REMOVAL OF ACTINIDES FROM SOIL

Treatability Study Work Plan

INFORMATION ONLY

6 6 5

U S Department of Energy
Rocky Flats Plant
Golden, Colorado

Environmental Restoration Program

RFP/ERM-94-00029
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1 0 PROJECT DESCRIPTION

Several locations of known soil contamination exist at the Rocky Flats Plant (RFP) site. One type of soil contamination of concern at RFP is the incidence of radionuclide activity above natural levels The major contributors to elevated radionuclide concentrations measured in the environment at RFP are the actinides plutonium (Pu), americium (Am), and uranium (U) Various transport mechanisms acting upon identified sources of actinide contamination have sometimes resulted in the migration and dispersion of that contamination Pu has become a widespread contaminant in soils at RFP and is a significant contributor to the human health risk and environmental impact estimated for the Operable Unit 2 (OU2) area. Am is a radioactive decay product of the dominant Pu isotope at RFP and exhibits behavior similar to Pu in the environment, resulting in their coexistence in contaminated soils. Uranium contamination at OU2 is not as significant as that of Pu and Am.

RFP remediation programs are addressing the cleanup of contaminated areas for the purpose of reducing their associated risks. As a part of the process to screen and select remedial options for OU2 at RFP, this treatability study was initiated to evaluate a series of soil decontamination techniques and will be referred to as the "soils washing" treatability study The soils washing study will assess the technological capability of high-potential physical and chemical separation processes to decontaminate the soil media of its Pu and Am constituents. Removal of uranium, if present, will not specifically be evaluated in this study. Information on the effectiveness of the processes studied, individually and in series, will be used for comparison with soil cleanup standards derived from risk reduction calculations. Although the treatability study will be performed to supply data for the OU2 feasibility study, the results of this effort will be pertinent to soil remediation at other locations contaminated with transuranic constituents as well

Treatability testing will be conducted using soils collected from a location on the east side of the 903 Pad, a recognized source of actinide contamination in OU2, which will make the soil sample representative of both the contamination levels to be encountered during remediation as well as the soil composition characteristic of the area.

2 0 TREATMENT TECHNOLOGY DESCRIPTION

Extensive decontamination studies have been conducted with soil at Rocky Flats. These studies evaluated wet and dry sieving, attrition scrubbing, rotary scrubbing, ultrasonic scrubbing, vibratory grinding, calcination, vitrification, flotation, acid leaching, hydraulic classification, and mineral jigging.[1 5] Various dispersants, surfactants, complexing agents, and adsorbents were incorporated into these evaluations. The most promising technologies tested were wet sieving, attrition scrubbing, vibratory grinding, hydraulic classifying, acid leaching, and the use of dispersants.

The soil washing treatability study will require a series of physical and chemical soil treatment processes to attempt complete removal of Pu and Am contaminants from the soil matrix. The physical processes selected on the basis of capability as well as implementability include wet sieving and attrition scrubbing. Rotary scrubbing is being re-examined using residence times which are closer to the recommended contact time for this technology, rather than the originally studied six minute duration which resulted in an unfavorable preliminary evaluation The use of chemical dispersants will be evaluated in conjunction with the physical processes for their ability to improve the efficiency of the physical separation of the $< 2\text{-}\mu m$ colloidal clay particles, referred to as micelles (microcells), from the remainder of the soil media. This effect is significant because the contaminant Pu and Am cationic complexes are attracted to the negatively charged micelles and will therefore follow them through the separation process. The intent of the physical separation procedure is to achieve a volume reduction of the contaminated media, and it is anticipated that the fine particle size soil fractions will contain the majority of the Pu and Am contamination measured in the original soil sample. Chemical leaching and magnetic separation are two alternative chemical separation processes which will be evaluated for reducing the concentration of Pu and Am in the soil fines which were previously physically separated from the larger particle size soil fractions. The chemical separation is employed to strip the relatively more concentrated levels of contamination from this reduced soil volume

The first soil decontamination test will consist of wet sieving the soil into fractions representing different particle size ranges. Several combinations of wash solutions comprised of water and chemical dispersants will be used during the sieving operation. Aqueous sodium hydroxide has been shown to be effective as a dispersant within the soil matrix studied. Aqueous solutions of sodium hydroxide and sodium hexametaphosphate dispersants will be evaluated alone and in combination Plain water will also be evaluated as a baseline for comparison purposes Sodium ions disperse clays in water while hydroxide ions increase the negative charge exhibited by clay particles to enhance dispersion. The dispersion and swelling of clays are also affected by the type of adsorbed cations. The order of strength of dispersion is $Na^+ > NH_4^+ = K^+ > Mg^{2+} > Ca^{2+} > Al^{3+}$, indicating that sodium has the most pronounced effect on the swelling and/or dispersion of soil colloids.[6] Studies have shown that calcium sulfate (~3 %) inhibits the dispersion of clay particles in soil.[7] The only practical means to effect the total dispersion of clay in soil is to reduce the calcium sulfate concentration to <3% prior to dispersion Therefore, each of the soil treatment processes will first involve one wet sieving step in an attempt to lower the calcium sulfate concentration in the soil. If calcium sulfate is present in the soil, it will be partially dissolved in the wash solution during the initial wet sieving. The soil fractions physically separated by the wet sieving operation will be analyzed to determine the mass of soil distributing into each fraction as well as the partitioning of Pu and Am activity into each mass fraction. The results anticipated are that some of the larger particle size fractions will yield decontaminated soil. Based on the lowest amount of actinide activity in these larger soil fractions, the most effective wash solution will be chosen from those selected for evaluation. The remaining soil treatment processes will be conducted using only the most effective wash solution identified Wash solutions generated by the experiments will also be analyzed for Pu and Am content.

An additional wet sieving operation with fresh wash solution will be performed during the second soil decontamination test to gauge if improvement in the effectiveness of the separation results from the supplemental washing and mechanical sieving action contact time. Data from this double wet sieving treatment process will also be used for comparison with the rotary and attrition scrubbing soil treatment processes, as they will also involve a secondary wet sieving procedure. Additionally, the second wet sieving operation will separate the recombined fractions from the initial wet sieving operation into fractions of even finer particle size discrimination. Measurements of the physically separated soil fractions will be repeated to determine the mass of soil distributing into each of these fractions as well as the partitioning of the Pu and Am contaminants into each mass fraction. Wash solutions will be evaluated as well.

The third soil decontamination test will evaluate rotary scrubbing. After an initial wet sieving wash, the soil fractions will be recombined and rotary-scrubbed with fresh wash solution. The purpose of recombining the soil fractions is to provide enhanced scrubbing action of the fine soil particles by the coarse soil particles The rotary scrubbing experiments will be performed using 2, 8, and 18 hour residence time intervals. Studies have shown that a minimum of eight hours mixing is recommended for the complete dispersion of clay particles in soil [7] The 8 hour rotary scrub interval was selected to meet the recommended residence time The 18 hour time interval was selected to encourage maximum dispersion of the clay particles in soil. In addition, the 18 hour time interval will be convenient because the scrubbing can be performed overnight using an Unattended Equipment Operation Permit. The 2 hour rotary scrub interval data point will be used to determine the reduction in separation effectiveness to be anticipated with the decreased residence times which correspond to scaling up the rotary scrubbing operation to higher throughput rates. Each soil slurry will be wet sieved after rotary scrubbing using fresh wash solution Soil fractions and solutions will be analyzed for Pu and Am content

A fourth soil treatment experiment will involve attrition scrubbing Previous soil studies at RFP have shown that attrition scrubbing releases actinides most effectively from the <4.0- to 0.5-mm soil particles [1] The soil fractions larger than 4 0-mm will not be attrition-scrubbed due to the potential for damage to the scrubbing impeller. Therefore, the recombined fine soil fractions between 0 5-mm and 4.0-mm that were previously wet sieved and rotary scrubbed at the most effective residence time will be attrition scrubbed with fresh wash solution for 10 minutes at 1,000 rpm. This soil slurry will then be wet sieved using fresh wash solution. Soil fractions and solutions will be analyzed for Pu and Am content.

The fifth decontamination test will evaluate chemical extractant solutions for their ability to desorb Pu and Am from the fine soil fractions, leaching the transuranics into the aqueous phase The two dilute solutions which will be examined, ascorbic acid with sodium citrate and sodium dithionite with sodium citrate, were chosen based on favorable results from an experimental investigation of a field of leaching agents appropriate for the removal of Pu and Am from contaminated soil.[8] The fine soil fractions <4.0-mm from the attrition scrubbing experiment as well as the fine soil fractions <0.5-mm from the rotary scrubbing experiment will be utilized in this evaluation

The soil treatment process to be evaluated for the sixth decontamination test will involve a newly developed magnetic separation procedure, the Mag • Met process from Rust Federal Services, for treating the fine clay particles. The less than 0 063-mm particle size soil fraction to be used in the evaluation will be obtained from the double wet sieve process. The soil fines will be stirred for 10 minutes with magnetite, a magnetic sorbent, after which the sorbent will be magnetically separated from the soil.

