Facility, and Process Building. The process for quantification must be technically sound, approved by the Technical Review and Approval Panel, and support the preparation of a performance assessment by providing data in the form necessary. In general, the MARSSIM is used as the underlying guidance for this characterization program. More specifically, Sections 4.8.4, 5.3, 6.0, and Appendix E are used in accordance with NRC correspondence.

- The isotopes that will be assessed under this project are I-129, C-14, Tc-99, U-232, U-233, U-234, U-235, U-238, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-243, and Cm-244. In addition, Cs-137 and Sr-90 will be assessed.
- Other isotopes that may be assessed are Eu-154 and Co-60.

Pursuant to the Project Implementation Plan, activities specifically included in this project include:

- Planning for and initiation of cell entries, as necessary, either remotely or manned to collect information in support of this project.
- Packaging, characterization, and/or removal of materials used to support characterization efforts, such as sampling tools, suit-up waste, etc.
- Safety evaluations, criticality assessments, inventory modeling efforts and inventory reporting.
- Technology development, purchase and deployment of characterization equipment, e.g., radiation detectors, video cameras, remote tooling.
- Data validation, equipment calibrations, and sample analysis.

Characterization activities that are not included as part of this project include:

- Resource Conservation and Recovery Act (RCRA) characterization or facility investigations sampling.
- Agency (e.g., EPA, NRC, NYSDEC, NYSERDA, DOE) approval of scope and methodology to be deployed.
- Performance assessment modeling of generated data.
- Final closure surveys/confirmations (Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)) for License Termination Rule.

1.5 Data Quality Objectives (DQOs) for Data Collection

The data quality objectives are provided in Appendix A of this document.

1.6 Training Requirements or Certifications

In accordance with WV-538, "Employee Indoctrination and Training," personnel are trained to the correct work methods and controls to assure safe performance and quality of work. Implementing documents containing the policies and principles that guide the training for these work activities include WVDP-002, "Quality Management Manual," WVDP-111, "Quality Assurance Program," WVDP-126, "Performance-Based Training Manual," WVDP-010, "Radiological Controls Manual," WVDP-011, "Industrial Hygiene and Safety Manual," and WVDP-099, "Environmental Compliance Manual."

Personnel who are performing dose-to-curie modeling to calculate inventories are trained in the use of the computer software and the principles of modeling source terms.

Laboratory personnel are qualified to perform the analytical procedures described in this CMP. After qualification, continued proficiency on a method is demonstrated through the analysis of a quality control sample within the range specified for that method. See WVDP-123, "Laboratory Quality Assurance Program Manual," Section PRD 3.0, Training and Qualification, for additional information.

1.7 Health and Safety

All work at the WVDP is conducted in accordance with the principles of ISMS and WVDP-241, "Site Specific Health and Safety Plan (HASP)".

Worker safety will be included in written work instructions, such as Work Orders and Standard Operating Procedures (SOPs) or addressed in Industrial Work Permits (IWPs) and Radiological Work Permits (RWPs). These permits describe the worker protection measures that should be taken during Facility Characterization Project activities. A work originator, group supervisor, and/or review group is assigned by the cognizant manager to perform a hazards analysis and to prepare and plan work instructions in accordance with WV-921, "Hazards Identification and Analysis." These instructions and activities are subject to radiation exposure reduction methods that are specified in WVDP-163, "ALARA Program Manual," in accordance with 10 CFR 835.

1.8 Documentation and Records

Each unit characterized pursuant to this plan will have a report prepared to include information as summarized in Section 2.4.

In addition, the following records and information may be generated if data collection is conducted to support this project:

- field logbook(s),
- survey data sheets,
- analytical request (chain-of-custody) forms,
- report of analyses,
- data packages,
- videos/pictures.

The following records, as generated per this Characterization Management Plan, will be maintained in accordance with WVDP-262, "WVNSCO Manual for Records Management and Storage":

- report of analyses,
- validated data packages,
- data assessment reports,
- MicroShield™ computer modeling results,
- decay correction calculations,
- videos/pictures,
- technical approach and review panel sign-off,
- data summary reports,
- this Characterization Management Plan,
- any work permits or documents,
- instrument calibration records,
- field logbook(s), and
- survey data sheets.

2.0 Characterization Methodology

As discussed in Section 1.1, there are three main facilities under investigation. In some cases, to simplify the characterization approaches for these facilities, they have been further subdivided into more manageable units (i.e., vessel, cell, or tank). The standardized characterization methodology described in this plan has been developed to apply to each unit to maximize the completeness, accuracy, and consistency of the investigations. This methodology is composed of standardized, recognizable elements, covering the entire investigation from planning through implementation to assessment.

2.1 Rationale for Characterization Process

The core process for establishing a radiological inventory for a particular unit is to use field measurement collection techniques (usually dose rate measurements and/or samples) to quantify the presence of a key dose emitting radioisotope (usually Cs-137) that can serve as a scaling radioisotope. Industry standard computer models will be run to transform the dose rate information into the curies present for the scaling radioisotope. Through the use of the scaling radioisotope and ratios of radionuclides to that scaling radioisotope, a source term will be calculated. The scaling ratios may be based on samples taken from a unit, process knowledge (e.g., ORIGEN calculated radioisotope quantities for the different fuels processed on site), or other bounding assumptions.

Other factors that affect the modeling results are the location of the radioactivity being measured (e.g., internal or external to facility components), the distance between the radioactivity source and the measurement instrument, background radiation levels, and the effect of shielding on both the source and the instrument. The computer model will be conservatively constructed to ensure that the calculated value is higher than the real curie value.

The ability to conservatively bound the radioisotope inventory is crucial to the successful completion of the Facility Characterization Project. Resources, both manpower and non-labor funds, will require the project to proceed with techniques that will provide maximum return for the available funds. Where possible, the project is structured to conduct simple general area dose measurements, construct bounding estimates of the scaling isotope (usually Cs-137), and apply bounding scaling factors to yield the source term for a particular unit. Where possible, the current inventories presently being modeled in the performance assessment may be reaffirmed as bounding conservative values. Some areas being assessed may require more substantial effort to collect field survey information (e.g., Extraction Cell 2), while other units may require significant amounts of sampling to define the radioisotopic scaling factors.

Several techniques are used to ensure that the radioisotopic inventory for each of the units is conservative. These techniques include one or more of the following:

- Establishing conservative assumptions for those factors that affect the dose-to-curie model, including but not limited to:
  - Assume all the utilized dose rate is coming from the modeled source when there are known contributions coming from other sources in the area.
  - Assume all the dose is attributable to a single isotope (e.g., Cs-137) when there are multiple gamma emitting isotopes that the dose rate can be fractionated to.
  - Use the dose rate that results in the highest reference isotope concentration where multiple dose rates are available (at various heights, at various locations).
  - Use the highest dose rate where a range of dose rates are available for a specific location.
- Design and implement a biased physical sampling or dose rate measurement program that keys in on worse case contaminated areas within a unit.
- Use nonvalidatable historical data for a population (due to the absence of documentation needed to perform a Level 1 validation) when that data results in scaling factors higher than validatable data for that population.

In all instances, the consensus from the Technical Review and Approval Panel insures that a technically sound level of conservatism is achieved.

2.2 Investigation Levels

To guide the Facility Characterization Project Team in the deployment of limited resources to specific characterization activities in a unit, investigation levels have been established. Investigation levels are curie values of select key radioisotopes. The select key radioisotopes were identified in Section 1.2 as U-233 and Np-237 for intruder doses, and Pu-239/240 for erosion doses.

These investigation level values are intended to assist the Project Team in decision making. It is expected that for many units within the Process Building, the curie values for these key radioisotopes will be relatively low and thus have little to no impact on the long-term performance assessment results. The Project Team can thus make decisions on resource deployment based on this knowledge. If a unit that is being reviewed has simplified bounding assumptions made, and the resultant key radioisotope values are at or below the investigation levels, then these initial residual radionuclide inventory estimates can be used since their contribution to the overall performance assessment results will be minimal. These investigation levels provide a quantitative means of helping the Project Team implement the graded approach.

Investigation level values were derived from the dose values in Tables 1-1 and 1-2 along with the underlying curie values that were used in the performance assessment models. For the groundwater release scenario, the underlying curie values were mathematically aged to the general time of the peak dose and a simplified regression performed to help quantify the investigation levels. One unique item identified during these steps was the need to add Am-241 to the list of controlling radionuclides for the groundwater release scenarios. This is due to the relative amounts of Am-241 and Np-237 currently in place and the decay of Am-241 to yield additional amounts of Np-237. For the groundwater release scenario, the investigation levels are:

Am-241	2 Ci
Np-237	0.001 Ci
U-233	0.01 Ci

If a unit that is being reviewed had each of these radionuclides at exactly these curie levels, the simplified regression predicts that a dose rate would be approximately 4 - 5 mrem/year (or about 1% of the desired 500 mrem/year limit). Actual performance assessment analyses are required to establish the true values. However, the values noted above do provide guidance to the Facility Characterization Project Team to conduct a graded approach for this characterization effort.

Although similar, the regression conducted on the erosion release results was focused on the specific peak at 2040 years. The performance assessment model indicates that erosion will yield discrete peaks of dose separated by many years of essentially zero dose rates. At the 2040 year mark, erosion of numerous cells will occur simultaneously and yield the highest combined value (discounting the single value of 34.6 mrem/year at the 3370 year mark for the non-decontaminated General Purpose Cell per Table 1-2) for the Process Building. Regression on those cells and their underlying Pu-239/240 values yields an investigation level of 0.37 Ci.

Again, similar to above, if an area that is being reviewed had Pu-239/240 curie content at exactly the investigation level, the simplified regression predicts that a dose rate would be approximately 0.24 mrem/year (or about 1% of the desired 25 mrem/year limit). Actual performance assessment analyses are required to establish the true value. However, the value noted above does provide guidance to the Facility Characterization Project Team to conduct a graded approach for this characterization effort.

2.3 Methodology for Characterization Process

The general process to evaluate the units and to generate conservatively bounded curie estimates involves the following steps:

- Collection and evaluation of existing information and data on the unit and preparation of a draft technical approach by the unit lead.

- Review of the existing and draft technical approach by the Technical Review and Approval Panel with a recommendation for the path forward.

- Implementation of the technical approach. The technical approach may require additional data collection or proceed directly to modeling the unit source term using historic knowledge.

- Final review and concurrence of the unit technical approach, unit source term determination, and supporting documentation by the Technical Review and Approval Panel.

Note: At any time during this process the Unit Lead or Project Manager may reconvene the Technical Review and Approval Panel to assess newly gathered/identified information and modify the technical approach as appropriate.

2.3.1 Collection/Evaluation of Existing Data

The first step in the characterization process is to locate, collect, and assess available information about the various units. Since spent fuel reprocessing operations ceased in 1972, information about unit conditions have been documented in numerous sources. The quality of this information in these sources varies from document to document, unit to unit, and ranges from hypothetical estimates to quantifiable data. Earlier source term estimates in support of the DEIS were based largely on this existing unit information. Since preparation of the DEIS, additional verifiable survey and isotopic distribution data has been generated for several of the units in the Process Building, Waste Tank Farm, and Vitrification Facility as a result of ongoing operations, flushing, and decontamination. By collecting and assessing both the historical and newly generated data, a decision can be made as to whether sufficient verifiable data exists to generate conservatively bounded curie estimates or if additional data needs to be collected.

A. Information Collection

The Unit Lead will collect available information on a unit. Examples of information sources that will be located and collected include, but are not limited to:

- General and specific reports on the facilities and units.
- Specific source data (e.g., surveys, on-site and off-site laboratory data).
- Waste characterization data.
- Videos/pictures.
- Drawings.
- Personnel interviews.

