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TREATABILITY STUDY WORK PLAN

**ROCKY FLATS PLANT
POTASSIUM FERRATE TREATABILITY STUDY**

**U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO**

ENVIRONMENTAL RESTORATION PROGRAMS

FEBRUARY, 1994

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EG&G ROCKY FLATS PLANT
ENVIRONMENTAL RESTORATION PROGRAM
Treatability Work Plan
Potassium Ferrate Treatability Study

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Potassium Ferrate Treatability Study Work Plan

Approved by

_____/_____/_____
Manager, Remediation Programs

Date

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TABLE OF ACRONYMS

ACTA	ACTA Resources, Inc
ADC	Analytical Development Corporation
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CERCLA	Comprehensive Environmental Responsibility, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWQCC	County Water Quality Control Commission
DOE	Department of Energy
FEMP	Fernald Environmental Management Project
MSDS	Material Safety Data Sheet
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
QA	Quality Assurance
QAU	Quality Assurance Unit
QAPjP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFP	Rocky Flats Plant
SOP	Standard Operating Procedure
TCLP	Toxicity Characteristics Leaching Procedure
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

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**WORK PLAN FOR THE
POTASSIUM FERRATE PRECIPITATION PROCESS
TREATABILITY STUDY AT
THE ROCKY FLATS PLANT**

1 0 PROJECT DESCRIPTION

EG&G Rocky Flats Plant Environmental Science and Engineering Department and ACTA Resources, Inc (ACTA) will perform a bench-scale treatability study to evaluate the use of potassium ferrate for the removal of radionuclides from contaminated groundwater and/or wastewaters at the Rocky Flats Plant. Potassium ferrate has been shown to lower the gross alpha radioactivity in tested wastewaters from 3.88×10^6 pCi/L to 4.84×10^3 pCi/L while generating eight times less radioactive settleable solids than the current treatment procedure being used at the Rocky Flats Plant.

Treatability testing will be conducted on 3 to 4 wastewaters to evaluate the applicability of potassium ferrate to remove actinides and priority pollutant metals. The treatment objective of this study is to evaluate the efficiency of potassium ferrate in the removal of americium, plutonium, uranium, and priority metals in the wastewaters to levels that meet the County Water Quality Control Commission (CWQCC) discharge limits.

The study will require a series of coagulation-flocculation jar tests (bench scale experiments), to achieve optimum results for the removal or reduction of contaminants in wastewater. Coagulation-flocculation is used to reduce suspended, colloidal, and non-settleable materials and contaminants from wastewater followed by gravity settling. The design data necessary for the implementation of the treatment process in a wastewater treatment plant can be obtained from these jar tests. The primary variables investigated in a coagulation/flocculation jar test include chemical additives, pH, temperature, order of addition, mixing conditions, and efficiency in removal of contaminants from wastewaters.

Although the primary goal is to evaluate the effectiveness of potassium ferrate for the removal of radionuclides and priority pollutant metals from the Rocky Flats waste waters, the secondary goal is to gather operational data which is directly applicable to the day-to-day operations of a wastewater treatment facility. The proposed test program will evaluate the effectiveness of potassium ferrate for the treatment of water contaminated with radionuclides and priority pollutant metals. Since the main advantage of potassium ferrate is minimum sludge generation, the volume of sludge generated using optimum treatment conditions will be monitored to estimate the total waste management costs of the potassium ferrate treatment procedure.

2.0 TREATMENT TECHNOLOGY DESCRIPTION

Potassium ferrate differs from other inorganic coagulants such as alum or iron salts. Unlike these inorganic coagulants, which almost instantly form large floc, the ferrate ion is highly soluble in alkaline matrix much like an organic polymer. For the ferrate or alum ion to be an effective coagulant, it must collide with the negatively charged colloids such as americium, plutonium, or uranium in order to destabilize the colloidal particles and start the floc formation process. Ferrate destabilizes the colloids through the formation of multicharged cation iron species when Fe(VI) is reduced to Fe(III). The eventual reduction of Fe(VI) to Fe(III) results in the formation of ferric hydroxide precipitates which agglomerates the colloid particles into larger settleable agglomerates. Due to the solubility and the efficiency of the floc formation of ferrate, 5 mg/L of ferrate iron can improve or accomplish the same treatment goals as 30 mg/L or higher iron as a Fe(III) salt.

The effectiveness of potassium ferrate for the removal of uranium and heavy metals from various aqueous waste streams was first demonstrated at the Fernald Environmental Management Project (FEMP) in December 1990. A two-step treatment of the process wastewaters and storm water lowered the concentration of uranium in the waste streams from 500 ug/L to 10 ug/L. Filtration of the samples further lowered the uranium concentration to less than 1 ug/L. Results in a side-by-side comparison between TRU/Clear[®] "4" (a mixture of potassium ferrate and magnesium salts) and lime have demonstrated the ability of potassium ferrate to remove widely varying concentrations of uranium and other priority pollutant metals while generating 55% less wet filter cake than an equivalent lime treatment.

3.0 TEST OBJECTIVES

The experimental program is designed to

- Identify treatment options including potassium ferrate or TRU/Clear® "4" dosing requirements and pH adjustment requirements
- Determine the volume of sludge generated using potassium ferrate or TRU/Clear® "4" treatment procedures
- Optimize treatment conditions that are directly applicable to operations of the wastewater treatment facility
- Answer operational concerns on the use of potassium ferrate, and operational costs including total waste management costs
- Evaluate the effectiveness of potassium ferrate or TRU/Clear® "4" to remove americium, radium, plutonium, uranium and priority pollutant metals from the identified contaminated water sources to meet County Water Quality Control Commission (CWQCC) wastewater discharge limits as shown in Table 3-1

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Table 3-1 CWQCC Wastewater Discharge Limits

Radionuclides		
Gross alpha (α)	7 - 11	pCi/L
Gross beta (β)	5 - 19	pCi/L
Am 241	0.05	pCi/L
Pu 239, 240	0.05	pCi/L
U 233, 234, 235, 238	5 - 10	pCi/L
Priority Metals		
Aluminum	0.087	mg/L
Antimony	0.014	mg/L
Arsenic	0.05	mg/L
Barium	1.0	mg/L
Beryllium	0.004	mg/L
Cadmium	0.0015	mg/L
Chromium (III)	0.05	mg/L
Chromium (VI)	0.011	mg/L
Copper	0.023	mg/L
Iron (d)	0.3	mg/L
Iron	13.2	mg/L
Lead	0.028	mg/L
Manganese (d)	0.58	mg/L
Manganese	1.0	mg/L
Mercury	0.00001	mg/L
Nickel	0.125	mg/L
Selenium	0.01	mg/L
Silver	0.00059	mg/L
Thallium	0.000012	mg/L
Zinc	0.35	mg/L

4.0 EXPERIMENTAL DESIGN AND PROCEDURES

4.1 Initial Screening

The initial screening phase of the potassium ferrate wastewater treatment testing is to identify the necessary coagulant(s) and flocculant aids required, to identify optimal treatment conditions, to maximize radionuclides removal, and determine the effectiveness of the potassium ferrate treatment procedure. About 50 to 100 liters of one wastewater will be required to complete the initial testing. Sampling activities of the waste waters will be performed by EG&G Rocky Flats Plant personnel. The analytical work will be performed by Accu-Lab Research, Inc, Golden, CO 80403.

The results of the initial screening will provide the baseline data for potassium ferrate treatment conditions, provide data to further optimize the potassium ferrate treatment to minimize radioactive sludge generation, and provide data on the radionuclide concentrations and priority pollutant metals in the wastewater.

4.2 Wastewater Characterization Analysis By Accu-Lab Research

All the analyses will be performed by Accu-Lab Research, Inc, to characterize the radionuclide and inorganic (metals, anions & others) contamination in the wastewaters. A list of the analytes is shown in Table 4-1. A few sets of 6 - 10 liter samples of each wastewater will be used for comparative analysis. Sampling activities of the wastewaters will be performed by EG&G Rocky Flats Plant personnel using EG&G Standard Operating Procedures for sample designation, handling, shipping, and documentation procedures. There will be a chain of custody form in transferring samples from EG&G RFP to Accu-Lab for analysis.

Table 4-2 lists the EPA approved analytical methods that Accu-Lab will be utilizing during the treatability tests and the detection limits of each analyte by the selected analytical method.

Table 4-3 lists the TCLP parameters, EPA approved analytical methods, and the detection limits of each analyte by Accu-Lab.

Table 4-1 Summary of Analytical Work*

<u>Metals (ICP)</u>	<u>Anions and Others</u>	<u>Isotopes</u>
Aluminum	Alkalinity	Gross Alpha/beta
Antimony	Ammonia	Gamma Spectrometry
Arsenic	COD	Americium-241
Barium	Cyanide (total)	Plutonium-238,239,240
Cadmium	Nitrate	Radium-226
Chromium	pH	Radium-228
Cobalt	Phenols (total)	Uranium-234,238
Copper	Phosphorous (total)	Uranium (total)
Iron	Solid, dissolved	
Magnesium	Solid, total	
Manganese	Sulphate	
Molybdenum	TOC	
Nickel	Turbidity	
Potassium		
Silver		
Sodium		
Zinc		
<u>Metals (AA)</u>		
Lead		
Mercury		
Selenium		

* Turn around time by Accu-Lab for analysis is 2-4 weeks for metals and anions and others, and 4 weeks for radionuclides of americium, plutonium, radium, and uranium.