A separate magnetic separation process will be evaluated for removing actinide ions from the wash solutions generated by the soil decontamination tests. In this process, the spent wash solution is pumped through a column of magnetic adsorbent while in a magnetic field [9] The sorbent will be either Nucon™ magnetite or magnetic resin.

Figure 1 graphically illustrates the experimental task plan for the Removal of Actinides from Soil Treatability Study

REMOVAL OF ACTINIDES FROM SOIL EXPERIMENTAL TASK PLAN

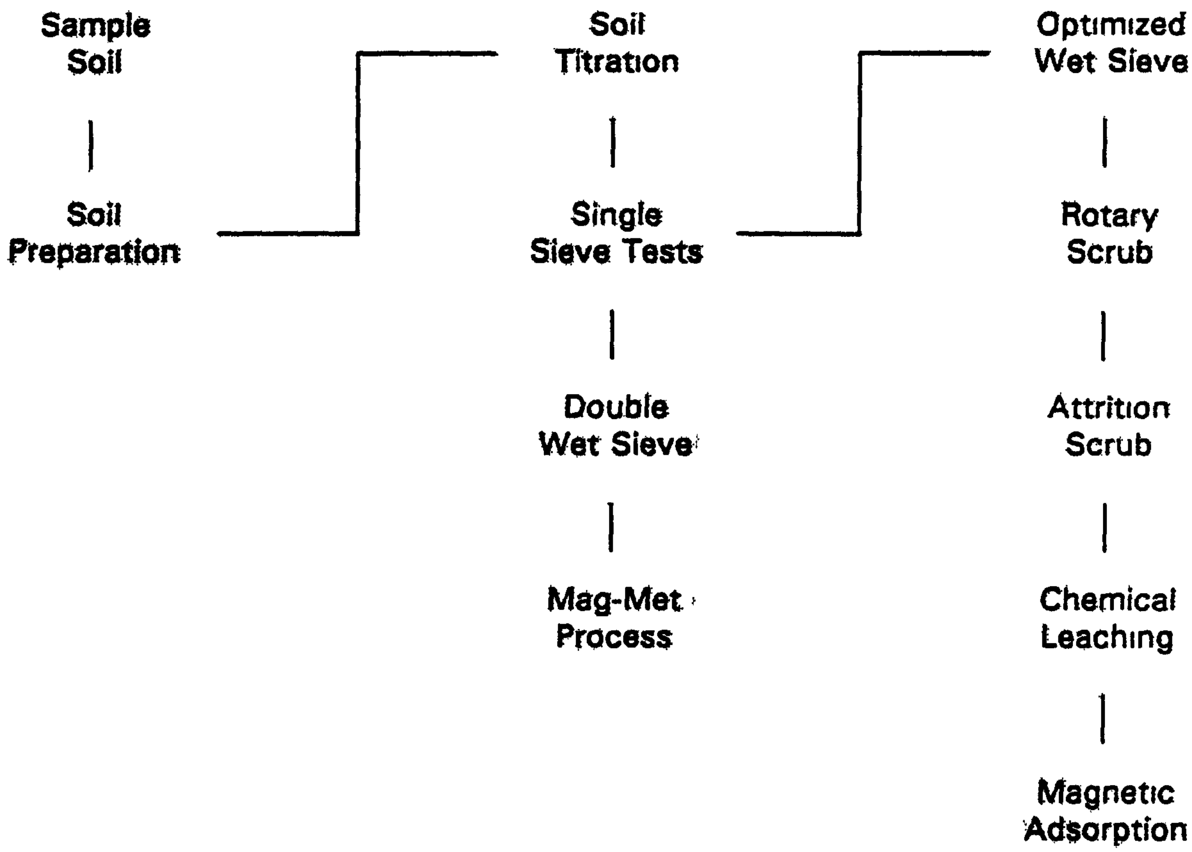

Figure 1

3 0 TEST OBJECTIVES

The experimental program is designed to;

1) Determine which of the wash solutions under evaluation is most effective for separating Pu and Am constituents from the contaminated soil matrix,

2) Evaluate the effect of dissolving calcium sulfate from the soil on clay particle dispersion;

3) Evaluate the effectiveness of wet sieving for separating Pu and Am from the remainder of the soil matrix;

4) Evaluate the effect of varying residence times for the rotary scrub operation on separation of Pu and Am from soil media,

5) Evaluate the effectiveness of attrition scrubbing for removing Pu and Am from the 4 0- to 0.5-mm soil fraction,

6) Evaluate the effectiveness of chemical leaching agents for their ability to desorb Pu and Am from <4.0-mm soil fraction;

7) Evaluate the effectiveness of magnetic adsorbents for removing Pu and Am from the <0.063-mm soil fraction;

8) Evaluate the effectiveness of magnetic adsorbents for removing Pu and Am from spent aqueous solutions generated by soil washing;

9) Optimize soil treatment processes and conditions in anticipation of scaling up activities for a soil remediation pilot plant operation; and,

10) Determine the levels of Pu and Am activity to which the soil treatment processes tested are technologically capable of reducing contamination in RFP soil.

4.0 EXPERIMENTAL DESIGN AND PROCEDURES

4.1 Soil Preparation

Approximately 25 kg of soil (<50.0-mm) for experimental use will be supplied through the Sitewide Treatability Studies Soil Sampling Program. The soil sample will be spread out to dry for several days at ambient room temperature to its approximate surface-dry condition. Reproducibility of analytical techniques is complicated by heterogeneities in the soil matrix. Representative sampling of bulk solids is difficult to achieve without some pre-treatment by physical methods. The dried soil sample will be dry sieved into two fractions (<50.0- to 12.5-mm and <12 5-mm) and weighed to determine the weight percent of total mass contained in each fraction. The <50.0- to 12.5-mm soil will then be coned and quartered and the <12.5-mm soil will be split with a riffle splitter. Proportional amounts of both the cone/quartered and riffle split soil fractions will then be recombined for use in the soil decontamination tests.

4.2 Soil Characterization

4.2.1 Soil Analysis

A sample of the prepared soil will be sent to the laboratory for an initial soil characterization analyses to include plutonium, americium, and uranium, as well as specific gravity, pH, total organic carbon, and calcium sulfate.

4.2.2 Soil pH Titrations

Soil pH titrations will be performed to determine the buffering capacity of the soil, or the resistance of the soil pH to change. This information will be used to estimate the amount of 0.1M sodium hydroxide which will be required to produce a change in soil pH during processing. The tests will be used to develop a curve which graphically describes the buffering capacity behavior of the soil and to determine the upper and lower pH values which define the limits of the region of maxium soil buffering capacity on the curve . This will be accomplished by titrating 10 grams of soil (<4 0-mm) at a soil-to-solution mass ratio of 1.4 while stirring The titration procedure will be repeated using 0 1M sodium hydroxide plus

0.1M sodium hexametaphosphate solution

4.3 Soil Decontamination Tests

4.3.1 Wet Sieve Tests

Each wet sieve test will be performed with a Tyler Model RX-24 sieve shaker and U.S Standard sieves (20-cm diameter). A sieve lid (with spray head) and bottom pan (with drain tube) will be used in conjunction with the sieves. In addition, a Masterflex peristaltic pump as well as a supply reservoir and receiving vessel (4-liter containers) will complete the wet sieving system.

Four wet sieve tests will be conducted, each using ~1000 grams of soil with ~6 liters of wash solution (the exact volume will be determined during titration procedures). The wash solutions to be evaluated are:

1 Water;

2. 0 1M $(NaPO_3)_6$ solution;

3. 0.1M NaOH solution- Two tests: one at the upper pH limit & one at the lower pH limit identified during titration tests); and,

4. 0.1M NaOH / 0 1M $(NaPO_3)_6$ solution- Two tests: upper & lower pH limits,

The soil will be wet sieved into five fractions (<50.0- to 12.5-mm, <12.5- to 4.0-mm, <4 0- to 0 5-mm, <0.5- to 0.063-mm, and <0.063-mm). Each of the soil fractions separated are dried at ambient temperature and weighed. Samples of the soil fractions will be collected and sent to the laboratory for $Pu^{239,240}$ and Am^{241} analysis.

The spent wash solutions from the wet sieve operations will be filtered through coarse (Whatman No. 41 or 20-25 μm) and fine (Whatman No. 42 or 2.5 μm) paper. A portion of these wash solutions will be syringe filtered through a 0 2 μm membrane, and these samples of the collected wash solution will be sent to the laboratory for $Pu^{239,240}$ and Am^{241} analysis.

4 3 2 Double Wet Sieve Test

A subsequent wet sieve test will be performed using ~1000 grams of soil from the recombined fractions of the previous sieving process which identified the most effective wash solution with an additional ~4 liters of the fresh wash solution The second sieving operation will separate the soil into five particle size fractions (<50.0- to 12.5-mm, <12.5- to 4.0-mm, <4.0- to 0 5-mm, <0.5- to 0 063-mm, and <0 063-mm) Each of these fractions will be dried and weighed. Samples of the soil fractions and wash solutions will be collected and sent to the laboratory for $Pu^{239\ 240}$ and Am^{241} analysis. The wash solutions will be filtered and sampled as described in Section 4.3 1.