These sources have the potential to contain information that may directly or indirectly impact the generation of the curie estimate for a unit. The three primary areas of information include: a) unit usage, b) radiological conditions, and c) unit accessibility.

The quality and quantity of available information will vary from unit to unit depending on several factors including the projected curies remaining in the unit and unit accessibility. The amount of available verifiable data on units with limited accessibility is generally low due to high dose rates, high airborne contamination areas, and inability of physical access, etc.

B. Information Evaluation

The collected information will be assessed by the Unit Lead and a preliminary determination made as to whether sufficient verifiable data exists to generate a conservatively bounded curie estimate or if additional data needs to be generated. In most cases, verifiable data means that samples or surveys can be validated. It is the intent of the project to have all data validated regardless of the vintage. However, there may be instances where validation is not possible but the data is still considered critical and usable for project purposes. This decision will be made based on the recommendation from the Technical Review and Approval Panel. The assessment process will review the following information.

1. Unit Usage Information

- Historic use of the unit.
- Process flow of activities which occurred/occur in unit.
- Major curie-contributing equipment/entities (e.g., floor debris) in unit.
- Current use or expected future use of the unit.

2. Radiological Conditions Information

- What is/are the expected radionuclide distribution(s) associated with the unit.
- Are gamma-signature isotopes present (e.g. Cs-137).
- Are there multiple radiological distributions in the unit, and if so, where are they located in the unit.
- Are significant amounts of isotopes expected to be present.
- What activities may have impacted the radiological conditions of the unit.
- Past decontamination events.
- Radioactivity entrapment points or records of system plugging (e.g., pipe loops).
- Spills in the unit.
- What field measurement or sampling data exists, and can it be verified.

3. Unit Accessibility Information

- What radiological and safety issues limit access into the unit.
- What physical barriers exist that prevent or limit access.

Based on the above evaluation of existing data, the Unit Lead will draft a technical approach for the path forward. The draft technical approach may recommend additional data collection or proceed directly to calculating an inventory or dose-to-curie modeling using verifiable data already available.

2.3.2 Review of Draft Technical Approach by Technical Review and Approval Panel

The Unit Lead will present a summary of the existing information and the recommended path forward to the panel for consideration. One of three generalized conclusions will be reached by the panel for the unit. The general conclusions and examples of the rationale behind the conclusions are as follows:

Conclusion A: The current curie estimate is determined to be conservatively bounded based on an evaluation of existing data.

Examples of bases for Conclusion A include one or more of the following:

- Historical and current unit usage is known.
- The current radionuclide estimate is based on verifiable data.
- Only one bounding radiological distribution is associated with the unit.
- Significant radionuclides above the investigative levels are not expected to be present.

Conclusion B: Sufficient verifiable data exists which facilitates the modeling of the unit and generation of a conservatively bounded curie estimate.

Examples of bases for Conclusion B include one or more of the following:

- Historical and current unit usage is known.
- The radioisotopic distribution of the unit is known based on verifiable data or a conservative radioisotopic distribution can be developed based on verifiable process knowledge.
- Physical conditions of the cell are known.
- The isotopic distribution in the unit includes the presence of measurable gamma emitters.
- Verifiable field measurement (dose rate surveys) data exists.
- The unit can be modeled to conservatively bound the expected curie inventory.

Conclusion C: Additional data collection is warranted to generate a conservatively bounded radionuclide inventory.

Examples of bases for Conclusion C include one or more of the following:

- Unit entities (e.g., floor, tanks, piping) are expected to contain significant radionuclides (as defined by the investigative levels) that may have not been captured by the initial curie estimate. The curie contribution of these entities needs to be further identified.

- Assumed physical conditions need to be confirmed (via remote cameras, liquid level determination in vessels, etc.). Unit configuration and geometry are critical to the modeling efforts being conducted to support radiological inventory development.
- Unit conditions have changed since the current curie estimate was generated. New data points need to be generated.
- There are multiple radioisotopic distributions associated with a unit that may make dose-to-curie modeling more difficult.
- Gamma emitting signature isotopes are not present.
- Unit usage information, such as processing history, spill history, or past decontamination events, is unclear.

2.3.3 Implementation of Technical Approach

A. Additional Data Collection

For units where a determination is made to collect additional data, the technical approach will include the rationale for the data collection activities and details of the specific data collection. Data collection planning, or the determination of what, where and how data will be retrieved is an integrative and progressive process. The process is dictated, in part, by the purpose of the project (e.g., generate conservatively bounded curie estimates). As a result, the Unit Lead will design a biased sampling program to ideally collect the most conservative ratios for the radionuclides of concern. The sampling program will take into consideration: data type and sources, available technologies, and unit access constraints. Data collection will be conducted pursuant to written work instructions as appropriate.

Data types that can be used to generate and support conservatively bounded curie estimates exists in multiple forms and include:

- Video/pictures of cell conditions.
- Physical conditions (e.g., component layout, vessel composition, liquid levels in vessels, pipes, etc.).
- Field measurements (e.g., radiation dose rates, contamination levels).
- Sample data (e.g., samples of pipe, liquids, floor debris).

The type of additional (new) data to be generated for each of the units is dependent on the outcome of the assessment process, unit conditions and complexity, expected isotopes, etc.

A description of technologies to be used to gather additional data presented in Section 2.3.5.

For units in which additional data gathering is identified as being warranted, an important factor in determining how and to what extent additional data is to be collected is the unit access. Unit access issues that will be evaluated include:

- Airborne radiation levels
- Contamination levels
- Dose levels
- ALARA
- Physical conditions of the cell
- Platform/ladder stability
- Access points
- Pipe and vessel configurations

Based on an assessment of access issues, it will be determined if data will be gathered remotely and/or if manned cell entries will occur.

B. Data Analysis

The data analysis process will be led by the Unit Lead and supported by the Data Modeler and the expertise of the Technical Review and Approval Panel. Although other methods may be used, Appendix B summarizes the standardized approaches for inventory development.

As described in Section 2.1, the core process for quantifying the source term for a unit is dose-to-curie modeling similar to the technique for establishing a waste container radioisotopic inventory. For waste packages, the dose-to-curie technique can provide a radioisotope inventory that is comparable to results from direct sampling. This will be true for homogeneous wastes within a waste container and dose rate measurements that are both consistent (from all sides of the waste package) and fully attributed to the waste within the container.

The factors that enable radioisotopic inventories to be established for waste containers are not always available in the units and areas that will be characterized: measured dose rates in an area can be very heterogeneous, the result of numerous sources (e.g., pipes, tanks, floor debris). Yet the same dose-to-curie technique can provide valid bounding estimates of the source term in a unit by establishing conservative assumptions for those factors that affect the model, including the scaling factors or radioisotopic distribution selected for the unit.

This technique has been used extensively in the establishment of radioisotopic bounding inventories to support site-wide Safety Analysis Reports. For the Facility Characterization Project, the effort to develop bounding inventories will be matched against available resources, the relative impact of the bounded inventories in an area to the Performance Assessment modeling results, the potential radiation exposure to personnel, and whether alternate techniques can be used to develop radioisotopic inventories for the area or unit.

For example, a statistically based sampling and analysis program was developed and deployed for establishing the radioisotopic inventory in

HLW Tanks 8D-1 and 8D-2. The multi-million dollar, multi-year effort for this one area has established one of the most important source terms for the performance assessment models. The effort to establish this inventory was matched to the significance/impact in the performance assessment. This graded-approach helps ensure that the available WVDP resources are applied to those areas and radioisotopic inventories (source terms) that are important to the performance assessment.

As each area or unit is being assessed, simplified bounding assumptions may initially be used at the beginning to establish new estimates of the radioisotope inventories. If the results of these initial efforts corroborate the fact that the existing radioisotope inventories are valid, then the work may be concluded (see Section 2.1 for further discussion). Another conclusion could be that additional data is needed (samples for analyses to confirm the scaling factors, or updated dose rate measurements at key areas), or that more representative assumptions need to be made in the dose-to-curie modeling. Some areas may require alternate techniques, such as sampling of pipes or tanks to directly establish the radioisotope presence per amount of surface area sampled, or volumetric samples to establish the inventory for filters, liquids, or other material.

C. Calculated Inventories

Dose-to-curie computer modeling is the main process that will be used for units to translate the field information (dose rate) into a radiological inventory for the key radioisotope (usually Cs-137). When multiplied by appropriate scaling factors, the radiological inventory for all the desired radioisotopes (Section 1.4) can be established. The development of scaling factors and dose-to-curie modeling are described further in Appendix B. The basis for the generation of scaling factors are decided as part of the Technical Review and Approval Panel process and is determined on a unit-by-unit basis.

To ensure a conservative estimate, the Unit Lead will work with the Technical Review and Approval Panel to establish the assumptions and calculations. The goal in establishing these assumptions and their application is to control how conservatism is applied to the calculated inventories.

For example, some areas in the Process Building had grout poured on top of the contaminated floors to provide shielding to workers during the fuel reprocessing years. The amount of grout may be over-estimated to ensure that the calculated dose-to-curie Cs-137 value is higher than it is likely to be in the specific area. This could be multiplied by scaling factors that are derived from specific field samples. The laboratory data can be averaged to provide typical values, or worse-case values selected depending on the particular case.

Dose-to-curie calculations in some areas may be biased by applying all the dose measured in the field to specific locations or pieces of equipment in an area. Although dose rates in the field will integrate the actual photon flux from all the sources in the area, the decision to assign the dose to a particular item provides substantial conservatism in establishing the inventory for that area.

Selection of the scaling factors may be one of the main choices in ensuring that the results will be conservatively bounding. In some areas, a choice may be made to apply analytical results from field samples to particular portions of a cell. For example, samples from pump niches within the Process Building may provide conservative scaling factors. The fact that the scaling factors will be applied to a particular calculation may be the main choice to ensure that conservative inventory levels are established. These results may be averaged, or the highest ratios to Cs-137 selected as the scaling factor for that calculation.

As noted above, these assumptions and the degree of conservatism in the calculations will be worked together between the Unit Lead and the Technical Review and Approval Panel.

2.3.4 Technical Review and Approval Panel Final Review and Concurrence

The Technical Review and Approval Panel will review the final documentation package prepared for each unit and indicate their concurrence with the technical approach, data collection process (if applicable), and that the source term represents a conservatively bounded estimate for the unit. The Technical Review and Approval Panel can, at any time during this process, request additional information or ask for modifications to the technical approach before concurring that the radioisotope inventory for that unit is ready for release.

2.3.5 Technologies

Technical approaches are developed on a unit specific basis and will reflect, as necessary, the need to collect additional data, required detection levels, and what technology is most appropriate for collection of that data. Because technical approaches have yet to be developed for many of the units, technologies to be deployed have not been firmly established. Following is a general description of data gathering techniques that may be deployed during the lifetime of this project. It should be noted that this is not an inclusive list.

A. Field Measurements

The primary data mechanism for the determination of curie estimates is radiation surveys or dose rate measurements. The dose rate measurements are converted to curies using computer models and radionuclide distribution(s) associated with a particular unit or component of a unit. Survey instrumentation used will vary depending upon unit complexity, identified data requirements, unit/vessel access, background radiation levels, availability of key radioisotopic signatures, etc.

Naturally occurring radioactive materials (NORM) are not an issue with the selection of radiation detectors because this project is generally looking at man-made materials at levels much higher than would typically be found in the environment due to fall-out. Data collection from air, water, and soils have shown that most radionuclides are present at or below E-10 FCi/ml in groundwater and E-12 FCi/gr for solids and, therefore, have no appreciable impact on the inventories of these facilities.