Table 4-2 Analytical Methods for Analytes and Detection Limits

Analytes	Analytical Method	Detection Limit (mg/L)
Alkalinity	EPA 310 1	5
Ammonia	EPA 350 3	0 2
Aluminum,ICP	EPA 200 7	0 1
Antimony,ICP	EPA 200 7	0 05
Arsenic,AA	EPA 208 2	0 005
Barium,ICP	EPA 200 7	0 05
Cadmium,ICP	EPA 200 7	0 005
COD	EPA 410 4	5
Chromium,ICP	EPA 200 7	0 005
Cobalt,ICP	EPA 200 7	0 005
Copper,ICP	EPA 200 7	0 005
Cyanide (Total)	EPA 335 3	0 005
Iron,ICP	EPA 200 7	0 01
Lead,AA	EPA 239 2	0 005
Magnesium,ICP	EPA 200 7	0 05
Manganese,ICP	EPA 200 7	0 005
Mercury,AA	EPA 245 1	0 0001
Molybdenum,ICP	EPA 200 7	0 005
Nickel,ICP	EPA 200 7	0 01
Nitrate	EPA 353 2	0 05
pH	EPA 150 1	—
Phenols, Total	EPA 420 1	0 005
Phosphorous, Total	EPA 385 2	0 02
Potassium,ICP	EPA 200 7	0 3
Selenium,AA	EPA 270 2	0 005
Silver,ICP	EPA 200 7	0 005
Sodium,ICP	EPA 200 7	0 1
Solids, Dissolved	EPA 180 1	5
Solids, Total	EPA 180 3	5
Sulfate	EPA 375 4	5
Surfactants	EPA 425 1	0 5
TOC	EPA 415 1	1
Turbidity	EPA 180 1	0 2 NTU
Zinc, ICP	EPA 200 7	0 005
Gross alpha/beta	EPA 900 0	3/4 pCi/L
Americium-241	*	0 1 pCi/L
Plutonium-238,239,240	**	0 1 pCi/L
Gamma spectrometry	EPA 901 1	Depends on isotope
Radium-228	EPA 903 1	0 2 pCi/L
Radium-226	EPA 904 0	5 pCi/L
Uranium, Total	EPA 908 1	0 005 mg/L

- ALR 3804224 compliation of several methods
- ** ALR 3804223 compliation of several methods

Table 4-3 TCLP Parameters

<u>Analyte</u>	<u>EPA SW-846 Method</u>	<u>Detection Limit (mg/L)</u>
Metals:		
Arsenic	6010	0.1
Barium	6010	0.1
Cadmium	6010	0.01
Chromium	6010	0.02
Lead	6010	0.1
Mercury	7470	0.004
Selenium	6010	0.1
Silver	6010	0.01
Reactivity:		
Cyanide	Chapter 7.3	20
Sulfide	Chapter 7.3	5
Corrosivity:		
pH Towards Steel	Chapter 7.2 1110	0.1 unit *
Flashpoint:	1010	1 °C
VOC:	8260	*
Extraction:		
Volatile Organics (Zero Headspace)	1311	---
Metals Liquid	1311	---
Solid	1311	---

* Detection limit varies dependent on compound. However, all detection limits are equal to or lower than the regulatory limits. Turn around time by Accu-Lab 4 weeks.

4.3 Wastewater Treatment Testing

4.3.1 Phase One Jar Testing

To evaluate the removal of radionuclides and other trace metals, one wastewater will be subjected to a series of coagulation-flocculation jar tests. These jar tests can simulate the types of mixing and settling conditions found in a clarification plant.

The purpose of coagulation-flocculation is to reduce suspended, colloidal, and non-settleable materials and contaminants from wastewater followed by gravity settling. The primary objectives in the coagulation/flocculation jar test are to investigate the effect of chemical additives, pH, temperature, order of addition, mixing conditions, and efficiency in removal of contaminants from wastewaters. Interferences can occur if complexing or chelating agents complex with contaminants or the chemical treatment and prevent flocculation or removal of contaminants from occurring.

The Phase One jar tests will provide information on the optimum treatment pH, mixing conditions, and the necessity of the use of organic coagulants/flocculants to enhance the potassium ferrate treatment conditions.

The general procedure for conducting the jar tests is given below.

1. Add 2 liters of a waste water to the test beaker. Adjust the pH to the desired value in the range of pH 8.0 - 12.0 with sodium hydroxide (NaOH) or hydrochloric acid (HCl). Stir the sample with a stirrer. Record the sample temperature at the start of the jar test.
2. Stir the solution well at an approximate mixing speed of 200 rpm. Add the appropriate weight of the coagulant specified for the waste stream (see Table 5-1). Flash mix for 1 to 2 minutes after the addition of the treatment chemicals. Record the flash mix time and mixing speed (rpm).
3. Reduce the speed to the minimum required to keep floc particles uniformly suspended throughout the "slow mix" period (20 to 35 rpm). Slow mix for 20 to 60 minutes depending on the degradation time potassium ferrate and the size of the floc. Record the time for the first visible floc formation. Every 5 minutes during the slow mix period, record relative floc size and mixer speed (rpm). If flocculant aids are used, record the time added, the mixer speed, and the concentration of flocculant aid used. During the first 5 minutes of the jar test and every 15 minutes thereafter, measure the concentration of ferrate, if necessary, in the liquid using visible spectrophotometry (This equipment will be provided as part of the treatability study.)
4. After the slow mix period, withdraw the paddles and observe the settling rate of the floc particles. Measure the ferrate concentration to ensure that the ferrate has degraded. Record the time required for the bulk of the particles to settle. Measure the turbidity of the solution every 15 minutes after the slow mixing time to determine when the majority of the floc particles have settled to the bottom of the beaker. In most cases, this time will be required for the particles to settle to the bottom of the beaker; however, in some cases there may be interfering convection currents. If so, the recorded settling time should be that at which the unsettled or residual particles appear to be moving equally upward or downward.

- 5 After 15 minutes after complete settling, record the appearance of floc on the beaker bottom. After 30 minutes to twenty-four hours of settling (depending on treatment conditions) and by means of the siphon tube, withdraw an adequate sample to conduct required analyses.
- 6 Siphon the treated wastewater sample into acid-washed, deionized water rinsed, 1-4 liter rinsed glass bottles with teflon lined lids. Refrigerate the treated samples to 4°C if the samples will be delivered to the lab for analysis within 24 hours after completion of the jar tests. Properly preserve the sample according to the preservation procedure required for the specific analysis or analyses. If the acidified samples give off a sulfur dioxide odor, add one to two drops of 12 wt% sodium hypochlorite (NaOCl) and mix well.
- 7 If required, based on the visual observation of suspended solids, filter the treated sample through an acid-washed, deionized water rinsed 0.45 micron filter. Refrigerate or acidify the filtered samples to a pH of 1 to 2 with nitric acid (HNO₃).

Table 4-4 Phase One Jar Tests with Potassium Ferrate

Treatment with Potassium Ferrate					
Test Run Number	Potassium Ferrate Dose (mg/L Fe ⁶⁺)	Sodium Thiosulfate Dose (mg/L)	Treatment pH	Mixing Time (minutes)	Settling Time (hours)
1	5	0	8.5	60	24
2	5	0	9.5	60	24
3	5	0	10.5	60	24
4	5	0	11.5	60	24
5	5	15	8.5	60	24
6	5	15	9.5	60	24
7	5	15	10.5	60	24
8	5	15	11.5	60	24
9	15	45	8.5	60	24
10	15	45	9.5	60	24
11	15	45	10.5	60	24
12	15	45	11.5	60	24

Table 4-5 Phase One Jar Tests with TRU/Clear® "4"

Treatment with TRU/Clear® "4" ¹					
Test Run Number	Potassium Ferrate Dose (mg/L Fe ⁶⁺)	Sodium Thiosulfate Dose (mg/L)	Treatment pH	Mixing Time (minutes)	Settling Time (hours)
13	5	10	8.5	60	24
14	5	10	9.5	60	24
15	5	10	10.5	60	24
16	5	10	11.5	60	24
17	15	30	8.5	60	24
18	15	30	9.5	60	24
19	15	30	10.5	60	24
20	15	30	11.5	60	24

¹ TRU/Clear is a registered trademark of Analytical Data Corporation, Colorado Springs, CO
TRU/Clear "4" is a mixture of potassium ferrate and magnesium and zirconium salts

Table 4-6 Summary of Analytical Work Scope*
 Phase One Jar Tests

Sample Description	Number of Samples	Analytical Parameters
Wastewater as Received	1	Gross alpha / beta
		Americium - 241
		Plutonium - 238, 239, 240
		Radium - 226
		Radium - 228
		Uranium, Total
		Priority Pollutant Metals **
Phase Two Jar Tests	12	Gross alpha / beta
		Americium - 241
		Plutonium - 238, 239, 240
		Radium - 226
		Radium - 228
		Uranium, Total
		Priority Pollutant Metals **

* The number of samples and analytical parameters may change depending on the number of experiment runs (some may be duplicate) and samples produced and the need for additional analytical parameters (see Table 4-1)

** Priority pollutant metals to be monitored will be dependent on the waste stream and the metal contaminating the water source

4.3.2 Phase Two Jar Testing

Based on the results of the Phase One Jar Tests, Phase Two Jar Tests will be performed to enhance the potassium ferrate treatment procedure using the same optimum treatment conditions found in the Phase One jar tests. The parameters that will be investigated include chemical treatment dosage to minimize sludge generation and the use of polymeric coagulants and flocculants to enhance all the treatment procedures. The jar tests will also provide data on the volume of settleable solids using the optimum ferrate treatment so that a total waste management cost analysis can be performed.