4 3.3 Rotary Scrub Tests

Three rotary scrub tests will be performed Each sample of ~1000 grams of soil will be initially wet sieved into five fractions (<50.0- to 12.5-mm, <12.5- to 4 0-mm, <4 0- to 0.5-mm, <0.5- to 0.063-mm and <0.063-mm) using ~6 liters of the most effective wash solution Next, the separated soil fractions will be recombined with fresh wash solution at a soil to solution mass ratio of 1.5 and placed into an 8-liter wide-mouth polyethylene bottle. The soil slurry in the bottle will then be rotated on a rotary jar mill at 290 rpm for 2, 8, or 18 hours for the three experimental trials. Each of the rotary scrubbed soil slurries will then be wet sieved into five fractions (<50.0- to 12 5-mm, <12.5- to 4 0-mm, <4 0- to 0.5-mm, <0.5- to 0.063-mm, and <0.063-mm) with ~4 liters of fresh wash solution Each soil fraction will then be dried and weighed. Samples of the soil fractions and wash solutions will be collected and sent to the laboratory for $Pu^{239\ 240}$ and Am^{241} analysis. The wash solutions generated will be filtered and sampled as described in Section 4.3.1.

4.3 4 Attrition Scrub Tests

One attrition scrub test will be performed with soil (<4.0- to 0.5-mm) which was previously wet sieved and rotary scrubbed at the most effective residence time identified The quantity of soil used in the test will be determined by the amount of soil available from the soil fractions resulting from the rotary scrubbing operation. The soil will be attrition scrubbed with fresh wash solution at a soil to solution mass ratio of 1·5 for 10 minutes at 1,000 rpm using a laboratory attrition scrubber. This scrubbing device consists of two three-bladed, stainless steel opposed-pitch propellers (7-cm diameter) mounted in tandem (4-cm apart) with one propeller at the end of a stainless steel drive shaft. The propeller assembly (lowered into a 1-liter stainless beaker containing the soil slurry) performs the scrubbing action. The attrition scrubbed soil will then be wet sieved into three fractions (<4.0- to 0.5-mm, <0 5- to 0.063-mm, and <0 063-mm) with ~4 liters fresh wash solution. Each of these fractions will be dried and weighed. Samples of the soil fractions and wash solutions will be collected and sent to the laboratory for $Pu^{239,240}$ and Am^{241} analysis. The wash solutions generated during the experiment will be filtered and sampled as described in Section 4.3.1.

4.3.6 Chemical Leaching Process

Two chemical leaching tests will be performed using the <4 0-mm soil fractions from the attrition scrub experiment and the <0 5-mm soil fractions from the rotary scrub experiments. Two chemical extractant solutions will be evaluated, a 0.1 M sodium citrate with 0.1 M sodium dithionite and a 0 1 M sodium citrate with 0 1 M ascorbic acid. The soil and leaching solutions (a soil to solution mass ratio of 1.10 will be used) will be placed into an 8-liter wide-mouth polyethylene bottle and rotated on a rotary jar mill at 290 rpm for 18 hours. The soil slurries will then be wet sieved into three fractions (<4.0- to 0 5-mm, <0.5- to 0.063-mm, and <0.063mm) with ~4 liters of water. Each of these fractions will be dried and weighed. Samples of the soil fractions and wash solutions will be collected and sent to the laboratory for $Pu^{239\ 240}$ and Am^{241} analysis. The wash solutions generated during the experiment will be filtered and sampled as described in Section 4.3.1.

4.3.7 Mag • Met Process

One Mag • Met test will be performed with ~100 grams of the <0.063-mm soil fraction resulting from the double wet sieve experiments. First 1.0 gram of 0.4-μm magnetite and 0.1 gram of powdered iron will be mixed together and activated by stirring with 200 mℓ of sodium hydroxide (pH 12 0) solution for 10 minutes at 200 rpm. The soil will be attrition scrubbed for 30 minutes with the activated magnetite/iron adsorbent. The adsorbent will then be magnetically separated from the soil by passing the soil/magnetite/iron slurry through a column containing a plug of No. 431 stainless steel wool approximately 5-mm thick, surrounded by an applied magnetic field strength of ~0 3 Tesla. The iron is utilized to encourage the removal of actinides by formation of an iron ferrite complex.

The Mag * Met experiment will be repeated without the use of magnetite and iron This second test will be used to compare actinide removal effectiveness using the magnetite and iron. Samples of the soil and solutions will be collected and sent to the laboratory for $Pu^{239\ 240}$ and Am^{241} analysis. Solutions generated during the experiment will be filtered and sampled as described in Section 4.3.1.

4 3.8 Magnetic Adsorption Process

Spent wash solutions from the soil decontamination experiments will be treated with a magnetic adsorbent. The adsorbent will be either Nucon™ magnetite (~0.3-mm) or magnetic resin (<0.125- to 0.038-mm). A glass chromatographic column (19-mm inside diameter x 25-cm long) packed with a 10-cm plug of fine No. 431 stainless steel wool will be placed between the pole faces of an ANAC Model 3470 laboratory electromagnet, with the bottom portion of the stainless steel wool plug aligned with the electromagnet. The bottom of the column has a Teflon stop-cock (2-mm bore) and is secured at the top with a one-hole (6-mm i.d.) rubber stopper, fitted with a glass tube (6-mm o d x 5-cm). Tygon tubing (6-mm i.d.) is attached to both ends of the column.

The magnetic adsorbent (20.0 g) will be activated by stirring the adsorbent with 200 mℓ of sodium hydroxide (pH 12.0) solution for 10 minutes at 200 rpm. The adsorbent slurry is then pumped up-flow at 10 mℓ per minute by a peristaltic pump into the glass column while a field strength of 0.3 Tesla (3,000 Gauss) is applied to the electromagnet The pH of the spent wash solution will be determined and adjusted if necessary into the pH 10 to 12 range. The spent wash solution will then be pumped through the column up-flow at 10 mℓ per minute while a field strength of 0.3 Tesla is applied to the electromagnet. A quantity of effluent equal to the system volume will be collected and discarded prior to collecting the first sample. The column effluent will then be collected and sent to the laboratory for $Pu^{239\ 240}$ and Am^{241} analysis. Solutions generated during the experiment will be filtered and sampled as described in Section 4.3.1.

5 0 EQUIPMENT AND MATERIALS

5.1 APPARATUS

a U S. standard sieves (20-cm diameter) in the following sieve sizes: 50.0-mm, 12.5-mm, 4.0-mm, 0.5-mm, and 0 063-mm;

b. Sieve lid with spray head and bottom pan with drain tube,

c. Tyler Model RX-24 sieve shaker;

d. Masterflex peristaltic pumps;

e P K. "Yoke" Twin Shell® blender;

f. U.S. Stoneware rotary jar mill;

g. Tube rotator

h. Denver Model D-12 attrition scrubber;

i ANAC Model 3470 laboratory electromagnet and power supply;

j. Top loading balance;

k. Nuclear Measurements Corporation PC-5 proportional alpha counter;

l. Canberra Series 80 multichannel analyzer in conjunction with a Phoswich-type (NaI) detector;

m. Centrifuge;

n. Drying oven;

o. Sample splitter;

p. pH meter with pH probe; and,

q Glass and plastic ware (e g , beakers, cylinders, and pipette tips).

5 2 REAGENTS

a Sodium hydroxide

b. Sodium hexametaphosphate

c Sodium citrate

d Sodium dithionite

e Ascorbic acid

f Magnetite

g. Magnetic resin

h Nitric acid

i. Powdered iron

The Building 779 Chemical Control Officer will be informed of changes regarding the acquisition or depletion of reagents. The chemical control officer will be supplied with material safety data sheets (MSDS) as new reagents are received into Building 779.

6.0 SAMPLING AND ANALYSIS

The initial soil supply and the treated soils will all be sampled for analysis by the cone/quartering and/or riffle splitting methods as appropriate for the particle size fraction samples being collected. Soil sampling techniques will be performed in accordance with ASTM Designation: C 702-87 specifications. Sampling activities will be performed by EG&G RFP personnel using EG&G Standard Operating Procedures (Appendix A, OSA 779.066) for sample designation, handling, shipping, and documentation requirements. There will be a chain of custody form in transferring samples from EG&G RFP to the analytical lab.

The soil fractions and solution samples will be screened for Am^{241} using a Canberra multichannel analyzer and Pu^{239} using a proportional alpha counter within Room

139 of Building 779 by EG&G RFP personnel prior to packaging and shipment to the analytical laboratory for analysis. This will provide a guideline for the number and size of samples that can be sent at one time to the analytical lab for actinide analyses. In addition, the liquid samples will be stabilized with nitric acid prior to packaging to a pH of ~2.

Soil and solution sample analyses will be performed by an off-site laboratory. The analytical laboratory will follow the General Radiochemistry and Routine Analytical Services Protocol and use EPA approved methods.

