



**STARMET SAMPLING AND ANALYSIS PLAN
FOR THE SOURCE REMOVAL
AT TRENCH 1 IHSS 108**

RF/RMRS-98-220

REVISION 1

Submitted By:

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ADMIN RECORD

Administrative Information

Site: Rocky Flats Environmental Technology Site (RFETS), Golden, Colorado
Project Name: Source Removal at Trench 1 - IHSS 108
Date Prepared: April 1998

Approvals

I have read and approved this SAP with respect to project hazards and regulatory requirements.

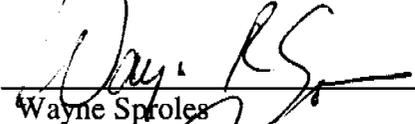
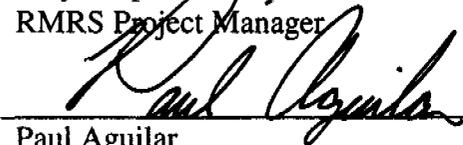
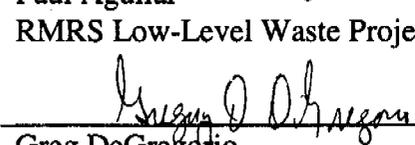
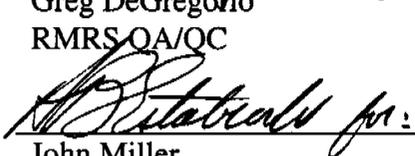
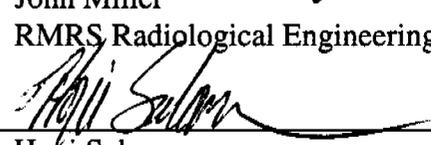
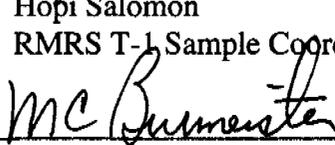
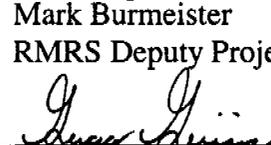
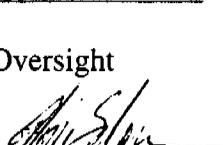
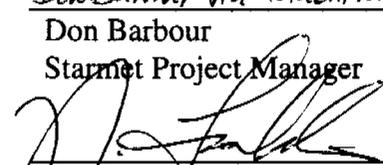
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LIST OF STANDARD OPERATING PROCEDURES

<u>IDENTIFICATION NUMBER:</u>	<u>PROCEDURE TITLE:</u>
5-21000-OPS-FO.03	General Equipment Decontamination
5-21000-OPS-FO.13	Containerization, Preserving, Handling and Shipping of Soil and Water Samples
4-B29-ER-OPS-FO.14	Field Data Management
2-G32-ER-OPS-FO.14	Evaluation of ERM Data for Usability in Final Reports
4-S23-ROI-03.02	Radiological Requirements for Unrestricted Release
4-Q97-REP-1003	Radiological Evaluation for Unrestricted Release of Property/Waste
1-T95-Traffic-120	Off-Site Transportation Manual

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, 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 is 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 within the weather structure. The SIP will be located inside the west end of the temporary shelter in close proximity to the excavation. The SIP will consist of a soil-bermed pad lined with a high-density polyethylene (HDPE) synthetic liner, covered with a layer of soil or gravel for protection. Operations on the SIP will include receiving, managing, segregating, stabilizing, sampling, weighing, and packaging the depleted uranium drums and soils, drums containing unknown liquids and solids, and other waste materials.

All waste packages will be sealed, decontaminated, weighed, and labeled prior to being released from the SIP. The exterior of the packages will be decontaminated using dry decontamination methods (e.g., brushing, wiping). Radiological screening and surveying will be conducted on the package exteriors to achieve applicable release limits specified by the RFETS Radiological Control Manual. Package weights will be recorded before and after inerting agents are added. All waste packaging on the SIP will be conducted under the supervision of an RMRS representative in accordance with applicable RFETS waste packaging procedures. Waste packages will be approved by RMRS prior to use to assure compliance with RMRS policies, DOT, and selected disposal facility requirements. Following sampling and release of the package from the SIP, the package will be transferred to a temporary storage area inside the weather structure. RMRS will then release the package from the structure and place it into temporary onsite storage until analytical results are received. Starmet will then load the package into the truck for transport to the Starmet facility. The activities to be outlined in this 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.

- Final treated DU material at Starmet to facilitate certification and shipment of the material to Envirocare or the Nevada Test Site (NTS) for disposal.
- Spent mineral oil and other secondary wastes generated at the Starmet facility.
- Excavated cemented cyanides to facilitate future management decisions.
- Excavated "still bottoms" to facilitate future management decisions.
- Unknowns requiring characterization at the SIP.

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 to Support the Source Removal at the Trench T-1 Site, IHSS 108" (RMRS, 1998b).

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 Site Specific Health and Safety Plan for the Source Removal at Trench 1 IHSS 108 (HASP) (RMRS, 1998c) 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, 1998a).
- 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 (yd³) 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 yd³ of debris, contaminated soil, and other drummed wastes are suspected to be located throughout the remaining two-thirds of the trench.

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 characterize and determine whether this material is a viable candidate for shipment to and treatment at Starmet's facility.
- 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 characterize and determine the most appropriate waste handling, treatment, and disposal methods.
- 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.
- To collect the required information necessary to address the radioactive characteristics of the used mineral oil, and use this information to certify the material for treatment at the selected facility.
- 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.
- 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.
- To collect the required information necessary to address the hazardous and/or radioactive characteristics of any unknowns 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 characterize and determine the suitability of the waste for treatment at on-site facilities.
- 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 the used mineral oil and analyzed for the specific parameters needed to support transportation and treatment facility 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 of any unknowns encountered and analyzed to determine the most appropriate waste handling, treatment, and/or disposal methods.
- Samples will be collected during decontamination of sampling equipment and dismantlement of the SIP area 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. Starmet can receive the excavated DU and associated material if it contains no RCRA metals, VOCs, or semivolatile organic compounds (SVOCs) above EPA thresholds, and has a Pu concentration of <50 pCi/g.

Depending on the integrity of excavated drums of DU, the material will be placed in a 7A, Type A, 83 (or 55)-gallon overpack drum, or into a 7A, Type A, steel "B-12" box. Materials placed into the 83 (or 55)-gallon overpack drums will likely include the DU chips and turnings, lathe coolant (for intact drums), and graphite that may have been used as packing material prior to placement of the drums into the trench. Materials placed in B-12 boxes will likely include DU chips and turnings, drum fragments, graphite, soils, and possibly small debris fragments.