Table 4-7 Phase Two Jar Tests with Potassium Ferrate

Treatment with Potassium Ferrate and Polyelectrolytes						
Test Run Number	Potassium Ferrate Dose (mg/L Fe ⁶⁺)	Sodium Thiosulfate Dose (mg/L)	Flocculant Aid (mg/L)	Treatment pH	Mixing Time (minutes)	Settling Time (hours)
21	Optimum	Optimum	0.5	Optimum	30	30
22	Optimum	Optimum	1.0	Optimum	30	30
23	Optimum	Optimum	5.0	Optimum	30	30
24	Optimum	Optimum	10	Optimum	30	30
25	Optimum	Optimum	Determined at time of testing	Optimum	30	30
26	Optimum	Optimum	Determined at time of testing	Optimum	30	30

Table 4-8 Phase Two Jar Tests with TRU/Clear® "4"

Treatment with TRU/Clear® "4" and Polyelectrolytes						
Test Run Number	Potassium Ferrate Dose (mg/L Fe ⁶⁺)	Sodium Thiosulfate Dose (mg/L)	Flocculant Aid (mg/L)	Treatment pH	Mixing Time (minutes)	Settling Time (hours)
27	Optimum	Optimum	0.5	Optimum	30	30
28	Optimum	Optimum	1.0	Optimum	30	30
29	Optimum	Optimum	5.0	Optimum	30	30
30	Optimum	Optimum	10	Optimum	30	30
31	Optimum	Optimum	Determined at time of testing	Optimum	30	30
32	Optimum	Optimum	Determined at time of testing	Optimum	30	30

Table 4-9 Summary of Analytical Work Scope*
 Phase Two Jar Tests

Sample Description	Number of Samples	Analytical Parameters
Wastewater as Received	1	Gross alpha / beta
		Americium - 241
		Plutonium - 238, 239, 240
		Radium - 226
		Radium - 228
		Uranium, Total
		Pnorty Pollutant Metals **
Phase Two Jar Tests	12	Gross alpha / beta
		Americium - 241
		Plutonium - 238, 239, 240
		Radium - 226
		Radium - 228
		Uranium, Total
		Pnorty Pollutant Metals **

* The number of samples and analytical parameters may change depending on the number of experment runs (some may be duplicate) and samples produced and the need for additional analytical parameters (see Table 4-1)

** Pnorty pollutant metals to be monitored will be dependent on the waste stream and the metal contaminating the water source

4.3.3 Phase Two Confirmation Jar Tests

Confirmation jar tests will be performed based on the optimum treatment results seen in the Phase Two Jar Tests only if requested by the Project Manager and if sufficient funds are available. The results from the jar tests will provide complete analytical data on the removal of radionuclides, organic and inorganic contaminants (Table 4-1). The jar tests will also provide data on the volume of settleable solids generated using the optimum potassium ferrate treatment so that a total waste management cost analysis can be performed. Comparison of contaminant removal by filtration and solids settling will also be compared. The data will also provide information on the need for secondary or tertiary treatment of the wastewaters to ensure that the concentration of radionuclides, organic and inorganic constituents meet the CWQCC discharge limits.

Table 4-10 Summary of Analytical Work Scope Phase Two Confirmation Jar Tests

Sample Description	Number of Samples	Analytical Parameters
Waste water, as received	3	See Table 4-1
Phase Two Confirmation Jar Tests	3 unfiltered 3 filtered	See Table 4-1

Table 4-11 Phase Two Confirmation Jar Tests* (1st Wastewater)

I. Optimum TRU/Clear [®] "4" Treatment - 1 st Wastewater				
Test Run Number	TRU/Clear [®] "4" Dose (mg/L)	Treatment pH	Mixing Time (min)	Settling Time (min)
33	Optimum	Optimum pH	Optimum	Optimum

Table 4-12 Phase Two Confirmation Jar Tests* (2nd Wastewater)

II. Optimum TRU/Clear [®] "4" Treatment - 2 nd Wastewater				
Test Run Number	TRU/Clear [®] "4" Dose (mg/L)	Treatment pH	Mixing Time (min)	Settling Time (min)
34	Optimum	Optimum pH	Optimum	Optimum

Table 4-13 Phase Two Confirmation Jar Tests* (3rd Wastewater)

III. Optimum TRU/Clear [®] "4" Treatment - 4 th wastewater				
Test Run Number	TRU/Clear [®] "4" Dose (mg/L)	Treatment pH	Mixing Time (min)	Settling Time (min)
35	Optimum	Optimum pH	Optimum	Optimum

• These samples will be run in duplicate to evaluate reproducibility in retention factors for radionuclides and other trace contaminants in wastewaters

5.0 EQUIPMENT AND MATERIALS

5.1 Apparatus

- a **Stirrer** A multiposition stirrer with continuous speed variation from approximately 15 to 300 RPM should be used
- b **Jars (or beakers) of variable sizes** laboratory beakers (400 ml to 4 liter)
- c **pH meter with pH probe**
- d **One-liter, acid-washed, deionized water rinse polyethylene or polypropylene bottles**
- e **One-liter microfiltration unit, 0.45 micron**

5.2 Reagents

- a **Sodium hydroxide (NaOH), 50 wt% solution**
- b **Sodium hydroxide, 1N solution**
- c **Nitric acid (HNO₃), 15.9N, trace metal grade or better**
- d **Sodium hypochlorite solution, available chlorine, approximately 10%, NaOCl**
- e **Coagulants per Table 5-1**
- f **Potassium ferrate or potassium ferrate based water treatment chemicals** Weight percent of potassium ferrate will be determined prior to the start of jar tests

Table 5-1 Weights of potassium ferrate Coagulation Formulation to be Added to Jar Tests

Formulation	Jar Test Volume (L)	Weight of potassium ferrate Formulation Required (g/L)	mg/L K_2FeO_4 Added	mg/L Fe^{6+} Added
potassium ferrate	1 - 4	0.072	25.0	5
potassium ferrate	1 - 4	0.072	25.0	5
TRU/Clear® "4"	1 - 4	0.120	17.7	5
TRU/Clear® "4"	1 - 4	0.120	17.7	5

6 0 SAMPLING AND ANALYSIS

After a wastewater is identified, the sampling activities of the waste waters will be performed by EG&G Rocky Flats Plant personnel using EG&G Standard Operating Procedures for sample designation, handling, shipping, and documentation procedures. For example, pH and temperature of the wastewater will be recorded on site. There will be a chain of custody form in transferring samples from EG&G RFP to Accu-Lab for analysis.

Past experience has indicated that if a wastewater is stored longer than several days, there is a tendency of sedimentation, precipitation, and algae formation. As a result, radionuclides and trace contaminants also tend to co-precipitate, which makes the study not useful in evaluating retention factors. Thus, it is important that the sampling of wastewater should be performed fresh each time. Experiments are planned to be performed in the laboratory. In view of investigations of several conditions (see Tables 4-4, 4-5, and 4-7, 4-8), the experiments will be performed in several stages.

All the analytical work will be performed by Accu-Lab Research. The analytes will include major and trace metals, anions and others, and radionuclides, and organics (VOC) and TCLP (see Tables 4-1 to 4-3). Organics and TCLP will be performed only on a few samples. The analysis will be performed using the EPA approved analytical procedures. The method to be used and the detection sensitivity of each analyte by a selected method are shown in Tables 4-2 and 4-3.

Total uranium (U-238) in each sample will be analyzed by EG&G using a uranium analyzer (Kinetic Phosphorescence Analyzer; KPA), which will provide a guideline on the sample volume to be required by Accu-Lab for the analysis of radionuclides. Further, the total uranium analysis by Accu-Lab will also provide a cross check with the EG&G uranium value.

7.0 DATA MANAGEMENT

All procedures used in the treatability study will be documented in bound notebooks and/or detailed in logs. Observations made during the study conduct are written in bound laboratory notebooks. The bound notebooks for the study will be project specific. All samples received and generated during the study will be labeled with unique sample identification numbers. In addition to the unique sample numbers, the source of each sample will be documented. Samples collected from a candidate site will be documented on sample transmittal forms describing collection location, observations, personnel involved, date of collection, preservation (if any) added, containers used, etc. Samples generated in the testing laboratories will be documented in a project notebook describing the necessary details.

There will be a complete history of the sample from collection through transportation to receipt, testing or analysis and disposition at the laboratory. At a minimum, the treatability testing logbooks will document the following:

- o Testing procedures
- o Departing from protocols and reasons for departures
- o Instrument calibration
- o Sampling methods
- o Chemical additions
- o Test observations

ACTA Resources, Inc. will provide, in the final report, all appropriate data necessary for the design of a treatment facility to utilize potassium ferrate as the treatment chemical.

8.0 DATA ANALYSIS AND INTERPRETATION

Upon completion of treatability experiments, data will be presented and interpreted in accordance with Section 3.12 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. Section 3.0 of the RFP Quality Assurance Project Plan (QAPP) describes the requirements for data reduction, validation, usability criteria, and reporting of data (see Appendix A).

The results of the Phase One (Table 4-4) and Phase Two jar tests (Tables 4-6) will be used to evaluate the effectiveness of the treatment procedures. Retention factors, which is the concentration ratio of an element in the influent to that in the effluent, will be established for the various radionuclides and other contaminants. The higher the retention factor, the more effective will be the treatment process at a given condition. The concentrations of the radioactive constituents and priority pollutant metals in the treated water will be used for assessing the performance of the treatment procedure when compared to other tested treatment procedures.

The data from these analyses will be used in conjunction with other experimental observation to determine the preferred operating condition. The various test conditions will provide optimum conditions in terms of the dose of potassium ferrate, pH, mixing and settling time, and the effect of an electrolyte, in order to establish maximum removal of radionuclides and other contaminants in the wastewaters.

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9.0 HEALTH AND SAFETY

The Health and Safety Plan will be the same as has been already outlined in Appendix B of the "Treatability Studies Work Plan for Ion Exchange and Adsorption Processes" of November 1992. This section has been included in this plan as Appendix A.

10.0 RESIDUALS MANAGEMENT

10.1 Wastewater

If the wastewater cannot be properly disposed of by the contract analytical laboratory (Accu-Lab), all wastewater sample will be returned to RFP for proper disposal using Waste Guidance criteria. The residual sludge will be collected and properly stored as a solid waste in a 55-gallon drum, and later disposed following approval from Waste Guidance.

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"). All disposal of materials at the source site will be in accordance with the requirements of CERCLA, RCRA, federal, state and site 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. Minimization efforts will be performed by 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.

Debris which is potentially, but not knowingly contaminated, will be kept in separate disposal containers. These items will be surveyed by EG&G RFP personnel and if found to be clean can be disposed of as unrestricted material.

