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U.S. DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL
RESTORATION MANAGEMENT

Work Plan for Potassium Ferrate
Treatment of RFP Ground Water
Rocky Flats Plant



July, 1994

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Work Plan for Potassium Ferrate Treatment of RFP Ground Water

Rocky Flats Plant

U.S. Department of Energy
Rocky Flats Plant
Golden, Colorado

Environmental Restoration Program

July, 1994

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ENVIRONMENTAL RESTORATION PROGRAM
Work Plan for Potassium Ferrate
Treatment of RFP Ground Water

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TABLE OF ACRONYMS

°C	Degrees Celsius
%C	Percent Completeness
σ	Standard Deviation / sigma
AA	Atomic Absorption Spectrophotometry
ACTA	ACTA Resources, Inc.
Am	Americium
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CAR	Corrective Action Report
CERCLA	Comprehensive Environmental Responsibility, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	Curie
cm	centimeter
COC	Chain of Custody
CST	Chemical and Separations Technology
CWQCC	Colorado Water Quality Control Commission
DOE	Department of Energy
dpm	disintegrations per minute
DQOs	Data Quality Objectives
EPA	Environmental Protection Agency
ER	Environmental Restoration
ERPD	Environmental Restoration Program Division
g	gram
H&S	Health and Safety
HASP	Health and Safety Plan
IAG	InterAgency Agreement
ICP	Inductively Coupled Plasma
IHSS	Individual Hazardous Substance Sites
IM/IRA	Interim Measure/Interim Remedial Action
KPA	Kinetic Phosphorescence Analyzer
lbs	pounds
LCS	Laboratory Control Sample
LLW	Low Level Waste
M	Molar
M&TE	Measuring and Test Equipment
MDA	Minimum Detectable Activities
MDA	Method Detection Limit
mm	millimeters
MSC	Measured Concentration in the QC check sample
MSDS	Material Safety Data Sheet
nCi	nano-Curies
NCR	NonConformance Report
OSHA	Occupational Safety and Health Administration
OU	Operational Unit

TABLE OF ACRONYMS (continued)

PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
pCi	pico-Curies
PRG	Preliminary Remediation Goal
psi	Pounds per Square Inch
Pu	Plutonium
QA	Quality Assurance
QAA	Quality Assurance Addendum
QAMS/005/80	Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans
QAPD	Quality Assurance Program Description
QAPJP	Quality Assurance Project Plan
QAU	Quality Assurance Unit
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFO	Rocky Flats Office
RFP	Rocky Flats Plant
RPD	Relative Percent Difference
SNS	Scientific Notebook System
SOP	Standard Operating Procedure
SRM	Standard Reference Material
TAC	True Analyte Concentration in the QC check sample
TCE	Trichloroethylene
TCLP	Toxicity Characteristics Leaching Procedure
TD	Technology Development
TTP	Technical Task Plan
um	micron
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

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 waters 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 to evaluate the applicability of potassium ferrate to remove actinides and target metals. The treatment objective of this study is to evaluate the efficiency of potassium ferrate in the removal of americium, plutonium, uranium, and target metals in the groundwaters to levels that meet the Colorado 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 groundwater. Coagulation-flocculation is used to reduce suspended, colloidal, and other non-settleable materials and contaminants from groundwater by gravity settling. The source of the design data for the implementation of the treatment process in a water treatment plant can be obtained from these jar tests. The primary variables investigated in a coagulation/flocculation jar test include: chemical additives, and pH, efficiency in removal of contaminants from groundwaters.

Although the primary goal is to evaluate the effectiveness of potassium ferrate to remove radionuclides and target metals from the Rocky Flats groundwaters, the secondary goal is to gather operational data which is directly applicable to the day-to-day operations of a water treatment facility. 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. For the ferric 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 charged 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 waters 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 target metals while generating 55% less dry filter cake than an equivalent lime treatment.

3.0 TEST OBJECTIVES

The experimental program is designed to:

- Identify treatment options including potassium ferrate dosing requirements and pH adjustment requirements
- Determine the volume of sludge generated using potassium ferrate or treatment procedures
- Optimize treatment conditions that are directly applicable to operations of the water treatment facility
- Gain operational experience on the use of potassium ferrate, and operational costs including total waste management costs
- Evaluate the effectiveness of potassium ferrate or to remove americium, radium, plutonium, uranium and target metals from the identified contaminated water sources to meet CWQCC water discharge limits as shown in Table 3-1.

Table 3-1. CWQCC Water 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
Target Metals		
Aluminum	0.087	mg/L
Antimony	0.024	mg/L
Barium	1.0	mg/L
Beryllium	0.004	mg/L
Cadmium	0.0015	mg/L
Chromium	0.05	mg/L
Cobalt	0.05	mg/L
Iron	0.3	mg/L
Lead	0.028	mg/L
Manganese	0.56	mg/L
Mercury	0.00001	mg/L
Nickel	0.125	mg/L
Selenium	0.01	mg/L
Silver	0.00059	mg/L
Vanadium	0.1	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 water treatment testing is to identify the necessary flocculant aids required to maximize radionuclides removal, and determine the effectiveness of the potassium ferrate treatment procedure. About 100 liters of one water will be required to complete the testing. Sampling activities of the groundwaters 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. A second level of tests will provide data for the minimization of radioactive sludge generation from potassium ferrate treatment. Data on the radionuclide concentrations and target metals in the treated groundwater will also be given.

4.2 Groundwater 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 groundwaters. A list of the analytes is shown in Table 4-1. Sampling activities of the groundwaters 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 (ICP¹)</u>	<u>Anions and Others</u>	<u>Isotopes</u>
Aluminum	pH	Gross Alpha/beta
Antimony	Solid, dissolved	Gamma Spectrometry
Arsenic	Solid, total	Americium-241
Barium	Turbidity	Plutonium-238,239,240
Cadmium		Radium-226
Chromium		Radium-228
Cobalt		Uranium-234,238
Copper		Uranium (total)
Iron		
Magnesium		
Manganese		
Molybdenum		
Nickel		
Potassium		
Silver		
Sodium		
Zinc		
<u>Metals (AA²)</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.

¹ ICP Inductively Coupled Plasma

² AA Atomic Absorption Spectrophotometry

Table 4-2. Analytical Methods for Analytes and Detection Limits

<u>Analytes</u>	<u>Analytical Method</u>	<u>Detection Limit (mg/L)</u>
Alkalinity	EPA 310.1	5
Ammonia	EPA 350.3	0.2
Aluminum	EPA 200.7	0.05
Antimony	EPA 204.7	0.005
Arsenic	EPA 206.2	0.005
Barium	EPA 200.7	0.05
Cadmium	EPA 213.2	0.0005
COD	EPA 410.4	5
Chromium	EPA 200.7	0.005
Cobalt	EPA 200.7	0.005
Copper	EPA 200.7	0.005
Cyanide (Total)	EPA 335.3	0.005
Iron	EPA 200.7	0.01
Lead	EPA 239.2	0.005
Magnesium	EPA 200.7	0.05
Manganese	EPA 200.7	0.005
Mercury	EPA 245.1	0.0001 ***
Molybdenum	EPA 200.7	0.005
Nickel	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 365.2	0.02
Potassium	EPA 200.7	0.3
Selenium	EPA 270.2	0.005
Silver	EPA 272.2	0.0002
Sodium	EPA 200.7	0.1
Solids, Dissolved	EPA 160.1	5
Solids, Total	EPA 160.3	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	EPA 200.7	0.005
Gross alpha/beta	EPA 900.0	3/4 pCi/L
Americium-241	*	0.01 pCi/L
Plutonium-238,239,240	**	0.01 pCi/L
Gamma spectrometry	EPA 901.1	Depends on Isotope
Radium-226	EPA 903.1	0.2 pCi/L
Radium-228	EPA 904.0	5 pCi/L
Uranium, Total	EPA 908.1	0.005 mg/L

* ALR 3804224 compilation of several methods
 ** ALR 3804223 compilation of several methods
 *** Best available method

Table 4-3. RCRA Characteristics

<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 Groundwater Treatment Testing

4.3.1 Phase One Jar Testing

To evaluate the removal of radionuclides and other contaminant metals, one set of water samples 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 standard jar test apparatus is a Fisher Model 15-43-49 High Speed 4 Paddle Stirrer.