Used mineral oil will be sampled and analyzed for treatment at the Diversified Scientific Services, Inc. (DSSI) low-level waste incinerator. Properties of the oil, such as heat content and viscosity, will be known from information provided upon purchase of the oil. Analysis will be required to determine uranium content. Secondary wastes generated during processing will include PPE and filters. If the PPE and filters cannot be reused, they will be analyzed as required and sent directly for disposal or to RFETS.

2.1.1 Radiological Evaluation

Samples will be collected to evaluate radionuclide content with respect to the action level hold points described in the RMRS SAP (RMRS, 1998). Also, in order for the excavated DU and associated material to be shipped to Starmet, packages must have a Pu concentration < 50 pCi/g. One radiological sample will be collected from each package of material received at the SIP. Visual characteristics of the material will be noted for comparison to subsequently excavated material.

Gamma spectroscopy using a High Purity Germanium (HPGe) detector or equivalent will be used to evaluate radioisotope concentrations. Appendix 1 provides the assumptions used in determining Pu concentrations from americium-241 activities using gamma spectroscopy. Because of the dense DU matrix, Am-241 is not anticipated to be detected at a level sufficient to infer total Pu < 50 pCi/g. As a result, Pu concentration will be determined using radiochemistry in the RFETS Building 559 Laboratory. The technique will be an ion exchange separation followed by alpha spectroscopy. Because of limited analytical capacity and bounding activities having been determined by gamma spectroscopy, few samples are required to obtain the sensitivity required by Starmet. Therefore, sets of DU matrix gamma spectroscopy samples will be physically combined and homogenized to determine average concentrations.

DU samples for radiochemical evaluation will be collected from the original DU samples submitted for gamma spectroscopy analysis. Each radiochemical sample will consist of subsamples taken from approximately five original DU gamma spectroscopy samples (i.e., the radiochemical sample will represent the average activity of five containers originally evaluated by gamma spectroscopy).

The sole purpose of this analysis will be for evaluating acceptance of the DU at the Starmet facility.

2.1.2 Chemical Evaluation

In order for the excavated DU and associated material to be shipped to Starmet, packages must contain no RCRA metals or SVOCs above the EPA regulatory threshold, and no VOCs above EPA thresholds as modified by any "contained in" project exception limits established by the Colorado Department of Health and the Environment (CDPHE). These limits are: 0.23 mg/kg

for carbon tetrachloride, 2.0 mg/kg for tetrachloroethylene (PCE), and 3.0 mg/kg for trichloroethylene (TCE).

Because the drums of DU chips were placed in the trench over many years, they may be found in several different locations within the trench. As a first step in segregating the DU material and determining sample frequency, drums of chips excavated from the same region will be considered a geographic population. The next step in segregating the DU material will be to compare the results of visual examination, field screening, and gamma spectroscopy performed on the material following excavation. Field screening of all materials excavated from the trench will be performed prior to transfer of the material to Starmet, and will be used to assess pyrophoric characteristics, low-energy radiation, and total organic vapor. Additional details on field screening are provided in Section 3.1 of this document and in the "Sampling and Analysis Plan to Support the Source Removal at the Trench 1 Site, IHSS 108" (RMRS, 1998b).

From each geographic population, the first three DU packages received at the SIP will be sampled for chemical evaluation. If the first three packages from the geographic population are visually similar, have similar field screening results, and similar gamma spectroscopy results, sampling frequency for chemical evaluation will be reduced to every fifth DU package received from the geographic population. This sampling frequency (every fifth package) will hold for the remainder of the geographic population, provided the material is visually similar and has similar field screening and gamma spectroscopy results to the previous packages received from the population. If package contents differ visually, or have different field screening or gamma spectroscopy (different isotopes identified) results than other packages from the same geographic population, a sample will be obtained for chemical evaluation. As described above, radiological samples will be obtained from each package received at the SIP.

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, or other appropriate containers, located inside the structure. The liquid will be sampled for waste characterization analysis. Analysis will be conducted to determine if treatment of the waste at the on-site Building 374 Evaporator is possible. 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 Building 374. DQOs for the drained CimCool were developed to collect data that supports the determination of treatment parameters for the evaporator. The lathe coolant will be analyzed for radionuclides including Pu 239/240, americium (Am)-241, and uranium isotopes, total metals, total cyanide, PCBs, as well as fingerprint analysis. All analyses for the drained lathe coolant will take place in the RFETS Building 559 Laboratories. One sample will be collected from each phase present in each tank (or other package). *Note: If small (e.g., 55-gallon) drums are used in lieu of a tank to contain the CimCool, sampling frequency will be determined in the field and documented on the sample logsheets.*

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 visually inspected and screened on a one to two inch mesh. 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. All activities will be conducted in accordance with Starmet's ROCTEC Operations Calcining Procedure. 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. Debris packaging will be in accordance with RFETS Procedure 00-T1-07.

The calcination process is designed to oxidize any pyrophoric materials contained in the waste. Following calcination, the material will be inspected. If the material is 90% uranium oxide and meets Starmet quality requirements, it will be segregated for use in the DUCRETE process, and will become the property of Starmet. The DUCRETE process uses the uranium oxide as an additive to create high-density concrete products. Material that does not meet the quality requirements 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 disposal facilities.

The final waste form will be a homogeneous mixture of the calcined DU and soil along with any clays, binders, or moisture added during processing. This homogeneity, along with the upfront characterization done on the material before shipment to Starmet, will minimize the number of samples required for the final waste form.

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

Isotopic analysis using radiochemistry techniques will be performed for Pu, Am, and U. As required by the Envirocare Customer Information Manual (Envirocare, 1996), gamma spectroscopy using an HPGe detector will also be used to evaluate gamma-emitting radioisotope concentrations.

2.3.2 Chemical Evaluation

Treated waste will be tested to facilitate offsite disposal criteria. In general, the analytical suite required for 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.

All chemical analysis used for final waste form determinations will be conducted by a Utah Department of Health, Division of Laboratory Services certified laboratory (certified for the parameter being evaluated). Characterization of the untreated material prior to shipment to Starmet will provide strong process knowledge for final waste form determination. Because pre-shipment samples will not be shipped offsite to a Utah certified laboratory (due to the pyrophoric nature of the untreated material), the pre-shipment analytical results will be supplemented with additional analysis performed at a Utah-certified laboratory.

Sampling frequency for offsite WAC:

The final treated waste will be a homogeneous mixture of the calcined soil, DU, and additives. Characterization of the material before shipment to Starmet will ensure process knowledge of the waste. The material will be treated in batch mode. Batch size will be 18 ft³, as determined by the capacity of the mixer. One B-12 box of material will be treated in approximately three batches. A sample will be collected from every third batch of material, until a total of three samples have been collected. Additional samples will be collected if the process is modified, or if the original three samples indicate the need for additional sampling. Samples will be collected following pressing, which is the final step in the treatment process. Each batch of treated material will be traceable to the packages received from RFETS. The 90% Upper Confidence Limit will 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 90% Upper Confidence Limit 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 drums 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. If the waste is LDR compliant, it is anticipated that potential disposal facilities include Envirocare.