7.0 DATA MANAGEMENT

All procedures used in the treatability study will be documented in project databook 2419. Observations made during the study will be recorded in bound laboratory notebooks. The project and laboratory notebooks for this study will be specific to this project. The treatability study logbooks will document the following at a level of detail sufficient to allow another qualified reseacher to retrace the investigation and confirm the results.

- Testing procedures;
- Departure from protocols and the reasons for departures;
- Instrument calibrations;
- Sampling methods;
- Chemical additions; and,
- Test observations.

All samples received and generated during this study will be labeled with unique sample identification numbers. In addition to the unique sample numbers, the source of each sample will be documented There will be a complete history of all samples from collection through transportation to receipt, testing or analysis and disposition at the laboratory. The experiment's soil supply sample will be accompanied by documentation on the sample transmittal form describing the sample collection location and method, pertinent observations, personnel involved, date of collection, any sample preservation performed, containers used, etc.

8.0 DATA ANALYSIS AND INTERPRETATION

Upon completion of the treatability experiments, data will be presented and interpreted in accordance with Section 3 11 of The Guidance for Conducting Treatability Studies under CERCLA (EPA 1992) Data will be summarized and evaluated to determine the validity of measurements and performance of the treatment processes

9 0 HEALTH AND SAFETY

Health and safety issues pertaining to this project are addressed in an Operational Safety Analysis provided in Appendix A.

The laboratory hoods in Room 139, Building 779, require a minimum face velocity of 150 feet per minute (fpm) in order to insure confinement of airborne contaminants. Operations shall be terminated if the air flow falls below this velocity

10 0 RESIDUALS MANAGEMENT

10 1 Treated Soil and Wash Solutions

All excess soil and wash solutions will be disposed of as specified in the Waste Stream and Residue Identification and Characterization Program (WSRIC) documentation. This process is described in the Building 779 WSRIC manual. The soil and solution samples sent off-site for analysis will be properly disposed of by the analytical lab contracted. None of the solids or solutions are RCRA regulated Ultimately, there will be ~25 kg of soil and ~150 liters of solution requiring disposal. The other waste generated (e g , dry combustibles, glass, plastic) will occupy less than a 55-gallon drum The waste generators will be responsible for disposal of the solid and aqueous wastes generated. All sludge and residual waste shipments will comply with the provisions of the Federal Treatability Study Exemption Rule (see Section 3.9 to "Guide for Conducting Treatability Studies Under CERCLA"). Disposal of materials at the source site will be in accordance with the requirements of CERCLA, RCRA, federal, state and RFP waste management practices.

10.2 Contaminated or Potentially Contaminated Debris

All efforts will be taken to minimize the quantity of contaminated or potentially contaminated debris Efforts will include minimizing the use of disposable materials Glassware, which can normally be decontaminated and reused for other treatability studies, will be used for bench-scale testing. Porous media such as clothing and paper towels will be evaluated for disposal as low level radioactive waste

11.0 REPORTS

A final treatability test report will be prepared after completion of the treatability study to document the test results. The report organization will follow the general outline suggested in Section 3 12 of EPA Guidance for Conducting Treatability Studies under CERCLA.

12.0 SCHEDULE

The draft project schedule is provided as Appendix C

13 0 MANAGEMENT AND STAFFING

EG&G RFP Environmental Restoration Management (ERM) is investigating decontamination technologies for environmental media as remedial action options. ERM Environmental Engineering and Technology (EE&T) has initiated treatability studies to gather data to support remediation alternatives. EE&T is funding the RFP Environmental Technology (ET) department to perform this bench-scale treatability study which evaluates selected treatment processes for removal of Pu and Am from soil contaminated with these transuranic elements. Rust Federal Services will be contracted to assist ET with experimental design, data interpretation and analyses, and documentation. The EE&T project manager will be A. M. Long and the ET project lead will be R. L. Kochen.

14.0 QUALITY ASSURANCE PLAN

Quality assurance issues pertaining to this project are addressed in a Quality Assurance Addendum included as Appendix B.

15 0 REFERENCES

1 R. L. Kochen and J. D. Navratil, "Americium and Plutonium Removal From Contaminated Soil," in **Actinide Recovery From Waste and Low-Grade Sources**, (J. D. Navratil and W. W. Schulz, Eds), Harwood Academic Publishers, New York, NY, pp 95-100, 1982.

2. J. R. Stevens, R. L. Kochen, and D. W. Rutherford, "Comparative Scrub Solution Tests For Decontamination Of Transuranic Radionuclides From Soils," RFP-3161, Rockwell International, Rocky Flats Plant, Golden, CO, August 2, 1982.

3 J. R. Stevens and D. W. Rutherford, "Separation Of Transuranic Radionuclides From Soil By Vibratory Grinding," RFP-3296, Rockwell International, Rocky Flats Plant, Golden, CO, August 13,1982

4. R. L. Kochen and J. J. Blakeslee, "Decontamination Of Johnston Island Coral: A Preliminary Study," RFP-3849, Rockwell International, Rocky Flats Plant, Golden, CO, February 17, 1986

5. R. L. Kochen, S. C. McGlochlin, and S A. Pettis, "Removal Of Actinides From Rocky Flats Soil," RFP-4479, EG&G Rocky Flats, Rocky Flats Plant, Golden, CO, September 12, 1991.

6. N. C. Brady, **The Nature And Properties Of Soils**, 10th ed., pp 177-212, Macmillan Publishing Company, New York, NY, 1990.

7. E. H. Tyner, "The Use Of Sodium Metaphosphate For Dispersion Of Soils For Soil Analysis," **Soil Sci. Soc. Amer. Proc.** 4, pp 106-113, 1939.

8. I. R. Triay and G. W. Loge, "Batch Experiments for Desorption of Plutonium and Americium in Contaminated Soil from the Rocky Flats Plant", LA-UR-94-1165, Los Alamos National Laboratory, May, 1994.

9. R. L. Kochen and J. D. Navratil, "Removal Of Radioactive Materials And Heavy Metals From Water Using Magnetic Resin," Patent Application No S-75,566, 1993.

APPENDIX A

OPERATIONAL SAFETY ANALYSIS

OPERATIONAL SAFETY ANALYSIS

TITLE PROCESS CHEMICAL RESEARCH LABORATORY, ROOM 139 No 779 066

RESPONSIBLE ORGANIZATION Plutonium Recovery Technology

OPERATION

The laboratory located in Room 139, Building 779 will be used to investigate methods and processes related to actinide recovery The actinides will be studies and handled according to the procedures set forth in the H&SP Manual The chemicals will be received and handled according to their hazard ratings Following each investigation, the waste solids and solutions will be disposed of through either Chemical Operations processes or Waste Treatment No special hazards other than those associated with the handling of actinide materials and standard laboratory chemical will be encountered. No special procedures are used in the R+D operations.

RESPONSIBILITY

R J Ballenger	Manager	Plutonium Recovery Technology
(Name)	(Position)	(Organization)

is responsible for this laboratory It is his/her responsibility to ensure that this operation is carried out in accordance with this OSA, and that all employees who perform this operation are familiar with this document

CHANGES

No changes will be made in this OSA without coordinating the change through the H&S Area Management Representative who will determine if additional reviews and/or approvals are necessary

CONCURRENCE

H&S Area Management Representative — Concurrence Date: 06-13-94

APPROVAL AUTHORITY

R J Ballenger Manager Plutonium Recovery Technology

R J Ballenger

Approval Authority — Approval Date: 6/14/94

OPERATIONAL SAFETY ANALYSIS
HAZARD/HAZARD CONTROL

TITLE PROCESS CHEMICAL RESEARCH LABORATORY, ROOM 139 No 779 066

RESPONSIBLE ORGANIZATION Plutonium Recovery Technology

GENERAL HAZARD REVIEW AND CONTROL

1 Operators will read, understand, and follow approved posted nuclear material safety limits All limits will be posted and kept current

2 Operators will know and understand hazards associated with individual chemicals by consulting material safety data sheets beforehand and will use all prescribed protective clothing and equipment to avoid personal injury

3 All operators will be instructed regarding operations to be performed and will fully understand these before any work is undertaken

4 All fume hoods will have air flow checked regularly and will have current green R&D stickers per ROI 7 4

5 All operators will be waste generator trained for waste disposing

6 All work will be done using an active radiation work permit

7 All operators will maintain proper training for work performed

BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
1 Diluting of plutonium and americium standards at starting concentrations of 100,000 D/M/G Pu and 30,000 D/M/G Am, or 0 1 g/l Pu, and 1 x 10^{-3} g/l Am	1 Radioactive contamination and radiation exposure from the handling of actinides	1 Radioactive materials are received into the laboratory All operations will be in compliance with the procedures, requirements and responsibilities outlined in H&SP 9 01 When performing operations, complete company clothing must be worn The worker must wear safety glasses and have in his/her possession full face respiratory protection (ready for use) as

