#c00068625

RMRS Rocky Mountain Remediation Services, L.L.C.
. . . protecting the environment
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, Colorado 80402-0464
Phone: (303) 966-7000

February 9, 1998

TO: Distribution

TRANSMITTAL OF STARMET'S DRAFT SAMPLING AND ANALYSIS PLAN FOR PYROPHORIC DEPLETED URANIUM SOURCE REMOVAL FROM ROCKY FLATS ENVIRONEMNTAL TECHNOLOGY SITE TRENCH 1 (IHSS 108) - MCB-005-98

Attached is a copy of Starmet's Draft Sampling and Analysis Plan for the Trench 1 Project. This document is being distributed for concurrent review and comment. The review will be conducted by the Department of Energy (DOE), Kaiser-Hill (K-H), Rocky Mountain Remediation Services, L. L. C. (RMRS), DynCorp, and Safe Sites of Colorado, L.L.C (SSOC) in parallel to maintain the project schedule. In doing so, all comments should be submitted to RMRS in writing on the attached Review Comment Sheet by close of business on February 13, 1998.

Please contact me at extension 5891 if you have any questions.

MC Burmeister

Mark C. Burmeister
Project Manager, Trench 1

MCB/aw

Attachments:
As Stated

Distribution:

K. F. Lenarcic, DynCorp, 441
J. J. Miller, SSOC, T690B

RMRS

L. Allen, RTG, T891C
G. D. DiGregorio
J. M. Forbes, SEG, T664A
K. Gillespie, T893B
J. E. Law, T893B
S. L. Luker, T893B
S. L. Myrick, T893B
V. Piers, B116
W. G. Pierce, T893B
D. M. Salyers, T664A
H. Salomon, T893B
J. P. Schmuck, T893B
T. H. Spence, T893B
W. R. Sproles, T893B
R. A. Wagner, T893B

cc:
T. C. Greengard, T130C
RMRS Records

ER/WM&I DDT

Source/Driver: (Name & Number from ISP, IAG milestone, Mgmt. Action, Corres. Control, etc.)	**Closure #:** (Outgoing Correspondence Control #, if applicable)	**Due Date**
W. R. Sproles/M. Burmeister	G. DiGregorio	J. E. Law
Originator Name	**QA Approval**	**Contractor Manager(s)**
T. Greengard		A. D. Rodgers
Kaiser-Hill Program Manager(s)		**Kaiser-Hill Director**

Document Subject:

TRANSMITTAL OF STARMET'S DRAFT SAMPLING AND ANALYSIS PLAN FOR PYROPHORIC DEPLETED URANIUM SOURCE REMOVAL FROM ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE TRENCH 1 (IHSS 108) - JEL-021-98

KH-00003NS1A February 9, 1998

Discussion and/or Comments:

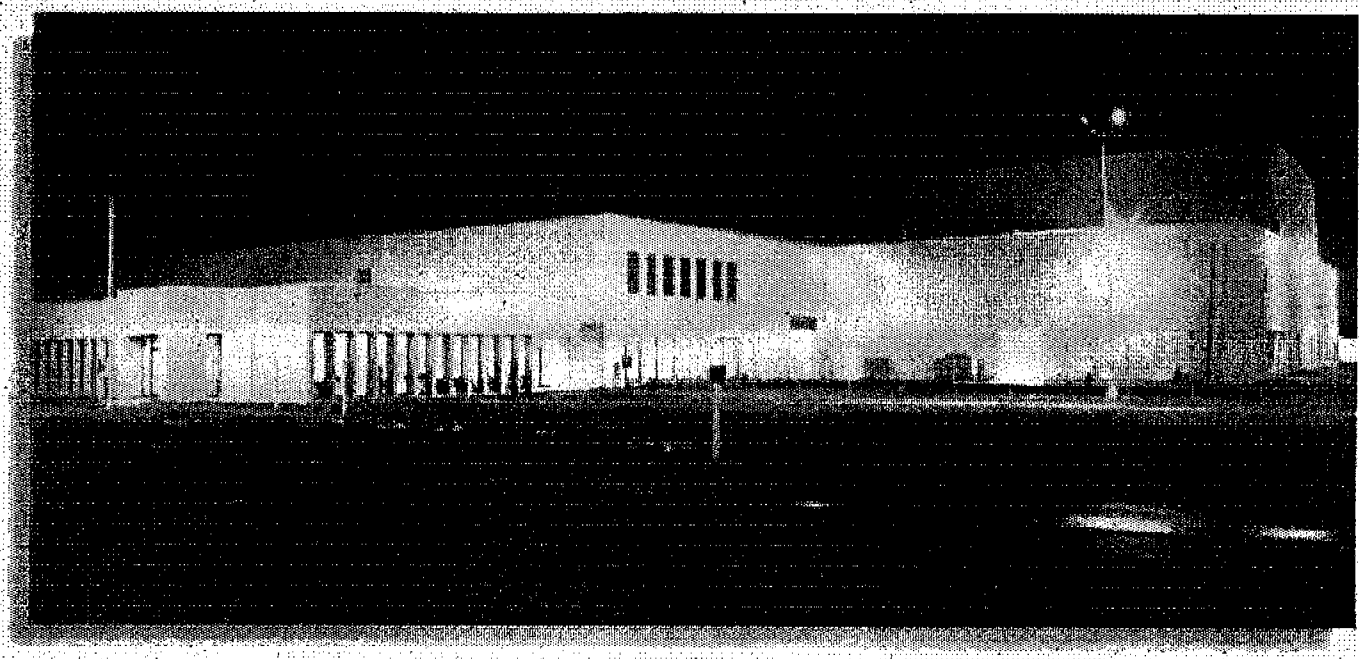
Attached are four (4) copies of Starmet's ***Draft Sampling and Analysis Plan for the Trench 1 Project***. One copy is for your review and three (3) copies are for distribution to the DOE for review and comment. All other Kaiser-Hill copies are being distributed directly as per listing below. Also reviewing this document concurrently are RMRS, DynCorp, and SSOC in order to maintain the project schedule. RMRS, DynCorp, and SSOC reviewers are receiving their copies under separate cover (copy attached). It is requested that all comments be submitted to RMRS in writing on the attached Review Comment Sheet by close of business on February 13, 1998.

Please contact Mark Burmeister at extension 5891 if you have any questions.

Attachments:
As Stated

Kaiser-Hill Distribution:
J. Bruse, B130
G. Geisinger, Horne Eng., T883C
W. Gillen, Tenera, B130
K. North, T130C
N. Stoner, B881

cc:
M. C. Burmeister
A. C. Crawford
J. E. Law
A. L. Primrose
Administrative Record
RMRS Records



STARMET
Metallurgical Excellence

Pyrophoric Depleted Uranium Source Removal from Rocky Flats Environmental Technology Site T-1 Trench (IHSS)

Sampling and Analysis Plan

January 28, 1998

REVIEW COMMENT SHEET

Page ___ of ___

Please review the attached procedure: _____ Number _____ Rev. _____ Draft _____ Title

Comment Due Date: _____

☐ Internal Review QA ____ Peer ____ ☐ Parallel Review ☐ Verification ☐ Validation ☐ Revalidation

General (G) comments require resolution but do not require resolution acceptance. Mandatory (M) comments require resolution and resolution acceptance. 1-88000-PP-004 provides complete definitions of General and Mandatory comments.

ITEM G or M	PAGE	SECTION OR STEP	COMMENT	RESOLUTION	Resolution accepted INIT/DATE

POC/Reviewer: (Comments not signed by Reviewer POC will be considered unofficial and not subject to resolution)

☐ No Comments

☐ This procedure revision has no impact or relevance to our discipline or organization and we waive need to concur. We acknowledge this concurrence waiver does not affect our responsibility to implement the requirements of this procedure when needed.

_____ Name _____ Signature

_____ Ext./Pager/Fax _____ Bldg./Dept _____ Date

Return to

_____ FAX _____ Name _____ X ____ Ext. _____ Location

Questions on content, please call the SME

_____ Name _____ Ext.

REVIEW COMMENT SHEET (continued)

Review comments for document: _____ Number _____ Rev. _____ Draft

ITEM G or M	PAGE	SECTION OR STEP	COMMENT	RESOLUTION	Resolution accepted INIT/DATE

POC/Reviewer: (Comments not signed by the Reviewer/POC will be considered as unofficial comments)

_____ Name _____ Signature _____ Date

Resolutions Accepted

_____ Initials _____ Date

STARMET
Metallurgical Excellence

Draft Sampling and Analysis Plan for Removal and Treatment of DU

Pyrophoric Depleted Uranium Source Removal

from

Rocky Flats Environmental Technology Site T-1 Trench (IHSS 108)

Submitted By:

Starmet Corporation

2229 Main Street

Concord, MA 01742

Table of Contents

List of Tables

LIST OF STANDARD OPERATING PROCEDURES

Procedure Number	Procedure Name
ROI-6.6	Use of Bicron FIDLER
4 S23-ROI-03.02	Radiological Requirements for Unrestricted Release
4-Q97-REP-1003	Radiological Evaluation for Unrestricted Release of Property/Waste
4-U50-REP-1006	Radiological Characterization of Bulk or Volume Material
2-G32-ER-ADM-08.02	Evaluation of ERM Data for Usability in Final Reports
5-21000-OPS-FO.1	Air Monitoring and Particulate Control
5-21000-OPS-FO.03	General Equipment Decontamination, Section 5.3, Cleaning Procedures for Stainless Steel or Metal Sampling Equipment.
5-21000-OPS-FO.13	Containerization, Preserving, Handling, and Shipping of Soil and Water Samples.
4-B29-ER-OPS-FO.14	Field Data Management
5-21000-OPS-FO.15	Photoionization Detectors and Flame Ionization Detectors
4-E42-ER-OPS-GT, GT-08	Surface Soil Sampling
L-6245-F	Sampling Procedure for Waste Characterization

1.0 Introduction

This Sampling and Analysis Plan (SAP) supports the accelerated Source Removal at the Trench 1 (T-1) Site, Individual Hazardous Substance Site (IHSS) 108, at the Rocky Flats Environmental Technology Site (RFETS) located near Golden, Colorado. The T-1 source removal project is described in the Proposed Action Memorandum (PAM) for the Source Removal at Trench 1, IHSS 108 (RMRS, 1997a).