1. Scaler/Ratemeter Geiger-Mueller Detector System

   This system consists of a Geiger-Mueller (GM) detector (which may or may not be inserted into shielding and/or a cylindrical collimator) with a 5/8" opening at the detector window. The detector is attached to a scaler/ratemeter by a coaxial cable. The collimated gamma detector system will be used to take contact dose readings on vessels and equipment in units. Sensitivity of this system ranges from approximately 1 mR/hr to 1000 R/hr.

2. Single Channel Analyzer (SCA) System

   The SCA system consists of a low energy gamma scintillation detector inserted into a cylindrical shield. The scintillator is 1" diameter x 1 mm thick sodium iodide. The detector is attached to a scaler/ratemeter by a coaxial cable. The system is optimized to detect Am-241 (photon energy of 59.5 keV) by discriminating photon energies below 49 keV and above 69 keV. This discrimination is accomplished by setting a threshold with a window on either side of the threshold. An example of this would be a threshold setting of 49 keV with a window of 20 keV will detect only photons with energies from 49 keV to 69 keV. The sensitivity of the detector is approximately 5 FCi per 50 cpm cesium-137 background.

3. Gamma Camera - AIL and British Nuclear Fuels Limited (BNFL) Instruments RadScan™ 700

   The AIL Systems, Inc. GammaCam M31 (gamma camera) is an imaging system that provides two-dimensional spatial mapping of gamma ray emitting nuclides in real time. The electronics have been repackaged with a radiation shield and laser range finder (for distance measuring and target spotting) added, and the software program modified to the site requirements. The gamma camera provides a closed circuit television (CCTV) image with an overlay of graduated colors representative of the target's gamma radiation levels. The associated software provides the laser range finder distances to target and the amount of gamma curies per 100 square centimeters. The gamma camera has a field of view of 26.7 degrees. This results in a nominal 2.9-foot square image area at the minimum six-foot range and a nominal 19-foot square image at a 40-foot range.

   The system consists of a sensor head, control box, operator control panel and interconnecting cables. The head enclosure is constructed of stainless steel and is shielded to withstand an integrated gamma exposure of 10^7 Rads. The sensor head is 28 inches long by 11.5 inches high by 18.25 inches wide. The detector head and tungsten shielding weighs 650 pounds. The control box is located outside the radiation field and the operator control panel is located in a personnel access area.

The gamma camera collectively measures the sum of all gamma emitting radionuclides present in the field of view's surface and can be used to characterize unit surfaces and vessels. The primary purpose of the gamma camera is to detect localized accumulation of radioactivity in a unit. Significant fluctuations in the measured results will be an indication of relative heterogeneity of waste distribution in the unit.

The uncertainty in activity derived from the gamma camera measurements based on a field of view of 73 x 58E video camera or 27.5E gamma will be developed and reported as part of the calculation package for data reduction.

The second Gamma Camera Radiation Detector (gamma camera) is based on BNFL Instruments RadScan™ 700 Gamma Scanner. The RadScan™ 700 remotely locates and characterizes gamma hot spots in a wide variety of environments including building surfaces, cells, in or on glove boxes and process vessels. It shows the origin of measured radiation using radiometric data and real-time color video images.

The inspection head can be mounted on many platforms including a fixed or mobile stand, crane, or tripod. Deployment is achieved manually or remotely depending on the application. The system uses a detachable detector head which is optimized for both plutonium and fission product gamma energies. This is achieved by the use of tungsten shielding.

The RadScan™ 700 is operated from a remote, safe location using a PC-based workstation. On-screen information is presented via software which includes a high definition color video picture of the area being surveyed. A circle, which represents the field of view (FOV) of the detector is overlaid onto the video picture using color graphics software. The system is controlled using the keyboard's rollerball and cursor keys. Communication between the workstation and the inspection head is via a single cable. Electrical power is supplied by a second cable.

Performance specifications provided by BNFL are as follows:

Detection limits:	<1 FCi for Cs-137 in FOV at 1 meter
	<50mg for Pu (approx 20% Pu^{240})in FOV at 1 meter
	<1g for U-235 in FOV at 1 meter
Detection range:	1 - 50 meters
Angle of view:	9E, 4E, and 2E
Dynamic range:	<1 FCi to 0.2 Ci for Cs-137 in FOV at 1 meter

Remote operation: Up to 40 meters from inspection head with option of longer cable lengths

Operating range: 0-1 Gray/hr

4. Multi-Channel Analyzer/In Situ Object Counting System

A Multi-Channel Analyzer Gamma Spectropic System (MCA) is made up of a number of electronic components which basically consist of a detector, preamp, amplifier, and multi-channel analyzer. This system of components allows for gamma detection, gamma isotope identification and, depending on system calibration, the quantification of gamma isotopes.

MCA systems can be configured with many different types of detectors, some of which may require cooling for operation. The detector energy and efficiency calibrations and the geometry in which these calibrations were performed determines the MCA's ability to quantify certain gamma isotopes. The type of detector used also determines the applicable use of the system (in cell, high background etc.)

The In Situ Object Counting System (ISOCS) is a trade name for Canberra's portable MCA which has a characterized detector and special software that can model certain types of geometries for the purpose of quantifying gamma activities contained in the chosen geometries (boxes, cylinders, vessels, etc.). With certain modifications(shielding, collimation, type of detector) the ISOCS System can be used in high radiation areas with generally good results.

Sensitivity for the ISOCS MCA is dependent upon the type of detector to be used with the MCA. Canberra has a large selection of detectors for use with ISOCS, so the sensitivity would be determined at the time of detector selection.

B. Visual Techniques

Visual techniques will be employed in the units, as necessary, to aid in the characterization efforts. The unit configuration/geometries and spacial distribution of residual waste will be accomplished using a variation of approaches.

Some of the units contain functional shielded windows that allow for the direct visual inspection of the unit. For other units, visual documentation can be ascertained either remotely (using boroscope, Kazoom video camera, etc.) or via a manned entry (use of digital camera, video, etc.).

C. Physical Conditions

Physical conditions, including component layout and current unit conditions, can be assessed with video as described above. Vessel and piping composition can be determined through drawings.

In non-operational units, the presence of liquid in vessels and/or piping can be assessed by various methods depending on vessel specifics, accessibility, etc. Potential methods include use of existing vessel liquid level measurement devices (if operational), tell-taling, visual observation, and ultrasonics.

D. Physical Sampling

Physical sampling may be accomplished using a number of techniques depending on the medium to be characterized and will be detailed in the technical approach as appropriate. The purpose of this project is to generate bounding curie estimates for the units. As a result, the physical sampling program will be designed such that it is purposely biased to provide the most conservative samples.

The radionuclide composition of contamination is a critical factor in determining curie estimates for a unit. For units, or components of units, for which a radionuclide distribution can not be assumed, actual physical samples will be collected and analyzed for the necessary isotopes. Examples of matrices which may be sampled include process piping, floor debris, vessel/pipe liquids. For solid matrices, actual portions of the item may be retrieved (e.g., piece of pipe) and/or wipes of the surfaces of the items will be collected.

2.4 Characterization Documentation

A final report will be prepared in accordance with WVDP-257, "WVNS Manual for the Preparation, Review, Approval, Distribution, and Revision of Controlled Documents," to document the implementation of this project. The main body of the report will contain a synopsis for each of the investigated areas/units which discuss:

- description of the area/unit,
- previously available historical data,
- the technical approach and/or data gathering process that was implemented,
- the data analysis technique that was utilized,
- the conservatively bounded curie estimate, and

Supporting documentation will be presented in area/unit specific appendices to the main body of the report. The supporting documentation will include more detailed discussions of the information summarized in the main body of the report along with, where applicable, supporting data including, but not limited to:

- analytical data/validation summary,
- survey sheets,
- modeling calculations and assumptions,
- scaling factors,
- pictures/drawings,
- employee interviews, if applicable,
- listing of work documents,
- reference list, and
- Technical Review and Approval Panel’s Consensus Statement (See Section 4.2).

If, during the course of the project, interim reports are required to support WVNSCO Regulatory Program and/or other site activities, such reports will be prepared.

3.0 Quality Assurance Project Requirements

There are three phases of data collection and assessment for the Facility Characterization Project that are the subject of these quality assurance project requirements: dose measurements; dose-to-curie modeling; and scaling factor determinations through physical sampling. This section is applicable only to data collected since the issuance of this CMP and is not applicable to historical data that may be used as part of this project to develop the conservatively bounded estimates.

3.1 Quality Assurance Objectives for Dose Measurements

3.1.1 Precision

Precision will be assessed by the collection and analysis of duplicate measurements and performance checks. In general, duplicate field measurements will be collected every 20 measurements. However, this is dependent on ALARA considerations, the tooling used, and the method of deployment used for data collection. For example, it will be impossible to collect a duplicate measurement using a general area probe suspended in a unit since the data collector cannot be assured of the same geometry for both measurements. The Unit Lead will make a determination as to the appropriateness of duplicate field measurements and document this as part of the technical approach. The anticipated performance checks and associated objectives are presented in Table 3-1 along with collection, frequencies, and corrective actions.

3.1.2 Accuracy

The achievement of accurate data in the field will be addressed through the calibration and maintenance of field instruments. Calibration and maintenance objectives for field measurement instruments are summarized in Table 3-1.

Accuracy for field measurements can be calculated as:

$$\%D = (A-B/A) \times 100$$

where,

A = true value
B = measured value
D = % percent difference

3.1.3 Completeness

The objective for field measurement completeness is 100 percent. This may not always be the case. The acceptability of less than 100 percent complete data will be reviewed on a case by case basis based on the objectives outlined in a unit's technical approach.

Table 3-1

Quality Control and Control Limits for Field Measurements

Instrument	Initial Calibration	Calibration Frequency	Performance (Source) Check	Performance Check Frequency	Acceptance Criteria	Corrective Action	Performance (Source) Recheck Frequency	Acceptance Criteria	Corrective Action
Collimated Gamma Detector	Calibrated by using NIST traceable standards	Every six months	Check designated source check in survey area	Daily when in use	± 20%	Repair/replace as required	Daily when in use (after measurements have been collected)	± 20% or evaluate additional data within data set	Repair/ replace as required and retake measurements from affected data set
Single Channel Analyzer	Calibrated by using NIST traceable standards	Every six months	Check designated source check in survey area	Daily when in use	± 20%	Repair/replace as required	Daily when in use (after measurements have been collected)	± 20% or evaluate additional data within data set	Repair/ replace as required and retake measurements from affected data set
General Area Probe 1 mR/hr - 1000 R/hr	Calibrated by using NIST traceable standards	Probe to be replaced if unit fails. No ongoing check frequency proposed due to the inability to check a specific known contaminated spot in a unit. Because of contamination, removal for calibration is not proposed. Readout instrument is calibrated at 6-month intervals.							
Gamma Camera/ RadScan™	Calibrated by using NIST traceable standards	Every year	Check designated source image in unit or use cesium confirmation source at time of removal	Daily when in use or reverify with cesium confirmation source at time of removal	± 20%	Software adjustment	Daily when in use (after measurements have been collected) or reverified	± 20%	Recalibrate
Multi Channel Analyzer	Calibrated by using NIST traceable standards	Every year	Check designated source check in survey area	Daily when in use	± 20%	Software adjustment	Daily when in use (after measurements have been collected) or reverified	± 20%	Recalibrate

3.1.4 Representativeness

Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program. The sampling scheme to be developed in a unit's technical approach will be designed to provide data that conservatively bounds a unit's conditions. During development of the technical approach, consideration will be given to historical processes, existing analytical data, and physical setting and processes. The rationale of the sampling design will be outlined in the technical approach. Representativeness will be satisfied by ensuring that this technical approach is followed.