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BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
		prescribed in H&SP 18 02 A radiation protection technologist must be present for all airlock entries and bag cuts, and all procedures described in ROI 7 2 and in H&SP 18 02 must be adhered to
	1a Criticality	1a The nuclear material safety limits will be read, understood, and followed All limits will be posted and kept current
1b Use of nitric acid	1b Reaction with combustible material causing fire	1b Rags or paper containing nitric acid will be neutralized by treatment with basic solution prior to disposal All combustible material will be placed in an approved container with a tight fitting lid
	1c Contamination	1c This material will be removed from the glovebox on the last working day of each week by a bag cut in the presence of a radiation protection technologist All procedures described in ROI 7.2, H&SP 21 01,

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BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
		and F-0010 will be adhered to Combustibles will then be placed in a barrel for further processing
	1d Pressurization of stored liquid Nitric acid can build up pressure when stored in a closed container	1d All actinide solutions containing nitric acid will be stored in vented containers
2 Preparation and addition of chemical reagents such as hydrochloric, nitric, hydrofluoric, sulfuric, and oxalic acid to aqueous actinides	2 Can cause physical damage to the eyes, skin, and respiratory system	2 Proper ventilation will be maintained in work areas by using fume hoods bearing a current green or yellow air flow label (per ROI 7 4) or by use of gloveboxes Toxic chemicals will be handled inside fume hoods or gloveboxes Wear proper protective clothing, e g , Class III eye protection (chemical goggles worn with a face shield), gloves (specific to the chemical handled), clothing that will not absorb chemicals

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BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
2a Use of hydrogen peroxide	2a The liquid is toxic and can be explosive in the presence of metal ions High concentrations can cause fire and explosions	2a Hydrogen peroxide will not be used if impurities are not known Solutions more concentrated than 35% H_2O_2 will not be used No open flames will be allowed when H_2O_2 is being used Other personnel in the area will be notified not to use open flames, when H_2O_2 is being used
2b Use of beryllium compounds	2b Beryllium compounds are suspect carcinogens	2b Beryllium solutions will be made up in fume hoods having a green tag, or in gloveboxes Gloves and half mask respiratory protection will be worn when handling beryllium compounds in fume hoods Any beryllium solutions coming in contact with the skin or eyes will be washed off immediately with copious amounts of water Supervision will be contacted immediately, and a radiation technologist will be contacted to obtain transportation to Medical

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BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
		Containers will be kept tightly closed and clean when outside of fume hoods or gloveboxes
	2c Reagent labeling and stability	2c All reagents will be properly labeled Reagents with limited stability are dated as to their expiration date and will be removed upon expiration date and discarded per manufacturer's recommendation and Rocky Flats chemical disposal policies
3 Filtration of liquids from precipitates	3 Criticality	3 The nuclear material safety limits will be read, followed, and understood by all operators
4 Drying & calcination of solids at high temperature	4 Combustibles such as paper and organic solvents in the presence of heat sources can cause fire	4 Combustibles will be stored in approved containers with tight-fitting lids No highly flammable organic will be permitted within the glovebox during this operation All calcining will be done in porcelain or metal boats no larger than 4 liters in volume

OPERATIONAL SAFETY ANALYSIS
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RESPONSIBLE ORGANIZATION Plutonium Recovery Technology

BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
5 Separation of actinides by solvent extraction using solvents such as carbon tetrachloride, toluene and chloroform	5 Some organics are fire hazards as well as irritants to the eyes, skin, and respiratory system	5 Surgeons gloves will be worn when handling organics in fume hoods having a green tag No open flames or heat sources will be in the vicinity of flammable organics Other personnel in the area will be notified not to use open flames when organics are being used
6 Waste and Product Disposal	6 Radioactive contamination and radiation exposure can be a problem when removing waste, product and equipment from the glovebox of hood	6 A radiation protection technologist will be present during removal of materials from a glovebox or hood Bagout operations will be performed in the presence of a radiation protection technologist All procedures described in ROI 7 2, H&SP 21 01, and F-0010 will be adhered to
	6a The above wastes are potential environmental contaminants, the wastes may be either uncontaminated or radioactively contaminated	6a. Waste Processing will be consulted in order to coordinate the disposal method set forth by HS&E 21 - 01 As mentioned above, a radiation protection technologist

OPERATIONAL SAFETY ANALYSIS
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RESPONSIBLE ORGANIZATION Plutonium Recovery Technology

BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
		will be present during the removal of any materials from the glovebox or hood as per H&SP 21 01 and F-0010
7 Many chemicals are available for use in the Chemical Technology laboratories	7. Chemicals can be toxic, flammable, corrosive and/or have other harmful characteristics	7 Material Safety Data Sheets (MSDS) are kept on file in Room 136 Consult this information to determine what precautions and personal protection are required for using individual chemicals A complete list of chemicals stored in Rooms 137, 138, and 139 is attached All chemical containers are labeled with room number and cabinet number so that they can be returned to their proper place after use All chemicals are stored according to their INMAT compatibility ratings
	7a Fumes from mixing chemical reagents.	7a All mixing of chemical reagents will be performed either in fume hoods with prope-

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BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
		rly certified air flow or in gloveboxes
8 Common laboratory equipment such as hot plates, muffle furnaces, glass columns, constant temperature water baths, balances, pH meters, centrifuges, tube rotators, tube shakers, drying ovens, ultrasonic cleaners, and miscellaneous laboratory glass will be used	8 Burns and cuts are main concern	8 Only proper laboratory safety and common sense can avoid these types of accidents All materials will be properly labeled and all procedures will be fully explained and followed All equipment will be stored or left in a safe condition when not in use
9 Special lab equipment to include shaker for wet sieving, jar mill for rotary scrubbing, attrition scrubber, lab flotation unit, and lab mineral jig	9 Electrical and moving mechanical parts, water overflow	9 Use in accordance with manufacturer recommendations and plant safety procedures
10 Planchet preparation for alpha counting involves pipetting 10 to 100 ul of plutonium (10^{-4} g/l or less) and americium (10^{-6} g/l or less) onto a stainless steel planchet, evaporating liquid from planchet on hot plate, heating planchet in flame of Bunsen burner until	10 Radioactive contamination and radiation exposure from the handling of actinides	10 All of these operations are done in a B-box or fume hood with properly certified air flow (per ROI 7 4)and are handled in accordance with the procedures outlined in Section 18 02 of the H&SP Manual

OPERATIONAL SAFETY ANALYSIS
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RESPONSIBLE ORGANIZATION Plutonium Recovery Technology

BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
cherry red, and allowing planchet to cool		
	10a Personnel burn hazard	10a Handle hot planchets with tongs or other gripping device
11 Planchet counting involves carrying cool planchets from B-box or fume hood across room to an alpha counting instrument	11 Spread of contamination	11 Flaming a planchet fixes the contamination into its stainless steel surface Planchets with 10^{-4} g/l Pu and 10^{-6} g/l 'Am have been checked for alpha smear and shown no loose contamination
12 Low level decontamination testing to include wet sieving, attrition scrubbing, flotation, and jigging	12 See 1a, 1b, 6, 6a and 9	12 See 1a, 1b, 6, 6a and 9
13 Use of propane in Bunsen burner for flamming planchets	13. Personnel burn hazard	13 See 10a Propane gas will be stored in a certified an approved propane gas tank and operated with an approved gas regulator, flash back fuel arrestor, and flash-back air arrestor All work with the Bunsen burner will be in a B-box or fume hood with properly certified air flow

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TITLE PROCESS CHEMICAL RESEARCH LABORATORY, ROOM 139 No 779 066

RESPONSIBLE ORGANIZATION Plutonium Recovery Technology

BASIC OPERATIONS	POTENTIAL HAZARDS	HAZARD CONTROL
		All equipment will be stored or left in a safe condition when not in use

APPENDIX B

QUALITY ASSURANCE ADDENDUM FOR THE REMOVAL OF ACTINIDES FROM SOIL TREATABILITY STUDY WORK PLAN

This Quality Assurance Addendum (QAA) supplements the "Rocky Flats Plant Site Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP).

The Rocky Flats Plant (RFP) Environmental Technology (ET) group identified several treatment processes for removing actinides Pu and Am from RFP soil The Removal of Actinides from Soil Treatability Study Work Plan (TSWP) describes the experimental procedures for these treatment technologies. This QAA establishes the study-specific management and process quality controls applicable to the tests described in the TSWP

B.1 ORGANIZATION AND RESPONSIBILITIES

The overall organization of EG&G Rocky Flats and the Environmental Restoration (ER) Management Organization responsible for implementing the ER Program activities at the RFP is presented in Section 1.0 of the QAPjP. Functional responsibilities are also described in Section 1.0 of the QAPjP The project-specific organization is described in Section 13.0 of the TSWP.