The purpose of coagulation-flocculation is to reduce suspended, colloidal, and non-settleable materials and contaminants from groundwater by gravity settling. The primary objectives in the coagulation/flocculation jar tests are to investigate the effect of chemical additives and pH on the efficiency in removal of contaminants from groundwaters. Interferences can occur if complexing or chelating agents complex with contaminants or the treatment chemicals which will prevent flocculation or removal of contaminants.

The Phase One jar tests will provide information on the optimum treatment pH and the use of a water treatment chemical to enhance the potassium ferrate treatment conditions.

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

1. Two (2) liters of water to be treated into the reactor.
2. Start agitator at high rpm (about 250 rpm).
3. Adjust pH with KOH to the test condition.
4. Measure/record water temperature.
5. Add the required amount of ferrate.
6. Add potassium thiosulfate at:
 $0.16 \text{ (mg/L } K_2FeO_4) = \text{mg/L } K_2S_2O$
7. Mix for 15 min.
adjust pH with either sulfuric acid or potassium hydroxide
8. Slow agitator to slow speed (about 10 to 20 rpm).
9. Add Alum, the amount from the test program.
10. Mix for 5 min.
11. Add polymer, the amount from the test program.
(polymer is to be prepared daily at a concentration of 1000 ppm in tap water)
12. Continue mixing for an additional 15 min.

13. Stop agitator and remove it from the reactor.
14. Record the time required for the bulk of the particles to settle.
15. Let the solution stand overnight (18 hr) measure and record the temperature and pH.
16. Siphon the treated groundwater 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.
17. Second level tests.

Table 4-4. Ferrate Technology Test Program

TRIAL	pH	ferrate	Alum	Polymer
11	10.0000	47.1500	30.000	2.7500
3	11.5000	15.7000	50.000	5.0000
8	8.5000	15.7000	10.000	5.0000
4	8.5000	78.6000	10.000	0.5000
2	11.5000	15.7000	10.000	0.5000
5	11.5000	78.6000	10.000	5.0000
7	11.5000	78.6000	50.000	0.5000
6	8.5000	15.7000	50.000	0.5000
3	11.5000	15.7000	50.000	5.000
10	8.5000	15.7000	10.000	0.5000
2	11.500	15.7000	10.000	0.5000
1	8.500	78.6000	50.000	5.000
9	11.500	78.6000	50.000	5.000
1	8.500	78.6000	50.000	5.000

Response Variables for this initial test series.

Am241, Pu239/240, U238, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc.

(22 responses in all).

Table 4-5. Summary of Analytical Work Scope* - Phase One Jar Tests

Sample Description	Number of Samples	Analytical Parameters
Groundwater as Received	1	Americium - 241
		Plutonium - 238, 239, 240
		Uranium, Total
		Target Metals:
		Al Fe Ba Pb Be Mn Cd Hg Cr V Co Sb Ag Zn Ni
Americium - 241		
Phase One Jar Tests	14	Plutonium - 238, 239, 240
		Uranium, Total
		Target Metals:
		Al Fe Ba Pb Be Mn Cd Hg Cr V Co Sb Ag Zn Ni

* Target metals plus cobalt 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 optimum treatment conditions found in the Phase One jar tests. The parameters that may be investigated include chemical treatment dosage to minimize sludge generation using a two step treatment with ferrate and final filtration. 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. The data will provide information if secondary or tertiary treatment will be required to meet CWQCC discharge limits. The actual test condition will be established after the results of Phase I tests are received and analyzed using the ECLIPS program.

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

Sample Description	Number of Samples	Analytical Parameters
Groundwater as Received	1	Americium - 241
		Plutonium - 238, 239, 240
		Uranium, Total
		Target Metals: Al Fe Ba Pb Be Mn Cd Hg Cr V Co Sb Ag Zn Ni
Phase Two Jar Tests	Determined By Phase I	Americium - 241
		Plutonium - 238, 239, 240
		Uranium, Total
		Target Metals: Al Fe Ba Pb Be Mn Cd Hg Cr V Co Sb Ag Zn Ni

*The number of samples and analytical parameters may change depending on the results of Phase I testing.

**Target metals plus cobalt to be monitored will be dependent on the waste stream and the metal contaminating the water source.

4.3.3 Phase Three Confirmation Jar Tests

Confirmation jar tests will be performed based on the optimum treatment results seen in the Phase Two Jar Tests. 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. If necessary this third phase of tests will include 2 stage ferrate treatment plus filtration. The data will also provide information on the need for secondary or tertiary treatment of the groundwaters to ensure that the concentration of radionuclides, organic and inorganic constituents meet the CWQCC discharge limits.

Table 4-7. Summary of Analytical Work Scope - Phase Three Confirmation Jar Tests

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

Table 4-8. Phase Three Confirmation Jar Tests* (1st Groundwater Sample)

Treatment - 1st Groundwater Sample				
Test Run Number	Potassium Ferrate (mg/L)	Treatment pH	Mixing Time (min)	Settling Time (min)
Function of Phase II	Optimum	Optimum pH	Optimum	Optimum

Table 4-9. Phase Two Confirmation Jar Tests* (2nd Groundwater Sample)

Treatment - 2nd Groundwater Sample				
Test Run Number	Potassium Ferrate (mg/L)	Treatment pH	Mixing Time (min)	Settling Time (min)
Function of Phase II	Optimum	Optimum pH	Optimum	Optimum

Table 4-10. Phase Two Confirmation Jar Tests* (3rd Groundwater Sample)

Treatment - 3rd Groundwater Sample				
Test Run Number	Potassium Ferrate (mg/L)	Treatment pH	Mixing Time (min)	Settling Time (min)
Function of Phase II	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 groundwaters.

5.0 EQUIPMENT AND MATERIALS

5.1 Apparatus

- a. Stirrer: A multiposition stirrer with continuous speed variation from approximately 15 to 300 RPM will 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, polypropylene or glass bottles
- e. One-liter microfiltration unit, 0.45 micron

5.2 Reagents

- a. Potassium hydroxide (KOH), made up to 1N.
- b. Nitric acid (HNO_3), 15.9N, trace metal grade or better for preservation.
- c. Sodium hypochlorite solution, available chlorine, approximately 10%, NaOCl
- d. Potassium ferrate or potassium ferrate based water treatment chemicals.
- e. Alum (made up in a diluted solution, 1000 ppm.).
- f. Polymer (yet to be chosen) made up in a diluted solution 1000 ppm.
- g. Potassium thio sulfate.
- h. Sulfuric acid,

6.0 SAMPLING AND ANALYSIS

After a groundwater is identified, the sampling activities of the groundwaters will be performed by EG&G Rocky Flats Plant personnel or an EG&G subcontractor (Golder & Associates) using EG&G Standard Operating Procedures for sample designation, handling, shipping, and documentation procedures. For example, pH and temperature of the groundwater 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 groundwater 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 groundwater 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. The criteria for evaluating holding times is as follows:

- time < 6 weeks after sampling = groundwater is usable for this study
- time > 6 weeks after sampling = groundwater is **not** usable for this study.