3.1.5 Comparability

For this project, comparability will be maximized by the use of approved WVNSCO procedures, the recording of data in a validated format, the use of standardized field methods, and the reporting of data in appropriate, consistent units.

3.1.6 Instrument and Equipment Testing, Maintenance, and Calibration Requirements

Inspection, maintenance, and calibration must be performed, as needed, for field instruments and equipment. Any field instruments and equipment used in performing this work effort should be inspected and maintained in accordance with WVDP-318, "Radiological Instrumentation, Calibration and Maintenance Program Manual." Radiological Control Instrument Operation and Calibration procedures (RCIOCs) are contained in WVDP-131, and contain specific testing, inspection, maintenance, and calibration procedures for different field instruments and equipment. The RCIOCs will be used in conjunction with WVDP-318. Table 3-1 summarizes calibration requirements for field equipment. Preventative maintenance will be conducted per the manufacturer's specifications.

3.1.7 Preventative Maintenance Calibration Procedures and Corrective Actions

Preventative maintenance and corrective actions for field equipment are summarized in Table 3-1.

3.1.8 Data Management

Once field measurements are obtained, they will be managed and controlled in accordance with the applicable written work instructions. This will ensure data traceability is maintained. A data package containing appropriate data management documentation will be produced and delivered to the Project Unit Lead and the Data Validator, as appropriate.

Once the data package is received, the data will then be assessed for usability by WVNSCO or subcontractor personnel.

3.2 Quality Assurance Objectives for Dose-to-Curie Modeling

Dose-to-curie modeling is used to convert dose measurements to curies of key radioisotopes as defined in the Data Quality Objectives provided as Appendix A.

3.2.1 MicroShield™ Model Verification and Validation

The Verification and Validation Report for the MicroShield™ modeling program is maintained in the Facility Characterization Project File.

3.2.2 Peer Review of Calculations

All MicroShield™ modeling calculations will be peer reviewed by an independent reviewer and signed off. This peer review serves to ensure that the modeler uses appropriate assumptions and that calculations are performed correctly.

3.2.3 Training

All personnel performing MicroShield™ modeling in support of this project will have been trained on the use of this software. This will provide consistency between modelers and results.

3.3 Scaling Factor Determinations Through Physical Sampling

Scaling factors can be established using historical information or by collecting samples that represent bounding conditions in the field. This section discusses the quality assurance process for samples collected under this project.

3.3.1 Field Custody Procedures

The sample collector (operator) will be responsible for the care and custody of the samples once collected until they are transferred or dispatched properly to the laboratory or an interim staging facility.

The Project Manager or Project Lead will review field activities to determine whether proper custody procedures are followed during the fieldwork and decide if additional samples are required.

3.3.2 Sampling Documentation

As appropriate, data sheets will provide the means of recording the data collection activities performed. As such, entries will be described in detail so that persons can later reconstruct a particular situation without reliance on memory. Data sheets will be appendices to formal work instructions making retrieval from the Master Records Center possible.

Samples collected with a description of their location will be recorded. The equipment used to collect samples will be noted, along with the time of sampling, sample description, volume, and number of containers.

All entries will be recorded in black ink and signed and dated by the person making the entry. No erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, the correct entry recorded, and the change initialed and dated by the person making the correction. If the reason for the change is not self-evident, a note shall be made of the reason for the change.

3.3.3 Transfer of Custody and Shipment Procedures

Samples will be accompanied by a properly completed chain-of-custody form. This record documents the transfer of custody of samples from the operator to the A&PC Laboratory.

Since all laboratory analysis will be conducted on site, samples will be packaged and dispatched directly to the A&PC Laboratory or to an interim staging location and then the A&PC Laboratory for analysis.

3.3.4 Laboratory Custody Procedures

Implementation of laboratory custody procedures will be the responsibility of the A&PC staff receiving the sample. Laboratory custody procedures will conform to ACP 7.3, "Control of Samples," for sample receiving and control.

Upon arrival at the laboratory, samples will be examined using the criteria in ACP 7.3. All samples will be inspected to confirm that the integrity of the samples and containers has not been compromised. As warranted, an A&PC Sample Discrepancy Form, WV-2359, is completed for any samples arriving without proper paperwork, questionable sample integrity, or samples not clearly identified.

The sample containers will be checked against the accompanying Analytical Request form (chain-of-custody) to verify that the samples are identical to the samples described on the chain-of-custody documents. If discrepancies exist, they will be reported to the laboratory management, who will notify the Project Lead. The problem will be resolved before analytical work begins.

Each sample will be entered into the Vitrification Analytical Sample Tracking (VAST) computer program as specified in ACM 7.3. A VAST sample ID and login date shall be assigned by the VAST system and the information recorded in the sample logbook. This VAST sample ID is then recorded on the corresponding Analytical Request form. Information pertaining to the sample is entered into VAST. The analysis requested is also logged into VAST.

Each sample container shall be labeled with its assigned VAST sample ID. Samples that have been transferred to the Analytical Cells shall be labeled once they have been removed from the cells. Until then, the permanent ink marking on poly bottles shall be used for tracking.

The sample analysis is completed by the A&PC Laboratory as requested and the data package is generated in accordance with Section 5.3 of this CMP.

3.3.5 Instrument and Equipment Testing, Maintenance, and Calibration Requirements

Inspection, maintenance, and calibration must be performed, as needed, for laboratory instruments and equipment. The A&PC Laboratory must maintain acceptable QA programs to ensure all instrumentation can produce data that is adequate for its intended use. Table 3-2 provides a summary of preventative maintenance requirements for the laboratory equipment. Table 3-3 provides an overview of calibration requirements for laboratory equipment. Refer to WVDP-123 or WVDP-124 for current maintenance and control protocols.

3.3.6 Preventative Maintenance Calibration Procedures and Corrective Actions

Preventative maintenance and corrective actions for laboratory equipment are summarized in Tables 3-2 and 3-3. Refer to WVDP-123 or WVDP-124 for current maintenance and control protocols.

3.3.7 Data Management

Laboratory data will be managed and controlled in accordance with the applicable SOP or written work instructions. This will ensure data traceability and custody are maintained. A data package containing appropriate data management documentation will be produced and delivered to the Project Lead who will provide it, as applicable, to the Sample Management Team for validation.

Table 3-2

Preventative Maintenance for Laboratory Instrument/Equipment

Instrument	Activity	Frequency
Liquid Scintillation Counter	Outside PM Service	Annually
	Repair or service	As needed
	Check background	Daily or as needed
Alpha/ Beta proportional counters	Leak Checks	Each time the gas cylinder is changed and as needed
	Repair or service	As needed
	Check P-10 Gas supply	Daily or as needed
Gamma Spectroscopy system	Replenish liquid nitrogen supply	Weekly
	Check background	Daily or as needed
	Outside PM Service	Annually
	Repair or service	As needed
Alpha Spectroscopy System	Check vacuum	Daily or as needed
	Check background	As needed
Analytical Balances	Verify the pan is clean	Weekly
	Repair and service	As needed
	Class S weights	Calibrated annually
Thermometers	Checked for separated columns	Prior to use
	Service	Calibrated annually
Volumetric Flask -Class A (used for preparing standards)	Checked for damage	Prior to use
Digestion Vessels	Cleaning	After every use
	Disposal	After six months

Table 3-3

Summary Table of Calibration Procedures

Method	Parameter	Calibration	Frequency	Acceptance Criteria	Corrective Action
ACM-2704[1]	Plutonium Analysis by Isotope Dilution Alpha Spectrometry	Method blank	Every time method is performed	#10 counts per hour (CPH) or less than 5% of sample activity in any isotopic plutonium Region Of Interest (ROI) on Alpha Spectrometry	Evaluate and repeat as necessary
		^{242}Pu tracer verification	Every six months	Per certification value	Prepare new standard
		Known ^{242}Pu Tracer	Added to QC and all samples in batch	At least 2000 counts are required in the 242Pu tracer peak.	Evaluate and repeat as necessary
		Calibration verification (QC) ^{238}Pu and ^{239}Pu	Every time method is performed, included in a batch of 10	Decay corrected activity is ± 10% expected response[2]	Repeat sample analysis
		Routine samples	Every time method is performed	Peak shape - FWHM #80keV ^{238}Pu peak ratio is #25 ^{239}Pu peak ratio is #20 Extra peaks are <1% of smallest Pu peak	Evaluate and repeat as necessary
ACM-2706	Alpha Spectral Analysis	Energy calibration of detectors	During initial installation or after replacement or repair to alpha spectrometer	Channel (1) corresponds to ~2.940 Mev and channel 1024 corresponds to ~8.060 Mev	Reanalyze and/or recalibrate
		Efficiency calibration of detectors	Every 3 years or when required due to replacement of detector or per request of cognizant scientist.	Acceptable results of a QA analysis from ACM 2704 or ACM 2707	Reanalyze and/or recalibrate

[1] Alpha counting is done per ACM 2706 and background information is addressed in the software and in ACM 2707.

[2] After 25 points are obtained, the acceptance criteria is maintained at ±3 standard deviations of the average concentration.

Table 3-3 (Continued)

Summary Table of Calibration Procedures

Method	Parameter	Calibration	Frequency	Acceptance Criteria	Corrective Action
ACM-2707	Actinide Analysis	Detector backgrounds	Prior to analyses for at least 8 hours	Stored for background subtraction	Clean and reanalyze
		Tracer isotopic ratio verification	Every 6 months	Per certification value (if available)	Prepare new standard
		QC isotopic ratio verification	Annually	Per certification value (if available)	Prepare new standard
		Method blank	Every time method is performed	# 10 counts per hour (CPH) or less than 5% of sample activity in each isotopic Region Of Interest (ROI)	Evaluate and repeat as necessary
		Calibration verification (QC)	Every time method is performed, included in a batch of 8	± 20% of expected response	Repeat sample analysis
		Tracer	Each sample requires a traced analysis	(When counted at a position closest to the detector) ~1.E-3 FCi tracer: 10000 counts or at least 4 hour count ~5.E-5 FCi tracer: 200 counts or at least 8 hour count ~5.E-6 FCi tracer: 100 counts or at least 16 hour count	Repeat acquisition of spectrum
		Routine samples	Every time method is performed	Peak shape resolution	Recount or repeat sample analysis
ACM-2708	Plutonium-241 Analysis by Scintillation	Method Blank	Every Time Method is Performed	# 2X the average background in the (0 to 20.8) KeV range and (100 to 1000) KeV range	Evaluate and Repeat as Necessary
		Calibration Verification (QC standard or matrix spike)	Every time method is performed	Initial acceptable recovery between 75% and 125% for the QC or between 50% and 150% for the matrix spike.	Repeat sample analysis
		Instrument normalization	Each day method is performed	Instrument will detect out of calibration	Notify cognizant scientist for troubleshooting
		Counting efficiency and quench curve	Every 3 years, when required due to instrument service, or under the direction of cognizant scientist	Acceptable result of QC standard	Reanalyze and/or recalibrate

Table 3-3 (Continued)

Summary Table of Calibration Procedures

Method	Parameter	Calibration	Frequency	Acceptance Criteria	Corrective Action
ACM-3002	^{90}Sr Analysis by Strontium Selective Ion Exchange Separation	Calibration protocol using efficiency curves	Prior to analyses	Instrument will detect out of calibration	Notify cognizant scientist for troubleshooting
		Beta efficiency factor	Yearly, after service to instrument, or under direction of Scientist	Average efficiency evaluated for acceptance	Recalibrate
		Method blank	Every time method is performed	less than MDL	Evaluate and repeat as necessary
		Calibration verification (QC)	Every time method is performed, included in a batch of 10	Decay corrected activity is ± 10% of expected response[2]	Repeat sample analysis
ACM-3104	^{137}Cs Gamma Spectrometric Analysis	Calibration protocol using efficiency curves	As determined by the cognizant scientist and upon initial set-up	-Energy range 59.5 to 1836keV over 8K channels -Full width half maximum (FWHM) resolution and efficiency -QC evaluated to confirm efficiency	Reanalyze and/or recalibrate
		Background	Daily	Below the established upper specific limit (see method for details)	The detector shall not be used for further analysis until it is back in control
ACM-3104	Gamma Spectrometric Analysis	Calibration verification (QC)	Daily	**Ortec System:** -Total Activity, Average FWHM Ratio, and Average Peak Centroid is ± 3 sigma of calculated mean	The detector shall not be used for further analysis until it is back in control
ACM-4001	Purifying and Counting ^{99}Tc	Counter Efficiency	At least once every 2 years	Average efficiency evaluated for acceptance	Repeat Analysis
		Method blank	Every time method is performed	Less than MDL	Repeat Analysis
		Calibration verification (QC)	Every time method is performed, included in a batch of 10	±20% expected response[2]	Repeat Analysis

Data validation will be performed on each data package to confirm completeness and acceptability of the data. Upon completion of validation, the Sample Management Team will return the data package and validation report to the Project Lead. The Project Lead will determine the usability of the data based on the validation input.