B.2 QUALITY ASSURANCE PROGRAM

The QAPjP was written to address QA controls and requirements for implementing ER Program activities, as required by the RFP Interagency Agreement (IAG). The content of the QAPjP was driven by Department of Energy (DOE) Order 5700.6C, the RFP QA Manual (RF QAM), and the IAG. DOE 5400.1 and the RF QAM both require a QA program to be implemented based on American Society of Mechanical Engineers (ASME) NQA-1, "Quality Assurance Requirements for Nuclear Facilities." The IAG specifies development of a QAPjP in accordance with the Environmental Protection Agency (EPA) QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans." The 18-element format of NQA-1 was selected as the basis for both the QAPjP and subsequent QAAs with the applicable elements of QAMS-005/80 incorporated where appropriate Figure 2-1 of Section 2 0 of the QAPjP illustrates where the 16 QA elements of QAMS-005/80 are integrated into the QAPjP and also into this QAA. Section 2 0 of the QAPjP also identifies other DOE Orders and QA requirements documents to which the QAPjP and this QAA are responsive.

The quality assurance requirements addressed in the QAPjP are applicable to the Actinide Removal treatability tests, unless specified otherwise in this QAA Where sitewide administrative and process controls are applicable to Actinide Removal tests, the applicable section of the QAPjP is referenced in this QAA. Study-specific quality administrative and process controls that are applicable to the Actinide Removal treatability testing (that may not have been addressed on a sitewide basis in the QAPjP) are addressed in this QAA. Many of the quality process controls specific to the Actinide Removal testing to be conducted are addressed in the Actinide Removal TSWP and are referenced in this QAA

B.2.1 Training

The minimum personnel qualification and training requirements applicable to EG&G and subcontractor staff for RFP ER Program activities are addressed in Section 2 0 of the QAPjP. All EG&G and subcontractor staff working on the actinide treatability tests, including those collecting soil samples from the RFP, shall be trained in the procedures that are applicable to their assigned tasks. These procedures include the soil washing bench-scale testing procedures described in Section 4.0 of this TSWP and the laboratory analytical procedures that are applicable to the analytical methods referenced in Section 4.0. In addition to procedures training, EG&G and subcontractor personnel shall receive training on the applicable process control requirements of the QAPjP and the soil washing TSWP (including this QAA). Training may consist of formal classroom training, on-the-job training, briefings, and/or reading assignments. Training must be recorded, with verifiable documentation of training submitted to the EG&G Project Manager prior to implementing the activities described in the soil washing TSWP.

EG&G and subcontractor personnel shall also be qualified to perform the tasks they have been assigned. Personnel qualifications must be documented, with documentation of qualification verified by the EG&G Project Manager in accordance with EM administrative procedure 3-21000-ADM-02 02, Personnel Qualifications

B 2 2 Quality Assurance Reports to Management

A QA summary report will be prepared quarterly or at the conclusion of the soil washing treatability testing activities (whichever is more frequent) by the EG&G Environmental Quality Support Manager (EQSM). This report should include a summary of field operation and sampling oversight inspections, laboratory assessments, surveillance, and a report on data verification/validation results

B 3 DESIGN CONTROL AND CONTROL OF SCIENTIFIC INVESTIGATIONS

B.3 1 Design Control

The Actinide Removal TSWP describes the experimental design and contains the detailed testing procedures for the soil washing treatability study. The work plan also identifies the objectives of the treatability tests; specifies the sampling, testing, analysis, and data management requirements, identifies applicable field operations and sampling procedures to provide controls for the sampling process; and presents the methods to be used to evaluate and report the results of the bench scale soil washing As such, the Actinide Removal TSWP is considered the environmental investigation control plan for the soil washing treatment process evaluation

B 3.2 Data Quality Objectives

Data quality is typically measured in terms of precision, accuracy, representativeness, comparability, and completeness (also referred to as PARCC parameters). These parameters are defined in Appendix A of the QAPjP. Duplicate soil decontamination tests will be conducted and samples analyzed during each phase of wet sieving, rotary scrubbing, attrition scrubbing, chemical leaching, magnetic adsorption, and magnetic separation. This will help assure precision of the analytical data received from the off-site analytical laboratory. Accuracy and precision of data from contracted, off-site laboratories is addressed by the General Radiochemistry and Routine Analytical Services Protocol using the following: (1) reagent blanks for monitoring contamination introduced during the analytical process; (2) lab control samples for obtaining a measure of accuracy of the analytical method; and (3) laboratory replicates for measuring precision of the analytical method. This treatability study will analyze soil of elevated actinide activity from the east side of the 903 Pad The soil will be taken from the top three to four inches of the topsoil and is representative of the levels of contamination in the soil media. Analyses will be performed on each soil fraction and wash solutions throughout the experiment to ensure data completeness in tracing the movement of actinides through the treatment process. Also, this treatability study will be performed in a manner consistent with past Rocky Flats Plant studies (see Section 15 0 References) for comparability

B 3.3 Sampling Locations and Sampling Procedures

Treatability testing will be conducted on actinide contaminated soils located from the east side of the 903 Pad. The plutonium activity levels from past soil excavations in the pad area have ranged from 400 to 20,000 pCi/g. The goal of this treatability testing will be to decontaminate the soil. The specific soil washing procedures are outlined in Section 4.0 of this Treatability Study Work Plan.

B.3.4 Analytical Procedures

Water and soil samples that are sent to analytical laboratories for analysis of radionuclide concentrations will be analyzed according to EPA Contract Laboratory Program (CLP) methods referenced in Parts A and B of the RFP General Radiochemistry and Routine Analytical Services Protocol (GRRASP).

B.3.5 Equipment Decontamination

Sampling equipment will be decontaminated between sampling events in accordance with OPS-FO.03, General Equipment Decontamination.

B.3.6 Quality Assurance Monitoring

To assure the overall quality of the soil washing treatability testing, the EG&G EQSM may conduct field inspections of the testing procedures at the laboratory.

B.3.7 Data Reduction, Validation, and Reporting

Observational data from screening tests and analytical data from the bench top treatability tests will be managed as specified in Section 7 0 of the Actinide Removal TSWP Analytical data will be evaluated to determine the validity of the data in accordance with the data validation guidelines identified in Section 3.0 of the QAPjP The treatability study results will be presented in a report prepared at the end of the 1994 fiscal year and at the conclusion of the study. The reports will follow the format presented in EPA's Guidance for Conducting Treatability Studies Under CERCLA and in the EG&G document (2-G32-ER-ADM-08.02) "Evaluation of ERM Data for Usability in Final Reports".

B.4 PROCUREMENT DOCUMENT CONTROL

Procurement documents for items and services shall be prepared, handled, and controlled in accordance with the requirements and methods specified in Section 4 0 of the QAPjP.

B.5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

The Actinide Removal TSWP describes the field sampling and laboratory testing activities to be performed The work plan will be reviewed and approved in accordance with the requirements for instructions, procedures, and drawings outlined in Section 5.0 of the QAPjP.

Changes and variances to approved operating procedures and the Actinide Removal TSWP shall be documented through preparation of Document Modification Requests (DMRs), which will be prepared, reviewed, and approved in accordance with requirements specified in Section 5.0 of the QAPjP.

B.6 DOCUMENT CONTROL

The following documents will be controlled in accordance with Section 6 0 of the QAPjP

- Treatability Study Work Plan for Actinide Removal Process.
- "Rocky Flats Plant Sitewide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPjP).
- EM Operating Procedures (all operating procedures specified in the Actinide

Removal TSWP)

B 7 CONTROL OF PURCHASED ITEMS AND SERVICES

Subcontractors who provide services to support the soil washing treatability study will be selected and evaluated as outlined in Section 7.0 of the QAPjP. This includes pre-award evaluation/audit of proposed subcontractors as well as periodic assessment of the acceptability of subcontractor performance during the program Any items or materials that are purchased for use during the soil washing treatability study that have the potential of affecting the quality of the data should be inspected upon receipt.

B 8 IDENTIFICATION AND CONTROL OF ITEMS, SAMPLES, AND DATA

Soil washing treatability study samples and laboratory analytical samples shall be identified and controlled in accordance with Section 8.0 of the QAPjP. This includes identifying samples, establishing the chain-of-custody (COC) of samples, recording the information in COC forms, and handling, storing and shipping of samples in accordance with 5-21000-OPS-FO.13, Containerizing, Preserving, Handling, and Shipping Samples.

B.9 CONTROL OF PROCESSES

The overall processes of collecting and analyzing samples and conducting Actinide Removal Treatability Study tests requires control. The processes are controlled by adhering to the Actinide Removal TSWP and the sampling and analytical procedures identified therein.

B.10 INSPECTION

Inspection of laboratory sampling activities shall be conducted in accordance with Section 10.0 of the QAPjP.

B.11 TEST CONTROL

The soil washing treatability testing process will be controlled by adhering to the experimental design and testing procedures described in Section 6.0 of the Actinide Removal TSWP. Additional detailed testing procedures may be developed as additional knowledge of the specific characteristics of the treatability study becomes available. All observations will be recorded in laboratory testing logbooks.