11.0 REPORTS

An interim draft report will be prepared in accordance with section 3.12 of The Guidance for Conducting Treatability Studies under CERCLA (EPA 1992) following the completion of each phase of treatability testing, and will document the results of the separation procedures used. A final treatability testing report will be prepared after the study is complete. The final report will incorporate information from the interim draft reports. The following outline will be used as a guide when preparing this report.

OUTLINE FOR TREATABILITY TESTING REPORT

1.0 INTRODUCTION

1.1 Site description

- 1.1.1 Site name and location
- 1.1.2 History of operations
- 1.1.3 Prior removal and remediation activities

1.2 Waste stream description

- 1.2.1 Waste matrices
- 1.2.2 Pollutants/chemicals

1.3 Treatment technology description

- 1.3.1 Treatment process and scale
- 1.3.2 Operating features

1.4 Previous treatability studies at the site

2.0 CONCLUSIONS AND RECOMMENDATIONS

- 2.1 Conclusions
- 2.2 Recommendations

3.0 TREATABILITY STUDY APPROACH

- 3.1 Test objectives and rationale
- 3.2 Experimental Design and Procedures
- 3.3 Equipment and materials
- 3.4 Sampling and analysis
 - 3.4.1 Waste stream
 - 3.4.2 Treatment process

- 3 5 Data management
- 3 6 Deviations from the Work Plan

4 0 RESULTS AND DISCUSSION

- 4 1 Data analysis and interpretation
 - 4 1 1 Analysis of waste stream characteristics
 - 4 1 2 Analysis of treatability study data
 - 4 1 3 Comparison to test objectives
- 4 2 Quality assurance/quality control
- 4 3 Costs/schedule for performing the treatability study
- 4 4 Key contacts

References

Appendices

- A Data summaries
- B Standard operating procedures

12 0 SCHEDULE

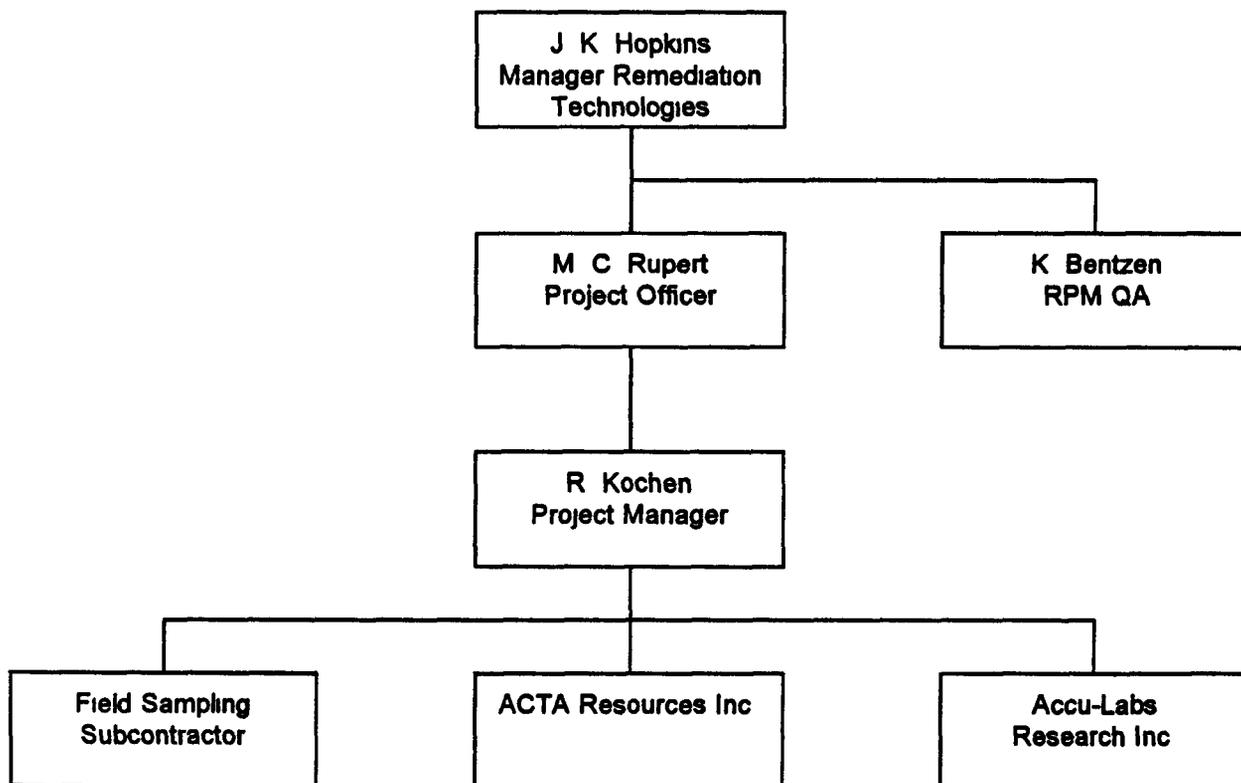
Following the approval of the Work Plan and the Quality Assurance Plan, Phase One jar tests will be initiated. There are at least 40 experiments planned (some duplicates and some dry runs) in various test conditions. Performance of radioactive experiments may be slowed due to the constraints of working in a radioactive control area (RCA). (The potential for radioactive contamination is a major concern). In addition, there is considerable time involved in washing radioactive glassware and in obtaining approval for disposal of radioactive wastes (solids and liquids) through Waste Guidance.

Because of various study conditions in the Phase One and Phase Two jar tests (see Tables 4-4 through 4-9), the experiments will be performed in several stages. Following the completion of some of these experiments, the samples (influent and effluents) will be sent to Accu-Lab for analysis for the various analytes (see tables 4-1 to 4-3). The turn around time is 2 - 4 weeks for the metals and anions and 4 weeks for the radionuclides. Based on the results of the phase one experiments, tests for the second phase can be planned. The tests may be repeated, or the test conditions may be altered before the second phase experiments are run.

13.0 MANAGEMENT AND STAFFING

Personnel involved in the management of the treatability tests includes members from EG&G Rocky Flats Plant and ACTA Resources, Inc. Michael E. Potts and Duane R. Churchwell of ACTA Resources, Inc. will be the consultants for tests involving treatment of wastewater. The project will be performed under the direction of M. C. Rupert and R. Kochen of EG&G Rocky Flats. Figure 14-1 shows below the assigned personnel and their lines of communication.

Figure 1 ORGANIZATIONAL CHART FOR POTASSIUM FERRATE TREATABILITY STUDY WORK PLAN



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14.0 QUALITY ASSURANCE PLAN

Quality Assurance Project Plan (QAPJ) is written separately for the treatability studies and is referenced as Manual 11000-WP-TS93 01 Appendix B of this work plan is an addendum to this QAPJ manual

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**APPENDIX A
HEALTH AND SAFETY PLAN FOR POTASSIUM FERRATE**

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HEALTH AND SAFETY PLAN

This health and safety plan (HSP) is an example HSP. A HSP will be kept on site during field activities and will be reviewed and updated as necessary.

1.0 PROJECT INFORMATION AND DESCRIPTION

CLIENT OR OWNER: _____ **PROJECT NO:** _____

PROJECT MANAGER: _____ **OFFICE:** _____

SITE NAME: Rocky Flats Plant

SITE ADDRESS: Golden, CO

DATE(S) OF INITIAL VISIT: _____

DATE(S) OF SITE WORK: _____

DATE HEALTH AND SAFETY PLAN PREPARED: _____

SITE ACCESS: _____

LOCATION:

The Rocky Flats Plant (RFP) site is located in northern Jefferson County approximately 16 miles northwest of Denver. It is comprised of 6,550 acres of federally owned land. Major administrative and manufacturing buildings are located within RFP security area of 400 acres. The remaining 6,150 acres comprise the buffer zone surrounding RFP complex.

SITE OPERATIONS:

The RFP is a government owned, contractor-operated facility, which is part of the nationwide nuclear weapons production complex. EG&G Rocky Flats, Inc. became the prime contractor at RFP on January 1, 1990, and is the existing contractor to date. RFP fabricates nuclear weapon components from plutonium, uranium, and other nonradioactive materials (principally beryllium and stainless steel).

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THIS PAGE RESERVED FOR SITE MAP

**NOTE LOCATIONS OF SUPPORT, DECONTAMINATION, AND EXCLUSION ZONES;
SITE TELEPHONE; FIRST AID STATION**

2.0 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

2.1 PROJECT ORGANIZATION

2.2 DESCRIPTION OF TASKS

The treatability study objective is to investigate bench scale testing of Potassium Ferrate Technology to remove metals and radionuclides from Rocky Flats Plant (RFP) wastewaters. Groundwater samples and/or wastewater samples will be collected. No new wells will be drilled.

Bench scale testing will be conducted in an onsite laboratory. Coagulation/Flocculation will be tested for the treatability study. The primary variables to be studied include use of chemical additives, pH, temperature, order of addition and mixing conditions.