2.4.1 Radiological Evaluation

Isotopic analysis using radiochemistry techniques will be performed for Pu, Am, and U. As required by the Envirocare Customer Information Manual (Envirocare, 1996), gamma spectroscopy using a Utah certified laboratory HPGe detector will also be used to evaluate radioisotope concentrations.

2.4.2 Chemical Evaluation

Cemented cyanide waste will be tested to facilitate offsite disposal. 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. Each container of suspected cemented cyanides will be sampled and analyzed for total cyanide. The results of these analyses will be used by RMRS to determine if excavation boundaries need

to be sampled for cyanides. For the purpose of evaluating solid wastes, the 90% Upper Confidence Limit will 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 90% Upper Confidence Limit 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 future management decisions for 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 potential receiving facilities WAC. The PAM (RMRS, 1997a) states that one drum of still bottoms is expected in the trench. Each visible phase present in the waste will be sampled.

2.5.1 Radiological Evaluation

Gamma spectroscopy will be used to evaluate radioisotope concentrations. Isotopic analysis using radiochemistry will also be performed for Pu, Am, and U.

2.5.2 Chemical Evaluation

Still bottom waste will be tested to facilitate offsite treatment criteria. A typical analytical suite required for a mixed or low level radioactive waste incineration facility will be used as a basis for analytical requirements. The typical tests required to meet such offsite facility WAC are discussed further in Section 3.

Sampling frequency for offsite WAC:

At least one sample for chemical analyses will be taken randomly from each phase observed in the drum(s) of excavated still bottoms for evaluation of the waste stream with respect to a typical offsite facility WAC. The number of phases present, as well as other visual characteristics of the material, will be noted on the sample log sheets. When an offsite facility is selected for treatment of the waste, a determination of waste characterization with respect to the WAC for the facility will be performed.

2.6 DQOs to Support Evaluation of Excavated Unknowns

Unknown liquid or solid wastes may be encountered during the remediation process. For liquid wastes, the strategy outlined Section 2.5 will be followed. For solid wastes, the strategy outlined in Section 2.4 will be followed.

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, radiological control personnel, and project health and safety personnel, additional samples may be collected based on collective professional judgment. Documentation of additional sampling events and the 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 and contained in the T-1 HASP (RMRS, 1998c). 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; segregate the hazard or condition from the project activity, if it can be done safely; or curtail operations to address the unexpected hazard or condition. Concurrence to proceed down the selected path must be obtained from the RMRS Environmental Restoration Director, or 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 potential 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. Sample packaging will be conducted in accordance with Environmental Management Department (EMD) Operating Procedures Volume 1, Field Operations 5-21000-OPS-FO.13, *Containerization, Preserving, Handling, and Shipping of Soil and Water Samples*, and Operation Order 00-T1-04, *On-Site Transfer of Potentially Pyrophoric Samples from the Trench T-1 Source Removal Project*.

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 (using heat testing to identify any temperature increases), 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 potential for mixing of waste streams and associated increased waste disposal costs. Material screening will be conducted by using direct scans on all environmental media and waste materials excavated from the trench. Results from field screening of materials will be used, in conjunction with geographic location in the trench and visual inspection of the material, to categorize materials received at the SIP. This categorization will form the initial basis for determining sampling frequency. Sampling frequency is discussed in more detail in Section 2.

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. Field screening of materials will be conducted while materials are contained in the overpack or B-12 box. The overpack drum or box will be transported to the SIP for inerting and sample collection. Packages will be weighed when received at the SIP, and again following inerting activities.

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. 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.

Note: Because gamma spectroscopy may not be capable of detecting Am-241 at concentrations suitable for inferring total Pu < 50pCi/g (the Starmet limit), DU gamma spectroscopy samples will be evaluated using radiochemistry at the RFETS Building 559 laboratory. Section 2.1.1 describes the analysis and rationale, including composting frequency, which will be performed at Building 559. Samples of DU are expected to be delivered to Building 559 for composting and radiochemical evaluation following gamma spectroscopy. Since the radiochemical samples will be composites of previously collected samples, new sample identification numbers will be assigned. The radiochemical composite samples will be traceable back to the original gamma spectroscopy samples that make up the composite.

Table 3.1 Excavated Depleted Uranium Analyses

Analytical Method	Line Item Code	Analyte	# of Samples	Container	Preservative	Holding Time
Gamma Spectrometry	RC03A003	Gamma-emitting isotopes	125+	TBD – Standard fixed geometry sample container as required by the gamma spectroscopy subcontractor.	None	6 months
SW-846 Method 6010A, and 7000 Series	RS05A022 PA03A016	8 RCRA Metals + Cu, Zn, Sb, Be, Ni, Ti, Hg and V	33+	1 x 25g 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	RS01A006	Volatile Organic Compounds	33+	60g wide mouth glass jar. Teflon lined lid	Cool, 4° C	14 days
SW-846 Method 8270B	RS02A004	Semi-Volatile Organic Compounds	33+	60g 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)	RS01A005	Volatile Organic Compounds	1 trip blank per cooler	2 x 40 mL glass, Teflon lined septa lid	Cool, 4° C HCl pH<2	14 days
Litmus Paper field test	N/A	Soil pH	125+	N/A	N/A – field test	N/A – field test

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 package 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 7470. Volatiles analysis shall be performed according to Methods 8240B/8260A. Semivolatiles analysis will be performed according to Method 8270B.

3.2.3 Sampling Strategy

Samples will be collected from the package 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 drums (DU received in overpack containers) and for completely degraded drums (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. The overpack drums will be inspected and sampled when received at the SIP. Samples will be obtained prior to inerting, and after draining of CimCool (if present), unless safety issues preclude this sequence of events. Sampling prior to inerting is preferred to preserve sample integrity and ensure the lowest possible analytical laboratory detection limits. If necessary due to safety issues, the overpack drums will be inerted prior to sampling. A sample of the mineral oil used to inert the overpack drums may be analyzed to quantify the effects of the oil on laboratory detection limits. Drum lids may 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 package. To the extent practical, the scoop- or spoonful will be obtained from beneath the top surface of the exposed material. Care will be taken not to use excess force when obtaining samples in order to minimize the potential for ignition of any pyrophoric 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. The B-12 boxes will be inspected and sampled when received at the SIP. Samples will be obtained prior to inerting, unless safety issues preclude this sequence of events. Sampling prior to inerting is preferred to preserve sample integrity and ensure the samples represent the waste

material and not the inerting material. If necessary due to safety issues, the B-12 boxes will be inerted prior to sampling. A composite sample will be created by filling the required sample containers with material from four or five different locations in the box using the scoops or spoons. If the packages are interred prior to sampling, the sample technician will note the location of visually identifiable DU material prior to adding soil to the package, and all of the subsamples will be collected from beneath the layer of soil that is used to inert the material. At least one of the subsamples will be collected from near the bottom of the package and will be obtained using a shovel to expose the material near the bottom of the package. All of the subsamples will be collected on a biased basis, maximizing the amount of DU and minimizing the amount of soil in the subsample. No homogenization of material will be performed due to the pyrophoric nature of the material. Care will be taken not to use excess force when obtaining samples in order to minimize the potential for introducing sufficient energy to ignite the potentially pyrophoric material.