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

Data acquisition and management at RFP follow the general DOE Standard DOE-ER-STD-600192, Implementation Guide for Quality Assurance Programs for Basic and Applied Research, Criteria 4 and 6. Data and other experimental information, which is collected by RFP for the test program in Section 4, will be recorded and managed in accordance with draft ERPD procedure for "Scientific Notebooks" (2-G06-ER-ADM-05.10, Rev. 0). Additionally, all data must be submitted to the ERPD records center in a timely manner and comply with the QAPJP, QAPD, and QAMS-005/80.

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. This history will be monitored using RFP ERPD chain-of-custody forms. At a minimum, the treatability testing logbooks will document the following:

- Testing procedures
- Departing from protocols and reasons for departures
- Instrument calibration
- Sampling methods
- Chemical additions
- Test observations
- Chain of Custody.

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. This analysis will be computer aided using the ECLIPS program.

The results of the three phase of jar testing (Tables 4-7 and 4-8) will be used to evaluate the effectiveness of the treatment procedures. Removal 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 the treatment process at a given condition.

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 and pH and the effect of added water treatment chemicals, in order to establish maximum removal of radionuclides and other contaminants in the groundwaters.

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 Groundwater

If the groundwater cannot be properly disposed of by the contract analytical laboratory (Accu-Lab), all groundwater 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 STUDY 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

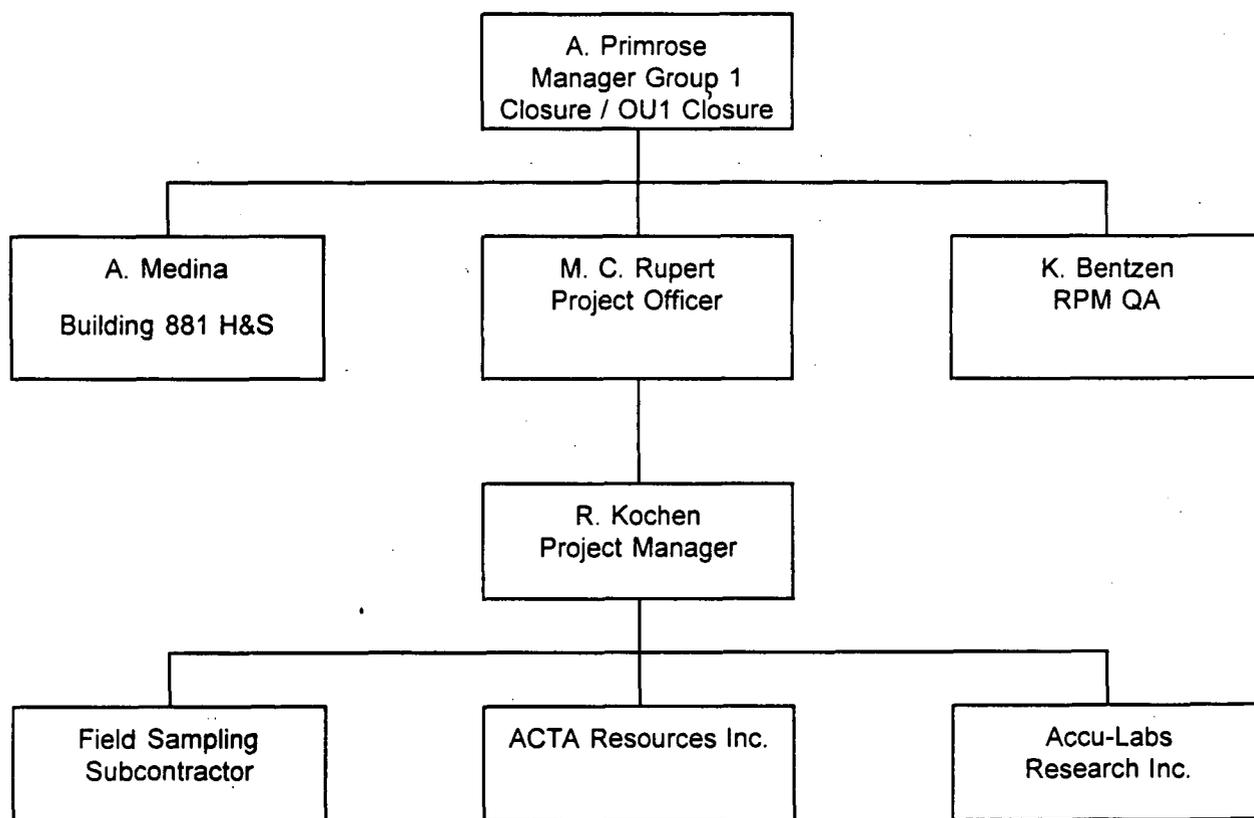
Following the approval of the Work Plan and the Quality Assurance Plan, Phase One jar tests will be initiated. There are at least 40 experiments planned (some duplicates and some dry runs) in various test conditions. Performance of radioactive experiments may be slowed due to the constraints of working 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 groundwater. The project will be performed under the direction of M. C. Rupert and R. Kochen of EG&G Rocky Flats. Figure 13-1 shows below the assigned personnel and their lines of communication.

Figure 13-1. ORGANIZATIONAL CHART FOR POTASSIUM FERRATE
TREATABILITY STUDY WORK PLAN



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Work Plan for Potassium Ferrate
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14.0 QUALITY ASSURANCE PLAN

Quality Assurance Project Plan (QAPjP) 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 QAPjP manual.

APPENDIX A: 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).

Site groundwater sampling locations for this work plan are Well Nos. B203989, 7287, 03991, 09091 and 3086. The Potassium Ferrate Treatability Test work will be conducted in Lab 264 of Building 881.

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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

See Section 13.0 of Treatability Work Plan

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 in accordance with Groundwater Monitoring Program and Surfacewater Health and Safety Plans. No new wells will be drilled.

Bench scale testing will be conducted in Laboratory 264 of Building 881. 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.

This health and safety plan covers bench scale laboratory testing conducted in Lab 264 of Building 881. The groundwater sampling activity was performed in accordance with the Groundwater Monitoring and Surfacewater Health and Safety Plans.

3.0 HAZARD EVALUATION AND CONTROL

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

Hazard	Engineering or Administrative Controls
Noise > 85 dBA	Noise protection and monitoring required.
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.
Back injury	Use proper lifting techniques, or provide mechanical lifting aids.
Protruding objects	Flag visible objects.

3.2 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).

Radiological hazards are expected to be minimal during Potassium Ferrate Treatability testing in Lab 264 of Building 881. The water to be tested is expected to be low level wastewater with radionuclide concentrations of approximately 20 picocuries per liter. The laboratory test work will be conducted in a non-radiologically controlled area due to the low radionuclide concentrations.

3.3 HAZARDS POSED BY CHEMICALS BROUGHT ONSITE

The Project Manager is to request Material Safety Data Sheets (MSDSs) from the client, or contractors and subcontractors for chemicals that employees are potentially exposed to during laboratory testing. The MSDS will identify all known hazards of handling the chemicals below.	
Chemical	Location
Sodium Hydroxide	Treatability Laboratory
Nitric Acid	Treatability Laboratory
Sodium Hypochlorite	Treatability Laboratory
Coagulants	Treatability Laboratory
Potassium Ferrate	Treatability Laboratory

3.4 OCCUPATIONAL EXPOSURE TO HAZARDOUS CHEMICALS IN LABORATORIES

A laboratory chemical hygiene program will be established according to OSHA 29 CFR 1910.1450.