Numerous waste streams and environmental media are expected to be generated during the remediation of T-1, including excavated soils, incidental waters, natural soils, drums containing waste materials, empty drums/drum fragments, debris, bulk liquids, sludges/still bottoms, cemented cyanide, treated waste (calcined depleted uranium [DU]), sanitary waste, high efficiency particulate air (HEPA) filters, and used personal protective equipment (PPE).

Starmet CMI has been contracted to treat the DU material excavated from the trench. Treatment will consist of calcining the material to remove its pyrophoric nature and will take place at Starmet's facility located in Barnwell, South Carolina.

This SAP was designed to support the characterization of specific waste streams to be generated during T-1 remediation. All of the materials covered under this SAP will be excavated from the trench by RMRS and transferred to Starmet at the sampling and inerting pad (SIP) located in the excavation structure. The activities to be outlined in the SAP include the characterization of:

- excavated DU material to facilitate shipment of the material to Starmet for treatment;
- lathe coolant (CimCool) drained from intact drums of DU to facilitate treatment at onsite facilities; and
- final treated DU material at Starmet to facilitate certification and shipment of the material to Envirocare or the Nevada Test Site (NTS) for disposal;
- excavated cemented cyanides to facilitate future management decisions; and
- excavated "still bottoms" to facilitate future management decisions.

Characterization of other materials generated during excavation of the trench, including segregated contaminated excavated soils, incidental waters, trash, debris, artifacts, and secondary wastes are covered under the "Sampling and Analysis Plan for the Source Removal at Trench 1" (RMRS, 1997).

Sampling and analytical testing activities will be conducted in accordance with the RMRS Quality Assurance Program Description (QAPD) (RMRS, 1996). Site and ambient air monitoring will also be conducted, however, these activities will be addressed in the T-1 health and safety plan (HASP) and in enhancements to the Rocky Flats Ambient Air Program (RAAMP).

Background

The T-1 site is located just northwest of the inner east gate, and about 40 feet south of the southeast corner of the Protected Area (PA) fence. The trench is approximately 250 feet long, 16 to 22 feet wide, and 10 feet deep. Historical documentation indicates DU metal chips (lathe and machine turnings) originating from Building 444 were packed with lathe coolant and buried in the west end and possibly the east end of T-1 in approximately 125 drums. The drums were reportedly double stacked end-on-end in the trench and covered with approximately 1 to 2 feet of soil. No written documentation exists for the contents of the center and east end of the trench. However, interviews with former site workers indicate that the eastern two-thirds of the trench is likely to contain trash consisting of pallets, paper, and other debris such as empty or crushed drums. Burial operations in the trench continued intermittently from November 1954 to December 1962.

Weed cutting activities conducted in October and November, 1982 unearthed the upper portion of two drums not adequately covered with fill material. Both drums were sampled and the liquids transferred to the RFETS Waste Processing for disposal. One drum is documented to have contained an oil/water mixture which yielded plutonium (Pu) analyses of 55 picocuries per liter (pCi/l) and uranium analyses of 2.3×10^5 pCi/l. The other drum is documented as having contained an oily sludge which yielded results of 4.3 picocuries per gram (pCi/g) Pu and 1.2×10^6 pCi/g uranium.

Since discovery of the drums, a site investigation has been conducted to evaluate the suspected area of impact and the potential contaminants. This investigation has included additional soil and groundwater samples at locations surrounding the trench area; a soil gas survey; an electromagnetic and ground penetrating radar survey; a review of historical aerial photographs; employee interviews; and a detailed records search. Because of the pyrophoric nature of DU, no excavation, borings, or disturbance of any kind has been permitted within the trench boundaries. Based on a review of these data, impacts of the T-1 contaminants are considered to be primarily confined to the soil within the trench boundaries. The T-1 contents are thought to consist of 125 drums of DU chips and lathe coolant, soil, and debris, mostly contaminated with depleted uranium and possibly volatile organic compounds (VOCs). In addition, 10 drums of cemented cyanide and one drum of "still bottoms" (recovered waste solvents or evaporated lathe coolant sludge) are suspected to be buried in T-1.

Additional information on the site background, investigation data, suspected radiological and chemical impacts, geology and hydrogeology have been collected and documented in the reports listed below:

- Historical Release Report for the Rocky Flats Plant (DOE, 1992);
- Phase II RFI/RI Report for Operable Unit 2 - 903 Pad, Mound, and East Trenches Area, Rocky Flats Environmental Technology Site (DOE, 1995);
- Proposed Action Memorandum for the Source Removal at the Trench T-1 Site, IHSS 108 (RMRS, 1997a);

- Trenches and Mound Site Characterization Report (RMRS 1996b)

The goals of this accelerated action are to (1) remove the drummed wastes and contaminated soil and debris exceeding Rocky Flats Cleanup Agreement (RFCA) (DOE, 1996) Tier I action levels for radionuclides and VOCs, and (2) disposition the materials. Specifically, the T-1 remedial action will involve excavation of an estimated 250 cubic yards (yd^3) of soil and drums of DU chips located at the west end and possibly the far east end of the trench. In addition, approximately 1,000 to 1,500 yd^3 of debris, contaminated soil, and other drummed wastes are suspected to be located throughout the remaining two-thirds of the trench.

The debris and soil materials will be tested and segregated based upon the RFCA Tier I and II action levels for radionuclides and VOCs. The contaminated soil, drummed material, and debris exceeding Tier I action levels will be segregated for either treatment at Starmet or direct packaging for offsite disposal. Treatment will consist of calcining radiologically contaminated DU chips that are believed to be pyrophoric. If material volumes are sufficient to warrant the action, low temperature thermal desorption (LTTD) would be used to treat VOC-contaminated soil and debris on-site. Following processing (either at Starmet for calcining or at RFETS for LTTD), the treated material will be packaged for off-site disposal with the other materials that do not require treatment. Materials not requiring treatment, but needing off-site disposal could include radiological and VOC contaminated wastes that exceed Tier II action levels but are below Tier I action levels. Depending upon the contaminants and corresponding concentrations, materials designated for offsite disposal will be classified as hazardous, low-level, or mixed low-level waste.

Excavated soil that does not exceed Tier II action levels may be returned to the trench as backfill material. Soil that exceeds Tier II action levels but is below Tier I action levels may be either disposed offsite, or contained in a geotextile membrane and stored in the trench for potential future retrieval. Additional backfill material and topsoil meeting cleanup criteria will be placed in the trench. The entire project area will be graded and seeded to promote natural drainage and runoff control.

2.0 Sampling and Data Quality Objectives

The data needed to support the objectives of the T-1 Source Removal project were determined using the process established in "Guidance for Data Quality Objective Process", EPA QA/G4 (EPA, 1994). The data gaps, study boundaries, and decisions are described in Sections 2 and 3 of this plan.

The primary objectives of this SAP are:

- To collect the required information necessary to address the hazardous and/or radioactive characteristics of the DU, graphite packing material, and any associated soil or debris material encountered, and use this information to determine whether this material is a viable candidate for shipment to and treatment at Starmet's facility; and

- To collect the required information necessary to address the hazardous and/or radioactive characteristics of any liquid (lathe coolant) drained from excavated intact drums of DU material, and use this information to determine the most appropriate waste handling, treatment, and disposal methods; and

- To collect the required information necessary to address the hazardous and/or radioactive characteristics of the treated DU material, and use this information to certify the material for disposal at the selected disposal facility; and

- To collect the required information necessary to address the hazardous and/or radioactive characteristics of the cemented cyanide encountered, and use this information to determine the most appropriate waste handling, treatment, and disposal methods; and

- To collect the required information necessary to address the hazardous and/or radioactive characteristics of the "still bottoms" encountered, and use this information to determine the most appropriate waste handling, treatment, and disposal methods.

The primary sampling and analytical needs to support the characterization of the materials covered in this SAP are as follows:

- Samples will be collected from the excavated DU materials and analyzed to determine the materials suitability for treatment at Starmet;

- Samples will be collected from any lathe coolant pumped from intact drums of DU chips and analyzed to determine the need for and suitability of the waste for treatment at the on-site Centralized Water Treatment Facility (CWTF).

- Samples will be collected of the treated material and analyzed to verify that treatment goals have been achieved. Samples from treated material designated for disposal as hazardous, low level, or mixed radioactive waste will be collected and laboratory tested for the specific parameters needed to support transportation and waste acceptance criteria (WAC).