3.3 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, or other appropriate container, located inside the structure. Prior to pumping the CimCool into the tank or other package, a field pH test will be performed to ensure that incompatible materials are not mixed together. The liquid will be sampled for waste characterization analysis. Analysis will be conducted to determine if treatment of the waste at the on-site, Building 374 Evaporator is possible. 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 Building 374 Evaporator. Data requirements for the drained CimCool include determination of treatment parameters for the Evaporator. These parameters have been identified as radionuclides including Pu 239/240, Am-241, and uranium isotopes, PCBs, total metals, and total cyanide.

The analyses specified in Table 3.2 are required by the Building 374 personnel to assist in the effective treatment of the liquids. Samples will be collected using the most convenient method available such as with a bailer, peristaltic pump or similar device. The sampling device will be lowered to specified depth, raised to the surface and emptied, either into an intermediate container, or directly into the sample container. The depth from which the sample was obtained will be recorded on the sample logsheet, along with physical appearance and any other observations. If a bailer is used, a bottom decanting control device may be used to fill the VOC sample vials. The actual sampling method will be described in the field logbook. Quality control samples (e.g., trip blanks, duplicates) are not required by the Building 374 personnel for this activity.

Table 3.2 Drained Lathe Coolant (CimCool) Analyses

Analytical Methods	Line Item Code	Analyte	# of Samples	Container	Preservative	Holding Time	Comment
Fingerprint Analysis	PA03A005		1 per phase per package	1-20 ml poly with Teflon lined lid	Cool, 4° C	6 months	
Isotopic Analysis (g/L)	PA04A003 PA04A004 PA04A005	Pu, Am, Uranium isotopes	1 per phase per package	Combine with fingerprint	HNO ₃ to pH<2	6 months	
Gamma Spectrometry	RC03A001	Plutonium, Americium	1 per phase per package	Combine with Isotopic	HNO ₃ to pH<2		
SW-846 Method 8080/8081	RS03A005	PCBs	1 per phase per package	40 ml amber glass with Teflon lined lid	Cool, 4° C	7 days until extraction, 40 days after extraction	
SW-846 Method 6010A and 7000 series	RS05A022	Total Target Analyte List (TAL) Metals	1 per phase per package	125 ml poly with Teflon lined lid	HNO ₃ to pH<2, Cool, 4° C	6 months, except mercury - 28 days	
335 Series Methods, or SW-846 Method 9010A/9012	PA03A014	Total Cyanide	1 per phase per package	125 ml poly with Teflon lined lid	NaOH to pH>12, Cool, 4° C	14 days	Detection Limit (DL) of 0.005 mg/L required
SW-846 Method 8260A	SS01B005	Volatile Organic Compounds	1 per phase per package	3-40 ml glass vials	HCl to pH<2, 4° C	14 days	
SW-846 Method 8270B	SS03A001	Semi-Volatile Organic Compounds	1 per phase per package	3-1 L amber glass	Cool, 4° C	7 days until extraction, 40 days after extraction	

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. Table 3.3 lists the analytical parameters necessary to evaluate the final waste with respect to the WAC.

As discussed in Section 2.3, the sampling approach for the final treated waste involves taking a total of three samples of treated material. The material will be homogeneous due to the mixing steps in the processing of the material, and each batch of material will be traceable to the packages received from RFETS.

The debris and other material 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. Visual inspection will be performed to ensure the debris material is similar to debris material from T-1.

As discussed in Section 2.1, used mineral oil will be characterized for treatment at DSSI. Table 3.3a lists the analytical parameters necessary to evaluate the mineral oil with respect to the DSSI WAC. Many of the properties of the oil required by the WAC will be known from information provided upon purchase of the oil.

3.4.1 Radiological Sampling

Isotopic analysis for radioactivity will be performed utilizing gamma spectroscopy to determine the concentrations of gamma-emitting radioisotopes. Isotopic analysis, using radiochemistry techniques, will also be performed for Pu, Am, and U.

3.4.2 Chemical Sampling

Material samples will be collected to identify RCRA hazardous materials. Toxic Characteristic Leaching Procedure (TCLP) will be performed.

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 7470. Volatiles analysis shall be performed according to Methods 8240A/8260. Semivolatiles analysis will be performed according to Method 8270A.

3.4.3 Sampling Strategy

Samples will be collected from every third batch of treated waste at Starmet. New disposable sampling spoons/scoops, or decontaminated stainless steel spoons/scoops will be used. Samples will be collected either as the material is being placed into the shipping package, or immediately following placement of material into the package. Because the waste will be homogeneous following treatment, samples will be representative of the entire batch of treated waste. Three

samples will be collected of the treated waste. Additional samples may be collected if the process changes or if it is determined that additional samples are required.

Table 3.3 Final Treated Waste Analyses

Analytical Method	Line Item Code	Analyte	# of Samples	Container	Preservative	Holding Time
Gamma Spectroscopy (offsite)	TBD	gamma emitting radioisotopes	3	TBD - enough for 1000 g of sample	None	6 months
Isotopic Analysis	RC01B004	Uranium, Americium, and Plutonium isotopes	3	250 mL wide mouth glass jar, with Teflon lined lid	None	6 months
SW-846 Method 9045	N/A	Soil pH or corrosivity	3	Combine with TCLP jar	Cool, 4° C	ASAP (up to 14 days)
SW-846 Chapter 7	SS08B005	Reactive Sulfide	3	Combine with TCLP jar	Cool, 4° C	7 days
SW-846 Method 8240B/8260A (Trip Blanks)	SS01B005	Reactive Cyanide	3	Combine with TCLP jar	Cool, 4° C	14 days
TCLP SW-846 1311 (extraction)	SS08B008	Volatile Organic Compounds	1 trip blank per cooler	2 x 40ml VOA vials - Teflon-lined lid	Cool, 4° C HCl pH<2	14 days
	SS08B008	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.	3	150g 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
	SS08B011	TCLP Semivolatiles (Method 8270/8270A)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	SS08B013	TCLP Chlorinated Herbicides (Method 8150)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	SS08B012	TCLP Organochlorine Pesticides (Method 8080/8081)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	SS08B010	TCLP Volatiles (Method 8240B/8260)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
Determined by Envirocare	N/A	Envirocare evaluation (fingerprint) samples	5	2 pounds, as required	None	None

Table 3.3a Used Mineral Oil Analysis

Analytical Method	Line Item Code	Analyte	# of Samples	Container	Preservative	Holding Time
Isotopic Analysis	RC01B020	Uranium	1	1-20 ml poly with Teflon-lined lid	Cool, 4°C	6 months

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 package for gamma spectroscopy analysis. Isotopic analysis, using radiochemistry techniques, will also be performed for Pu, Am, and U, at the frequency listed in Table 3.4.