3.5 KNOWN CONTAMINANTS OF CONCERN

Contaminant	Location and Highest Concentration (solid media: mg/kg or liquid media: ug/l)		PEL or TLV (ug/m ³)
Aluminum	Well No. 03991	581000	5000
Arsenic	Well No. 3086	10000	10
Barium	Well No. 03991	11000	500
Beryllium	Well No. B203989	108	2
Cadmium	Well No. B203989	1720	2
Chromium	Well No. 03991	1590	500
Iron	Well No. 03991	757000	1000
Lead	Well No. 7287	540	50
Manganese	Well No. 03991	6200	5000
Mercury	Well No. 03991	4.7	100
Nickel	Well No. 3086	1620	1000
Selenium	Well No. 09091	50	200
Plutonium	Well No. 3086	354.6	N/A
Radium	Well No. 3086	1.959	N/A
Uranium 235	Well No. 3086	6.419	N/A

Note 1: Lower value of PEL or TLV listed. Note 3: PIP = photoionization potential A (Air) D (Drums) F (Flyash)
 Note: NL = no limit found in reference materials. Note 4: Location refers to location.
 Abbreviations specify media: GW (Groundwater) L (Lagoon) TK (Tank) S (Soil) SL (Sludge) SW (SurfaceWater)

3.6 Potential Routes of Exposure

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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. The "buddy system" requirements of OSHA 29CFR1910.120 are to be met at all times. All employees working in Lab 264 of Building 881 shall be familiar with all building laboratory practices.

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	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
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.

6.0 Air Monitoring Equipment Specification

All air monitoring equipment for groundwater sampling shall be in compliance with the Groundwater Monitoring Program and Surfacewater Health and Safety Plans.

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	Level D Level C Level B Stop Work;	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	Level D Level C Level B Stop Work;	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	Continue Work Consult RHM ⁶ Establish REZ ⁷	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: RHM = 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 G.M. or scintillation radiation detector instruments. No portable instrumentation will be placed within Lab 264 of Building 881 to monitor radiation exposure since radionuclide concentrations of the waters are so low and the testing is to be conducted in a non-Radiologically Controlled Area.

Personnel Monitoring (External and Internal Dosimetry):

Personnel will wear thermoluminescent dosimeters (TLDs) for measurement of external radiation dose. 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 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. Alpha surveys shall be performed routinely and whenever gamma/beta surveys are performed.

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:

Radiological Control 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 5 mR/hr—continue routine operations.
- 5 mR/hour 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 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 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/hour—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 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 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 HSP 18.10 "Release of Property/Waste for Conditional/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	
300	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.

RESIDUALS HANDLING:

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

Precipitate generated from the treatability testing will be picked up by Golder Associates and shipped to Accu-Lab Research Inc. for analysis.

Used filters will be placed within a drum currently assigned to hold low level waste generated in Lab 264 of Building 881.

7.0 DECONTAMINATION SPECIFICATION (REFERENCE STANDARDS OF PRACTICE)

Personnel (Whole Body Monitor- as appropriate)	Sample Equipment	Heavy Equipment
• Inner glove removal		
• Hand wash/rinse		
• Face wash/rinse		
• PPE disposal method:		
• Water disposal method:		

Note - All work performed as part of this study will be conducted in a non-Radiologically Controlled laboratory with blended groundwater samples containing radionuclide concentrations of approximately 20 picocuries/liter.

8.0 SPILL CONTAINMENT PROCEDURES

Any spills of groundwater samples shall be contained in accordance with the Groundwater Monitoring Program and Surfacewater Health and Safety Plans. Any spills of samples within Lab 264 of Building 881 shall be contained in accordance with applicable Building 881 Emergency Response Procedures and Laboratory Procedures.

9.0 WORK PROCEDURES

9.1 WORK PRACTICES

- No spark sources within exclusion or decontamination zones or laboratory.
- No eating, drinking, or smoking in contaminated areas, or exclusion or decontamination zones.
- Laboratory lead personnel to establish areas for eating, drinking, smoking.
- No facial hair that would interfere with respirator fit if Level C or B is anticipated.

9.2 SITE CONTROL MEASURES

- Laboratory lead to conduct site safety briefing (see below) before starting field activities, or as tasks and site conditions change.
- Laboratory lead records safety briefing attendance in logbook, and documents topics discussed.
- Post OSHA job site poster in a central and conspicuous location at the site.
- Establish work zones: support, decontamination, and exclusion zones, and delineate work zones with flagging or cones as appropriate.
- Utilize access control at the entry and exit from each work zone.
- Chemicals shall be stored in properly labeled 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 Laboratory lead in appropriate level of protection.
- Laboratory lead 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)

The following sections and the Building 881 Emergency Plan EPP-146 and the Building 881 Emergency Evacuation Plan (draft) form the basis for the Emergency Response Plan for the Potassium Ferrate Treatability Study activities.

10.1 PRE-EMERGENCY PLANNING

The Laboratory lead performs the applicable pre-emergency planning tasks before starting laboratory 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 medical consultants 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 Laboratory lead 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:
- Building 881 emergency equipment: Safety showers, Fire sprinklers

10.3 EMERGENCY MEDICAL TREATMENT

- The Laboratory lead 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.