- Samples will be collected of suspected cemented cyanide waste and analyzed for the specific parameters needed to support transportation and waste acceptance criteria.

- Samples will be collected from suspected still bottom waste and analyzed for the specific parameters needed to support transportation and waste acceptance criteria.

- Samples will be collected during decontamination of sampling equipment and either analyzed or screened with field instruments to verify achievement of release standards.

2.1 DQOs to Support Evaluation of Depleted Uranium Destined for Treatment at Starmet

It is anticipated that approximately 125 drums of depleted uranium will be encountered during excavation. Historical records and information obtained through employee interviews indicate that 125, 30-gallon and 55-gallon steel drums containing 10,000-20,000 kilograms of depleted uranium chips and turnings were disposed in T-1. Drum inventory lists, memoranda, and drum shipping logs documenting the placement of 85 drums in T-1 have been located. The inventory lists and former employee interviews indicate that the depleted uranium waste disposed in T-1 originated from Building 444. The uranium chips and turnings were coated with a water-soluble lathe coolant (trade name CimCool) during machining of parts. Several of the drums containing depleted uranium and lathe coolant oil are described in historical documents as 30-gallon drums placed inside 55 gallon drums and then over packed with graphite. The graphite is believed to have been excess material derived from waste graphite molds utilized during production operations in Building 444.

All DU material and associated soils, debris, and drum fragments that are received by Starmet will be assumed to be pyrophoric material. Samples will be collected to support a determination of the materials suitability for shipment to and treatment at Starmet. The data quality objective for excavated DU will be to collect data which supports an evaluation of the material with respect to Starmet's receiving requirements. Depending on the integrity of excavated drums of DU, the material will be placed in either an overpack drum, or into a 7A, Type A, steel "B-12" box. Materials placed into the overpack containers will likely include the DU chips and turnings, lathe coolant (for intact containers), and graphite used as packing material. Materials placed in B-12 boxes will likely include DU chips and turnings, drum fragments, graphite used as packing material, soils, and possibly small debris fragments.

2.1.1 Radiological Evaluation

In order for the excavated DU and associated material to be shipped to Starmet, containers must have a plutonium (Pu) concentration < 50 pCi/g. Samples will initially be collected from each container of material received at the SIP. This sampling frequency will continue for the first ten containers received at the SIP. If the material in the first ten containers is confirmed to have Pu concentrations < 50 Pci/g based on analytical results, sampling frequency will be reduced to every fifth container. Visual confirmation that the material is similar to the previously sampled containers will be performed to ensure that unknown material is not shipped to Starmet. Any variations in the visual appearance or packaging configurations of excavated materials will result in additional sampling frequency.

Gamma spectroscopy using a High Purity Germanium (HPGe) detector is expected to be used to evaluate radioisotope concentrations. Appendix 1 provides the assumptions used in determining Pu concentrations from americium-241 activities using gamma spectroscopy.

2.1.2 Chemical Evaluation

In order for the excavated DU and associated material to be shipped to Starmet, containers must contain no RCRA metals above the EPA regulatory threshold, and no VOCs or SVOCs above EPA thresholds as modified by any "contained in" project exception limits established by the Colorado Department of Health and the Environment (CDPHE). Samples will initially be collected from each container of material received at the SIP. This sampling frequency will continue for the first ten containers received. If the material in the first ten containers is confirmed to contain no RCRA metals above the EPA threshold and no VOCs or SVOCs above EPA thresholds as modified by CDPHE based on analytical results, sampling frequency will be reduced to every fifth container. Visual confirmation that the material is similar to the previously sampled containers will be performed to ensure that unknown material is not shipped to Starmet. Any variations in the visual appearance or packaging configurations of excavated materials will result in additional sampling frequency.

2.2 DQOs to support On-Site Treatment of Drained Lathe Coolant (CimCool)

There is a possibility that intact drums of uranium material will be discovered during the excavation of T-1. If these drums still contain CimCool, this liquid will be pumped into a tank located inside the structure. When the tank is full, or when all the drums have been excavated from the trench, the tank will be sampled to determine the properties of the drained liquid. Analysis will be conducted to determine the need for treatment of the waste at the on-site Centralized Water Treatment Facility (CWTF). Because the properties of CimCool are known, and the material is largely composed of water, it is assumed that the CimCool is a likely candidate for treatment at the CWTF. DQOs for the drained CimCool were developed to collect data that supports the determination of treatment parameters for the CWTF. These parameters have been identified as radionuclides including plutonium 239/240, americium-241, uranium isotopes, VOCs, SVOCs, PCBs, metals, cyanide, and standard water quality parameters. The existing CWTF SAP establishes sampling and analytical criteria for the lathe coolant following treatment at the CWTF.

2.3 DQOs to Support Evaluation of Final Treated Waste Form for Off-Site Disposal

The final waste form after treatment at the Starmet facilities will consist of treated DU and soil. The incoming waste will be screened and any soil, DU, or other material small enough to pass through the screen will be calcined. A visual examination of the material too large to pass through the screen will be conducted, and any DU fragments or other material suitable for calcining will be manually introduced into the calciner. The remainder of the material that does not pass through the screen is expected to consist of rocks, drum fragments, and other debris. This material will be packaged in metal waste boxes separately from the treated material.

The calcination process is designed to oxidize any pyrophoric materials contained in the wast Following calcination, the material will be introduced into a mixer where binders and other additives will be mixed. The waste mixture will then be briquetted to form pellets of sufficient particle size to meet the WAC of the receiving facilities.

Samples will be collected to support disposal of the briquetted waste. The data quality objective for the briquetted waste will be to collect data which supports a complete evaluation of the waste with respect to the receiving facilities WAC. It is anticipated that the disposal facilities include the Envirocare of Utah facility (Envirocare) and the Nevada Test Site (NTS). DU and associated material will be rendered non-pyrophoric in nature during the treatment process.

2.3.1 Radiological Evaluation

Gamma spectroscopy using a Utah certified laboratory is expected to be used to evaluate radioisotope concentrations. Appendix 1 provides the assumptions used in determining Pu concentrations from americium-241 activities using gamma spectroscopy.

2.3.2 Chemical Evaluation

Treated waste will be tested to facilitate offsite disposal criteria. In general, the analytical suite required for mixed or low level radioactive waste disposal at the Envirocare facility is sufficient to meet the analytical requirements of the NTS WAC or other facilities. The tests required to meet the offsite facility WAC are discussed further in Section 3.

Sampling frequency for offsite WAC:

At least three samples for chemical analyses will be taken randomly from each batch of treated material for evaluation of the waste stream with respect to the offsite facility WAC. EPA SW 846 (Chapter 10, *Sampling Methods*) stipulates that, for the purpose of evaluating solid wastes, the upper limit of the 80% Confidence Interval should be compared to action levels of interest for decision making (i.e., determination of waste as nonhazardous or hazardous).

Decisions and error limits:

If the sampling frequencies are adequate based on variances and mean values of the sample results (specifically EPA G-4 or Gilbert, 1987), sampling is complete; otherwise collect the newly required minimum number of samples for comparison with WAC. If the upper limit of the 80% Confidence Interval exceeds the appropriate WAC, the waste stream is designated as exceeding the appropriate WAC and will require reprocessing; otherwise the waste stream is designated as acceptable for offsite disposal.

2.4 DQOs to Support Evaluation of Excavated Cemented Cyanides for Off-Site Disposal

Cemented cyanide may be encountered during the remediation process. Historical information indicates that 10 containers of cemented cyanides were placed in the T-1 trench. Samples will be collected to support offsite disposal of the waste. The data quality objective for excavated cemented cyanides will be to collect data which supports a complete evaluation of the waste with

respect to the receiving facilities WAC. It is anticipated that the disposal facilities include Envirocare and NTS. Each container of suspected cemented cyanides received by Starmet will be sampled.

2.4.1 Radiological Evaluation

Gamma spectroscopy is expected to be used to evaluate radioisotope concentrations. Appendix I provides the assumptions used in determining Pu concentrations from americium-241 activities using gamma spectroscopy.

2.4.2 Chemical Evaluation

Cemented cyanide waste will be tested to facilitate offsite disposal. In general, the analytical suite required for mixed or low level radioactive waste disposal at the Envirocare facility is sufficient to meet the analytical requirements of the NTS WAC or other facilities. The tests required to meet the offsite facility WAC are discussed further in Section 3.

Sampling frequency for offsite WAC:

At least three samples for chemical analyses will be taken randomly from the excavated cemented cyanides for evaluation of the waste stream with respect to the offsite facility WAC. EPA SW-846 (Chapter 10, *Sampling Methods*) stipulates that, for the purpose of evaluating solid wastes, the upper limit of the 80% Confidence Interval should be compared to action levels of interest for decision making (i.e., determination of waste as nonhazardous or hazardous).

Decisions and error limits:

If the sampling frequencies are adequate based on variances and mean values of the sample results (specifically EPA G-4 or Gilbert, 1987), sampling is complete; otherwise collect the newly required minimum number of samples for comparison with WAC. If the upper limit of the 80% Confidence Interval exceeds the appropriate WAC, the waste stream is designated as exceeding the appropriate WAC and will require reprocessing; otherwise the waste stream is designated as acceptable for offsite disposal.