B 12 CONTROL OF MEASURING AND TEST EQUIPMENT (M&TE)

Laboratory equipment that is used in the soil washing treatability study will be identified in logbooks by model number and manufacturer's serial number, or suitable substitute identification number. Laboratory equipment and materials are listed in Section 5 0 of the TSWP. The equipment will be used, calibrated, and maintained in accordance with the manufacturer's instructions. A file shall be maintained by the testing contractor that contains:

- Specific model and instrument serial number,
- Operating instructions,
- Routine preventative maintenance procedures, including a list of critical spare parts to be provided or made available;
- Calibration methods, frequency, and description of the calibration solutions;
- Standardization procedures (traceability to nationally recognized standards),
- Source of calibration standard solutions, as applicable; and,
- Calibration data, including instrument output and corresponding reference values.

B.13 HANDLING, STORAGE, AND SHIPPING

Soil washing treatability study soil samples will be handled and stored in accordance with Appendix A of the Actinide Removal TSWP and 5-21000-OPS-FO.13.

B.14 STATUS OF INSPECTION, TEST, AND OPERATIONS

The requirements for the identification of inspection, test, and operating status specified in Section 14.0 of the QAPjP do not apply to the Actinide Removal Treatability Study.

B.15 CONTROL OF NONCONFORMANCES

The requirements for the identification, control, evaluation, and disposition of nonconforming items, samples, and data will be implemented as specified in Section 15.0 of the QAPjP. Nonconformances identified by the researcher shall be processed as outlined in the QAPjP.

B.16 CORRECTIVE ACTION

The requirements for the identification, documentation, and verification of corrective actions for conditions adverse to quality will be implemented as outlined in Section 16.0 of the QAPjP. Conditions adverse to quality identified by the researcher shall be documented and submitted to EG&G for processing as outlined in the QAPjP.

B.17 QUALITY ASSURANCE RECORDS

QA records produced during implementation of the soil washing treatability study will be handled and managed in accordance with the requirements of Section 17 0 of the QAPjP and 3-21000-ADM-17 01, Records Management. QA records to be produced during this study include but are not limited to the following·

- Soil washing treatability testing logbooks;
- Standard bench sheets, as applicable;
- Quarterly progress reports;
- Actinide Removal Treatability testing procedures, and,
- Actinide Removal Treatability Study Report.

B.18 QUALITY VERIFICATION

The requirements for the verification of quality shall be implemented as specified previously in subsection B.3.6 of this appendix

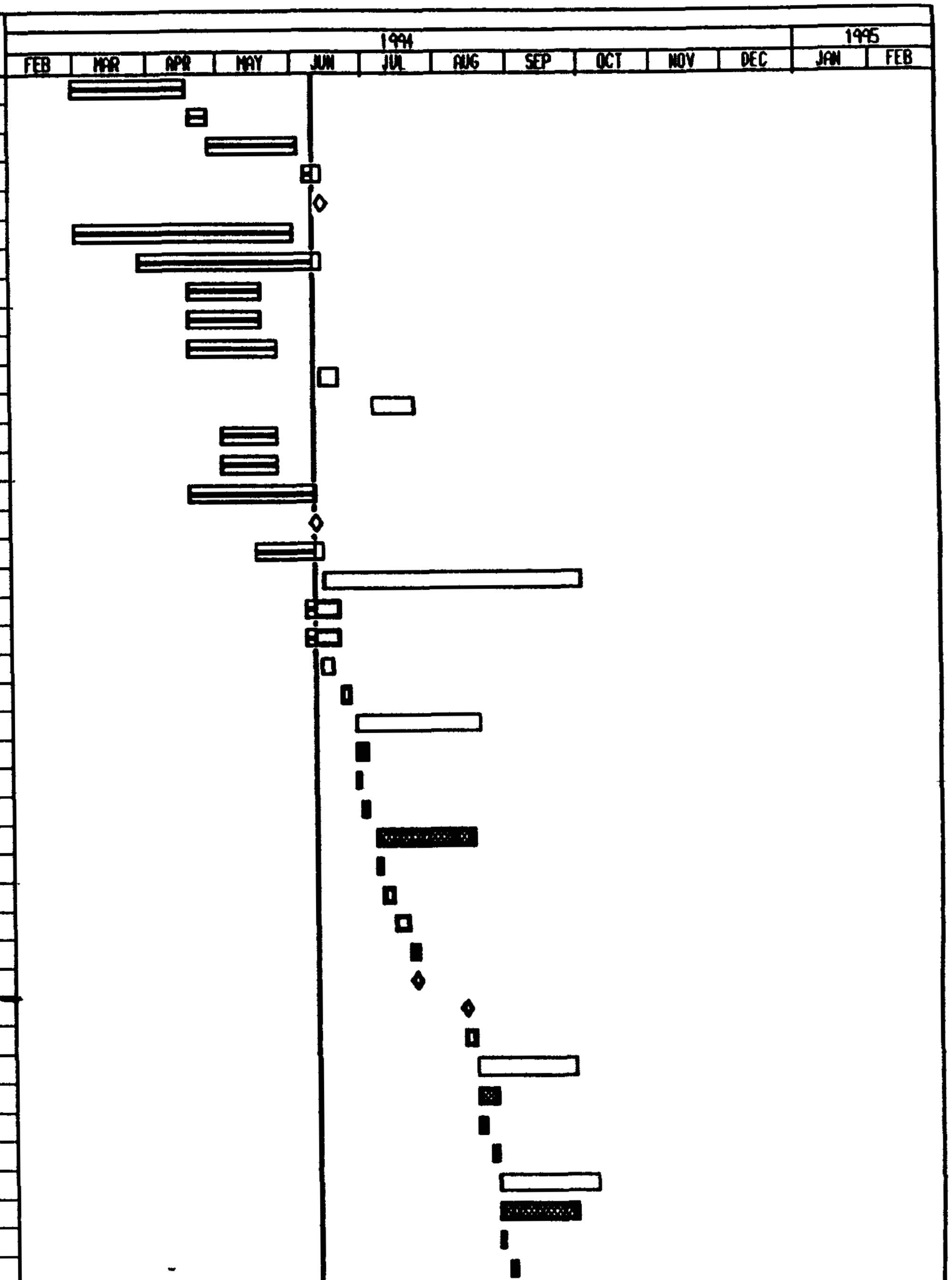
B.19 SOFTWARE CONTROL

Requirements for software control are not applicable to the Actinide Removal Treatability Study.

APPENDIX C

PROJECT SCHEDULE

ACTIVITY ID	ACTIVITY DESCRIPTION	ORIG DUR	TOTL FLT	EARLY START	EARLY FINISH
1005	WRITE DRAFT EXPERIMENTAL WORK PLAN	0		28FEB94A	18APR94A
1010	REVIEW DRAFT EXPERIMENTAL WORK PLAN	23		19APR94A	26APR94A
1015	AMEND EXPERIMENTAL WORK PLAN	1		27APR94A	3JUN94A
1020	REVIEW AMENDED EXPERIMENTAL WORK PLAN	6	9	6JUN94A	13JUN94
1030	FINAL EXPERIMENTAL WORK PLAN	0	9		13JUN94
1110	EQUIPMENT/SUPPLY PROCUREMENT	10		1MAR94A	1JUN94A
1120	QSA/INGL/USRIC PREPARATION	10	9	28MAR94A	13JUN94
1131	SIEVE SYSTEM SETUP	1		18APR94A	18MAY94A
1132	ROTARY SCRUB EQUIPMENT SETUP	1		18APR94A	18MAY94A
1133	ATTRITION SCRUB EQUIPMENT SETUP	1		18APR94A	25MAY94A
1134	LEACHING APPARATUS EQUIPMENT MODIFICATION	6	64	13JUN94	20JUN94
1135	MAGNETIC SEPARATION EQUIPMENT SETUP	14	115	5JUL94	22JUL94
1136	MULTI-CHANNEL ANALYZER	1		2MAY94A	25MAY94A
1137	PROPORTIONAL ALPHA COUNTER	1		2MAY94A	25MAY94A
1200	FIELD SOIL SAMPLING	39	1	18APR94A	10JUN94
1210	RECEIVE SOIL SUPPLY	0	1		10JUN94
1300	PROCURE RUST SERVICES	7	9	16MAY94A	13JUN94
1400	RUST SERVICES CONTRACT	64	79	14JUN94	30SEP94
1500	AMEND ACCU-LAB CONTRACT	15	0	6JUN94A	20JUN94
1600	AMEND JACOBS ENGINEERING CONTRACT	20	0	6JUN94A	20JUN94
1700	SOIL PREPARATION	5	1	13JUN94	17JUN94
1800	SAMPLING & SHIPPING	4	0	21JUN94	24JUN94
1900	ANALYSES	25	109	27JUN94	18AUG94
2000	TITRATION TESTS	5	0	22JUN94	1JUL94
2010	PREPARE SOLUTIONS	2	0	22JUN94	28JUN94
2020	PERFORM TITRATIONS	3	0	29JUN94	1JUL94
2100	WET SIEVE TESTS	17	0	5JUL94	15AUG94
2110	WATER TESTS	3	0	5JUL94	7JUL94
2120	SODIUM HEXAMETAPHOSPHATE TESTS	3	0	8JUL94	12JUL94
2130	SODIUM HYDROXIDE TESTS	4	0	13JUL94	18JUL94
2140	HEXAMETAPHOSPHATE/HYDROXIDE TESTS	4	0	19JUL94	22JUL94
2145	BEGIN SCHEDULE RESERVE	0	0	22JUL94	
2146	END SCHEDULE RESERVE	0	0		11AUG94
2150	SAMPLING/SHIPPING	3	0	11AUG94	15AUG94
2200	ANALYSES	29	83	16AUG94	26SEP94
2300	DOUBLE WET SIEVE TESTS	7	0	16AUG94	24AUG94
2310	WASH TESTS	4	0	16AUG94	19AUG94
2320	SAMPLING/SHIPPING	3	0	22AUG94	24AUG94
2400	ANALYSES	29	76	25AUG94	5OCT94
2500	ROTARY SCRUB TESTS	22	0	25AUG94	26SEP94
2510	PRELIMINARY WET SEIVE	2	0	25AUG94	26AUG94
2520	2-HOUR SCRUB TESTS	3	0	29AUG94	31AUG94