3.0 HAZARD EVALUATION AND CONTROL

3.1 HEAT AND COLD STRESS

3.1.1 GUIDELINES FOR WORKING IN TEMPERATURE EXTREMES WHILE WEARING PERSONAL PROTECTIVE EQUIPMENT (PPE)

Temperature	Work Cycle	Rest Cycle	Control Measures
<32° F or <55° F & raining	2 hrs	15 min	Review cold stress in safety meeting Rest in a warm area Drink at least 8 ounces of warm non-caffeinated, non-alcoholic beverage at each rest break Schedule a mid-day lunch break of at least 30 minutes in a warm area to begin not later than 5 hours after startup
72° to 77° F	2 hrs	5 min	Review heat stress in safety meeting Take resting pulse rate before beginning work Drink 8 ounces of cool water before beginning work, and 4 ounces at rest break Have ice available
77° to 82° F	2 hrs	5 min	As above, but seated rest break Monitor pulse rate (See below)
82° to 87° F	60 min	15 min	As above, but rest area to be shaded
87° to 90° F	30 min	15 min	As above Try to provide a shaded work area
>90° F	15 min	15 min	As above Provide a shaded area with seats in the work area for team members to use as needed Try to reschedule work to avoid mid-day heat

PULSE CRITERIA. Take resting radial (wrst) pulse at start of work day, record it Measure radial pulse for 30 seconds as rest period begins Pulse not to exceed 110 beats per minute (bpm), or 20 bpm above resting pulse If pulse exceeds this criteria, reduce work load and/or shorten the work cycle by one third, and observe for signs of heat stress No team member is to return to work until his/her pulse has returned to <110 bpm, or resting pulse +20 bpm

3.1.2 SYMPTOMS AND TREATMENT OF HEAT AND COLD STRESS

Heat Stroke	Heat Exhaustion	Frostbite	Hypothermia
Red, hot, dry skin, dizziness, confusion, rapid breathing and pulse, high body temperature	Pale, clammy, moist skin, profuse sweating, weakness, normal temperature, headache, dizzy, vomiting	Blanched, white, waxy skin, but tissue resilient, tissue cold and pale	Shivering, apathy, sleepiness, rapid drop in body temperature, glassy stare, slow pulse, slow respiration
Cool victim rapidly by soaking in cool (not cold) water Get medical attention immediately!!	Remove victim to a cool, air conditioned place Loosen clothing, place in head low position Have victim drink cool (not cold) water	Remove victim to a warm place Rewarm area quickly in warm (not hot) water Have victim drink warm fluids—not coffee or alcohol Do not break any blisters Elevate the injured area and get medical attention	Remove victim to a warm place Have victim drink warm fluids—not coffee or alcohol Get medical attention

3 2 PHYSICAL (SAFETY) HAZARDS AND CONTROLS (REFERENCE STANDARD OF PRACTICE [SOP])

Hazard	Engineering or Administrative Controls
Flying debris/objects	Provide shielding and PPE
Noise > 85 dBA	Noise protection and monitoring required
Steep terrain/unstable surface	Brace and shore equipment
Build-up of explosive gases	Provide 20 lb A,B,C fire extinguisher and ventilation
Build-up of static electricity	No spark sources within 50 feet of an excavation, heavy equipment, or UST removal Ground as appropriate
Gas cylinders	Make certain gas cylinders are properly anchored and chained Keep cylinders away from ignition sources
High pressure hose rupture	Check to see that fitting and pressurized lines are in good repair before using
Electrical shock	Make certain third wire is properly grounded Do not work on electrical wiring unless qualified to do so
Suspended loads	Work not permitted under suspended loads
Moving vehicles	Back-up alarm required for heavy equipment. Observer remains in contact with operator and signals safe back-up Personnel to remain outside of turning radius
Overhead electrical wires	Heavy equipment (e.g. drill rig) to remain at least 15 feet from overhead powerline for powerlines of 50 kV or less For each Kv > 50 increase distance 1/2 foot
Buried utilities, drums, tanks, and so forth	Locate buried utilities, drums, tanks, etc prior to digging or drilling and mark location
Slip, trip, fall hazards due to muddy work areas	Use wood pallets or similar devices in muddy work areas
Back injury	Use proper lifting techniques, or provide mechanical lifting aids
Confined space entry	Permit and safety plan required
Trenches/excavations	Make certain trench meets OSHA standard before entering All excavations > 5 feet deep must be sloped or shored Excavations > 4 feet deep must have a ladder every 25 feet. If not entering trench, remain 2 feet from edge of trench at all times
Protruding objects	Flag visible objects

3.3 TICK BITES, LYME DISEASE, AND ROCKY MOUNTAIN SPOTTED FEVER (RMSF)

Check often for tick bites If bitten, carefully remove tick with tweezers, making certain to remove pinners, being careful not to crush the tick. After removing the tick, wash your hands. Disinfect area, and dress. If the tick resists or cannot be completely removed, seek medical attention.

Look for symptoms of lyme disease or RMSF Lyme rash that looks like a "bull's-eye", with small welt in center, several days to weeks after tick bite. RMSF Rash comprising red spots under skin, 3 to 10 days after tick bite. For both, chills, fever, headache, fatigue, stiff neck, bone pain. If symptoms appear, seek medical attention.

3.4 RADIOLOGICAL HAZARDS AND CONTROLS

Exposure to ionizing radiation can cause cancer. However, recognizing the risks from radiation, recommendations for working with radioactivity and exposures to members of the public have been issued by the International Commission on Radiological Protection (ICRP) and the U.S. National Council on Radiation Protection and Measurements (NCRP). Furthermore, these recommendations have been promulgated into standards and regulations by the EPA, the U.S. Nuclear Regulatory Commission (Chapter 10 of the Code of Federal Regulations), and the Occupational Safety and Health Administration (OSHA, Chapter 29 of the Code of Federal Regulations). For work related to DOE sites, the DOE has issued Orders providing criteria for protection of health and safety and the environment. The basis of the recommendations on radiation by the ICRP and NCRP is to minimize radiation exposures and to develop criteria to ensure that the risks to radiation workers are equal to or less than those in the safety industries. The general basis for the criteria for radiation exposures to the general population is a factor of 10 or more reduction below occupational exposures, plus ensuring that the risk from the exposures is less than the risks to which people are exposed to in normal life (ICRP 26 and NCRP 91).

3.5 HAZARDS POSED BY CHEMICALS BROUGHT ONSITE

The Project Manager is to request Matenal Safety Data Sheets (MSDSs) from the client, or contractors and subcontractors for chemicals that employees are potentially exposed to	
Chemical	Location
Sodium Hydroxide	Treatability Laboratory
Nitric Acid	Treatability Laboratory
Sodium Hypochlonte	Treatability Laboratory
Coagulants	Treatability Laboratory

3.6 OCCUPATION EXPOSURE TO HAZARDOUS CHEMICALS IN LABORATORIES

A laboratory chemical hygiene program will be established according to OSHA 29 CFR 1910 1450
--

3.7 KNOWN CONTAMINANTS OF CONCERN

Contaminant	Location and Highest Concentration (solid media mg/kg or liquid media ug/l)	PEL, REL, or TLV (ppm)	IDLH (ppm)	Symptom and Effects of Exposure	PIP
Aluminum					
Arsenic					
Barium					
Beryllium					
Cadmium					
Chromium					
Iron					
Lead					
Manganese					
Mercury					
Nickel					
Selenium					
Plutonium					
Radium					
Uranium					

Note 1 Lower value of PEL, REL, or TLV listed.
 Note 2 NL = no limit found in reference materials.
 Note 3 PIP = photolionization potential
 Note 4 Location refers to location. Abbreviations specify media.

A (Air) D (Drums) F (Flyash)
 GW (Groundwater) L (Lagoon) TK (Tank) S (Soil) SL (Sludge) SW (Surface Water)

3.8 Potential Routes of Exposure

DERMAL ALL	INHALATION ALL	OTHER PUNCTURE WOUND AND INGESTION ALL
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4.0 PERSONNEL

4.1 EMPLOYEES MEDICAL AND TRAINING REQUIREMENTS

Personnel must meet the medical surveillance, 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training requirements of OSHA 29CFR1910 120. Copies of training and medical certifications will be kept by the project health and safety officer. Employees designated "SSC" have received 8 hours of supervisor and 8 hours of instrument training and can serve as site safety coordinator (SSC) for the level of protection indicated. There must be one SSC present during any task performed in exclusion or decontamination zones with the potential for exposure to safety and health hazards. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. There must be one FA-CPR designated employee present during any task performed in exclusion or decontamination zones with the potential for exposure to safety and health hazards. The "buddy system" requirements of OSHA 29CFR1910 120 are to be met at all times.

Employee Name	Office	Responsibility	SSC/FA-CPR
		Field Team Leader	
		Site Safety Coordinator	Level () SSC, FA-CPR

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4.2 HEALTH AND SAFETY AND FIELD TEAM CHAIN OF COMMAND AND PROCEDURES

4.2.1 CLIENT

4.2.2 CONTRACTOR

4 2.3 SUBCONTRACTOR

5.0 Personal Protective Equipment (PPE) Specification¹ (REFERENCE STANDARD OR PRACTICE)

Task	Level	Body	Foot	Head ²	Eye	Hand	Respirator
Groundwater and surfacewater sampling	D	Cotton coveralls on tyvels	Neoprene steeltoed boots	Hardhat	Safety Glasses with sideshields, splashproof goggles	Depends on contaminants	None Required
Laboratory analysis	D	Laboratory coat or rubber apron	Street shoes		Splashproof goggles	Latex gloves	None required
Groundwater and surfacewater sampling	C	Tyvels or Saranex or PVC coated coveralls	Neoprene steel toed boots with latex covers	Hardhat	Safety Glasses with sideshields, splashproof goggles	Depends on contaminants	APR, full face MSA Ultratwin or equivalent cartridges
Groundwater and surfacewater sampling	B	Saranex coveralls or PVC coated coveralls	Neoprene steel toed boots with latex covers	Hardhat	Safety Glasses with sideshields, splashproof goggles	Depends on contaminants	Positive pressure demand SCBA, MSA Ultralite or equivalent

Note 1: Modifications:
 Note 2: The SSC will specify hardhat areas.

5.1 Reasons to Upgrade or Downgrade Level of Protection

Upgrade	Downgrade
<ul style="list-style-type: none"> Request of individual performing task. Change in work task that will increase contact or potential contact with hazardous materials. Occurrence or likely occurrence of gas or vapor emission. Known or suspected presence of dermal hazards. Instrument action levels (Section 6.0) exceeded. 	<ul style="list-style-type: none"> New information indicating that situation is less hazardous than originally thought. Change in site conditions that decrease the hazard. Change in work task that will reduce contact with hazardous materials.