2.5 DQOs to Support Evaluation of Excavated Still Bottoms for Off-Site Disposal

Sludges and/or still bottoms may be encountered during the remediation process. Samples will be collected to support offsite disposal of the waste. The data quality objective for excavated still bottom waste will be to collect data which supports a complete evaluation of the waste with respect to the receiving facilities WAC. It is anticipated that the disposal facilities include Envirocare and NTS. Each container of suspected still bottoms received by Starmet will be sampled.

2.5.1 Radiological Evaluation

Gamma spectroscopy is expected to be used to evaluate radioisotope concentrations. Appendix I provides the assumptions used in determining Pu concentrations from americium-241 activities using gamma spectroscopy.

2.5.2 Chemical Evaluation

Still bottom waste will be tested to facilitate offsite disposal criteria. In general, the analytical suite required for mixed or low level radioactive waste disposal at the Envirocare facility is sufficient to meet the analytical requirements of the NTS WAC or other facilities. The tests required to meet the offsite facility WAC are discussed further in Section 3.

Sampling frequency for offsite WAC:

At least three samples for chemical analyses will be taken randomly from the excavated still bottoms for evaluation of the waste stream with respect to the offsite facility WAC. EPA SW-846 (Chapter 10, *Sampling Methods*) stipulates that, for the purpose of evaluating solid wastes, the upper limit of the 80% Confidence Interval should be compared to action levels of interest for decision making (i.e., determination of waste as nonhazardous or hazardous).

Decisions and error limits:

If the sampling frequencies are adequate based on variances and mean values of the sample results (specifically EPA G-4 or Gilbert, 1987), sampling is complete; otherwise collect the newly required minimum number of samples for comparison with WAC. If the upper limit of the 80% Confidence Interval exceeds the appropriate WAC, the waste stream is designated as exceeding the appropriate WAC and will require reprocessing; otherwise the waste stream is designated as acceptable for offsite disposal.

3.0 Sample Collection and Analysis

The sampling requirements for each sample event to be performed under this SAP are described in the following sections. To fully understand the rationale and methodology for collecting samples, these sections are to be reviewed and used along with the appropriate subsections of Section 2 (the DQOs) of this SAP.

Circumstances may be encountered in which the field supervisor determines that samples not specified in this SAP are required. In conjunction with the sample coordinator, and project health and safety personnel, additional samples may be collected based on this professional judgment. Rationale for collecting such samples will be described in detail on the sample log sheets used for the project. Changes to this SAP will not necessarily be required in such events. In addition, if conditions are encountered in the field which make the use of a procedure unsafe or inappropriate for the task at hand, the specified procedures may be modified or replaced as long as the modification or replacement procedure is justified and detailed in the sample log sheets, and the resulting data is comparable and adequate to meet the objectives of the project.

All activities will be conducted in accordance with the Activity Hazards Analysis prepared for this project. Unanticipated hazards or conditions encountered during this project will be managed in accordance with this RMRS policy statement:

"In the event unanticipated hazards or conditions are encountered, the project activities will pause to assess the potential hazard or condition. The potential hazard or condition will be evaluated to determine the severity or significance of the hazard or condition. Based on this initial evaluation, a determination will be made whether to proceed with controls currently in place, or curtail operations to address the unexpected hazard or condition. Concurrence to proceed down the selected path must be obtained from the RMRS Vice President or their designee. In addition, the resumption of field activities involving radiological issues will be in accordance with article 345 of the RFETS Radiological Control Manual."

It is important to note that the "unanticipated hazards or conditions" described in the policy statement do not replace conditions which require emergency response, rather they ensure that all work is performed based on an informed approach in regards to all hazards.

Each sampling event is described according to the anticipated sequence of field operations and the constituents of concern. Tables have been prepared for each sampling event to describe, as completely as possible, analytical methods, containers, and preservation criteria. Standard operating procedures (SOPs), specifically L-6245-F, *Sampling Procedure for Waste Characterization*, will be followed for all sample collection activities.

3.1 Material Screening and Sampling

As materials are excavated from T-1, visual inspection and field screening will be performed by qualified health and safety specialists (HSSs) and/or radiation control technicians (RCTs). Field screening will be used to assess pyrophoric characteristics, low-energy radiation, and total

organic vapor. The primary purpose of the screening effort is to assign the necessary segregation and handling techniques to material as it is removed from the trench. This will minimize the mixing of waste streams and associated waste disposal costs. After materials are segregated into manageable stockpiles or containerized, samples will be collected for laboratory analysis to assess the contaminant concentrations/activities and to determine the necessary treatment and/or disposal methods. It is expected that material screening will be conducted on all environmental media and waste materials excavated from the trench.

Drums of material and soil/debris observed to contain DU turnings will be placed in a closed lid steel container (an overpack drum or B-12 box, depending on excavated container integrity) adjacent to the open trench as excavation is conducted. The over pack container or B-12 box is intended to safely containerize the potentially pyrophoric materials by reducing exposure to the open atmosphere and protect workers from possible flaring. The overpack or box will be transported to the SIP for sample collection and inerting. Field screening of materials will be conducted of materials while contained in the overpack or B-12 box.

3.1.1 Sample Screening

Because of the hazards associated with entry into steep sided, unsupported excavations, field personnel will not be permitted to enter the excavation to screen materials or obtain samples. In general, screening will be conducted from a distance for unknown materials, such as sealed drums, or by using grab samples collected from the excavator bucket. The excavated material (soil or debris) contained in the bucket will be elevated from inside the trench to the ground surface for access by field personnel. Loose soil and debris will be collected from the central portion of the bucket, avoiding contact with the sides or blade, and transferred to the appropriate sample containers using a stainless steel spoon, or similar device. Each sample container will be filled as completely as possible to assure a sufficient quantity of material for analysis. The primary screening methods and contaminants of concern are described in the Sampling and Analysis Plan for the Source Removal at Trench 1 (RMRS, 1997b).

3.2 Sampling of Depleted Uranium to Evaluate Suitability for Treatment at Starmet

As described above, DU material will be field screened for radiological, pyrophoric, and organic vapor concentrations as a preliminary step for determining material characteristics. Samples will be collected to evaluate the excavated material's suitability for shipment to and treatment at Starmet. Excavated DU material will be required to meet the DQOs described in Section 2.1. These DQOs were established to meet the criteria for acceptance of the material at Starmet. Table 3-1 lists the analytical parameters necessary to evaluate the material with respect to Starmet's material receiving criteria.

3.2.1 Radiological Sampling

Isotopic analysis for radioactivity will be performed utilizing on-site gamma spectroscopy facilities (HPGe detector) for the determination of plutonium content. The results of the analysis of each sample will be assumed to be representative of the material in the container and extrapolated to estimate the total activity of the material type for material shipment purposes.

3.2.2 Chemical Sampling

Material samples will be collected to identify RCRA hazardous materials. Total analyses will be performed as a replacement for the Toxic Characteristic Leaching Procedure (TCLP) in an effort to minimize analytical costs.

Samples will be analyzed for 8 RCRA metals in addition to Cu, Zn, Sb, Ni, Ti, and V by EPA's Test Methods for Evaluation of Soil Waste Physical/Chemical Methods (SW-846) Method 6010A with the exception of Hg which will be performed utilizing Method 8270B. Volatiles analysis shall be performed according to Methods 8240B/8260A. Semivolatiles analysis will be performed according to Method 8270B. Reactive cyanide and reactive sulfide will also be performed as specified in Chapter 7 of SW-846.

3.2.3 Sampling Strategy

Samples will be collected from the container received by Starmet at the SIP. New disposable sampling spoon/scoops, or decontaminated stainless steel spoons or scoops will be used. The following sections describe the strategy planned for sampling of intact or nominally intact containers (DU received in overpack containers) and for completely degraded containers (DU received in B-12 boxes).

3.2.3.1 Sampling Strategy for Intact or Nominally Intact Drums

Intact or nominally intact drums will be placed into an overpack drum and transferred to Starmet. Starmet will take samples of the material at the SIP. Drum lids will be removed or sufficiently opened prior to transfer of the material, so that the sample technician can reach into the drum to obtain a sample. The sample technician will collect a scoop- or spoonful of material from the container. To the extent practical, the scoop or spoonful will be obtained from beneath the top surface of the exposed material.

3.2.3.2 Sampling Strategy for Completely Degraded Drums

Completely degraded drums will be placed into a B-12 box prior to transfer of the material to Starmet. Boxes will likely contain DU, graphite, soil, as well as some small drum fragments. Material received in boxes will be assumed to be homogeneous, and samples will be obtained by collecting a spoon- or scoopful of material and placing it in the appropriate sampling container. If the material is visually segregated, the sample technician will obtain a biased sample of what is visually identifiable uranium material.