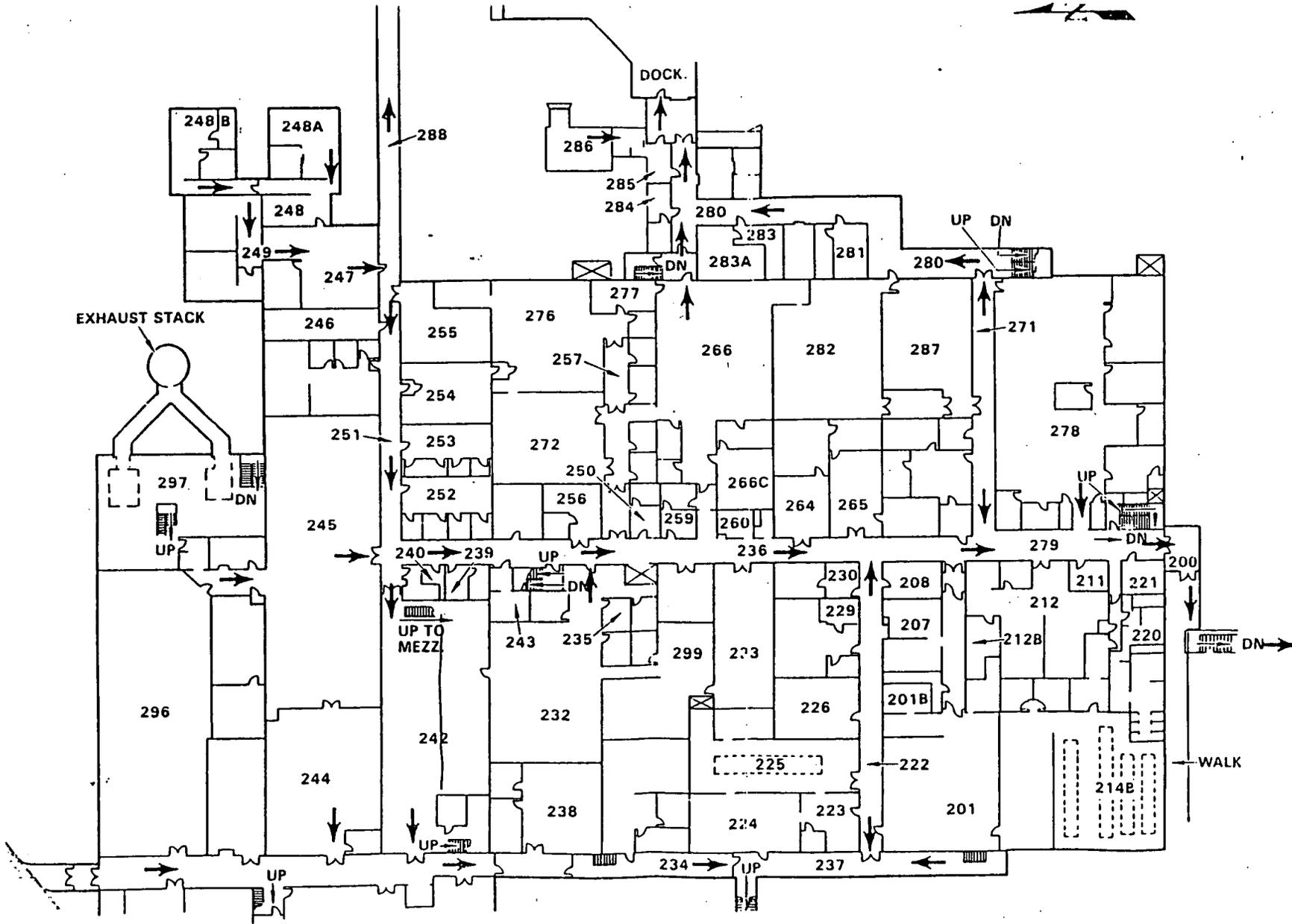
10.4 EVACUATION

- Evacuation routes will be designated by the Laboratory lead 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 Laboratory lead 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.
- Laboratory lead accounts for all personnel in the onsite assembly zone.
- A person designated by the Laboratory lead (prior to work) will account for personnel at the offsite assembly area.
- The Laboratory lead 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

See Figure 10-1, Building 881 Second Floor Evacuation Routes

Building 881 -
Second Floor Evacuation Routes



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11.0 EMERGENCY RESPONSE TELEPHONE NUMBERS

Department/Group	Name	Phone #	Pager #
Shift Superintendent (Incident Commander)		2911/ 2914	
Industrial Hygiene	N. Candido	5741	1658
Occupational Health	F. J. Furman	2895	
Occupational Safety	J. Listemann	7689	3049
Operations Manager	W. Hiler	2766	5062
Radiological Engineering	M. Bratley	5602	5884
Radiological Operations	K. Garland	3333	3547
RCRA/CERCLA	A. Schubert	5251	1177
Response & Reporting		3456	
Security		2444	
Responsible User	J. C. Lau/ C. E. Baldwin	3254/ 4008	1306/ 5438

If the supervisor is not available or the situation is life threatening, notify RFP emergency response personnel as detailed below:

Call **X2911** or **radio channel #1** for emergency assistance for life threatening emergencies to access:

- Incident Commander (Shift Superintendent)
- Plant Protection Central Alarm Station
- Fire Department Dispatch Center, and
- Occupational Health

Provide as much detail about the emergency as possible. A decision to dispatch any or all of the following equipment will be made on the information provided:

- Fire Engine/Equipment
- Ambulance
- Hazmat Response Vehicle

Provide the following information, upon request, to the qualified Emergency Dispatcher:

- Exact location of the emergency
- Nature of the emergency
- Condition of patient if applicable (breathing, consciousness, bleeding, etc.)
- Special hazards in the area
- Your name
- Building number, Cargo number or Unit number
- Any other information requested

If no details are given, emergency response personnel will respond automatically.

The Incident Commander (IC) will immediately respond to all emergency alerts and alarms. Radio/telephone communications shall be maintained with personnel having access to the plant Public Address System. At his/her discretion, the IC may activate the Emergency Operation Center (EOC) and notify departments that have an advisory role in the situation. The Rocky Flats Fire Department will determine if additional help from offsite agencies (police, hospitals, etc.) is required.

11.1 GOVERNMENT AGENCIES INVOLVED IN PROJECT

Federal: Department of Energy - Rocky Flats Plant **Phone:** (303) 966-7000
Environmental Protection Agency - Region VIII (303) 293-1603

State: Colorado Department of Health **Phone:** (303) 692-2000

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

Manual: RFP/ERM-94-00010
Document: Revision 0
Page: 24 of 29
Issue Date: July 18, 1994

THIS PAGE RESERVED FOR MAP OF ROUTE TO HOSPITAL

12.0 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: Ginger Ferguson **DATE:** February 24, 1994

PLAN APPROVED BY: **DATE:**

12.1 PLAN AMENDMENTS

DATE: **CHANGES MADE BY:**

CHANGES TO PLAN:

APPROVED: **DATE:**

12.2 PLAN AMENDMENTS

DATE: **CHANGES MADE BY:**

CHANGES TO PLAN:

APPROVED: **DATE:**

13.0 ATTACHMENTS TO PLAN

Attachment 1: Employee signoff

Attachment 2: Form 533

Attachment 3: Applicable MSDSs

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

Manual:
Document:
Page:
Issue Date:

RFP/ERM-94-00010
Revision 0
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July 18, 1994

ATTACHMENT 3

APPLICABLE MSDSs

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

APPENDIX B
**Quality Assurance Addendum for the Work Plan for Potassium Ferrate
Treatment of RFP Ground Water**

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1.0 PURPOSE

The purpose of the Quality Assurance Addendum (QAA) is to identify Quality Assurance (QA) requirements, and specific measures for implementing these requirements, that are applicable to the laboratory experiments addressing potassium ferrate treatment of RFP ground water. This QAA is intended to supplement the "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (referred to as the RFP Site-Wide QAPjP, or simply QAPjP). As a supplement to the QAPjP, this QAA establishes the specific measures and QA controls applicable to the actions described in this work plan. The purpose of this laboratory work is to characterize mobilization of target metals and radionuclides using controlled coagulation-flocculation devices (i.e. potassium ferrate).

2.0 SCOPE

This QAA addresses all quality affecting activities described in the work plan to be performed by EG&G Rocky Flats and analytical laboratories (Accu-Labs, Inc.).

The major actions of testing and experimentation within this work plan to which this QAA apply include:

- jar tests which will be used to select optimal treatment pH, mixing conditions, and use of coagulants/flocculants to enhance treatment conditions
- jar tests to optimize the potassium ferrate treatment procedure using optimum treatment conditions found in the first phase of jar tests referenced above.

3.0 BASIS FOR TECHNICAL ACTIVITY

This work indirectly supports legally binding requirements stated in the Interagency Agreement (IAG) regarding mitigation and/or remediation of contamination at the RFP. Results from this treatability study may be used in RFP feasibility studies, and may eventually be used to clean ground water at RFP.

4.0 BASIS OF QA REQUIREMENTS

The QAPjP was prepared to identify the QA requirements and methods applicable to the RFP Environmental Restoration (ER) Program activities, as identified in the Attachment 2 of the IAG Statement of Work. Section IV.A of the IAG specifies the minimum quality elements that the QAPjP must include, and references EPA QAMS/005/80, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, for guidance in preparing the QAPjP.