3.3.8 Analytical Procedures

Table 3-4 summarizes the A&PC analytical methods to be used for characterization. Requirements for analytical procedures are detailed in current WVNSCO laboratory procedures for radiochemical analyses. The A&PC Laboratory uses approved and controlled procedures to maintain an acceptable quality assurance program, and applicable certifications; and participates in cross-check programs.

Detection limits, QA/QC requirements, and data reporting requirements (such as appropriate units, analytical methods, quantity of sample analyzed, date of analysis, batch QC results, and any problems with the analysis), are also specified in WVNSCO laboratory procedures. Detection limits for the analytical methods are summarized in Table 3-5.

3.3.9 Parameters for Analysis

Samples collected will be analyzed for those parameters identified in Table 3-4. Appropriate process knowledge, computer codes, or historical data may also be used to establish scaling factors. (See Section 2.3.3.C for more information on scaling factors.)

3.3.10 Sample Containers, Labeling, Preservation, and Holding Times

A. Sample Containers

The types of samples that may be collected under this program range from ghost wipes to floor debris, liquids, and vessel/piping coupons. Specific sampling needs will be identified as part of the development of the technical approach. Containers for samples collected under this project will be selected based on the type and composition of the sampled media.

B. Sample Labeling

All samples will be labeled with a unique identifier for the unit and sample type. For example, samples collected from the Process Mechanical Cell may be labeled PMC-Debris-01.

C. Preservation

Radioactive samples do not require preservation.

D. Holding Times

For this CMP, holding times are not pertinent to radioactive samples.

E. Storage

Following processing, samples are stored pending data review. Otherwise, all samples are disposed after data validation has concluded that the data are acceptable for use. The Project Lead will direct long-term sample archival, as appropriate. Long-term storage will be coordinated through Waste Management.

Table 3-4

Parameters and Laboratory Methods

Parameter*	Method
C-14	ACM-4904
Cs-137	ACM-3103/3104
Sr-90	ACM-3002 or ACM-2707
Tc-99	ACM-4001
I-129	ACM-3104
Np237	ACM-2707
Pu-238	ACM-2704 or ACM-2707
Pu-239/Pu-240 (Reported Together)	ACM-2704 or ACM-2707
Pu-241	ACM-2708
Am-241	ACM-2707
Cm-243/Cm-244 (Reported Together)	ACM-2707
U-232	ACM-2707
U-233/U-234 (Reported Together)	ACM-2707
U-235 (Reported as U-235 + U-236)	ACM-2707
U-238	ACM-2707

* Eu-154 and Co-60(ACM-3103/3104) may also be determined for use as key radioisotopes for scaling.

Table 3-5

Control Limits and Required Reporting Limits
Matrix Spikes and Laboratory Control Samples*

Analysis	ACM	Recovery Limits	RPD	MDL/MDA
Alpha Plutonium Isotopes Pu-238 Pu-239/240	ACM-2704	QC ± 10% first 25 points ± 3 sigma thereafter	#20	1.0 x E-05 FCi/g MDAs are dependant on sample size, counting time, detector efficiency, isotope half-life and abundance, and background counts. Lower MDAs are achievable if requested. Refer to ACM for details.
Actinides U-234 Cm-243/Cm-244 U-235 Np-237 U-238 Am-241/Am-243 Sr-90 U-232 Pu-238 U-233 Pu-239/240	ACM-2707	QC ± 20%	N/A	1.0 x E-05 FCi/g MDAs are dependant on sample size, counting time, detector efficiency, isotope half-life and abundance, and background counts. Lower MDAs are achievable if requested. Refer to ACM for details.
Pu-241	ACM-2708	QC ± 25%	#25	1.0 x E-05 FCi/g MDAs are dependant on sample size, counting time, detector efficiency, isotope half-life and abundance, and background counts. Lower MDAs are achievable if requested. Refer to ACM for details.
Sr-90	ACM-3002	QC ± 10% first 25 points ± 3 sigma thereafter	#15	1.5 x E-05 FCi/g (Based on 1 g sample size)
Gamma Spectrometric Analysis Cs-137 Am-241 I-129	ACM-3104	± 3 sigma or 10%	N/A	1.0 x E-03 FCi/g
Tc-99	ACM-4001	QC ± 10% first 25 points ± 3 sigma thereafter	#20	1.5 x E-06 FCi/g (Based on 1 g sample size)
C-14	ACM-4904	QC ± 25%	#25	1.5 x E-03 FCi/g (Based on 1 g sample size)

QC = Quality Control Standard Concentration

* Matrix spikes and laboratory control samples are performed on an ACM method basis (not just samples collected per this plan).

3.3.11 Quality Assurance Objectives for Laboratory Measurement Data

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results that support a conservatively bounded source term for the units. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of equipment, and corrective action are described in other sections of this CMP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

A. Precision

Precision is a measure of the degree to which two or more measurements are in agreement. Precision is expressed as:

Precision = RPD= (S-D)/[(S+D)/2] x 100

RPD = Relative Percent Difference

where, S = original data point
D = duplicate data point

Precision in the laboratory will be assessed by calculating the RPD between laboratory generated duplicate sample results. Precision control limits for laboratory duplicate analyses are summarized in Table 3-5.

Data obtained that does not meet the acceptance criteria of Table 3-5 may also be found acceptable after further evaluation. Documentation for acceptance of data, including justification, shall be performed in accordance with ACP 8.6, "A&PC Data Approval."

B. Accuracy

Accuracy is the degree of agreement between the observed value and an accepted reference value. There are two ways that accuracy can be represented. The accuracy of laboratory results is calculated using the following equations:

%R = [(A-B)/C] x 100

where,
A = the analyte concentration determined experimentally from the spiked sample.
B = the background level determined by a separate analysis of the unspiked sample, and
C = the amount of the spike added.
R = amount recovered.

Or %R = (measured value/true value) x 100

Note: This applies to methods basing recovery on spiked samples only.

Laboratory accuracy will be expressed as percent recoveries and will be determined through the analysis of known standards or matrix spikes and laboratory control samples (LCS). Accuracy control limits are presented in Table 3-5.

The equation for calculating percent recovery in a LCS is as follows:

$$\%R = A/B \times 100$$

where,

A = The analytical concentration determined experimentally in the sample
B = The true or calculated value of the standard solution/source analyzed

Achievement of these objectives, which are for selected analytes only, represent the achievement of the accuracy objectives for all analytes within the method.

Data obtained that does not meet the acceptance criteria of Table 3-5 may also be found acceptable after further evaluation. Documentation for acceptance of data, including justification, shall be performed in accordance with ACP 8.6.

C. Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under "normal conditions."

"Normal conditions" are defined as the conditions expected if the sampling plan was implemented as planned. Completeness is calculated as:

$$\%C = (\text{Valid Data Obtained}/\text{Total Data Planned}) \times 100$$

The laboratory completeness objective is 100 percent for critical data (any data essential for decision-making as determined by the Technical Review and Approval Panel). Data not meeting the completeness criteria will be appropriately qualified and used accordingly.

D. Representativeness

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.

Representativeness will be ensured by using the proper field sampling procedures, analytical procedures and proper sample tracking.

E. Comparability

Comparability expresses the confidence with which one data set can be compared to another.

The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in this CMP, are expected to provide comparable data.

For this project, comparability will be maximized by the use of approved WVNSCO procedures, the recording of data in a validated format, the use of standardized field and laboratory methods, and the reporting of data in appropriate, consistent units.

3.4 Level of Quality Control Effort

3.4.1 Field Measurement Collection

As noted in Section 2.0, a number of nonintrusive data collection technologies may be used for the Facility Characterization Project (some of which have not yet been identified).

The QC level of effort for field measurements will include preoperational calibrations, periodic calibration checks, and duplicate measurements. Initial calibrations and routine checks will be performed in accordance with the manufacturer's SOPs and with Table 3-1 of this CMP.

3.4.2 Sample Collection

Matrix spikes will be analyzed to assess the accuracy of the data resulting from the field sampling and analytical programs.

Field and trip blanks are not required because samples will be collected with dedicated sampling equipment.

In-field duplicate measurements for survey and visual measurements are discussed in Section 3.1.1. If the criteria are not met, additional measurements will be taken until measurement stability is achieved. Failure to achieve the objective will result in evaluation of the measurement technique and instrument operating parameters and qualification of the data, if necessary. The data validator will be notified of the problems to aid in the validation of the data.

Field-supplied duplicate samples are analyzed to check for sampling and analytical reproducibility to support meeting a quantitative value. However, since the goal of this project is to produce conservatively bounded source term estimates, it is the intent of the program to use the most conservative reported results for a sample. As a result, the use of duplicate samples does not serve any true quality assurance purpose as a quantitative regulatory value is not being pursued.

Matrix spikes provide information about the effect of the sample matrix on the preparation and measurement methodology. Samples submitted for laboratory analysis will have one matrix spike for every 20 samples, as applicable.

3.4.3 Laboratory Analysis

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort required under the methods proposed for this project (see Table 3-5).

3.5 Project Files

The project files will be the central repository for all documents that constitute evidence relevant to data collection activities as described in this CMP and/or unit technical approach. WVNSCO will be the custodian of the evidence files and will maintain the contents of the files for the Facility Characterization Project. The project files will include all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, validated data packages, and data assessments. The project files will be maintained by the WVNSCO Project Lead or designee until archived at the Master Records Center.

The project files will contain copies of the following documentation, as applicable:

- project correspondence,
- historical data,
- field data,
- custody documentation (forms),
- photographs,
- analytical data (copies only, originals to be retained by the laboratory),
- data validation reports,
- drawings,
- QA reports - copies,
- deliverables (progress reports, interim reports, and final reports),
- analytical reports,
- MicroShield™ calculations and print-outs,

These documents will be included in the Facility Characterization Project Records Inventory and Disposition Schedule (RIDS).

3.6 Inspection and Acceptance Requirements for Supplies and Consumables

Inspections will be performed by Quality Services in accordance with established inspection requirements and acceptance criteria.

WVDP-127, "WVNSCO Procurement Manual and Guidelines," outlines the basic policies for procurement of goods and services. Included in WVDP-127 is guidance regarding procurement planning, preparation of purchase requisitions and solicitations, evaluation of bidders, and contract award and administration.

3.7 Data Acquisition Requirements

Any non-measurement data (i.e., historical data, data from literature or databases, etc.) used in this CMP must be qualified as process knowledge and traceable to the document from which it was obtained. Accordingly, the data can be evaluated as to its applicability to this CMP and its usability in terms of representativeness, accuracy, and precision.