Table 3.1 Excavated Depleted Uranium Analyses

Analytical Method	Analyte	# of Samples	Container	Preservative	Holding Time
HPGe	Plutonium, Americium	33+	250 mL wide mouth glass jar	None	6 months
SW-846 Method 6010A, and 7000 Series	8 RCRA Metals – Cu, Zn, Sb, Be, Ni, Ti, Hg and V	33+	1 x 8 oz. wide mouth glass jar, Teflon lined closure	Cool, 4° C	180 days to extraction, except Hg: 28 days from extraction to analysis
SW-846 Method 8240B/8260A	Volatile Organic Compounds	33+	125 mL wide mouth glass jar, Teflon lined lid	Cool, 4° C	14 days
SW-846 Method 8270B	Semi-Volatile Organic Compounds	33+	500 mL wide mouth glass jar, Teflon lined lid	Cool, 4° C	14 days until extraction, 40 days after extraction
SW-846 Method 8240B/8260A (Trip Blanks)	Volatile Organic Compounds	33+	2 x 40 mL glass, Teflon lined septa lid	Cool, 4° C HCl pH<2	14 days
SW-846 Method 9045B	Soil pH	33+	1 x 8 oz. wide mouth glass jar, Teflon lined enclosure	Cool, 4° C	ASAP (up to 14 days)
SW-846 Chapter 7	Reactivity (HCN, H_2S)	33+	1 x 8 oz. wide mouth glass jar	Cool, 4° C	7-14 days

3.5 Sampling to Support On-Site Treatment of Drained Lathe Coolant (CimCool)

There is a possibility that intact drums of uranium material will be discovered during the excavation of T-1. If these drums still contain CimCool, this liquid will be pumped into a tank located inside the structure. When the tank is full, or when all the drums have been excavated from the trench, the tank will be sampled to determine the properties of the drained liquid. Analysis will be conducted to determine the need for treatment of the waste at the on-site CWTF. Because the properties of CimCool are known, and the material is largely composed of water, it is assumed that the CimCool is a likely candidate for treatment at the CWTF. Data requirements for the drained CimCool include determination of treatment parameters for the CWTF. These parameters have been identified as radionuclides including plutonium 239/240, americium-241, uranium isotopes, VOCs, SVOCs, PCBs, metals, cyanide, and standard water quality parameters.

The analyses specified in Table 3.2 are required by the CWTF personnel to assist in the effective treatment of the liquids. Samples may be collected using the most convenient method available such as with a bailer, peristaltic pump or similar device from the top fill hatch of the tank(s) used to store the drained CimCool, or directly out of the tanks drain valve. If a bailer is used, a bottom decanting control device may be used to fill the VOC sample vials. Other sample material may be composited in a larger container as the material is drawn from the tanks, before placement in the appropriate sample containers. The actual sampling method will be described in the field log book. Quality control samples (e.g., trip blanks, duplicates) are not required by the CWTF personnel for this activity. The number of samples is dependent upon the number of intact containers encountered that contain lathe coolant.

Table 3.2 Drained Lathe Coolant (CimCool) Analyses

Analytical Methods	Analyte	# of Samples	Container	Preservative	Holding Time	Comment
Gas proportional counting	Radiological Screen (gross α & β)	TBD	1-125 ml poly	HNO_3 to pH<2	6 months	
Uranium and Thorium Isotopic	Uranium-, Thorium-isotopes		2-4 L poly	HNO_3 to pH<2	6 months	
Gamma Spectrometry	Plutonium, Americium		Combine with U, T Isotopic	HNO_3 to pH<2	6 months	
SW-846 Method 8240A/8260A	Volatile Organic Compounds		3-40 ml glass vials	HCl to pH<2, Cool, 4° C	14 days	
SW-846 Method 8270B	Semi-Volatile Organic Compounds		3-1L amber glass	Cool, 4° C	7 days until extraction, 40 days after extraction	
SW-846 Method 8080/8081	PCBs		2-1L amber glass	Cool, 4° C	7 days until extraction, 40 days after extraction	
SW-846 Method 6010A and 7000 series	Total Target Analyte List (TAL) Metals		1-1L poly	HNO_3 to pH<2, Cool, 4° C	6 months, except mercury - 28 days	CLP-TAL DL required
335 Series Methods, or SW-846 Method 9010A/9012	Total Cyanide		1-1L poly	NaOH to pH>12, Cool, 4° C	14 days	DL of 0.005 mg/L required

Table 3.2 Drained Lathe Coolant (CimCool) Analyses (continued)

Analytical Methods	Analyte	# of Samples	Container	Preservative	Holding Time	Comment
SW-846 Method 9060 or 415 Series Methods	Total Organic Carbon	TBD	500 mL poly or glass	H_2SO_4 to pH<2, Cool, 4° C	28 days	
SW-846 353 Series Method	Nitrate & Nitrite - N		Combine with TOC	H_2SO_4 to pH<2, Cool, 4° C	28 days	
SW-846 300 Series or 9000 Series Methods	Sulfate		1-L poly or glass	Cool, 4° C	28 days	
SW-846 300 Series or 9000 Series Methods	Fluoride		Combine with Sulfate	None	28 days	
SW-846 300 Series or 9000 Series Methods	Chloride		Combine with Sulfate	None	28 days	
SW-846 160 Series Methods	Solids (Total and Susp.)		Combine with Sulfate	Cool, 4° C	7 days	
ASTM Standard D-93-79 or D-93-80 or D-3278-78 or SW846 1010	Ignitability and Flashpoint		8 oz. glass	Cool, 4° C	28 days	
90300 or 376.2 Series Methods	Sulfide		Combine with Sulfate	pH>12, NaOH and Zinc Acetate preservative (may be added at lab)	7 days	

3.4 Sampling to Support Evaluation of Final Treated Waste Form Destined for Off-Site Disposal

Final treated waste forms created by calcining of DU and soil at Starmet will be required to meet the DQOs described in Section 2.3. These DQOs were established to meet the analytical WAC requirements for disposal as LLW at Envirocare or NTS. The Envirocare WAC requires that all chemical analysis be conducted at a Utah Department of Health, Division of Laboratory Services, certified laboratory. (Note: this is not required for geotechnical or radiochemical analyses.) Table 3.3 lists the analytical parameters necessary to evaluate the final waste with respect to the WAC.

The sampling approach for the final waste form will involve collecting a sample from each mixer batch of treated material. The sample will be collected after the material is briquetted, which is the final waste form. The briquetter will be operated in batch mode, and each batch of waste from the mixer will be traceable as a batch after briquetting. One sample set from each batch will be representative because the mixing process will homogenize each waste batch.

The debris and other material that was too large to pass through the separation screen will be segregated from the other incoming waste and will be packaged in metal waste boxes. This material will have the same waste characterization as the debris from Trench T-1, and will not require resampling. The material will be returned to RFETS for disposition.

3.4.1 Radiological Sampling

Isotopic analysis for radioactivity will be performed utilizing gamma spectroscopy to determine the concentrations of gamma-emitting radionsotopes. A sample will be collected from each batch for analysis.

3.4.2 Chemical Sampling

Material samples will be collected to identify RCRA hazardous materials. Total and Toxic Characteristic Leaching Procedure (TCLP) will be performed. One sample will be collected from each batch of treated DU waste at Starmet.

Samples will be analyzed for 8 RCRA metals in addition to Cu, Zn, Sb, Ni, Ti, and V by EPA's Test Methods for Evaluation of Soil Waste Physical/Chemical Methods (SW-846) Method 6010A with the exception of Hg which will be performed utilizing Method 8270B. Volatiles analysis shall be performed according to Methods 8240B/8260A. Semivolatiles analysis will be performed according to Method 8270B. Reactive cyanide and reactive sulfide will also be performed as specified in Chapter 7 of SW 846.

3.4.3 Sampling Strategy

Samples will be collected from each batch of treated waste at Starmet. New disposable sampling spoons/scoops, or decontaminated stainless steel spoons/scoops will be used. Samples will either be collected as the material is being placed into the shipping container, or immediately following

placement of material into the container. Because the waste will be homogeneous following treatment, samples will be representative of the entire batch of treated waste.

Table 3.3 Final Treated Waste Analyses

Analytical Method	Analyte	# of Samples	Container	Preservative	Holding Time
Gamma Spectroscopy (offsite)	gamma emitting radioisotopes		VHO - enough for 1000 g of sample	None	6 months
Isotopic Analysis	Uranium, Thorium, Americium, and Plutonium isotopes		250 mL wide mouth glass jar	None	6 months
SW-846 Chapter 7	Reactive Sulfide		Combine with TCLP jar	Cool, 4° C	7 days
	Reactive Cyanide				14 days
SW-846 Method 9045	Soil pH or corrosivity		Combine with TCLP jar	Cool, 4° C	ASAP (up to 14 days)
SW-846 Method 8240B/8260A	Volatile Organic Compounds		250 mL wide mouth glass jar Teflon lined lid	Cool, 4° C	14 days
SW-846 Method 8270B	Semi-Volatile Organic Compounds		1 x 8 oz. wide mouth glass jar, Teflon lined enclosure	Cool, 4° C	14 days until extraction, 40 days after extraction
SW-846 Method 8240B/8260A (Trip Blanks)	Volatile Organic Compounds		2 x 40 mL VOA vials - Teflon lined septa lids	Cool, 4° C HCl pH<2	14 days
TCLP SW-846 1311 (extraction)	8 TCLP metals + Cu, Zn, Sb, Ni, Tl, V, Hg (Method 6010A, except Hg, method 7470) all analysis with detection levels < RCRA UTS. Note - use Method 7841 for Tl if can't meet UTS levels with Method 6010A		1 L wide mouth glass jar with Teflon lined lid, as appropriate, so that the TCLP can be combined with other samples listed in this table	Cool, 4° C	180 days to extraction, 180 days from extraction to analysis, except Hg - 28 days to extraction, 28 days from extraction to analysis
	TCLP Semivolatiles (Method 8270/8270A)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Chlorinated Herbicides (Method 8150)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Organochlorine Pesticides (Method 8081A)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Volatiles (Meth. 1311/8240A/8260A)				14 days to extraction, 14 days from extraction to analysis
SW-846 Method 8270B	Semivolatile Organic Compounds		500 mL wide mouth glass jar with Teflon lid	Cool, 4° C	14 days to extraction, 14 days from extraction to analysis
Determined by Envirocare	Envirocare evaluation "fingerprint" samples		2 pounds, as required	None	None

3.5 Cemented Cyanides

Suspected cemented cyanides will be sampled to facilitate direct offsite disposal. This waste will be required to meet the DQOs described in Section 2.4. The DQOs were established to meet the analytical WAC requirements for either disposal as LDR compliant mixed waste at Envirocare or as LLW at Envirocare or NTS. Table 3.4 lists the analytical parameters necessary to evaluate the cemented cyanides with respect to the WAC.