3.5.2 **Chemical Sampling**

Material samples will be collected to identify RCRA hazardous materials. Total analyses and TCLP will be performed. At least three samples will be collected from the suspected cemented cyanides received by Starmet at the SIP for chemical evaluation. Each container of suspected cemented cyanides will be sampled and analyzed for total cyanide to confirm the waste type and to assist RMRS in determining if the excavation bottom needs to be sampled for cyanide.

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 7470. 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 package received by Starmet at the SIP. A decontaminated stainless steel coring device, or other appropriate sampling device, will be used to obtain a sample of the cemented material. The following sections describe the strategy planned for sampling of intact or nominally intact drums (cemented cyanides received in overpack containers) and for completely degraded drums (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 sample from within the cemented material using the coring device, or other appropriate device. To the extent practical, the sample 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. If the material is visually segregated, the sample technician will obtain a biased sample of what are visually identifiable cemented cyanides. The sample technician will collect a sample of material from within the cemented material using a coring device, or other appropriate device.

Table 3.4 Excavated Cemented Cyanide Analyses

Analytical Method	Line Item Code	Analyte	# of Samples	Container	Preservative	Holding Time
Gamma Spectroscopy (offsite)	TBD	Gamma emitting radioisotopes	10+	TBD - enough for 1000 g of sample	None	6 months
335 Series Methods, or SW-846 Method 9010A/9012		Total Cyanide	10+	125 ml poly with Teflon lined lid	Cool, 4° C	14 days
Isotopic Analysis	RC01B004	Uranium, Americium, and Plutonium isotopes	3+	250 mL wide mouth glass jar with Teflon lined lid	None	6 months
SW-846 Chapter 7	SS08B005	Reactive Sulfide	3+	Combine with TCLP jar	Cool, 4° C	7 days
	SS08B004	Reactive Cyanide				14 days
SW-846 Method 9045	N/A	Soil pH or corrosivity	3+	Combine with TCLP jar	Cool, 4° C	ASAP (up to 14 days)
SW-846 Method 8240B/8260A	SS01B006	Volatile Organic Compounds	3+	60 g wide mouth glass jar Teflon lined lid	Cool, 4° C	14 days
SW-846 Method 8270B	SS02B004	Semi-Volatile Organic Compounds	3+	125 g wide mouth glass jar, Teflon lined enclosure	Cool, 4° C	14 days until extraction, 40 days after extraction
SW-846 Method 8240B/8260A (1 trip Blanks)	SS01B005	Volatile Organic Compounds	1 trip blank per cooler	2 x 40 mL VOA vials - Teflon lined septa lids	Cool, 4° C HCl pH<2	14 days
TCLP SW-846 1311 (extraction)	SS08B008	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	3+	250g 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
	SS08B011	TCLP Semivolatiles (Method 8270/8270A)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	SS08B013	TCLP Chlorinated Herbicides (Method 8150)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	SS08B012	TCLP Organochlorine Pesticides (Method 8080/8081)				14 days to TCLP extraction, 7 days to preparative extraction, 40 days from preparative extraction to analysis
	SS08B010	TCLP Volatiles (Method 8240B/8260)				14 days to extraction, 14 days from extraction to analysis
Determined by IHS/TKA	N/A	Envirocare evaluation (fingerprint) samples	5	2 pounds, as required	None	None

3.6 Still Bottoms

Suspected still bottoms will be sampled to facilitate future management decisions for the waste. 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 a typical mixed waste incinerator. 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 phase present in the package for gamma spectroscopy analysis. Isotopic analysis, using radiochemistry techniques, will also be performed for Pu, Am, and U, at the frequency listed in Table 3.5.

3.6.2 Chemical Sampling

Material samples will be collected to identify RCRA hazardous materials. Total analyses will be performed. One sample will be collected from each phase present in the package 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 7470. Volatiles analysis shall be performed according to Methods 8240B/8260A. Semivolatiles analysis will be performed according to Method 8270B. Total cyanide and total sulfur analysis will also be performed.

3.6.3 Sampling Strategy

Samples will be collected from the package received by Starmet at the SIP. Spoons, scoops, or bailers will be used, depending on the characteristics of the excavated material. The following sections describe the strategy planned for sampling of intact or nominally intact drums (still bottoms received in overpack containers) and for completely degraded drums (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 sample of material from the drum. One sample will be obtained from each visible phase present in the 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. Samples will be obtained from each phase present in the material. If the material is visually

segregated, the sample technician will obtain a biased sample of what are visually identifiable still bottoms.

3.7 Unknowns

Unknown wastes received at the SIP will be sampled to facilitate future management decisions for the waste. Sampling tools will depend on the waste matrix (liquid, solid, and sludge). For solid wastes, the strategy outlined in Section 3.5 will be followed. For liquids, the strategy outlined in Section 3.6 will be followed.