4.0 Assessment and Oversight

4.1 Performance and System Audits

For the purpose of this CMP, surveillances and self-assessments shall be the mechanism of performance and system audits, as appropriate.

Program and compliance assessments shall be performed to:

- Verify that the QA program is documented in accordance with specified requirements
- Verify documented program has been implemented
- Identify any non-conformances
- Verify correction of identified deficiencies

This QA program operates independently of the overall project structure. The Quality Assurance Integrated Assessment Program shall be responsible for coordinating assessments. The QA department, in consultation with the Project Manager or Project Lead, shall perform surveillances to coincide, as appropriate, with activities on this CMP.

4.1.1 Field Performance and System Surveillances

Internal system surveillances on field work performance will be conducted at least once on the activities surrounding this CMP and as considered appropriate throughout the duration of the project. The Project Manager or Project Lead is responsible for supervising and checking that field measurements and samples are collected and handled in accordance with the approved project plans and that documentation of field work is adequate and complete. The Project Manager is responsible for overseeing that the project performance satisfies the QA objectives, as set out in this CMP. The QA Manager may also initiate unannounced field surveillances.

Surveillances will examine adherence to protocol specified for items such as sample collection, sample handling, QA/QC sample collection, equipment calibration, equipment maintenance, field logbook documentation, and chain-of-custody preparation.

Follow-up surveillances may be performed to verify that any previously identified deficiencies were corrected. Corrective actions may be identified and recommended.

4.1.2 Laboratory Performance and System Audits

ACP 9.1, "Analytical and Process Chemistry Laboratory Assessment Program," provides instruction for performing assessments of the A&PC Laboratory and assuring that program requirements are being satisfied. All assessments of A&PC Laboratory performance will be performed in accordance to ACP 9.1.

Follow-up may be performed to verify that any previously identified deficiencies were corrected. Corrective actions may be identified and recommended.

An independent assessment (e.g., audit or surveillance) is coordinated by the Quality Assurance Integrated Assessment Team according to a schedule established quarterly.

4.2 Assessments and Response Actions

A Technical Review and Approval Panel has been established for the project. The Technical Review and Approval Panel, using best engineering/technical judgement, will determine if the technical approach and final curie estimates are technically sound for purposes of this project's work scope.

The review panel consists of individuals whose collective technical expertise and qualifications span the issues associated with the curie validation process. At a minimum, the panel will consist of the Project Manager, Project Lead, Cell Lead(s), Radiation Protection Operations, Radiological Engineering & Dosimetry, and Decommissioning Planning. As described in Section 2.3, the documentation generated as a result of the unit investigations will include a statement by the Technical Review and Approval Panel which iterates their consensus with the technical approach that was utilized and the conservatively bounded curie estimates that were generated for each of the areas.

The Technical Review and Approval Panel may make recommendations to the Project Manager or Project Lead regarding additional data collection. If such recommendations are made, they will be captured in the project file. Completion of the recommendations will be documented by the completion of the Facility Characterization Project Technical Review and Approval Panel Consensus Statement form (Figure 2).

The Project Manager will be responsible for ensuring the quality of this project, including conducting management oversight and assessments as needed.

5.0 Data Reduction, Validation, and Usability

It is the intent to have all data used in this project validated. However, there may be instances where data validation is not possible, but the data is considered critical and usable for project purposes. These decisions will be made by the Technical Review and Approval Panel.

5.1 Dose Rate Measurements

5.1.1 Data Reduction

The results of monitoring for radiation are documented and maintained per 10 CFR 835.703(a) and (b) and DOE-STD-1098-99, Articles 751-754. Records will contain sufficient detail to be meaningful after the originator is no longer available. Sketches will be used to enhance the users understanding of the building, room, or equipment layout as appropriate. Information to be recorded on a survey sheet is detailed in WVDP-293, "WVDP Radiological Protection Record Keeping and Reporting Program Manual."

5.1.2 Data Reporting and Review

In accordance with WVDP-010, "WVDP Radiological Controls Manual," site surveys are reviewed and signed off by a supervisor to ensure that the survey was conducted and the form completed in accordance with approved site procedures.

5.1.3 Data Validation, Usability and Reporting

Level 1 data validation of the site surveys will be performed by the Sample Management Team per approved procedures. Data collected from field measurements will be validated based upon their comparison with known calibration sources to assure accurate instrument response. This will be the means by which data usability will be established and reported to the Project Manager or Project Lead.

Figure 2

FACILITY CHARACTERIZATION PROJECT

Technical Review and Approval Panel
Consensus Statement

Unit Name(s): _____

Summary of technical approach that was utilized (attach additional sheets if required):

_____

_____

_____

_____

_____

_____

Upper Bounded Curie Estimate:

insert table

Using best engineering judgement and available information, the following listed Technical Review and Approval Panel Members have reviewed the technical approach and resultant conservative curie estimate for the stated area/cell and have reached consensus that the approach and resultant estimate are technically sound for purposes of this project's scope as identified in the Characterization Management Plan for the Facility Characterization Project (CMP).

Project Manager: _____

Project Lead: _____

Cell Lead(s): _____

Radiological Engineering & Dosimetry: _____

Radiological Protection Operations: _____

Decommissioning Planning: _____

5.2 Dose-to-Curie (MicroShield™) Modeling

5.2.1 Model Reduction

Modeling inputs include dose rate surveys and, as applicable, analytical data that are generated, reported, and validated per Sections 5.1 and 5.3 of this plan. In addition, the model requires information regarding the configuration of the unit to be modeled. This data is generated during the information gathering process conducted by the Unit Lead. The modeler develops a strategy for modeling the unit, in consultation with the Unit Lead and other knowledgeable personnel, and inputs all of the necessary data. All assumptions and data inputs are documented as part of the modeling data package. Spreadsheets of modeling results are maintained in the modeling data package.

5.2.2 Model Reporting and Review

All modeling results are reviewed and signed off by another individual who has been trained to perform MicroShield™ modeling. The reviewer evaluates that the modeling assumptions are rational, data inputs are correct, and that the model outputs are reasonable for the unit being modeled.

In addition to the routine review of the modeling results, the Project Manager will retain external expertise to conduct at least one independent review of a unit modeling data package, including, data input, assumptions, and results. Based on the results of that review, the Project Manager may invoke additional external reviews as necessary to ensure that the quality of the project and its products are maintained.

5.2.3 Model Validation

Model inputs and assumptions validation will be conducted in conjunction with data reduction and reporting. The Technical Review and Approval Panel will serve as the final validator of the unit model results during the their final review and approval process. The Technical Review and Approval Panel will also serve as the final decision maker regarding the usability of the model as it is presented or whether additional work is required to make the results more usable. Additional work could include changes in the model through collection of additional field data. As part of the formal sign off (Figure 2), the Technical Review and Approval Panel will be the final decision makers regarding the usability of the modeling results.

5.3 Analytical Data

5.3.1 Data Reduction

Analytical worksheets shall be verified and approved by the A&PC Manager, Cognizant Scientist, A&PC Supervisor, or a Radiochemistry Technician "A" or above. Calculations performed by VAST need not be checked, as the software calculations have been independently verified. Verification and validation is performed as necessary on any changes to the code. When hand calculations are performed, the reviewer shall repeat all manual calculations beginning with the raw data and ending with the final calculated result. VAST approvals shall be performed by individuals designated within the VAST system on a per method qualification basis. Verification and approval of worksheets shall be performed by an individual who is independent of the analysis.

Independent verification and approval of computer generated worksheets shall consist of confirmation of the values from data printouts onto the worksheets (as applicable), values inputted from the worksheet into VAST, and electronic approval.

All the raw data and the worksheets generated by analyses shall be filed in designated areas or attached to the data package as applicable.

The analytical results shall be entered in the computer system by laboratory personnel trained on the VAST system.

When all requested analyses results have been entered and approved in the computer system, the Analytical Sample Report (ASR) shall be generated. The ASR form shall be verified and approved by the A&PC Manager, Cognizant Scientist, A&PC Supervisor, Radiochemistry Technician "A+" or above. Verification and approval of ASR forms shall be performed by an individual who is independent of the measurement process. The sign off shall include date and time of approval.

The Analytical Package shall be assembled. At a minimum it shall include the ASR, Analytical Request (AR), any contingent data forms generated, and any worksheets generated. Additionally, unless otherwise specified by the applicable Analytical Chemistry Method (ACM), any instrument or computer printouts generated during analysis shall be included in the analytical package.

5.3.2 Data Reporting and Review

Data reporting for radiochemical analyses will include:

- Chain-of-custody documentation,
- WVNSCO sample ID and location code,
- Date of collection,
- Date of processing (if applicable),
- Percent moisture or percent solids (if applicable),
- Amount of sample used in the analysis,
- Date of analysis,
- Analytical result in proper units,
- Counting uncertainty for radiological analyses in proper units,
- Detection levels for radiological analyses (when analyte is not detected),
- Results for instrument backgrounds, method blanks, QC standards, and duplicates analyzed as part of QC batch,
- Acceptance criteria for batch QC,
- Comments on any peculiarities concerning analysis of a sample,
- Control chart or other performance verification documentation for daily standard counts and instrument background,
- Sample preparation worksheets (if applicable),
- Sample matrix,
- Date of receipt,
- Analytical method reference,
- Report data,
- Sample preparation date, and
- Dilution factors, as applicable.

An internal (laboratory) review of analytical data will be conducted by the laboratory using procedures described in ACP 8.6 of the Laboratory Quality Assurance Program Manual, WVDP-123. The analyst will initiate the data review process by examining and accepting the data. The completed data package will then be reviewed by designated laboratory personnel. The review will include verification for accuracy and precision according to the methods employed and laboratory protocols and for adherence to specified QA/QC requirements. In addition, the data will be reviewed for QC sample acceptance criteria. A final review of the data will be provided by the ASR Approver to ensure that all requested analysis have been performed and verified for completeness of data prior to approval.

An independent validation of the data will be provided after the data is received from the laboratory.

Copies of the analytical package shall be sent to the requestor.

The completed analytical package and original raw data shall be transferred to the Master Records Center by the document custodian for records maintenance and storage.

Note: All packages are customized according to project needs because the A&PC Laboratory supports site operations. Hence, packages range from analytical results (VAST Reports - ASRs) to ASRs plus QC data plus AR (COC) and all raw data. At any given time additional data and details are readily available.

5.3.3 Data Validation

100% of the analytical data generated will be subjected to a data quality review in accordance with the requirements for Level I Data Validation. The criteria to be evaluated will include, but is not limited to:

- Chain-of-custody documentation
- Method blank samples, backgrounds, laboratory control samples, and tracer recoveries
- Matrix spike/laboratory duplicate analyses
- Field duplicate data, as applicable

Data qualifiers **U** (not detected), **J** (estimated value), and **R** (unreliable), shall be assigned by the validator in accordance with approved procedures.

If any out of control data points or data omissions are identified, the data deficiencies will be corrected before the data will be deemed acceptable. Recommendations to repeat sample collection and analyses will be made by the Project Manager or Project Lead based on the extent of the deficiencies and their relative importance in the overall context of the project.

The results of the validation will be summarized in a validation report that shall include, at a minimum, the following information:

- Samples included in the validation
- Validation guidelines used, including any project-specific requirements and modifications
- Analysis performed
- Review of results and associated raw data, when applicable
- Discussion of validation results, including any explanation of a qualifier assigned by the validator
- Resolution of any data deficiencies
- Percent completeness

The criteria used to accept or reject the analytical data based on quality will include but not be limited to procedures used by the Sample Management Team. The evaluation process for data often includes comparisons of the reported activities or concentrations to their respective minimum detectable activities (MDAs) or minimum detectable concentrations (MDC), an evaluation of the associated uncertainties of each result, and comparisons to appropriate action levels. Verification and validation requirements are covered under current Sample Management Team procedures.