3.5.1 Radiological Sampling

Isotopic analysis for radioactivity will be performed utilizing gamma spectroscopy facilities to determine the concentrations of gamma-emitting radioisotopes. A representative sample will be collected from each container for analysis.

3.5.2 Chemical Sampling

Material samples will be collected to identify RCRA hazardous materials. Total analyses and TCLP will be performed. One sample will be collected from each container received by Starmet.

Samples will be analyzed for 8 RCRA metals in addition to Cu, Zn, Sb, Ni, Ti, and V by EPA's Test Methods for Evaluation of Soil Waste Physical/Chemical Methods (SW-846) Method 6010A with the exception of Hg which will be performed utilizing Method 8270B. Volatiles analysis shall be performed according to Methods 8240B/8260A. Semivolatiles analysis will be performed according to Method 8270B. Reactive cyanide and reactive sulfide will also be performed as specified in Chapter 7 of SW-846.

3.5.3 Sampling Strategy

Samples will be collected from the container received by Starmet at the SIP. New disposable sampling spoons or scoops, or decontaminated stainless steel spoons or scoops will be used. The following sections describe the strategy planned for sampling of intact or nominally intact containers (cemented cyanides received in overpack containers) and for completely degraded containers (cemented cyanides received in B-12 boxes).

3.5.3.1 Sampling Strategy for Intact or Nominally Intact Drums

Intact or nominally intact drums will be placed into an overpack drum and transferred to Starmet. Starmet will take samples of the material at the SIP. Drum lids will be removed or sufficiently opened prior to transfer of the material, so that the sample technician can reach into the drum to obtain a sample. The sample technician will collect a scoop- or spoonful of material from the container. To the extent practical, the scoop- or spoonful will be obtained from beneath the top surface of the exposed material.

3.5.3.2 Sampling Strategy for Completely Degraded Drums

Completely degraded drums will be placed into a B-12 box prior to transfer of the material to Starmet. Boxes will likely contain cemented cyanide, soil, as well as some small drum fragments. Material received in boxes will be assumed to be homogeneous, and samples will be

obtained by collecting a spoon- or scoopful of material and placing it in the appropriate sampling container. If the material is visually segregated, the sample technician will obtain a biased sample of what are visually identifiable cemented cyanides.

Table 3.4 Excavated Cemented Cyanide Analyses

Analytical Method	Analyte	# of Samples	Container	Preservative	Holding Time
Gamma Spectroscopy (offsite)	gamma emitting radioisotopes	10+	TBD - enough for 1000 g of sample	None	6 months
Isotopic Analysis	Uranium, Thorium, Americium, and Plutonium isotopes	10+	250 mL wide mouth glass jar	None	6 months
SW-846 Chapter 7	Reactive Sulfide	10+	Combine with TCLP jar	Cool, 4° C	7 days
	Reactive Cyanide				14 days
SW-846 Method 9045	Soil pH or corrosivity	10+	Combine with TCLP jar	Cool, 4° C	ASAP (up to 14 days)
SW-846 Method 8240B/8260A	Volatile Organic Compounds	10+	250 mL wide mouth glass jar, Teflon lined lid	Cool, 4° C	14 days
SW-846 Method 8270B	Semi-Volatile Organic Compounds	10+	1 x 8 oz. wide mouth glass jar, Teflon lined enclosure	Cool, 4° C	14 days until extraction, 40 days after extraction
SW-846 Method 8240B/8260A (Trip Blanks)	Volatile Organic Compounds	10+	2 x 40 mL VOA vials - Teflon lined septa lids	Cool, 4° C HCl pH<2	14 days
TCLP SW-846 1311 (extraction)	8 TCLP metals = Cu, Zn, Sb, Ni, Tl, V, Hg (Method 6010A, except Hg, method 7470, all analysis with detection levels < RCRA UTS. Note - use Method 7841 for Tl if can't meet UTS levels with Method 6010A	10+	1 L wide mouth glass jar with Teflon lined lid, as appropriate, so that the TCLP can be combined with other samples listed in this table	Cool, 4° C	180 days to extraction, 180 days from extraction to analysis, except Hg - 28 days to extraction, 28 days from extraction to analysis
	TCLP Semivolatiles (Method 8270/8270A)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Chlorinated Herbicides (Method 8150)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Organochlorine Pesticides (Method 8080)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Volatiles (Method 8240A/8260)				14 days to extraction, 14 days from extraction to analysis
SW-846 Method 8270B	Semivolatile Organic Compounds	10+	500 mL wide mouth glass jar with Teflon lid	Cool, 4° C	14 days to extraction, 14 days from extraction to analysis
Determined by Environcare	Environcare evaluation (fingerprint) samples	10+	2 pounds, as received	None	None

3.6 Still Bottoms

Suspected still bottoms will be sampled to facilitate direct offsite disposal. This waste will be required to meet the DQOs described in Section 2.4. These DQOs were established to meet the analytical WAC requirements for either disposal as LDR compliant mixed waste at Envirocare or as LLW at Envirocare or NTS. Table 3.5 lists the analytical parameters necessary to evaluate the still bottoms with respect to the WAC.

3.6.1 Radiological Sampling

Isotopic analysis for radioactivity will be performed utilizing gamma spectroscopy to determine the concentrations of gamma emitting radioisotopes. A representative sample will be collected from each container for analysis.

3.6.2 Chemical Sampling

Material samples will be collected to identify RCRA hazardous materials. Total analyses and TCLP will be performed. One sample will be collected from each container received by Starmet.

Samples will be analyzed for 8 RCRA metals in addition to Cu, Zn, Sb, Ni, Ti, and V by EPA's Test Methods for Evaluation of Soil Waste Physical/Chemical Methods (SW-846) Method 6010A with the exception of Hg which will be performed utilizing Method 8270B. Volatiles analysis shall be performed according to Methods 8240B/8260A. Semivolatiles analysis will be performed according to Method 8270B. Reactive cyanide and reactive sulfide will also be performed as specified in Chapter 7 of SW-846.

3.6.3 Sampling Strategy

Samples will be collected from the container received by Starmet at the SIP. New disposable sampling spoons or scoops, or decontaminated stainless steel spoons or scoops will be used. The following sections describe the strategy planned for sampling of intact or nominally intact containers (still bottoms received in overpack containers) and for completely degraded containers (still bottoms received in B-12 boxes).

3.6.3.1 Sampling Strategy for Intact or Nominally Intact Drums

Intact or nominally intact drums will be placed into an overpack drum and transferred to Starmet. Starmet will take samples of the material at the SIP. Drum lids will be removed or sufficiently opened prior to transfer of the material, so that the sample technician can reach into the drum to obtain a sample. The sample technician will collect a scoop- or spoonful of material from the container. To the extent practical, the scoop- or spoonful will be obtained from beneath the top surface of the exposed material.

3.6.3.2 Sampling Strategy for Completely Degraded Drums

Completely degraded drums will be placed into a B-12 box prior to transfer of the material to Starmet. Boxes will likely contain still bottoms, soil, as well as some small drum fragments.

Material received in boxes will be assumed to be homogeneous, and samples will be obtained by collecting a spoon- or scoopful of material and placing it in the appropriate sampling container. If the material is visually segregated, the sample technician will obtain a biased sample of what are visually identifiable still bottoms.

Table 3.5 Excavated Still Bottoms Analyses

Analytical Method	Analyte	# of Samples	Container	Preservative	Holding Time
Gamma Spectroscopy (offsite)	gamma emitting radioisotopes	1*	7.3D - enough for 1000 g of sample	None	6 months
Isotopic Analysis	Uranium, Thorium, Americium, and Plutonium isotopes	1*	250 mL wide mouth glass jar	None	6 months
SW-846 Chapter 7	Reactive Sulfide	1*	Combine with TCLP jar	Cool, 4° C	7 days
	Reactive Cyanide				14 days
SW-846 Method 9045	Soil pH for corrosivity	1*	Combine with TCLP jar	Cool, 4° C	ASAP (up to 14 days)
SW-846 Method 8240B/8260A	Volatile Organic Compounds	1*	250 mL wide mouth glass jar Teflon lined lid	Cool, 4° C	14 days
SW-846 Method 8270B	Semi-Volatile Organic Compounds	1*	1 x 8 oz. wide mouth glass jar, Teflon lined enclosure	Cool, 4° C	14 days until extraction, 40 days from extraction
SW-846 Method 8240B/8260A (Trip Blanks)	Volatile Organic Compounds	1*	2 x 40 mL VOA vials - Teflon lined septa lids	Cool, 4° C HCl pH<2	14 days
TCLP SW-846 1311 (extraction)	8 TCLP metals = Cu, Zn, Sb, Ni, Tl, V, Hg (Method 6010A, except Hg, method 7470) all analyses with detection levels < RCRA UTS Note - use Method 7841 for Tl if can't meet UTS levels with Method 6010A	1*	1 L wide mouth glass jar with Teflon lined lid, as appropriate, so that the TCLP can be combined with other samples listed in this table	Cool, 4° C	180 days to extraction, 180 days from extraction to analysis, except Hg - 28 days to extraction, 28 days from extraction to analysis
	TCLP Semivolatiles (Method 8270/8270A)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Chlorinated Herbicides (Method 8150)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Organochlorine Pesticides (Method 8080)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	TCLP Volatiles (Method 8240A/8260)				14 days to extraction, 14 days from extraction to analysis
SW-846 Method 8270B	Semivolatile Organic Compounds	1*	500 mL wide mouth glass jar with Teflon lid	Cool, 4° C	14 days to extraction, 14 days from extraction to analysis
Determined by Excavator	Undisturbed overburden 'fingerprint' samples	1*	2 options, as required	None	None

3.7 Quality Control Sampling

This section states the general approach for QC sample collection for this project. Additional details regarding these samples are given in the tables of the respective sections of this document.