5.0 QUALITY REQUIREMENTS

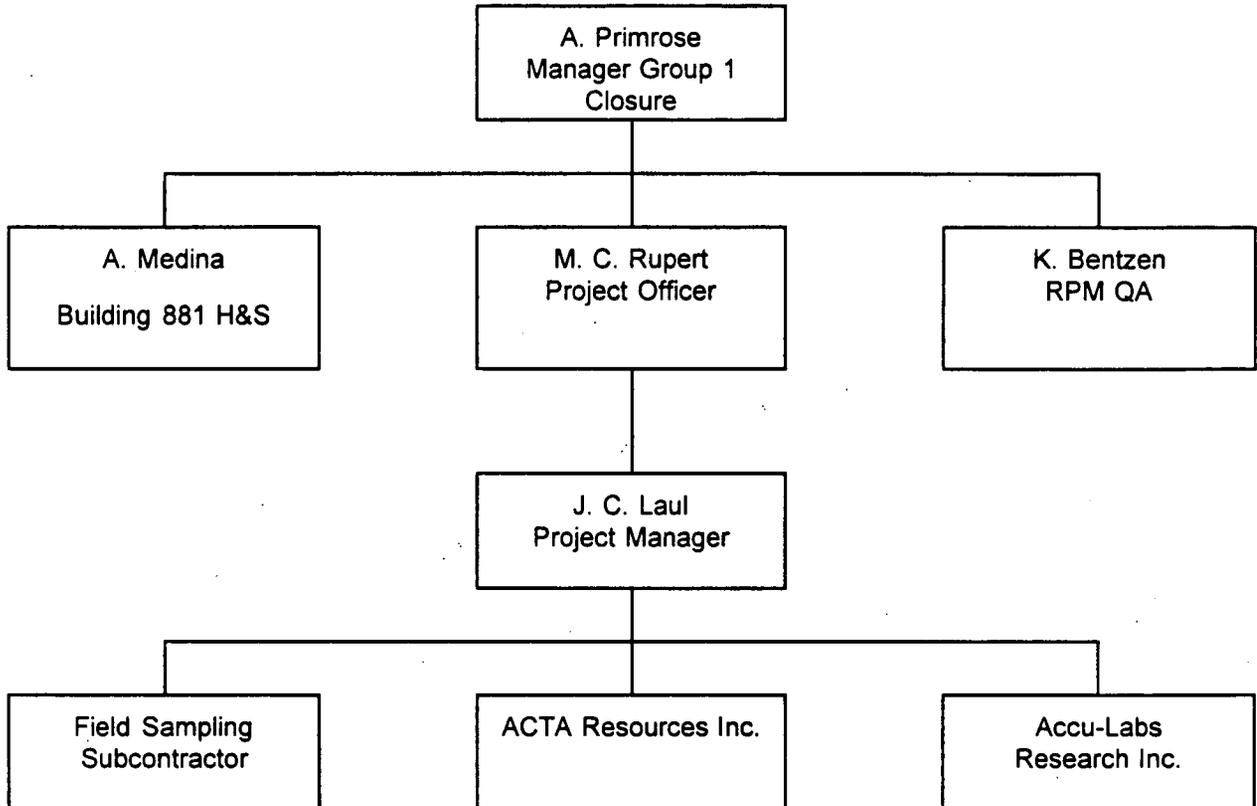
5.1 Organization and Responsibilities

Responsibilities for the Potassium Ferrate Treatability Study are outlined in the organizational chart shown in Figure 1. The organization has been structured such that quality is the responsibility of those who have been assigned the responsibility of performing the work, and conformance to established requirements is verified by individuals and groups not directly responsible for performing the work. The EG&G Rocky Flats Environmental Restoration Management (ERM) organization is responsible for management and coordination of the EG&G Rocky Flats resources dedicated to the project.

Responsibilities are as follows:

Manager Group 1 Closure -	Monitors schedule and budget, ensuring that the project stays within time and financial constraints.
Project Officer -	Provides contract oversight and expedites progress of the project. Ensures that all milestones are met in a timely manner. Provides a communication link with DOE/RFO.
RPM QA -	Ensure that the Treatability Study complies with applicable Quality Assurance procedures.
Project Manager -	Plans and directs the efforts of lab technicians performing the work.
Field Sampling Contractor -	Take groundwater samples for testing and analytical work as needed.
ACTA Resources, Inc. -	Write status reports to EG&G and supervise testing.
Accu-Labs Research Inc. -	Perform analytical lab work as deemed necessary by the work plan, determine the amounts of contaminants in the groundwater before and after performing the potassium ferrate treatment.

FIGURE 5-1 ORGANIZATIONAL CHART FOR POTASSIUM FERRATE
TREATABILITY STUDY WORK PLAN



5.2 Quality Assurance Program

The ERM Environmental Quality Support Division is responsible for providing internal quality implementation support (including inspections and surveillance of system acceptance and performance) to assure that the quality requirements of this QAA and the QAPjP are being implemented.

All EG&G Rocky Flats and subcontractor personnel that perform quality affecting activities on this project shall have qualification records that document they are qualified to perform their assigned tasks. The EG&G TD Manager shall identify any Rocky Flats Plant area-specific and/or specialized training requirements that are applicable to project personnel. Job specific training will include theory of operations, system components, principles of operations, system interrelationships, protective devices, and practical factors.

5.3 Design Control and Control of Scientific Investigations

The QAPjP considers activities that generate analytical data, which requires collection and analysis of environmental samples, to be scientific investigations. Controls for scientific investigations include developing data quality objectives, collecting and analyzing samples according to approved procedures, establishing and implementing quality controls, and reducing and reporting data in a controlled manner.

Established procedures shall be used for gathering samples in the field and subsequent testing in the laboratory(s). When deviations from the operations procedures occur, or when new or nonstandard procedures are implemented, a Scientific Notebook System (SNS) will be used as the primary means of documenting quality-affecting information.

Data quality objectives (DQOs) quantitatively and qualitatively describe the uncertainty that decision makers are willing to accept in results derived from environmental data (see Sections 5.12 and 5.13). This uncertainty is used to specify the quality of the data required to meet the objectives of the investigations. The process for developing DQOs for remedial investigations is summarized in Appendix A of the QAPjP. Precision, accuracy, representativeness, completeness, and comparability (referred to as PARCC parameters) are fundamental parameters used to indicate data quality.

Precision and accuracy are dependent on the analyte of interest, the sample matrix, analytical method, and the quality control procedures applicable to the method of analysis. Precision and accuracy of all measurements used to calculate results, as documented in the final report, shall be documented, as well as the physical/chemical methods used to produce the cited performance specifications (per item or system, as applicable).

Completeness can also be a quantitative measure of both the sampling and analysis process. However, because this project is based only on representative samples within the laboratory/bench scale settings, and not on a comprehensive field sampling scheme regarding site characterization, "completeness" in its typical context, is not an applicable quality indicator in this work plan.

Comparability and representativeness are qualitative parameters ensured through careful development of and adherence to sampling and analysis plans and procedures. Deviations from established sampling and analysis protocols, and potential impacts to data quality, shall be documented in the SNS. Samples sent to the laboratory(s) for testing shall represent physical and chemical characteristics of the groundwater to be potentially remediated. For comparability purposes, similarities and differences in groundwater samples must be discussed in the final report relative to explanation of the test results.

A more detailed description of the PARCC parameters is included in Section 5.12.

5.4 Document Control

Documents produced by EG&G that control the work described in this work plan shall be controlled to ensure that key project personnel receive accurate and up-to-date information. Such documents shall be controlled per EG&G procedure 3-21000-ADM-5.01, "Document Control". EG&G plans and procedures shall be managed in accordance with EG&G procedure 2-11000-ADM-06.01.