Table 3.5 Excavated Still Bottoms Analyses

Analytical Method	Line Item Code	Analyte	# of Samples	Container	Preservative	Holding Time
Gamma Spectroscopy	TBD	Gamma-emitting isotopes	1 per phase per package	TBD - enough for 1000 g of sample	None	6 months
Isotopic Analysis	PA04A003 PA04A004 PA04A005	Uranium, Americium, and Plutonium isotopes	1 per phase per package	250 mL wide mouth glass jar with Teflon lined lid	Cool, 4° C	6 months
EPA 600/4-84-017 Method EPA 300.00	N/A	Total Sulfur	1 per phase per package	250g glass with Teflon lined lid	Cool, 4° C	28 days
SW-846 Method 8240A/8260A	SS01B006	Volatile Organic Compounds	1 per phase per package	60g wide mouth glass vials Teflon lined lid	Cool, 4° C	14 days
SW-846 Method 8270B	SS02B004	Semi-Volatile Organic Compounds	1 per phase per package	250g wide mouth glass jar, Teflon lined enclosure	Cool, 4° C	7 days until extraction, 40 days after extraction
SW-846 Method 8240B/8260A (Trip Blanks)	SS01B003	Volatile Organic Compounds	1 trip blank per cooler	2 x 40 mL VOA vials - Teflon lined septa lids	Cool, 4° C	14 days
SW-846 Method 6010A and 7000 Series	SS05B022	Total Analyte List (TAL) Metals	1 per phase per package	250g glass with Teflon lined lid	Cool, 4° C	6 months except Hg - 28 days
336 Series Methods, or SW-846 Method 9010A/9012	N/A	Total Cyanide	1 per phase per package	250g glass with Teflon lined lid	Cool, 4° C	24 days
SW-846 Method 8080/8081	SS03B006	PCBs	1 per phase per package	250g glass with Teflon lined lid	Cool, 4° C	7 days until extraction, 40 days after extraction
SW-846 300 Series	N/A	Chlorine	1 per phase per package	250g glass with Teflon lined lid	Cool, 4° C	28 days
SW-846 340 Series	N/A	Flourine	1 per phase per package	250g glass with Teflon lined lid	Cool, 4° C	28 days
ASTM D240	N/A	Heat Content (BTU/lb)	1 per phase per package	250g glass with Teflon lined lid	Cool, 4° C	28 days
SW-846 Method 1010	SS08B001	Flashpoint/Ignitability	1 per phase per package	250g glass, Teflon lined lid	Cool, 4° C	28 days

3.8 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 may be required to support some of the sampling objectives of this SAP. Duplicates are independent samples collected as close as possible to the same point in time and space. These samples are two separate samples taken from the same source, placed in separate containers, and analyzed independently. The Waste and Residue Identification and Characterization (WSRIC) Program requires duplicate samples at a frequency of one in every 20 samples. This frequency will apply to each type of sampling event (e.g., one duplicate for every 20 HPGe samples, one duplicate for every 20 VOC samples, etc.).

Equipment rinsate blanks: These samples will be prepared by collecting distilled water, poured over decontaminated sampling equipment, between the collection of regular VOC samples. Equipment rinsate blanks will only be collected between collection of regular VOC samples because cross-contamination of other contaminants is considered highly unlikely. 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. Equipment rinsate blanks will be collected at a frequency of one in every 20 VOC samples.

Trip blanks: Trip blank samples will be packaged into coolers containing samples being analyzed for VOCs. Trip blank samples will be pre-prepared (not in the field) with minimal headspace 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 Services Division (ASD) 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 alphanumeric 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) Package Number
Drained Lathe Coolant	LC	Use RFETS WEMS Package Number
Treated DU	TU	Use RFETS WEMS Package Number
Excavated Cemented Cyanides	CC	Use RFETS WEMS Package Number
Excavated Still Bottoms	ES	Use RFETS WEMS Package Number

QC Codes will include the following:

REAL: Regular Sample
DUP: Duplicate Sample
RNS: Rinsate Sample
TB: 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, Section 5.3, Cleaning Procedures for Stainless Steel or Metal Sampling Equipment*. Although this procedure calls for decontamination to take place outside of the exclusion zone, decontamination for the T-1 project will take place within the exclusion zone.

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.

5.3 Quality Assurance

At least 25% of total data set generated under this SAP shall be validated. More emphasis will be placed on validating data to support excavation and "put back" decisions (described in the RMRS SAP [RMRS, 1998]), with less emphasis placed on validation of data used for waste management decisions. Data validation is the responsibility of K-H Analytical Services, and will be performed in accordance with the Rocky Flats ASD, Data Assessment Guidelines (DAGR01), but will be done after the data set is used for its intended purpose.

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. Completeness goals have been established at 90% for the project (all matrices and all methods). Field precision for non-radiological contaminants of concern is set at $\leq 40\%$ RPD for soils and $\leq 30\%$ for water. For radionuclides, a standard measurement of precision, a duplicate error ratio, must be ≤ 1.42 , a common precision test statistic used by several radioanalytical laboratories used by RFETS.

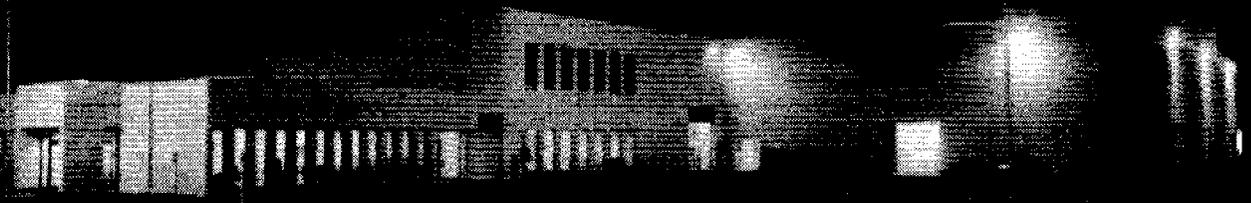
Since the T-1 cleanup project is committing large resources of personnel and equipment, field decisions will be based on Form 1 data faxed directly from the laboratory. This will allow for the

timely use of analytical results. Analytical laboratories supporting this task will have all passed regular laboratory audits by the Rocky Flats ASD.

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 ASD, 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.