Plot Date 16JUN94
Data Date 16JUN94
Project Start 28FEB94
Project Finish 7FEB95

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

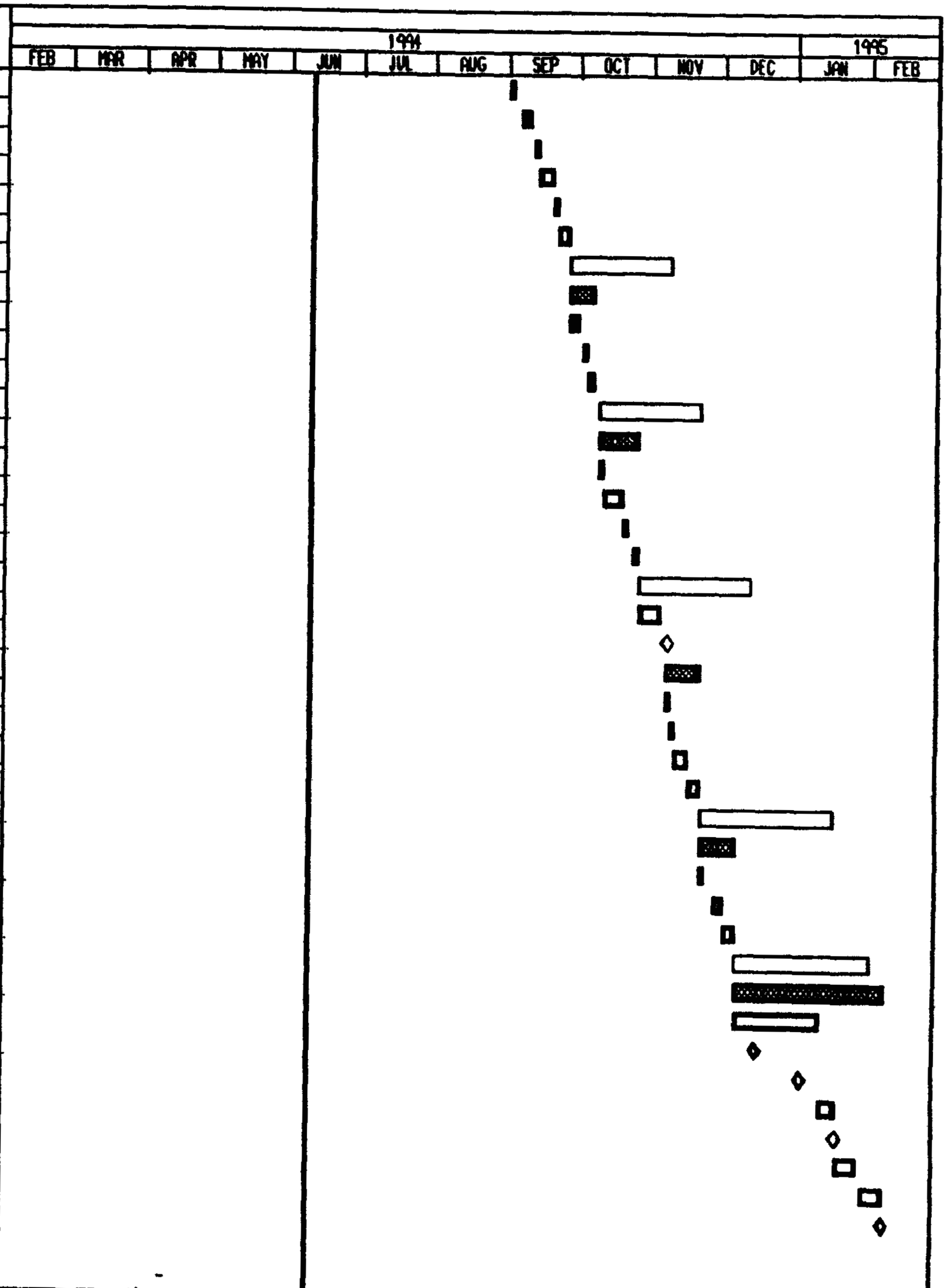
EG&G ROCKY FLATS
SOIL WASHING TREATABILITY STUDY
REMOVAL OF ACTINIDES FROM SOIL

Sheet 1 of 1

DRAFT 08JUN94

Date	Revision	Checked	Approved

ACTIVITY ID	ACTIVITY DESCRIPTION	ORIG DUR	TOTL FLT	EARLY START	EARLY FINISH
2530	SUBSEQUENT FRACTIONATION	2	0	1SEP94	2SEP94
2540	8-HOUR SCRUB TESTS	4	0	6SEP94	9SEP94
2550	SUBSEQUENT FRACTIONATION	2	0	12SEP94	13SEP94
2560	10-HOUR SCRUB TESTS	4	0	14SEP94	19SEP94
2570	SUBSEQUENT FRACTIONATION	2	0	20SEP94	21SEP94
2580	SAMPLING/SHIPPING	3	0	22SEP94	26SEP94
2600	ANALYSES	31	52	27SEP94	8NOV94
2700	ATTRITION SCRUB TESTS	9	0	27SEP94	7OCT94
2710	ATTRITION SCRUB	4	0	27SEP94	30SEP94
2720	SUBSEQUENT FRACTIONATION	2	0	3OCT94	4OCT94
2730	SAMPLING/SHIPPING	3	0	5OCT94	7OCT94
2800	ANALYSES	31	43	10OCT94	21NOV94
3000	CHEMICAL LEACHING TESTS	13	0	10OCT94	26OCT94
3010	PREPARE SOLUTIONS	2	0	10OCT94	11OCT94
3020	DESORPTION TESTS	6	0	12OCT94	19OCT94
3030	SUBSEQUENT FRACTIONATION	2	0	20OCT94	21OCT94
3040	SAMPLING/SHIPPING	3	0	24OCT94	26OCT94
3100	ANALYSES	31	30	27OCT94	12DEC94
3200	PREPARE STATUS REPORT	7	0	27OCT94	4NOV94
3210	STATUS REPORT TO DOE	0	53		7NOV94
3300	AQUEOUS MAGNETIC TESTS	11	0	7NOV94	21NOV94
3310	ACTIVATE ADSORBENT AND LOAD COLUMN	2	0	7NOV94	8NOV94
3320	CALIBRATE ELECTROMAGNET FIELD STRENGTH	2	0	9NOV94	10NOV94
3330	PROCESS SOLUTIONS	4	0	11NOV94	16NOV94
3340	SAMPLING/SHIPPING	3	0	17NOV94	21NOV94
3400	ANALYSES	27	16	22NOV94	16JAN95
3500	SOIL MAGNETIC TESTS	9	0	22NOV94	6DEC94
3510	PREPARE SLURRY	2	0	22NOV94	23NOV94
3520	PERFORM SEPARATION	4	0	28NOV94	1DEC94
3530	SAMPLING/SHIPPING	3	0	2DEC94	6DEC94
3600	ANALYSES	30	4	7DEC94	1FEB95
3700	INTERPRET DATA & WRITE TEST REPORT	34	0	7DEC94	7FEB95
3710	WRITE DRAFT REPORT	15	0	7DEC94	11JAN95
3715	BEGIN SCHEDULE RESERVE	0	0	16DEC94	
3716	END SCHEDULE RESERVE	0	0		3JAN95
3720	PREPARE CHARTS & GRAPHS	5	0	12JAN95	18JAN95
3730	DRAFT REPORT TO DOE	0	14		18JAN95
3740	INTERNAL REVIEW/REVISION	7	0	19JAN95	27JAN95
3750	EXTERNAL REVIEW/REVISION	7	0	30JAN95	7FEB95
3760	FINAL REPORT	0	0		7FEB95



Plot Date 18JAN94
Data Date 18JAN94
Project Start 28FEB94
Project Finish 7FEB95

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Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

EG&G ROCKY FLATS
SOIL WASHING TREATABILITY STUDY
REMOVAL OF ACTINIDES FROM SOIL

Sheet 2 of 2

DRAFT 08JAN94

Date	Revision	Checked	Approved