5.5 Control of Purchased Items and Services

Items or services procured under this project shall be performed in accordance with the requirements of the QAPjP and ERM administrative procedure ADM-4.01, "Procurement Document Control", including retention of purchase order receipts, contracts, or any other documentation related to the integrity/traceability of the purchased product or service.

5.6 Inspection and Assessment

Quality affecting activities are subject to assessments and inspections. These assessments will be performed formally, in accordance with EG&G procedures (e.g., 3-21000-ADM-10.01 and/or -ADM18.02), or informally, as requested by line management. The work place and working records shall be accessible during normal working hours for verification or ERM internal assessments and inspections by EG&G or their representatives during the performance of this project. Any nonconformances identified during formal assessments shall be documented with Nonconformance Reports. Independent audits of the project may be conducted by the Safety, Audits, and Assurance (SAA) organization in accordance with SAA procedures.

ERM internal assessments and inspections shall be performed by the EG&G Technical Program Manager or designee. Frequency of these audits will be determined after contract award. Additionally, EG&G Environmental Quality Support Division from Environmental Restoration shall review and approve Quality Assurance elements specific to this Work Plan and Statement of Work prior to contract award.

5.7 Sampling Procedures and Custody

A sample chain-of-custody (COC) will be initiated at the time the samples are collected and maintained through all transfers of custody until the sample is received at the testing laboratory. Procedure 5-21000-OPS.FO.13 provides instructions for preparing COC forms, and defines the procedures addressing sample containers, preservatives, handling, packaging, and shipping of groundwater. July 18, 1994 samples collected at RFP. Samples shall be logged in upon receipt at the analytical laboratory and sample tracking throughout the analytical process shall be maintained in accordance with laboratory procedures.

5.8 Measuring and Test Equipment

Measuring and test equipment (M&TE) used in the construction/installation, inspection, and testing of the simulated in situ rad chemistry remediation system shall be selected, identified, calibrated, and maintained in accordance with the methods established in RFP administrative procedure 1-50000-ADM-12.01, Control of Measuring and Test Equipment. The M&TE requirements of Section 12 of the QAPjP are implemented through procedures specific to the sampling/analysis event, manufacturers instructions, and specific laboratory procedures.

5.9 Control of Nonconformances

Items, samples, and data that do not conform to specifications and/or requirements shall be identified, segregated (where necessary to prevent inadvertent use), dispositioned, and evaluated in accordance with approved procedures. Nonconformances related to the design, construction/installation, or testing of the testing system, and any waste related nonconformance, shall be controlled in accordance with RFP procedure 1-50000-ADM-15.01, "Control of Nonconforming Items, Samples, and Data".

5.10 Corrective Action

The identification, reporting, closeout, and documentation of significant conditions adverse to quality shall be accomplished in accordance with RFP procedures 1-50000-16.16, Corrective Action Program.

5.11 Quality Assurance Records

Project records that are considered ERM QA records include, but are not necessarily limited to, the final report, (including all appendices), design documents, procurement documents, construction/installation records, supplier/subcontractor evaluations, inspection records, test records, logbooks, sampling records, sample chain-of-custody records, analytical data packages, interim and annual operating reports, action plans, operation manuals, NCRs, CARs, audit reports, surveillance reports, self-assessment reports, personnel training and qualification records, the QAPjP, any administrative and procedures referenced herein, and any other project records that are used to support observations and conclusions in the final report. All ERM QA records generated shall be submitted to the ERM Records Center for processing according to ERM procedures 3-21000-ADM-17.01 and 3-21000-ADM-17.02.

5.12 Data Quality Objectives

The primary objective of this demonstration is to evaluate the effectiveness of the Potassium Ferrate technology in removing selected radionuclides and target metals from contaminated RFP groundwater. QA objectives are developed to produce data that can be used to evaluate the effectiveness of the technology. The following sections discuss topics directly related to the QA objectives. These include: data required; PARCC objectives, and analytical detection levels.

5.12.1 Data Required

Data Uses:

- The data from the Potassium Ferrate Treatability Study will be used to determine how efficiently the technology extracts selected radionuclides and target metals from RFP groundwater.
- The Potassium Ferrate technology is being evaluated as an option for cleanup of RFP groundwater.

Data Types:

- At least ten gallons of water will be sampled and transported to Building 881.
- The groundwater will have a minimum of the following levels:

Table 5-1. Minimum Levels of Contaminants in Groundwater Samples

Contaminant:	Minimum Level of Contamination
<i>Radionuclide</i>	(pCi/L)
Am-241	4
Pu-239, 240	25
U-238	35
<i>Metal</i>	(µg/L)
Al	180000
Ba	1600
Be	20
Cd	60
Cr	225
Co	150
Ag	10
Ni	275
Fe	175000
Pb	85
Mn	2800
Hg	0.25
V	250
Sb	30
Zn	700

- Radionuclide analysis will be performed using:
 - ICP for base metals
 - Uranium analyzer
 - alpha spectrometry for Pu and Am.
- The data generated by this treatability study will be used to assess the efficiency of the Potassium Ferrate technology. Thus, an 80% confidence level is acceptable for this "proof of principle" study, and large errors are acceptable as the efficiency approaches zero.

Data Quality Needs:

- Sampling Needs:
 - Appropriate Analytical Levels
 - To adequately test the removal efficiency of the Potassium Ferrate process, the water must initially have activity of at least
 - Contaminants of Concern
 - Radionuclides:
 - Americium
 - Plutonium
 - Uranium
 - Priority Metals:
 - Aluminum - Iron
 - Barium - Lead
 - Beryllium - Manganese
 - Cadmium - Mercury
 - Chromium - Vanadium
 - Cobalt - Antimony
 - Silver - Zinc
 - Nickel

- o Preliminary Remediation Goals

Table 5-2. Preliminary Remediation Goals for Each Contaminant

CONTAMINANT	PRELIMINARY REMEDIATION GOAL
<i>Radionuclide</i>	(pCi/L)
Am-241	0.05
Pu-239, 240	0.05
U-238	5
<i>Metal</i>	(µg/L)
Al	50
Ba	1000
Be	4
Cd	5
Cr	50
Co	50
Ag	50
Ni	100
Fe	300
Pb	15
Mn	50
Hg	2
V	100
Sb	6
Zn	2000

- o Critical Samples
 - At least ten one gallon jars of water from wells B203989, 7287, 03991, 09041, and 3086.
 - Approximately ten gallons of water are necessary to perform the experiments, allowing for additional tests to be run in the event of experimental error and/or uncertainty.

Analytical methods for parameters of samples are shown in table 5-1.