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6.0 Air Monitoring Equipment Specification (REFERENCE CH2M HILL SOP HS-06)

Instrument	Tasks	Action Levels	Frequency	Calibration
Photoionization Detector (PID)	Groundwater and surfacewater sampling	0 to 1 ppm ^{ab4} 1 to 5 ppm ^{ab} 5 to 50 ppm ^{ab} > than 50 ppm ^{ab} reevaluate	Prior to purging well	Daily
Flame Ionization Detector (FID) OVA-128	Groundwater and surfacewater sampling	0 to 1 ppm ^{ab} 1 to 5 ppm ^{ab} 5 to 50 ppm ^{ab} > than 50 ppm ^{ab} reevaluate	Prior to purging well	Daily
Radiation Meter Alpha Scintillation Detector	Groundwater and surfacewater sampling and in treatability study laboratory	Background > 3 x Background < 2 mR/hr	Prior to purging well as needed in treatability laboratory	Daily

Note 1 expl = explosion Note 2 pot = potential Note 3 def = deficient Note 4 ab = above background
 Note 5 N/A = Not Applicable Note 6 RHIM = Radiation Health Manager Note 7 REZ = radiation exclusion zone

6.1 CALIBRATION SPECIFICATION

Instrument	Gas	Span	Reading	Method
PID HNU, 10.2 ev probe	100 ppm isobutylene	9.8 ± 2.0	55 ppm	1.5 l/m reg T-tubing 0.25 l/m reg direct tubing
PID HNU, 11.7 ev probe	100 ppm isobutylene	5.0 ± 2.0	68 ppm	1.5 l/m reg T-tubing 0.25 l/m reg direct tubing
FID OVA-128	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 l/m reg T-tubing

6.2 RADIOLOGICAL MONITORING EQUIPMENT AND PROCEDURES

Radiation Exposure:

Radiation exposure levels will be continuously monitored with portable instrumentation. Depending on the site, such instrumentation may include a simple personal monitor such as a Victoreen "Mini-Rad," ranging to more sophisticated portable GM or scintillation radiation detector instruments. Choice of instrumentation will be based on the site hazard evaluation and will be made after consultation with the company Radiation Health Officer (RHO).

Personnel Monitoring (External and Internal Dosimetry):

Personnel will wear thermoluminescent dosimeters (TLDs) for measurement of external radiation dose. In addition, self-reading dosimeters (SRDs) are required for work in radiation areas (areas where the exposure rate is greater than 2.5 mR/hr). TLDs will be processed on at least a quarterly basis.

Personnel who work in radiologically controlled areas will participate in a routine bioassay (internal dosimetry) program. This program will include baseline sampling to determine if previous uptakes of radioactive material have occurred, as well as routine bioassay sampling during fieldwork to detect any uptake of radioactive material. The scope of the bioassay program will be site-specific and must be determined in advance with the assistance of the company RHO.

Posting:

Areas where radioactive materials are present and/or elevated radiation fields may be present, must be posted as a Controlled Area at a minimum. When exposure rates reach 2.5 mR/hr or greater, the area must be posted as a "Radiation Area" at a minimum.

Contamination Control:

Samples taken in a radiologically controlled area (or at a site where radioactive materials may be present) will be surveyed with a G M pancake detector to determine gross beta/gamma contamination levels, and with an alpha scintillation detector if alpha contamination is suspected. Instruments or equipment used for well data or sample collection and analysis will be surveyed with a G M pancake detector as they are withdrawn from the well or borehole. Intermittent checks for alpha contamination will be made if alpha contamination is a possibility.

Personnel working in a radiologically controlled area must monitor periodically (at a minimum between samples, at breaks, and prior to exit from the site) for personal contamination. Proper techniques for checking for personal contamination shall be used. Limits for equipment are listed in Table 1.

Radiation Work Permits:

A Radiation Work Permit (RWP) is required in advance for work for which any of the following conditions are anticipated or possible:

- When an individual may receive a radiation dose in excess of 20 mrem to the total body or 300 mrem to the extremities during the work shift
- When an individual may be exposed to airborne concentrations of radioactive material in excess of the 40-hr week guide for that material (Derived Air Concentration [DAC] or Maximum Permissible Concentration [MPC])
- If radiologically controlled area posting is required to control the spread of known or suspected contamination
- When intrusive characterization efforts may encounter radioactive contaminants of unknown types and/or concentrations

Health Physics Coverage:

Health physics technicians are assigned monitoring responsibilities for locations with known radioactive contamination or radiation exposure rates greater than background. These technicians are responsible for determining natural background radiation exposure levels in areas known to be free of contamination, delineating areas of elevated radiation exposure and/or contamination, and monitoring personnel and equipment for radiation exposure and contamination.

Action Levels—External Radiation Exposure:

- Background to 2.5 mR/hr—continue routine operations
- 2.5 mR/hr to 10 mR/hr—alert level, recheck for proper operation of radiation monitoring equipment, monitor radiation level every 10 minutes, take special care to minimize the possibility of inhalation or ingestion of related materials. Notify the Project Manager and the PGDP staff. If the area is outside of posted radiation areas, determine the boundary for the area above 2.5 mR/hr and mark and post it as a radiation area as specified in DOE 5480.11 and the CH2M HILL RSP manual. An RWP is required for work in a radiation area. If an RWP has not been approved in advance, work must stop until an RWP is initiated and approved.
- Above 10 mR/hr—provide for orderly shutdown of sampling or monitoring operations without sacrifice of program integrity. Determine area of radiation readings above 2.5 mR/hr and post it. Notify Project Manager and the PGDP staff, and do not reenter area until plan is amended.
- Above 20 mR/hr—provide for orderly shutdown of sampling and monitoring activities and evacuate area as quickly as possible. Notify Project Manager and PGDP staff. Working from outside the area, determine the boundary for the area above 2.5 mR/hr and mark and post it.
- In accordance with DOE and NRC regulations, if project work activities result in radiation levels in any area outside of the site such that a major portion of a person's body could be exposed to a dose of 5 mrem over 1 hour or 100 mrem over a period of 5 consecutive days, the area will be posted as a radiation area and secured to minimize the potential for radiation exposure to members of the public.

Action Levels—Surface Contamination:

DOE Order 5480 11 specifies radiation levels of surface contamination for uncontrolled release of materials. The levels are the same as those in U.S. NRC Regulatory Guide 1.86 and American National Standards Institute, Inc. (ANSI) draft Standard N13.12. Surveys of material or equipment for unrestricted release will be conducted using RSP Procedure 7.0, "Evaluation of Surface Contamination on Articles to be Released for Unrestricted Use." In most cases, information on the isotopic breakdown of contamination will not be available because clearance surveys will be performed using gross α and gross β/γ counting techniques. The release criteria species in Table 1 are therefore set at the most restrictive limits recommended by DOE and NRC for unknown isotopes.

Table 1 Recommended Maximum Contamination Guide for Unrestricted Release of Equipment or Material			
Direct Survey		Transferrable (Smear Survey)	
Alpha	Beta Gamma	Alpha	Beta Gamma
DPM/100 cm ²		DPM/100 cm ²	
200	1,000	20	200 ^a
^a Except I-125, I-129, and Ac-227 for which the guide is 20 DPM/100 cm ²			
Note: No 100 cm ² area to average greater than this value			

These criteria for surface contamination will be used for assessing surface contamination of sampling equipment and boots and clothing. The control of surface contamination is important for health and safety and is also important to prevent contamination of samples. Fixed and removable contamination levels should be determined using the most sensitive instrumentation available.

Portable field instrumentation (i.e., thin-end window GM detectors for beta-gamma, and alpha scintillation detectors) should be used at a minimum during sampling operations to determine gross fixed plus removable contamination levels.

Removable contamination levels should be determined using low contamination background smear counting systems. Removable surveys should be conducted periodically (at least twice each day) during field sampling operations.

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RESIDUALS HANDLING:

Precipitate and used filters from the treatability laboratory may contain residual radionuclides. This section will address proper handling techniques.

7.0 DECONTAMINATION SPECIFICATION (REFERENCE STANDARDS OF PRACTICE)

Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse	• Wash/rinse equipment	• Power wash
• Glove wash/rinse	• Solvent rinse equipment	• Steam clean
• Outer glove removal	• Solvent disposal method	• Water disposal method
• Body suit removal		
• Inner glove removal		
• Respirator removal		
• Hand wash/rinse		
• Face wash/rinse		
• Shower ASAP		
• PPE disposal method		
• Water disposal method		

7.1 DIAGRAM OF PERSONNEL DECONTAMINATION LINE

8.0 SPILL CONTAINMENT PROCEDURES

9 0 WORK PROCEDURES

9.1 WORK PRACTICES

- No spark sources within exclusion or decontamination zones or laboratory
- Avoid visibly contaminated areas
- No eating, drinking, or smoking in contaminated areas, or exclusion or decontamination zones
- SSC to establish areas for eating, drinking, smoking
- No contact lenses in exclusion or decontamination zones
- No facial hair that would interfere with respirator fit if Level C or B is anticipated
- Site work will be performed during daylight when possible. Any work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."