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Final

Sampling and Analysis Plan

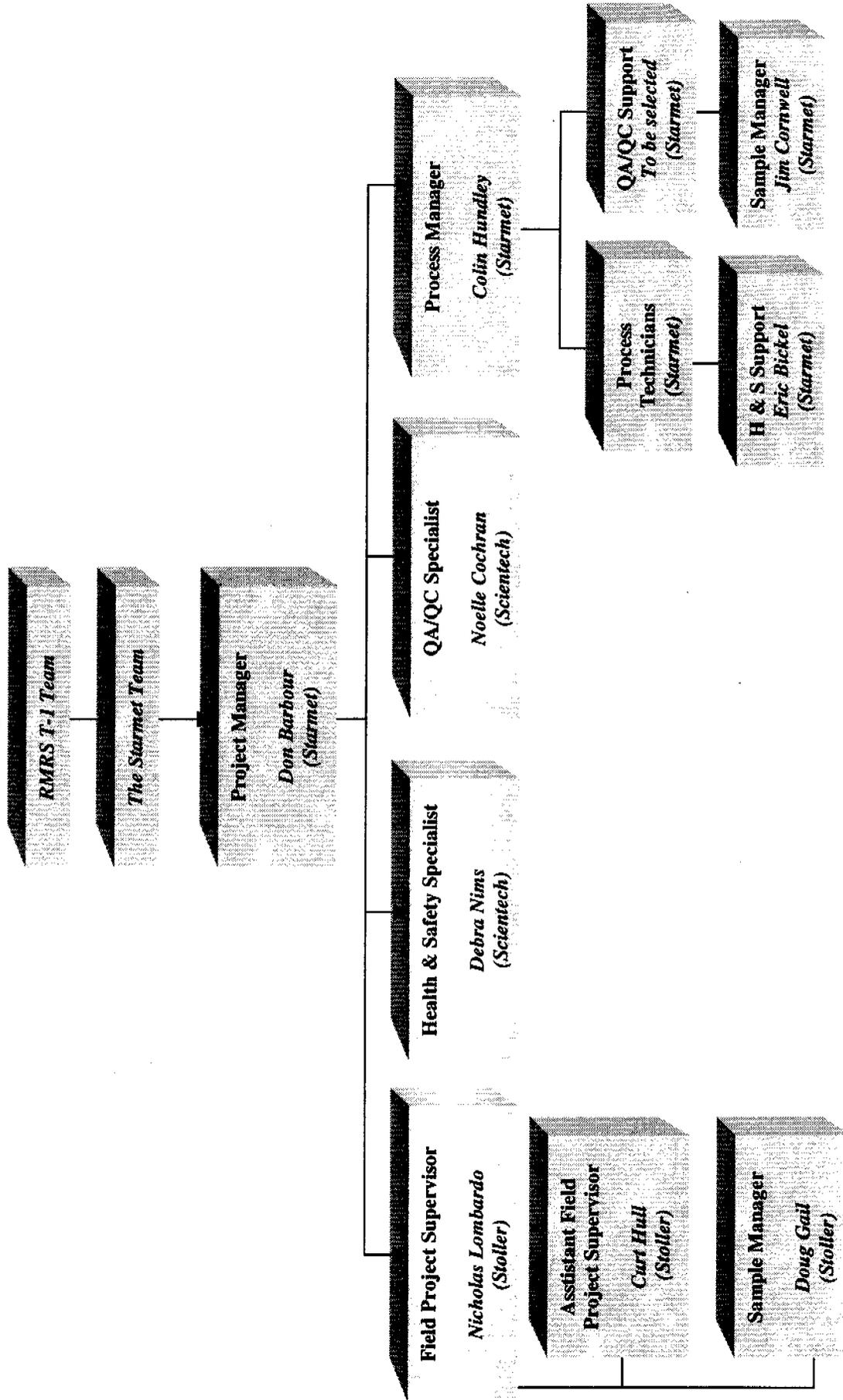
Source Removal at Trench 1

IHSS 108

April 1998

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

Figure 1



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

James M. Langsted, CHP
Rocky Mountain Remediation Services
April 2, 1998

Completed by: James M. Langsted, CHP Date: 4/2/98
Peer Reviewed by: Chad J. Brancosini Date: 4/2/98
Approved by: Smullin, J. M. Date: 4/2/98

I. Introduction

The Trench 1 Source Removal (T-1) project proposes to use High Purity Germanium (HPGe) Gamma Spectrometry for several purposes, including:

- Soil screening for compliance with the Rocky Flats Cleanup Agreement soil action levels
- Screening uranium sludge materials for the presence of plutonium below that required by the processor contracted to take this material
- Sample evaluations for DOT Low Specific Activity
- Inventory of any fissile material removed from Trench-1.

Since the photon emissions from plutonium isotopes are insufficient to allow direct gamma spectrometry 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.

II. Requirements Analysis

To identify the correct ratios to use for the T-1 project, it is necessary to review relevant requirements of the project to assure the correct radionuclide ratios are determined.

A. Soil Levels

The Rocky Flats Cleanup Agreement (Reference 1) specifies subsurface soil action levels for Plutonium-239+240. Thus, for gamma spectrometry of soil to evaluate this subsurface soil action level, the ratio of Pu-239+Pu-240 to Am-241 is appropriate.

B. Uranium Sludge Levels

The material processing subcontractor limits plutonium contamination of the material to less than 50 pCi/g (Reference 2). 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 inventory (sic) or licensing controls are necessary."

To determine which isotopes are intended by the use of the term "plutonium," a closer review of the requirements was necessary. The subcontractor's radioactive material license (Reference 3) lists as Condition L:

"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 ²³⁵U or 200 grams of ²³³U 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. Title 10 CFR Part 70.4 (Reference 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 limit as the sum of all plutonium isotopes contained in the material.

III. Calculations

The appropriate ratios are determined in the following sections.

A. Americium Ingrowth

The T-1 trench was in operation between November 1954 and December 1962. Thus, any material placed 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.

B. Weapons Grade Plutonium

Weapons grade plutonium consists of a mixture of:

- Pu-238
- Pu-239
- Pu-240
- Pu-241
- Pu-242
- Am-241 (ingrown from the decay of Pu-241).

To accurately estimate the proportion of Am-241 present in aged weapons grade plutonium, it is necessary to know the proportion of Pu-241 present the original mixture. The decay of Pu-241 results in the ingrowth of Am-241. In the late 1950s and early 1960s plutonium used in US weapons manufacture came primarily from the plutonium production and purification processes at Hanford, Washington and Savannah River, South Carolina. These materials were higher in Pu-241 than the weapons grade plutonium used in later years and that currently stored at DOE facilities. This is because the Pu-241 isotope present at the time of initial plutonium production decays over time, and is present in lesser amounts in older plutonium mixtures. Thus, it is inappropriate to use plutonium isotopic mixtures from today to understand any plutonium that may have been placed in Trench-1 in the 50s or 60s.

Unclassified average Rocky Flats plutonium isotopic levels for 1959 through 1962 were obtained from a classified notebook on product integrity and surveillance studies (Attachment 1). This data indicates weight percent values of:

Calendar Year	% ²³⁸ Pu	% ²³⁹ Pu	% ²⁴⁰ Pu	% ²⁴¹ Pu	% ²⁴² Pu
1959 → 1960	<0.05	93.714	5.593	0.5932	<0.05
1961 → 1962	<0.05	93.817	5.486	0.5957	<0.05

Data for earlier years were not available. For this analysis, the 1959 - 1960 values were used. Although this year is near the end of the Trench-1 period (1954 and 1962), it is felt to provide a reasonable estimate for the isotopic mixture for any plutonium that may be in the T-1 waste trench. The selected value indicates a slightly lower Pu-241 value than that for 1961 - 1962 which is more conservative for estimating plutonium from americium measurements in later years. Radioisotope half-life and specific activity values were taken from Reference 5.

C. Pu/Am Ratio Determination

To determine the Pu/Am ratio, a spreadsheet (Attachment 2) was developed. Assuming the original plutonium isotopic mix (by weight), this spreadsheet determines the plutonium activity, plutonium decay, and americium ingrowth over time, using equations taken from Reference 6. For validation, the isotopic activity results produced by this spreadsheet were compared with those produced independently by the peer reviewer, Charles J. Bianconi, using a different spreadsheet (PUDCF.xls).