For this project, the evaluation process for data will generally be limited to the uncertainties associated with data measurement and subsequent assumptions and calculations. The primary mode for the potential rejection of analytical data will be based on the severity of failures of analytical QA results as determined by the verifier and validator of the data.

5.4 Reconciliation with Project Data Quality Objectives

Decisions that determine if the Project DQOs have been satisfied will be made during the data assessment process and ultimately be accepted by the Technical Review and Approval Panel.

APPENDIX A

Data Quality Objectives for the Facility Characterization Project

Developed by the Environmental Protection Agency (EPA), the Data Quality Objectives (DQO) process is a guidance tool used to determine the type, quantity, and quality of environmental data needed to make a decision. It is the goal of the DQO process to minimize costs related to unnecessary, redundant, or overly precise data collection activities, while also collecting data of sufficient quality and quantity to support a defensible decision. The DQO process is an iterative, seven-step process, where decision performance criteria are developed during the first six steps, and the data collection design is developed in the last step. The seven steps are as follows:

- Step 1: State the Problem
- Step 2: Identify the Decision
- Step 3: Identify Inputs to the Decision
- Step 4: Define the Study Boundaries
- Step 5: Develop a Decision Rule
- Step 6: Specify Limits on Decision Errors
- Step 7: Optimize the Design

Although each step of the process derives criteria used to assist in establishing the final data collection design, the first four steps provide mostly qualitative criteria such as what decision is to be resolved, and the fifth and sixth steps define quantitative criteria such as decision error limits. These data quality objectives are the basis for the Characterization Management Plan (CMP) for the Facility Characterization Project (FCP). Given the unique nature of the units included in the scope of the FCP (e.g., underground tanks, remote only accessible process building cells, different chemical processes, etc) , the last step in the process, optimize the design, will be conducted as part of the development and documentation of the technical approach developed on a unit by unit basis. This process is further described in the CMP. The following sections describe each step and the corresponding activities necessary to complete the DQO process as it applies to the FCP.

1.0 Step 1: State the Problem

1.1 Members of the DQO Planning Team

J. A. Choroser, Process Building Unit Lead
A. Drobot, Process Building Unit Lead
J. M. Fazio, Waste Tank Farm Project Lead
P. M. Johnson, Data Validation and Quality Assurance
E. B. Lachapelle, Vitrification Facility Project Lead
C. J. Maddigan, Analytical and Process Chemistry Laboratory
L. M. Michalczak, Process Building Project Lead
L. E. Rowell, Project Manager Facility Characterization
B. V. Schaper, Instrument Technology

1.2 Primary Decision Makers

The Technical Review and Approval Panel will act together and have the authority to make final decisions based on the recommendations of the project manager, project lead, or cognizant engineer and their planning team. The Technical Review and Approval Panel will be, at a minimum, comprised of representatives from the following organizations: Facility Characterization Project, Radiological Engineering & Dosimetry, Radiation Protection Operations, Analytical and Process Chemistry Laboratory, and Decommissioning Planning.

1.3 Description of Problem

The information collected per this DQO will ultimately result in the validation of existing or the development of new radionuclide unit source terms that are data input into the site-wide performance assessment and the determination that the West Valley Demonstration Project (WVDP) meets or does not meet the License Termination Rule (LTR) criteria recently published by the Nuclear Regulatory Commission. There is interaction of the product of this DQO with other data inputs, including, the performance assessment modeling assumptions, site specific parameters, and closure engineering design features, to support the LTR determination. It should be noted that these other data inputs to support the LTR determination are the responsibility of other organizations, including the Department of Energy. These other data inputs were not considered within the scope of this DQO.

Specifically, the purpose of this project and associated DQO is to provide through sampling and analysis, process knowledge, or measurement, a conservatively bounded estimate of specific long lived radionuclides that remain in portions of the Waste Tank Farm, Vitrification Facility, and the Process Building. The quantification process for validation must be technically sound and provide the information necessary for preparation of a preliminary performance assessment of the proposed site closure scenario presented in the "Draft Environmental Impact Statement for Completion of the West Valley Demonstration Project and Closure or Long Term Management of Facilities at the Western New York Nuclear Service Center, January 1996, DOE/EIS-0226-D". Based on an evaluation of the performance assessment model, the radionuclides that are important to this study and the outcome of the performance assessment are:

- I-129, C-14, Tc-99, U-232, U-233, U-234, U-235, U-238, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Sr-90, Cs-137, Cm-243, and Cm-244.

- Another isotope that may be assessed is Eu-154 (for use in scaling).

1.4 Available Resources and Relevant Deadlines for the Study

It is assumed that necessary West Valley Nuclear Services Company (WVNSCO) and subcontract staff will be available for this study as reflected in the resource loaded baseline schedule contained in the Project Implementation Plan for the Facility Characterization Project.

Pertinent project milestones/deadlines are as follows:

- Complete HLW Tank (Tanks 8D-1 and 8D-2) Characterization - 09/30/02

- Complete Tank 8D-3/8D-4 and STS Characterization - 11/31/02

- Complete Vitrification Facility Characterization - 04/30/03

- Complete Process Building Characterization - 09/30/04

2.0 Step 2: Identify the Decision

Decisions made as a result of this study will be based on data obtained from new data collection activities, historical data, or a combination of both.

2.1 The Principle Study Question(s)

- Are the existing source term estimates (if any) technically sound to support the performance assessment?

- What is the conservatively bounded, select radionuclide inventory (refer to Section 1.3 or Table 1) in a given unit (e.g., facility, cell, vessel, or component) within the Waste Tank Farm, Vitrification Facility, or Process Building?

- What additional data are needed, if any, to develop a conservatively bounded radionuclide source term estimate?

2.2 Alternative Actions

Three alternatives can be implemented through the resolution of the principle study questions and one independent factor.

The independent factor, that is, obtaining feedback from the Nuclear Regulatory Commission on their expectations for generating radioactive inventory estimates to support a performance assessment is anticipated as part of the Environmental Impact Statement review process. This feedback could impact the alternative action chosen for a unit in the future.

A decision making action will be required following the evaluation of the radioactive source term for a unit. This decision making action is based on one of the following conclusions:

Conclusion A: ***The current curie estimate is determined to be conservatively bounded based on an evaluation of existing data.***

Examples of bases for Conclusion A include one or more of the following:

- Historical and current unit usage is known.

- The current radionuclide estimate is based on verifiable data.

- Only one bounding radiological distribution is associated with the unit.

- Significant radionuclides, as defined by the investigative levels, are not expected to be present.

Conclusion B: ***Sufficient verifiable data exists which facilitates the modeling of the unit and generation of a conservatively bounded curie estimate.***

Examples of bases for Conclusion B include one or more of the following:

- Historical and current unit usage is known.

- The radioisotopic distribution of the unit is known based on verifiable data or a conservative radioisotopic distribution can be developed based on verifiable process knowledge.

- Physical conditions of the cell are known.

- The isotopic distribution in the unit includes the presence of measurable gamma emitters.

- Verifiable field measurement (dose rate surveys) data exists.

- The unit can be modeled to conservatively bound the expected curie inventory.

Table 1

Radiological and Physical Parameters

Parameter*
C-14
Cs-137
Sr-90
Tc-99
I-129
Np-237
Pu-238
Pu-239
Pu-240
Pu-241
Am-241
Cm-243
Cm-244
U-232
U-233
U-234
U-235
U-238
Radiological Surveys (e.g., radioactive fluence rate, dose rates and/or count rates)
Spatial Distribution of Radioactivity
Composition and Physical Dimensions of Components
Component Geometry

* Eu-154 and Co-60 may also be determined for use as a key radioisotope for scaling

Conclusion C: ***Additional data collection is warranted to generate a conservatively bounded radionuclide inventory.***

Examples of bases for Conclusion C include one or more of the following:

- Unit entities (e.g., floor, tanks, piping) are expected to contain significant isotopes, as defined by the investigative levels, that may have not been captured by the initial curie estimate. The curie contribution of these entities needs to be further identified.
- Assumed physical conditions need to be confirmed (via remote cameras, liquid level determination in vessels, etc.). Unit configuration and geometry are critical to the modeling efforts being conducted to support radiological inventory development.
- Unit conditions have changed since the current curie estimate was generated. New data points need to be generated.
- There are multiple radioisotopic distributions associated with a unit that may make dose-to-curie modeling more difficult.
- Gamma emitting signature isotopes are not present.
- Unit usage information, such as processing history, spill history, or past decontamination events, is unclear.

2.3 Decision Statement(s)

If no additional data collection is warranted for the scope of this project, then prepare supporting documentation including the development of the radionuclide source term for the unit.

If additional data collection is warranted for the scope of this project, then collect data as required, and prepare supporting documentation including the development of the radionuclide source term for the unit.

3.0 Step 3: Inputs to the Decision

3.1 Information Required to Resolve the Decision Statement

Information on the radiological conditions and certain physical properties is required to resolve the decision statements. Table 1 lists the specific radiological and physical variables needed to resolve the decision statement.

3.2 Sources for Required Information

The radiological and physical parameters will be gathered either from historical data or a combination of historical data and new data collection activities.

3.3 Information Needed to Establish the Decision Levels

Decisions for this project will be made based on a qualitative assessment of information and the judgement of the Technical Review and Approval Panel rather than quantitative levels. As a result, numerical decision levels are not appropriate to this project.

3.4 Measurement Methods that Will Provide the Necessary Data

One or more of the following measurement methods may be used for obtaining the radiological and physical parameters listed in Table 1: dose-rate/count-rate, surveys in combination with dose-to-curie conversion and computer modeling, visual depiction (video mapping or facility drawings), and laboratory analyses (current and historical).

Dose-rates/count-rates are used as the base data for input into computer models, such as MicroShield™, to estimate the radionuclide activity. This method may be used to estimate radionuclide activity in specific geographic areas of the Waste Tank Farm, Vitrification Facility, and Process Building.

Visual depiction may be useful for developing spatial distribution of the residual waste remaining in the Waste Tank Farm, Vitrification Facility, or Process Building.

When traditional sampling is employed, radionuclide concentrations in samples will be determined by on-site WVNSCO laboratories in accordance with applicable WVNSCO Laboratory procedures and/or Department of Energy/Nuclear Regulatory Commission procedures. Other analytical requirements including QA/QC, required detection limits, and data reporting are specified in current WVNSCO procedures. These requirements along with the detection limits for the other measurement methods used in this data collection effort will be addressed in the CMP and associated work documents.

4.0 Step 4: Define the Study Boundaries

4.1 Characteristics that Define the Population of Interest

The population of interest (i.e., residual radioactivity from a unit in the Waste Tank Farm, Vitrification Facility, and Process Building) will be characterized by the parameters listed in Table 1.

4.2 The Spatial Boundary of the Decision Statement

The following is a list of Waste Tank Farm, Process Building, and Vitrification Facility units that will be covered under these DQOs and the corresponding data collection plans:

- Tank 8D-3
- Tank 8D-4
- The Supernatant Treatment System (STS)
- Vitrification Facility
- Process Building

NOTE: *During the data collection design, it may be desirable to divide one or more of the units into subcomponents of relatively homogeneous characteristics. When appropriate (i.e., based on existing information of a population or manageability and size of the component), subpopulations will be created to reduce the variability of the potential data or complexity of the component. Stratification of the components, thus creating the subpopulations, will be determined by the Project Manager, Project Lead, or Cognizant Engineer and his planning team with help from the Technical Review and Approval Panel.*

4.3 The Temporal Boundary of the Problem

The resolution(s) to the decision statement will apply to the population or subpopulation until that population or subpopulation is altered by an outside process that increases the radiological activity of the unit. Furthermore, since there are no expected temporal conditions (e.g., weather,

temperature, and wind) that may impact the success of data collection, data (if necessary) can be collected at any time.