The following types of QC samples are being collected to support the objectives of this SAP:

Duplicates: Duplicate (collocated) samples will not be required to support the sampling objectives of this SAP.

Equipment rinsate blanks: These samples will be prepared by collecting distilled water, poured over decontaminated sampling equipment, between the collection of regular VOC samples. These blanks will be submitted with the regular samples. These samples will be preserved to a pH<2 with hydrochloric acid (HCl), and will be analyzed for VOCs, as appropriate.

Trip blanks: Trip blank samples will be shipped with coolers sent off-site containing samples being analyzed for VOCs. Trip blank samples will be pre-prepared (not in the field). The trip blank will be prepared using carbon filtered water and preserved to a pH>2 with HCl.

All VOC samples sent to a laboratory for analysis will be analyzed according to the U.S. EPA SW-846 method 8260A (EPA, 1992).

4.0 Sample Designation

Each sample will be assigned a unique number in accordance with the RFETS Analytical Projects Office (APO) requirements. The unique sample number will be broken down into the following three parts:

- The Report Identification Number (RIN)
- The Event Number
- The Bottle Number

The first part of the number will be the RIN which is assigned by the APO. The RIN is used by the APO to track and file analytical data. Unique RINs will be assigned to different types of sampling events (e.g., samples for shipment to Starmet vs. samples for offsite disposal). The RIN will be a seven digit alpha-numeric code starting with "98" for 1998. The RIN will be followed by a dash "-" and then the event number. The event number is a three digit code, starting with "001" under the RIN, and will be sequential. Each typical sample location will have a unique event number under the RIN. QC samples will have unique event numbers to support a "blind" submittal to the analytical laboratories. The event number will be followed by a period "." and then the sequential bottle number. The bottle number will be used to identify individual sample containers under the same location (same event number).

In addition to the sample numbering scheme above, additional information will be collected with respect to each sample. This additional information will include:

- Sample type
- Location code
- QC code

Table 4.1 lists examples of the sample types, and location code blocks for the T-1 Site Source Removal Project.

Table 4.1 T-1 Sample Types and Location Codes

Sample Type	Sample Type Code	Location Code
Excavated DU	EU	Use RFETS Waste and Environmental Management System (WEMS) Container Number
Drained Lathe Coolant	LC	Use RFETS WEMS Container Number
Treated DU	TU	Use RFETS WEMS Container Number
Excavated Cemented Cyanides	CC	Use RFETS WEMS Container Number
Excavated Still Bottoms	SB	Use RFETS WEMS Container Number

QC Codes will include the following:

REAL: Regular Sample
DUP: Duplicate Sample
RINSE: Rinsate Sample
TRIP: Trip Blank Sample

5.0 Sampling Equipment and Procedures

This section describes the sample handling, documentation, and quality assurance requirements necessary to support the successful completion of this project.

5.1 Sample Handling Procedures

Samples collected for laboratory analysis will follow the Environmental Management Department (EMD) Operating Procedures Volume I, Field Operations 5-21000 OPS FO.13, *Containerization, Preserving, Handling, and Shipping of Soil and Water Samples.* All water samples will be collected without the use of filters. When reusable sampling equipment is used, the equipment will be decontaminated according to EMD Operating Procedure 5-21000 OPS-FO.03, *General Equipment Decontamination, and Section 5.3, Cleaning Procedures for Stainless Steel or Metal Sampling Equipment.*

5.2 Documentation

Field data shall be documented on the forms developed for the T-1 project, and in accordance with the referenced procedure. The originator shall authenticate (legibly sign and date) each completed hard copy of the data. A peer reviewer, someone other than the originator, shall perform a peer review of each hard copy of data. The peer reviewer shall authenticate (legibly sign and date) each hard copy completed by the originator. Any modifications shall be lined-through, initialed, and dated by the reviewer in indelible ink. Data planned for computerized reduction and analysis shall be entered into an electronic form in accordance with the procedure 4-B29-ER-OPS-FO.14, *Field Data Management.*

5.3 Quality Assurance

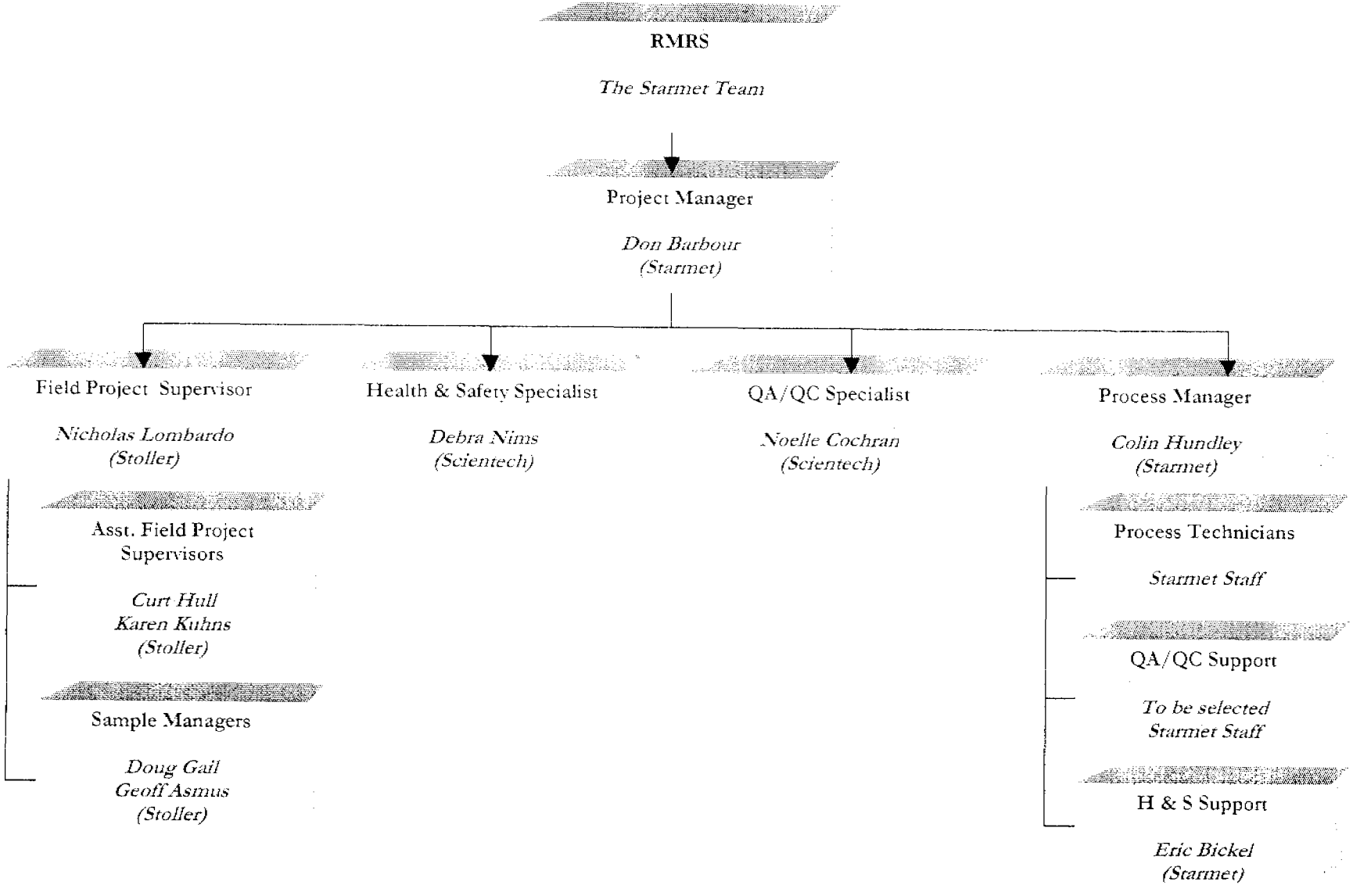
Analytical data collected in support of the T-1 remediation will be evaluated using the guidance established by the Rocky Flats Administrative Procedure 2-G32-ER-ADM-08.02, Evaluation of ERM Data for Usability in Final Reports. This procedure establishes the guidelines for evaluating analytical data with respect to precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. Since the T-1 cleanup project is committing large personnel and equipment resources, field decisions will be based on "Form 1's" faxed directly from the laboratory. This will allow for the timely use of analytical results. Data validation will be performed according to the Rocky Flats APO, Analytical Services Performance Assurance Group procedures, but will be done after the data is used for its intended purpose. Analytical laboratories supporting this task will have all passed regular laboratory audits by the Rocky Flats APO.