9 2 SITE CONTROL MEASURES

- Site safety coordinator (SSC) to conduct site safety briefing (see below) before starting field activities, or as tasks and site conditions change
- SSC records safety briefing attendance in logbook, and documents topics discussed
- Post OSHA job site poster in a central and conspicuous location at the site
- Determine wind direction
- Establish work zones support, decontamination, and exclusion zones, and delineate work zones with flagging or cones as appropriate. Support zone upwind of site
- Establish decontamination procedures, including respirator decontamination procedures, and test
- Utilize access control at the entry and exit from each work zone
- Chemicals to be stored in proper containers
- MSDSs are available for onsite chemicals employees exposed to
- Establish onsite communications. These should consist of
 - Line of sight/hand signals
 - Air horn
 - Two-way radio or cellular phone if available
- Establish emergency signals. For example
 - Grasping throat with hand—EMERGENCY—HELP ME
 - Grasping buddy wrist—LEAVE AREA NOW
 - Thumbs up—OK, UNDERSTOOD
 - Two short blasts on air horn—ALL CLEAR
 - Continuous air horn—EMERGENCY—EVACUATE
- Establish offsite communications
- Establish "buddy" system

- Establish procedures for disposal of material generated onsite
- Initial air monitoring conducted by SSC in appropriate level of protection
- SSC to conduct periodic inspections of work practices to determine effectiveness of this plan. Deficiencies to be noted and corrected
- Site safety briefing topics: general discussion of health and safety plan, site specific hazards, location of work zones, PPE requirements, equipment, special procedures, emergencies
- Laboratory analyses are to be conducted in a certified laboratory safety ventilation hood

10.0 EMERGENCY RESPONSE PLAN (REFERENCE STANDARD OR PRACTICE)

10.1 PRE-EMERGENCY PLANNING

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with the facility and local emergency service providers as appropriate

- Locate nearest telephone to the site and inspect onsite communications
- Locate chemical, safety, radiological, biological hazards
- Confirm and post emergency telephone numbers and route to hospital
- Post site map marked with location of emergency equipment and supplies
- Review emergency response plan for applicability to any changed site conditions, alterations in onsite operations, or personnel availability
- Evaluate capabilities of local response teams
- Where appropriate and acceptable to the client, inform emergency room/ambulance service and emergency response teams of anticipated types of site emergencies
- Designate one vehicle as the emergency vehicle, place hospital directions and map inside, keep keys in ignition during field activities
- Inventory and check site emergency equipment and supplies
- Review emergency procedures for personnel injury, exposures, fires, explosions, chemical and vapor releases with field personnel
- Locate onsite emergency equipment and supplies of clean water
- Verify local emergency contacts, hospital routes, evacuation routes, and assembly points
- Drive route to hospital
- Review names of onsite personnel trained in first aid and CPR
- Review notification procedures for contacting CH2M HILL's medical consultant and team member's occupational physician
- Rehearse the emergency response plan once prior to site activities
- Brief new workers on the emergency response plan

10.2 EMERGENCY EQUIPMENT AND SUPPLIES

The SSC marks the locations of emergency equipment on the site map and posts the map in the support zone

- 20 lb ABC fire extinguisher
- Industrial first aid kit
- Facility emergency equipment
- Additional emergency equipment

10.3 EMERGENCY MEDICAL TREATMENT

- The SSC will assume charge during a medical emergency until the ambulance arrives, or the injured person is admitted to the emergency room
- Prevent further injury
- Initiate first aid and CPR
- Call the ambulance and hospital
- Determine if decontamination will make injury worse Yes—seek medical treatment immediately
- Make certain that injured person is accompanied to emergency room
- Notify the Project Manager of the injury
- Notify the District or Regional Health and Safety Manager
- Notify the injured person's human resources department
- Prepare an incident report to the Site Health and Safety Officer

10.4 EVACUATION

- Evacuation routes will be designated by SSC prior to beginning of work
- Onsite and offsite assembly points will be designated prior to beginning of work
- Personnel will exit the exclusion zone and assemble at the onsite assembly point upon hearing the emergency signal for evacuation of the exclusion zone
- Personnel will assemble at the offsite point upon hearing the emergency signal for a site evacuation
- The SSC and a "buddy" will remain onsite after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident
- SSC accounts for all personnel in the onsite assembly zone
- A person designated by the SSC (prior to work) will account for personnel at the offsite assembly area
- The SSC is to write up the incident as soon as possible after it occurs, and submit a report to the Corporate Director Health and Safety

10.5 EVACUATION ROUTES AND ASSEMBLY POINTS

10.6 EVACUATION SIGNALS

Exclusion Zone	Site

11.0 EMERGENCY RESPONSE TELEPHONE NUMBERS

SITE ADDRESS:

Phone:

**Police:
Address:**

Phone: 911 (venfy)

**Fire:
Address:**

Phone: 911 (venfy)

**Ambulance:
Address:**

Phone: 911 (venfy)

Water:

Phone:

Gas:

Phone:

Electric:

Phone:

**Hospital:
Address:**

Phone:

Route To Hospital:

(Refer to map Page 20)

11.1 GOVERNMENT AGENCIES INVOLVED IN PROJECT

Federal:

Phone:

State:

Phone:

Local:

Phone:

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THIS PAGE RESERVED FOR MAP OF ROUTE TO HOSPITAL

12.0 EMERGENCY CONTACTS

Medical Consultant	Occupational Physician (Regional or Local)
Corporate Director Health and Safety Name Phone	Site Safety Coordinator (SSC) Name Phone
District Health and Safety Manager (DHSM) Name Phone	Regional Manager Name Phone
Regional Health and Safety Manager (RHSM) Name Phone	Project Manager Name Phone
Radiation Health Manager (RHM) Name Phone	Regional Human Resources Department Name Phone
Client	Corporate Human Resources Department Name Phone If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured. Notification <u>MUST</u> be made within 24 hours of the injury.

13.0 PLAN APPROVAL

This site safety plan has been written for use by _____ claims no responsibility for its use by others, unless specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

PLAN WRITTEN BY:

DATE:

PLAN APPROVED BY:

DATE:

13.1 PLAN AMENDMENTS

DATE:

CHANGES MADE BY:

CHANGES TO PLAN:

APPROVED:

DATE:

13.2 PLAN AMENDMENTS

DATE:

CHANGES MADE BY:

CHANGES TO PLAN:

APPROVED:

DATE:

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14 0 ATTACHMENTS TO PLAN

Attachment 1: Employee signoff

Attachment 2: Form 533

Attachment 3: Applicable MSDSs

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ATTACHMENT 3
APPLICABLE MSDSs

This attachment will be added to conform to site-specific requirements

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APPENDIX B
QUALITY ASSURANCE PLAN 11000-WP-TS93.01 FOR POTASSIUM FERRATE

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APPENDIX B

**QUALITY ASSURANCE ADDENDUM FOR THE
POTASSIUM FERRATE TREATABILITY STUDY WORK PLAN**

This appendix consists of the Quality Assurance Addendum (QAA) for the Potassium Ferrate Treatability Study Work Plan (TSWP). This QAA supplements the "Rocky Flats Plant Sitewide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (QAPJP).

The Rocky Flats Plant (RFP) Treatability Studies Plan (TSP) identified potassium ferrate as a candidate remediation technology to evaluate for the removal of metals and radionuclides from groundwater and surface water. The purpose of the Potassium Ferrate Treatability Study Work Plan is to describe the testing procedures for various potassium ferrate mixtures to remove metals and radionuclides from samples collected from the RFP. The purpose of this QAA is to establish the study-specific management and process quality controls that are applicable to the treatability tests described in the Treatability Study Work Plan for Potassium Ferrate Processes.

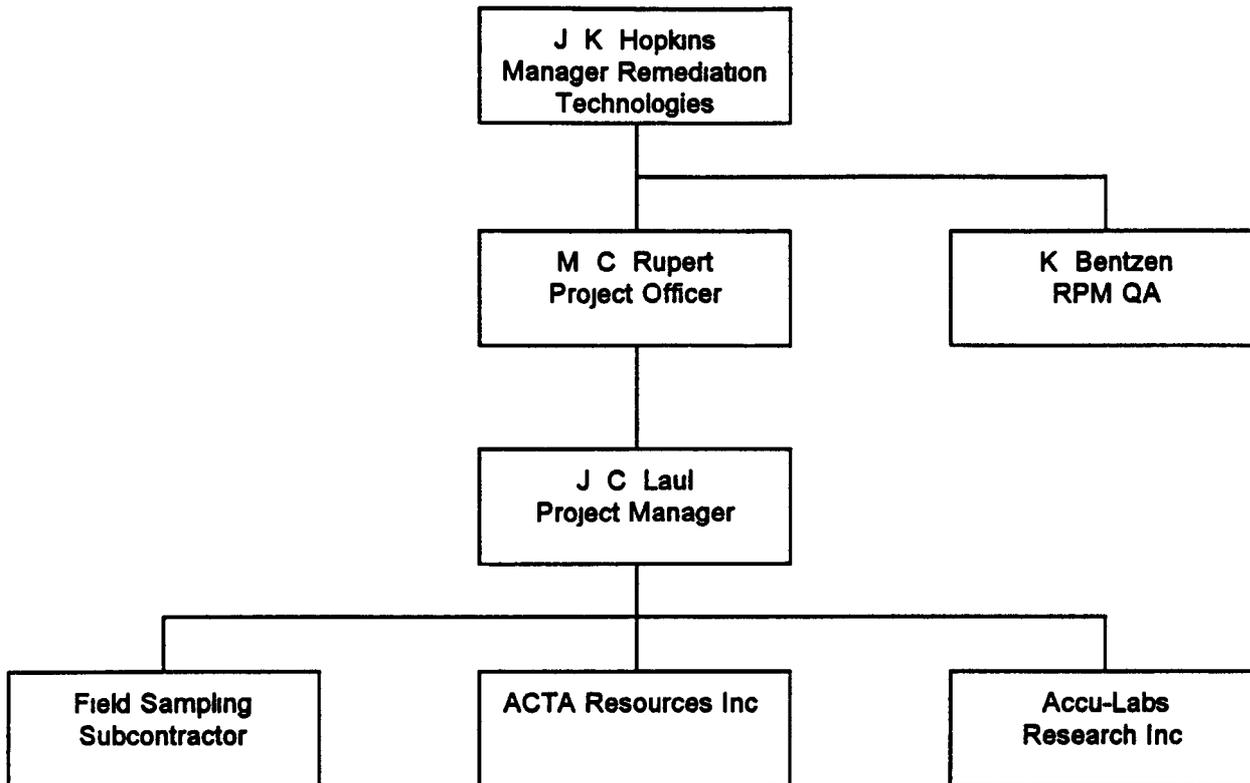
The potassium ferrate treatability tests will consist of two series of jar tests. The first will evaluate the optimum treatment pH, mixing conditions, and the use of coagulants/flocculants. Based on the first testing phase, the second will examine the potassium ferrate process at optimum treatment while varying the flocculant aid. Finally, time permitting, three wastewater samples will be tested under optimum conditions to reinforce the results of the second test phase.