D. Soil Ratio

The ratio of Pu-239+Pu-240 to Am-241 is taken from the spreadsheet. This ratio of 4.41 can be used as a multiplier for the measured Am-241 activity to estimate the Pu-239+240 present in the soil sample. This ratio is specific to the T-1 Source Removal project and may differ from ratios developed from other soil sample data. Any weapons grade plutonium that could have been placed in Trench-1 would have been from the late 1950s or early 1960s, when Pu-241 concentrations would have been higher than they are today. Older plutonium results in a relatively larger amount of Am-241 ingrowth and thus, a lower Pu/Am ratio. Soil samples taken from the environs surrounding RFETS most likely include contributions from multiple sources, including the 903 Pad, 1957 fire, and 1969 fire. It is likely that the Pu/Am ratio from more recent mixtures of material would differ from mixtures of plutonium that may have been placed in T-1.

E. 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 11.7. Dividing the desired action level of 50 pCi/g total plutonium by this ratio yields an Americium-241 activity of 4.28 pCi/g. This is the activity that must be detected to identify a total plutonium action level of 50 pCi/g.

IV. Conclusion

To estimate the quantity of Pu-239+240, multiply the measured Am-241 by 4.41.

In order to achieve satisfactory data quality, a gamma spectrometry method capable of detecting significantly less than 4.28 pCi/g Am-241 is required. To estimate the total plutonium concentration, multiply the measured Am-241 by 11.7.

V. References

1. *Modifications to the Action Levels & Standards Framework for Surface Water, Ground Water, and Soils*, Attachment 5, Rocky Flats Cleanup Agreement, August 30, 1996.
2. *Proposal for Pyrophoric Depleted Uranium Source Removal from Rocky Flats Environmental Technology Site Trench T-1 (IHSS 108)*, Starmet Corporation (Carolina Metals, Inc.).
3. *Radioactive Material License for Carolina Metals, Inc.*, License number 322, Amendment number 18, South Carolina Department of Health and Environmental Control (DHEC).
4. Title 10, *United States Code of Federal Regulations*, Part 70.4.
5. Nuclear Safety Technical Report, *Safety Analysis and Risk Assessment Handbook*, RFP-5098, Safety Analysis/Nuclear Engineering, Rocky Flats Environmental Technology Site, Golden, CO, April 22, 1997.
6. Nuclear Safety Technical Report, *Reference Computations of Public Dose and Cancer Risk from Airborne Releases of Plutonium*, RFP-4910, Vern L. Peterson, Rocky Flats Environmental Technology Site, Golden, CO, December 23, 1993.

AVERAGE ROCKY FLATS PLUTONIUM ISOTOPIC LEVELS

CALENDAR YEAR	% ²³⁸ Pu	% ²³⁹ Pu	% ²⁴⁰ Pu	% ²⁴¹ Pu	% ²⁴² Pu
1959-1960	<0.05	93.714	5.593	0.5932	<0.05
1961-1962	<0.05	93.817	5.486	0.5979	<0.05
1963-1964	"	94.398	4.854	0.6482	"
1965-1966	"	93.586	5.823	0.5610	"
1967-1968	"	93.451	5.953	0.5670	"
1969	"	93.538	5.953	0.4790	"
1970	"	93.450	5.965	0.4850	"
1971	"	93.533	5.929	0.4380	"
1972	"	93.513	5.939	0.4480	"
1973 1 st Qtr.	"	93.559	5.943	0.3980	"
1973 2 nd Qtr.	"	93.642	5.904	0.4160	"
1973 3 rd Qtr.	"	93.649	5.896	0.4190	"
1973 4 th Qtr.	"	93.536	5.931	0.4870	"
1974 1 st Qtr.	"	93.546	5.910	0.5010	"
1974 2 nd Qtr.	"	93.596	5.891	0.4700	"

Plutonium stream average data was utilized by the Product Integrity and Surveillance department while conducting the Stockpile Reliability Evaluation Program surveillance tests on pits. The data originated in analytical laboratory reports of plutonium castings; later assembled by the Quality Engineering group responsible for monitoring WR plutonium quality.

Source: Greg Spencer 4/1/98

REVIEWED FOR CLASSIFICATION/UCNI

By A. Neshaim

Date 04-01-98 (U/NU)

Am/Pu Ratios for Aged Weapons Grade Plutonium

Aged Plutonium Mixture Age= 35.5 years

Isotope	Original Mixture (wt. %)	Specific Activity (Ci/g-isotope)	Original Mixture (Ci)	Half Life (yr)	(Ci)	Aged Mixture (g)	(wt%)
Pu-238	0.05	1.71E+01	0.00855	87.74	6.46E-03	3.78E-04	0.04
Pu-239	93.714	6.22E-02	0.05829	2.41E+04	5.82E-02	9.36E-01	93.755
Pu-240	5.593	2.28E-01	0.012752	6.54E+03	1.27E-02	5.57E-02	5.580
Pu-241	0.5932	1.03E+02	0.610996	14.4	1.11E-01	1.07E-03	0.1076
Pu-242	0.05	3.93E-03	1.97E-06	3.76E+05	1.96E-06	5.00E-04	0.05
Am-241		3.43E+00		432.2	1.61E-02	4.69E-03	0.47
Total	100.00		0.69059		2.04E-01	9.99E-01	100.00

Total Pu 1.88E-01
 Total Pu/Am 11.7
 pCi Am-241 corresponding to 50 pCi total Pu 4.28
 Pu-239/240 7.09E-02
²³⁸Pu/Am 4.41

7.0 References

RMRS, 1998a, Final Proposed Action Memorandum for the Source Removal at Trench 1 IHSS 108, Revision 5, RF/RMRS-97-011, February 18, 1998, RMRS, L.L.C.

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RMRS 1996b, Draft Trenches and Mound Site Characterization Report, RF/ER-96-0044.UN, September

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

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

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RFETS Transportation Safety Manuals

RFETS Radiological Control Manual

Rocky Flats Ambient Air Program

RFETS Procedure I-T97-12, Sample Packaging and Transfer

RFETS Administrative Procedure 2-G32-ER-ADM-08.02, Evaluation of ERM Data for Usability in Final Reports

RFETS Analytical Services Division, Data Assessment Guidelines, DAGR01

RFETS Environmental Management Department, Operating Procedures, Vol. 1, Field Operations, 5-21000-OPS-FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples

RFETS Environmental Management Department, Operating Procedures, 5-21000-OPS-FO.03, General Equipment Decontamination

Appendix 1

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