6.0 Project Organization

Figure 6-1 represents the organization structure for this project. The Project Manager is responsible for ensuring that all data are collected, verified, transmitted, and stored in a manner consistent with relevant operating procedures. The Project Manager, or designee, will obtain sample numbers (RINs) from the APO, and will ensure that appropriate location codes are used.

The sample crew will be responsible for field data collection. The field crew's data management tasks will include completing all appropriate data management forms (e.g., log sheets) and completing the chain-of custody form. The sample crew will coordinate shipment with RMRS personnel. The Sample Coordinator is responsible for overall flow of data, and for verifying that the chains-of custody are complete and accurate before the samples are shipped to the laboratory.

Rocky Flats Environmental Technology Site T-1 Trench
Starmet Organizational Chart
Figure 1



7.0 References

RMRS, 1997a, Final Proposed Action Memorandum for the Source Removal at Trench 1 IHSS 108, Revision 4, RF/RMRS-97 011, July 23, 1997, RMRS, L.L.C.

RMRS, 1997b, Sampling and Analysis Plan for the Source Removal at Trench 1 IHSS 108, Draft, RF/ER-97 053, August 7, 1997, RMRS, L.L.C.

RMRS, 1996a, RMRS Quality Assurance Program Description (QAPD)

RMRS 1996b, Trenches and Mound Site Characterization Report

DOE, 1992, Historical Release Report for the Rocky Flats Plant

DOE, 1995, Phase II RFI/RI Report for Operable Unit 2 903 Pad, Mound, and East Trenches Area, Rocky Flats Environmental Technology Site

Plutonium to Americium Ratios for Various Purposes on T-1 Source Removal Project

James M. Langsted, CHP
Rocky Mountain Remediation Services
January 16, 1998

Completed by: _____ Date: _____

Peer Reviewed by: _____ Date: _____

Approved by: _____ Date: _____

Introduction

The Trench 1 Source Removal (T-1) project proposes to use High Purity Germanium (HPGe) Gamma Spectroscopy to:

- Screen soils for compliance with the Rocky Flats Cleanup Agreement soil action levels
- Uranium sludge materials for the presence of plutonium below that required by the processor contracted to take this material.

Since the photon emissions from plutonium isotopes are insufficient to allow direct gamma spectroscopy with sufficient sensitivity, the photon emissions from Am-241 are measured and the plutonium content determined by ratio. This ratio is determined by calculation from physical and historical knowledge of the material. This paper documents these ratio calculations.

Requirements Analysis

To identify the correct ratios to use, it is necessary to review the requirements to assure the correct radionuclide ratios are determined.

Soil Levels

"Modifications to the Action Levels & Standards Framework for Surface Water, Ground Water, and Soils, Attachment 5 of the Rocky Flats Cleanup Agreement," dated August 30, 1996, specifies subsurface soil action levels for Plutonium-239/240. Thus, for gamma spectroscopy of soil to meet this subsurface soil action level, the ratio of Pu-239+Pu-240 to Am-241 is appropriate.

Uranium Sludge Levels

The Starmet Corporation (Carolina Metals, Inc.) "Proposal for Pyrophoric Depleted Uranium Source Removal From Rocky Flats Environmental Technology Site Trench T-1 (IHSS 108)" limits plutonium contamination of the material to less than 50 pCi/g. Section 2.2.2 of that proposal states:

> *"CMI's nuclear materials license from the State of South Carolina Department of Health and Environmental Control allows the receipt of incidental or trace quantities of special nuclear material including plutonium. The license limit is 200 grams of plutonium ... For material with trace quantities of plutonium less than about 50 pCi/gm, no further analysis (sic) inventory or licensing controls are necessary."*

To determine what isotopes are intended by the use of the term "plutonium" are closer review of the requirements was necessary. The South Carolina Department of Health and Environmental Control (DHEC) Radioactive Material License for Carolina Metals, Inc. (License number 322, Amendment number 18) lists as Condition "L" states:

> *"To receive, possess, process and transfer as trace constituents in materials received for processing activities authorized under the license." "L. Special Nuclear Material (SNM), Any Form, 350 grams total of ^{235}U or 200 grams of ^{233}U or 200 grams of plutonium or any combination of these....[1]"*

The South Carolina DHEC regulations were not available for review. Since South Carolina is an NRC agreement state, their requirements will closely follow those of the NRC. The United States Code of Federal Regulations, Title 10, Part 70.4 states:

---

[1] It will be necessary to analyze the impact to this license requirement of any U-235 contained in material containing uranium enriched in excess of natural isotopic abundance.

"Special nuclear material means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, ..."

Thus, this analysis interprets the 50 pCi/g plutonium as the sum of all plutonium isotopes contained in the material.

Calculations

The appropriate ratios are determined in the following sections.

Weapons Grade Plutonium

The isotopic composition of Rocky Flats (RF) weapons grade plutonium is taken from Table 2.7.2-2 of the 1980 Final Environmental Impact Statement for the Rocky Flats Plant Site (DOE/EIS-0064). These percentages represent the average composition of the material over a two year production period Radiological half-life values are taken from Table 8.13 of "The Health Physics and Radiological Health Handbook, Revised Edition," 1992.

Americium Ingrowth

Americium 241 is a daughter product of the beta decay of Pu-241, which is present in RF weapons grade plutonium. Since Pu-241 has a relatively short half-life (14.4 years), the ingrowth of the daughter is significant over a relatively long (tens of years) period of time.

The T-1 trench was in operation between November 1954 and December 1962. Thus, any weapons grade plutonium in that trench will be at least 35.5 years old when source removal occurs around June, 1998. This plutonium represents the worst-case scenario in which freshly separated material (in which all americium has been removed) was placed in the trench. Americium ingrowth calculated for this material would represent the worst case for estimation of plutonium from the Pu/Am ratio.

Pu/Am Ratio Determination

To determine the Pu/Am ratio, a spreadsheet (attached) was developed. This spreadsheet determines the specific activity (curies per gram), plutonium decay over time, and americium ingrowth over time, using equations taken from Cember's "Introduction to Health Physics" (1982). For validation, the isotopic activity results produced by this spreadsheet were compared with those produced by another spreadsheet, independently developed by another health physicist for a different purpose.

Soil Ratio

The ratio of Pu-239+Pu-240 to Am-241 is taken from the spreadsheet. This ratio can be used as a multiplier for the measured Am-241 activity to estimate the Pu-239/240 present in the soil sample.

Determination of Uranium Sludge Action Level

The determination of the Am-241 action level corresponding to 50 pCi/g total plutonium is based on the ratio of Am-241 to all plutonium isotopes contained in aged Rocky Flats weapons grade plutonium material.

Dividing the americium activity in that mixture into the sum of the activities for all plutonium isotopes indicates a ratio of 14.3. Dividing the desired action level of 50 pCi/g total plutonium by this ratio yields an Americium-241 activity of 3.5 pCi/g. This is the activity that must be detected to identify a total plutonium activity of 50 pCi/g.

Conclusion

To determine compliance with the Rocky Flats Cleanup Agreement soil action levels, the estimated quantity of Pu-239/240 is determined by multiplying the measured Am-241 by 7.3.

To meet the Starmet plutonium contamination requirements for material recovered from the T-1 Source Removal project, a gamma spectroscopy system capable of detecting 3.5 pCi/g Am-241 is required. To estimate the total plutonium concentration in a sludge sample, multiply the measured Am-241 by 14.3.

Am/Pu Ratios for Aged Weapons Grade Plutonium

Isotope		wt. % aged mix	Half Life yr	Isotope Ci/g (Specific Activity)	nCi/g	g/g(mix)	Mixture Ci/g(mix) Alpha	Beta	nCi/g(mix)
Old Weapons Grade Pu				35.5 years					
Pu	238	0.008%	87.74	1.71E+01	1.71E+10	0.0000755	1.29E-03		1,294,397
Pu	239	93.826%	24065	6.22E-02	6.22E+07	0.9369415	5.83E-02		58,286,642
Pu	240	5.786%	6537	2.28E-01	2.28E+08	0.0577821	1.32E-02		13,177,828
Pu	241	0.065%	14.4	1.03E+02	1.03E+11	0.0006519		6.72E-02	67,211,060
Pu	242	0.030%	376300	3.93E-03	3.93E+06	0.0003000	1.18E-06		1,179
Am	241	0.285%	432.2	3.44E+00	3.44E+09	0.0028436	9.77E-03		9,768,062
		100.000%				0.9985946			

Total Pu	1.40E-01
^{Total}Pu/Am	14.3
pCi Am-241 corresponding to 50 pCi total Pu	3.5
Pu-239/240	7.1E-02
$^{239/240}$Pu/Am	7.3

Weapons Grade Plutonium

		% by Wt	Alpha Ci/gm	Beta Ci-gm
Pu	238	0.01	0.002	
Pu	239	93.79	0.058	
Pu	240	5.8	0.013	
Pu	241	0.36		0.371162
Pu	242	0.03	0.000	
		99.99	0.073	
Am	241		3.42	