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 for the potassium ferrate treatability tests described in the Potassium Ferrate Treatability Study Work Plan (TSWP) is presented in Figure B-1.

FIGURE B-1 ORGANIZATIONAL CHART FOR POTASSIUM FERRATE
TREATABILITY STUDY WORK PLAN



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 5400.1, 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 potassium ferrate treatability tests, unless specified otherwise in this QAA. Where sitewide administrative and process controls are applicable to potassium ferrate tests, the applicable section of the QAPjP is referenced in this QAA. Study-specific quality administrative and process controls that are applicable to the potassium ferrate 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 potassium ferrate testing to be conducted are addressed in the potassium ferrate TSWP and are referenced in this QAA.

B.2.1 Training

The minimum personnel qualification and training requirements that are 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 potassium ferrate treatability tests, including those collecting groundwater and surface water samples from the RFP, shall be trained in the procedures that are applicable to their assigned tasks. These procedures include the potassium ferrate bench-scale testing procedures described in Section 6.0 of the TSWP, the EM Operating procedures referenced in Appendix A of the TSWP, and the laboratory analytical procedures that are applicable to the analytical methods referenced in Section 6.0. In addition to procedures training, EG&G and subcontractor personnel shall receive training on the applicable process control requirements of the QAPjP and the potassium ferrate TSWP (including this QAA). Training may consist of formal classroom training, on-the-job training, briefings, or reading assignments. Training must be recorded, with verifiable documentation of training submitted to the EG&G Project Manager prior to implementing the potassium ferrate sample collection and testing activities described in the potassium ferrate 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 annually or at the conclusion of the potassium ferrate 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 potassium ferrate TSWP describes the experimental design and contains the detailed testing procedures for the treatability study for the potassium ferrate processes. 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 jar tests As such, the potassium ferrate TSWP is considered the environmental investigation control plan for the potassium ferrate treatment process evaluation

B.3.2 Data Quality Objectives

The development of Data Quality Objectives (DQOs) for the potassium ferrate treatability study was presented in Section 4.0 of the potassium ferrate TSWP. The DQOs were established in general accordance with the 3-stage process described in EPA/540/G-87/003 (OSWER Directive 9335 0-7B), Data Quality Objectives for Remedial Response Activities and Appendix A of the QAPjP. Table 4-1 of the potassium ferrate TSWP summarizes the data needs, the sample collection and analysis activities necessary to generate the type of data needed to evaluate the potassium ferrate treatability tests, identifies the appropriate analytical levels for the contaminants of concern, and summarizes the data uses for the potassium ferrate treatability study components.

Data quality is typically measured in terms of precision, accuracy, representativeness, comparability, and completeness (also referred to as PARCC parameters). Precision, accuracy, and completeness are quantitative measures of data quality, while representativeness and comparability are qualitative statements that express the degree to which sample data represent actual conditions and describe the confidence of one data set to another. These parameters are defined in Appendix A of the QAPjP. Precision and accuracy objectives for analytical measurements of Target Analyte List metals, radionuclides of interest, and the water quality parameters are as specified in Appendix A of the QAPjP (these objectives consist of the historical measures of precision and accuracy for the method of analysis, and ± 20 percent recovery and 20 percent relative percent difference for total dissolved solids for accuracy and precision respectively).

B.3.3 Sampling Locations and Sampling Procedures

Sampling associated with the potassium ferrate treatability study consists of collecting groundwater and surface water samples for conducting the treatability tests (referred to as treatability study samples), influent and effluent water samples prior to and following the initial screening tests (referred to in Table 4-1 of the potassium ferrate TSWP as capability tests).

The concentration of Target Analyte List (TAL) metals and radionuclides (identified in Table 4-2 of the potassium ferrate TSWP) in groundwater and surface water from the sampling locations at the RFP will be determined prior to initial column testing (i.e., influent water) by collecting samples for analysis at the same time the treatability study samples are collected. Influent characterization samples will be collected in the same manner, from the same locations, at the same time as the groundwater and surface water samples are collected for testing (i.e., according to the EM OPS identified in subsection A.1.2). These samples will be screened for radioactivity levels in accordance with EM OPS 5-21000-OPS-FO 18, Environmental Radioactivity Content Screening, prior to shipment to the laboratory for analyses. Indicator parameters shall be measured in the field according to OPS identified in subsection A.1.2.

B.3.4 Analytical Procedures

Water and wastewater samples that are sent to analytical laboratories for analyses of TAL metals and 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). The concentration of water quality parameters in initial test influent waters that are identified in Table 4-2 of the potassium ferrate TSWP, shall be determined according to the analytical methods referenced in Table 44 of Part A of the GRRASP.

B.3.5 Equipment Decontamination

Sampling equipment that is used at more than one field location shall be decontaminated between sampling locations in accordance with OPS-FO 03, General Equipment Decontamination.

B.3.6 Quality Control

Quality control requirements for surface and groundwater samples collected for characterization of influent test water shall consist of collecting an equipment rinsate blank from at least one of the four sample locations for analysis of TAL metals and radionuclides and water quality parameters of interest. At the discretion of the project manager, a duplicate influent characterization sample may be collected along with the influent characterization samples. Trip blanks are not required, since organics will not be analyzed for.

Quality control for analyzing effluent from the initial screening tests shall consist of collecting duplicate samples of effluent from each jar test for analysis as specified in Step 7 of subsection 6.4.2 of the TSWP. Laboratory analytical quality control (QC) requirements applicable to the potassium ferrate treatability study are identified in Table 4-2 of the potassium ferrate TSWP.

B.3.7 Quality Assurance Monitoring

To assure the overall quality of the potassium ferrate treatability testing, EG&G may conduct field inspections of the surface and groundwater sampling process and surveillance of the column testing at the testing laboratory. Field inspections, if conducted, shall be performed in accordance with the requirements of Section 10.0 of the QAPjP.

B.3.8 Data Reduction, Validation, and Reporting

Observational data from screening tests and analytical data from treatability influent and effluent characterization will be managed as specified in Section 7.0 of the potassium ferrate TSWP. Analytical data will be evaluated to determine 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 conclusion of the study. The report will follow the format presented in EPA's Guidance for Conducting Treatability Studies Under CERCLA.

B.4 PROCUREMENT DOCUMENT CONTROL

Procurement documents for items and services, including services for conducting the potassium ferrate treatability study and laboratory analysis of samples, 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 potassium ferrate TSWP describes the field sampling and laboratory testing activities to be performed. The potassium ferrate TSWP will be reviewed and approved in accordance with the requirements for instructions, procedures, and drawings outlined in Section 5.0 of the QAPjP.

The EM OPS that are applicable for collection of surface and groundwater samples and management and handling of samples and field data are identified in Appendix A of the potassium ferrate TSWP. The OPS identified have been approved in accordance with the requirements specified in Section 5.0 of the QAPjP. Any additional quality-affecting procedures proposed for use but not identified in here or in the potassium ferrate TSWP (including Appendix A) will be developed and approved as required by Section 5.0 of the QAPjP prior to performing the affected activity.

Changes and variances to approved operating procedures and the potassium ferrate TSWP shall be documented through preparation of Document Change Notices (DCNs), 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 Potassium Ferrate 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 potassium ferrate TSWP)

B.7 CONTROL OF PURCHASED ITEMS AND SERVICES

Subcontractors who provide services to support the potassium ferrate 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 potassium ferrate 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

Potassium ferrate 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, Containment, Preserving, Handling, and Shipping Samples. An exception to the container requirements of FO 13 for the treatability study samples consists of collecting samples for shipment to the testing laboratory in 12-gallon plastic drums.

B.9 CONTROL OF PROCESSES

The overall processes of collecting and analyzing samples and conducting potassium ferrate treatability study tests requires control. The processes are controlled by adhering to the potassium ferrate TSWP and the sampling and analytical procedures identified therein.

B.10 INSPECTION

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

B.11 TEST CONTROL

The potassium ferrate treatability testing process will be controlled by adhering to the experimental design and testing procedures described in Section 6.0 of the potassium ferrate TSWP. Additional detailed testing procedures may be developed as additional knowledge of the specific characteristics of the treatability study water becomes available. All observations, parameter inputs (e.g., flow volumes, time, chemical additions), and parameter measurements (e.g., flow rate and pH) will be recorded in laboratory testing logbooks.

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

Laboratory equipment that is used in the potassium ferrate treatability study will be identified in logbooks by model number and manufacturer's serial number, or suitable substitute identification number. Laboratory equipment will include a pH meter and peristaltic pump. 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

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- Standardization procedures (traceability to nationally recognized standards)
- Source of calibration standard solutions, as applicable

B.13 HANDLING, STORAGE, AND SHIPPING

Potassium ferrate treatability study and influent and effluent samples shall be packaged, transported, and stored in accordance with Appendix A of the Potassium Ferrate 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 potassium ferrate 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 laboratory testing contractor shall be submitted to EG&G for processing 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 testing contractor 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 potassium ferrate 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

- Field sampling data forms from the sampling and operations OPS identified in Appendix A of the potassium ferrate TSWP (field sampling records shall be submitted to the ER records custodian in accordance with OPS-FO 02, Field Document Control)
- Analytical laboratory data packages, which will include the information specified for data packages specified in Parts A and B of the GRRASP
- potassium ferrate treatability testing logbooks
- Standard bench sheets, as applicable

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- Monthly progress reports
- Potassium Ferrate Treatability testing procedures
- Potassium Ferrate Treatability Study Report

B 18 QUALITY VERIFICATION

The requirements for the verification of quality shall be implemented as specified previously in subsection B 3 7 of this appendix

A Readiness Review shall be conducted by the EQSM prior to implementing the potassium ferrate Treatability study (including prior to collecting treatability study surface and groundwater samples) The readiness review will determine if all activity prerequisites have been met that are required to begin work The applicable requirements of the QAPJP, the potassium ferrate TSWP, and this QAA will be addressed

B 19 SOFTWARE CONTROL

Requirements for software control are not applicable to the Potassium Ferrate Treatability Study