4.4 Scale of Decision Making

In accordance with the spatial boundaries of the study and as determined by the decision maker as defined in the CMP, decisions will be made based on the most appropriately sized unit within the Waste Tank Farm, Process Building, or Vitrification Facility. Studying each unit at the most appropriate scale may make the data collection design less complex and data results more representative, and can minimize the heterogeneity of the population or subpopulation.

4.5 Practical Constraints on Data Collection

Constraints or obstacles that may impact the implementation of the data collection design include, but are not limited to, the following: limited access to the Waste Tank Farm, Vitrification Facility, or Process Building units, the expected radiological exposure to the workers involved in the sampling effort, the availability of personnel, equipment, analytical laboratories, and the design and development of nondestructive data collection equipment.

5.0 Step 5: Develop a Decision Rule

The decision whether or not additional data should be collected will be made using available information from and the judgement of the Technical Review and Approval Panel. As part of the process, a consensus must be achieved within the Technical Review and Approval Panel that what is reported for a unit is a conservatively bounded curie estimate that can be defended as technically sound to the Department of Energy and Nuclear Regulatory Commission.

6.0 Step 6: Specify Limits on Decision Error

The conclusion that an inventory estimate for a unit reflects a conservatively bounded inventory, developed using a technically sound approach, is expected 100% of the time. If a consensus is not reached, then additional data collection would be warranted until a Technical Review and Approval Panel consensus can be reached. As a result, a null hypothesis and associated decision errors are not appropriate for this DQO.

7.0 Step 7: Optimize the Design

Optimization of the characterization design will be done in conjunction with the Technical Review and Approval Panel review and comment cycle as further described in the CMP. It is anticipated that each unit within the Waste Tank Farm, Vitrification Facility, and Process Building will have a unit specific technical approach that will be formalized and included as part of the characterization documentation to be maintained in the Project files.

APPENDIX B

Guidance Methodologies for Curie Estimation for the Facility Characterization Project

Method A

1. Laboratory data must be corrected (decay/ingrowth) to the date of the radiation survey if data was collected greater than one year apart. Note: The A&PC Laboratory corrects data from date of analysis to the date of the sampling and reports results in VAST reports. Off-site laboratories do not correct to date of sampling.

2. For data below the detection limit, use the detection limit.

3. Data reported as a combination of two isotopes must be split into component isotopes per memo of J. Wolniewicz.

4. For each separate sample result of each radionuclide, develop a ratio to Cs-137.

5. To get the scaling factor for each isotope, either take the worse case ratio, an "average" ratio, or a single sample ratio to Cs-137. This step may also take into account laboratory counting uncertainty if a technical review indicates that the uncertainty could significantly impact the inventory value.

   For areas whose scaling factors or ratios are generated from samples of a single population (e.g., cell's floor debris samples), the geometric mean ("average") of the population may be used. In many instances, the variability of a contaminant in a population can be expected to follow a log-normal distribution. With log-normal data, the mean of a data set would be properly computed as the log of the data (i.e., all data transposed to log values, mean of the log values calculated, and the mean log value transposed back into the original data units) (a.k.a geometric mean). The geomean is a useful summary statistic when we expect changes in data to occur in a relative fashion such as: filters will trap dusts in an amount relative to the amount of air flowing through them; floor surface contamination will vary relative to the amount of contaminant spilled on each of the floor areas; vacuumed debris will be contaminated in an amount relative to the contamination in each area being vacuumed. As such, geometric means can be applicable for summarizing ratios for the same population.

   The EPA has numerous references available that discuss the assessment of such environmental media data using a log-normal distribution. At the WVDP, the radiological classification of radioactive waste, to facilitate its off-site shipment, certification, and disposal, is performed using RadMan™. When more than one data point is available for a waste stream or waste population, RadMan™ calculates the scaling factors or ratios for that population using the geometric mean of the data points. For example, in classifying the cement floor debris vacuumed off the floor of the Acid Recovery Pump Room (ARPR) into three drums, the scaling factors associated with each of the three drums of debris was "averaged" using the geometric mean of the three drum's scaling factors. The resultant ARPR cement floor debris scaling factors were applied to the entire population of ARPR cement floor debris.

   For those areas in which data exists where the area's scaling factors are generated from multiple population sets (e.g., floor debris samples, filter samples), the geometric means of the population sets may be compared and the most conservative (worse case) scaling factor used. For those areas in which only one data point exists, the scaling factors may be generated using only the one data point.

   The choice of scaling factor approach (e.g., worse case, average) depends on area-specific conditions, the population being sampled, and if changes in the population are expected to be relative. Although the purpose of facility characterization is to develop conservative estimates, the worse case scenario for each variable does not need to be utilized in every area (See Section 2.1). It is possible to generate conservative scaling factors which address the relative variability in an area or a sample population by

using statistics rather than worse case constituent concentrations found in any sample associated with a particular population. Regardless of the scaling factor approach utilized, the Technical Review and Approval Panel has the ultimate decision as to the technical soundness of the entire cell's approach.

6. Run dose-to-curie model inputting only Cs-137. Exceptions may be necessary to address cells that do not have a cesium signature but should be considered as part of the Technical Review and Approval Panel review.

7. Calculate the curie contributions of all nuclides of interest, using the table of scaling factors.

8. Decay/ingrow curie contributions to September 30, 2004.

9. If there is more than one model used for the cell, total the results for each nuclide to get a total for that nuclide for the cell.

10. Total the results for long-lived curies for the cell.

11. Peer review of final package (ratio development, model, and final inventory calculations).

Peer reviews include the verification of all calculations, modeling, and assumptions.

Method B

1. Laboratory data reported as a combination of two isotopes must be split into component isotopes per memo of J. Wolniewicz.

2. For data less than (<) the minimum detectable activity (MDA) or minimum detectable concentration (MDC), use the MDA or MDC.

3. Laboratory data must be corrected (decay/ingrowth) to September 30, 2004.

4. Obtain scaling factors:

    a. Scaling factors from sample results:

        1. Normalize sample results (each radionuclide) to Cs-137 (ratio).
        2. Take either the worst case ratio or the "geometric mean" for a set of samples, or the ratio for a single sample.

For areas whose scaling factors or ratios are generated from samples of a single population (e.g., cell's floor debris samples), the geometric mean ("average") of the population may be used. In many instances, the variability of a contaminant in a population can be expected to follow a log-normal distribution. With log-normal data, the mean of a data set would be properly computed as the log of the data (i.e., all data transposed to log values, mean of the log values calculated, and the mean log value transposed back into the original data units) (a.k.a geometric mean). The geomean is a useful summary statistic when we expect changes in data to occur in a relative fashion such as: filters will trap dusts in an amount relative to the amount of air flowing through them; floor surface contamination will vary relative to the amount of contaminant spilled on each of the floor areas; vacuumed debris will be contaminated in an amount relative to the contamination in each area being vacuumed. As such, geometric means can be applicable for summarizing ratios for the same population.

The EPA has numerous references available that discuss the assessment of such environmental media data using a log-normal distribution. At the WVDP, the radiological classification of radioactive waste, to facilitate its off-site shipment, certification, and disposal, is performed using RadMan™. When more than one data point is available for a waste stream or waste population, RadMan™ calculates the scaling

factors or ratios for that population using the geometric mean of the data points. For example, in classifying the cement floor debris vacuumed off the floor of the Acid Recovery Pump Room (ARPR) into three drums, the scaling factors associated with each of the three drums of debris was "averaged" using the geometric mean of the three drum's scaling factors. The resultant ARPR cement floor debris scaling factors were applied to the entire population of ARPR cement floor debris.

For those areas in which data exists where the area's scaling factors are generated from multiple population sets (e.g., floor debris samples, filter samples), the geometric means of the population sets may be compared and the most conservative (worse case) scaling factor used. For those areas in which only one data point exists, the scaling factors may be generated using only the one data point.

The choice of scaling factor approach (e.g., worse case, average) depends on area-specific conditions, the population being sampled, and if changes in the population are expected to be relative. Although the purpose of facility characterization is to develop conservative estimates, the worse case scenario for each variable does not need to be utilized in every area (See Section 2.1). It is possible to generate conservative scaling factors which address the relative variability in an area or a sample population by using statistics rather than worse case constituent concentrations found in any sample associated with a particular population. Regardless of the scaling factor approach utilized, the Technical Review and Approval Panel has the ultimate decision as to the technical soundness of the entire cell's approach.

b. Scaling factors from ORIGEN - spent nuclear fuel:

1. Decay spent nuclear fuel scaling factors to September 30, 2004.

c. Scaling factors from Batch 10:

1. Decay Batch 10 scaling factors to September 30, 2004.

5. Run dose-to-curie model for Cs-137. Exceptions may be necessary to address cells that do not have a cesium signature (low Cs-137 concentration in the sample) and should be considered as part of the Technical Review and Approval Panel review.

6. Calculate the curie contribution of radionuclides of interest:

a. Decay MicroShield™ Cs-137 result to September 30, 2004.
b. Multiply decayed scaling factors by Cs-137.
c. Total the results.

NOTE: If there is more than one model for a cell, total the result for each radionuclide to obtain the total curie contribution of the radionuclide for the cell.

7. Peer review the final package (ratio development, MicroShield™ model, and final inventory calculations).

Peer reviews include the verification of all calculations, modeling, and assumptions.

WVNSCO RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue Departments affected by this document are Facility Characterization Project, Quality Assurance, Analytical & Process Chemistry Laboratory, Regulatory Programs, Radiological Engineering & Safety, and Radiation Protection Operations.	All	05/13/02
1	General revision made to incorporate External Peer Review comments (reference letters LW:2002:0001 and LW:2002:0002). Departments affected by this document are Facility Characterization Project, Quality Assurance, Analytical & Process Chemistry Laboratory, Regulatory Programs, Radiological Engineering & Safety, and Radiation Protection Operations.	All	10/31/02
2	Changed "approach" to "approaches" in first paragraph. Added Method B for curie estimation to Appendix B. Reformatted document to be consistent with DCIP-100. Department affected by this change is Facility Characterization Project.	25 65 All	08/06/03
3	Updated cover sheet to remove approval signatures per DCIP-100. 1.3 - Deleted responsibility of the Senior Project Manager and combined them with responsibilities of the Project Manager to reflect current organizational configuration. Deleted references to Senior Project Manager Figure 1 - Updated department titles as appropriate. 2.1 - Added examples of where technically sound levels of conservatism may be built into the radioisotopic inventory estimates. Table 3-4 - Updated methods. Table 3-5 - Specified isotopes for ACM-4704, ACM-4707. Added C-14 to table. Corrected MDL/MDA for Tc-99. Added statement regarding determination of MDAs for ACM-2707. 4.2 - Updated department titles as appropriate. Figure 2 - Updated text to be consistent with current Consensus Statement wording. Updated department titles as appropriate. Appendix A ,1.1 - Deleted Senior Project Manager. Appendix A, 1.2 - Updated department titles as appropriate. Appendix B - Added “Guidance” to appendix title. Expanded upon the discussion on the potential utilization of the geometric mean of population data to generate scaling factors in Step 5 of Method A and Step 4 of Method B. Deleted “Note” from Step 4 of Method B. Department affected by this change is Facility Characterization Project.	1 11 48 - 50, 54 14 18 41 42 48 49 54 54 61-63	01/16/04