Table 5-3. Potassium Ferrate Treatability Study QA objectives for Noncritical Measurements Liquid Samples

Measurement	Method	Measurement Unit	Practical Quantitation Limits	Precision (RPD)*	Accuracy (% Recovery)	Completeness (%)
<u>Radionuclides</u>						
Plutonium 239, 240	EPA-600/7-79-081*/HEA-0018-01*	pCi/L	0.01	30	80-120	90
Americium 241	EPA-600/7-79-081*/HEA-0018-01*	pCi/L	0.01	30	80-120	90
U-238	Uranium Analyzer	µg/L	0.2	30	70-130	90
<u>ICP Metals</u>						
Aluminum	6010*	0.019	mg/L	20	75-125	90
Antimony	6010*	0.024	mg/L	20	75-125	90
Arsenic	6010*	0.021	mg/L	20	75-125	90
Barium	6010*	0.002	mg/L	20	75-125	90
Beryllium	6010*	0.001	mg/L	20	75-125	90
Cadmium	6010*	0.003	mg/L	20	75-125	90
Chromium (IV)	6010*	0.002	mg/L	20	75-125	90
Copper	6010*	0.002	mg/L	20	75-125	90
Iron	6010*	0.002	mg/L	20	75-125	90
Lead	6010*	0.024	mg/L	20	75-125	90
Magnesium	6010*	0.046	mg/L	20	75-125	90
Manganese	6010*	0.001	mg/L	20	75-125	90
Mercury	6010*	0.002	mg/L	20	75-125	90
Nickel	6010*	0.009	mg/L	20	75-125	90
Selenium	6010*	0.028	mg/L	20	75-125	90
Silver	6010*	0.028	mg/L	20	75-125	90
Thallium	6010*	0.038	mg/L	20	75-125	90
Zinc	6010*	0.002	mg/L	20	75-125	90
<u>Physical Characteristics</u>						
Total Dissolved Solids	160.1*	mg/L	10	30	NA	90
Total Suspended Solids	160.2*	mg/L	5	30	NA	90
Electrical Conductivity	2510*	µmhos/cm	0.1	±6.0'	±10%'	90
Temperature	2550*	°C	0.1	±0.5'	±1'	90
pH	150.1*	pH units	0.01	±0.2'	0.04'	90

Notes:

- a RPD = Relative Percent Difference.
- b Acid Dissolution Method for Analysis of Plutonium in Soils, U.S. EPA Environmental Monitoring and Support Laboratory, Las Vegas, Nevada, 1979.
- c Maximum Sensitivity Procedures for Isolation of Plutonium and Americium in Compositated Water Samples, Rocky Flats Plant Health and Safety Laboratories, Golden, Colorado, 1990.
- d Prescribed Procedures for Measurement of Radioactivity in Drinking Water, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, EPA-600/4-80-032, 1980.
- f ICP = Inductively Coupled Plasma.
- g Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, U.S. EPA Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, U.S. Environmental Protection Agency, 1983, and subsequent EPA-600/4 Technical Additions.
- h Standard Methods for Examination of Water and Wastewater, 18th Edition, APHA, AWWA, and WEF, 1992.
- i For pH, precision is expressed in pH units as range. Accuracy is expressed in pH units as bias.
- l Precision for electrical conductivity is expressed as range. Precision for temperature is expressed as range. Accuracy for electrical conductivity is expressed as % error. Accuracy for temperature is expressed as bias.

5.12.2 PARCC Parameters

5.12.2.1 Precision

Precision is the degree of mutual agreement among individual measurements of the same property under prescribed similar conditions. Precision is evaluated by collecting and analyzing laboratory replicate samples.

For the measurements of plutonium and americium in solids and liquids, precision is determined by analysis of laboratory duplicate samples and calculating the relative percent difference (RPD). RPD is calculated using equation 5-1:

$$\% RPD = \frac{|A - B|}{(A + B)/2} \times 100 \% \quad (5-1)$$

where:

- % RPD = relative percent difference
- A = first replicate concentration
- B = second replicate concentration.

5.12.2.2 Accuracy

Accuracy is the degree of agreement between an analytical measurement and a reference accepted as true value. The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, handling, sample matrix, sample preparation, and analytical techniques. Accuracy is evaluated through the use of standard reference materials (SRMs), QC check samples, calibration standards, sampling equipment rinsate blanks, and bottle rinsate samples.

Accuracy for radionuclides in groundwater will be estimated by comparing the true to the measured analyte level from a QC check sample using equation 5-2:

$$Accuracy = \frac{MSC}{TAC} \times 100 \quad (5-2)$$

where:

MSC = measured concentration in the QC check sample.
TAC = true analyte concentration in the QC check sample

5.12.2.3 Representativeness

For this project, representativeness involves sample size, sample volume, sampling times, and sampling locations. The QA goal is to obtain a statistically adequate number of samples that represent the various process matrices at the time that the samples were collected. The volume of samples collected also depends on the analytical method chosen, allowing for QC sample analyses and reanalysis, if needed.

There will be 35 jar tests, all to be performed in duplicate. The 20 phase I jar tests will involve subjecting one wastewater to a series of coagulation-flocculation jar tests, in duplicate, and 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 Phase Two Jar Tests will be performed in duplicate using optimum treatment conditions determined by the Phase One jar tests, and will investigate parameters including 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. Confirmation jar tests will be performed in duplicate based on the optimum treatment results seen in the Phase Two Jar Tests. Comparison of contaminant removal by filtration and solids settling will also be compared for three filtered and unfiltered wastewater samples. For each of these experimental stages, duplicate samples will be taken before and after treatment.

5.12.2.4 Completeness

Completeness is a measure of the percentage of project-specified data that is valid. Valid data are obtained when: (1) samples are collected in accordance with the EMD Manual Operations Procedure, "Environmental Sample Radioactivity Content Screening," (5-21000-OPS-FO.18, Rev. 1); and (2) none of the QC criteria that affect data quality are exceeded. The project completeness value will be calculated by dividing the number of valid sample results by the total number of sample analyses completed for this treatability study as shown in equation 5-4:

$$\%C = \frac{V}{T} \times 100 \quad (5-3)$$

where:

% C = percent completeness
V = number of measurements judged valid
T = total number of measurements.

5.12.2.5 Comparability

The comparability of the data will be minimized by using standard U.S. EPA analytical methods and by reporting data in a tabular or graphical format. All methods used will be specified and any deviations from methods will be documented, and all results will be reported in standard units as shown in Table 5-1. All laboratory calibrations will be performed with standards traceable to NIST or other EPA-approved sources. Alpha Spectrometry will be used to analyze the Pu and Am content in the water after treatment. All samples will be analyzed in the same laboratory using the same analytical techniques.

5.13 Internal Quality Control Checks

An internal QC system is a set of routing internal procedures for verifying that the data output of a measurement system meets prescribed criteria for data quality. This system contains methods for measuring and defining the quality of the data output. LANL personnel performing the laboratory analyses will use the following internal analytical laboratory QC measures, where appropriate, to verify that the precision and accuracy objectives are met. The control limits for the critical parameters are listed in section 5.12. When these limits for the critical parameters are exceeded, the EG&G project and QA managers will be contacted.

Table 5-4 summarizes calibration and QC of analytical measurement equipment for specific analytical methods. QC checks consist of laboratory QC and field QC.

Table 5-4. Potassium Ferrate Treatability Study Calibration and Scheduled QC for Pu and Am

Parameter/Method	Procedure	Frequency	Acceptance Criteria	Corrective Action
Plutonium, Americium HEA-0018-01	SRM	5 % or 1 per batch, whichever is more frequent	See Table 5-3.	1) Evaluate other QC samples (blanks) in the batch, repeat analysis of sufficient sample 2) Recalibrate
	Method Blank	5 % or 1 per batch, whichever is more frequent	See Table 5-3.	1) Assess source of contamination 2) Repeat Analysis 3) Flag Data 4) Inform EG&G project and QA managers

Table 5-5. Potassium Ferrate Treatability Study Calibration and Scheduled QC for ICP Metals

Parameter/Method	Procedure	Frequency	Acceptance Criteria	Corrective Action
Uranium Laser Phosphorimetry	Initial calibration	Before analysis in triplicate.	See Table 5-3.	1) Check for system problems. 2) Repeat calibration.
	Initial verification SRM	Run at the beginning, middle, and end of daily run.	See Table 5-3.	1) Check calibration/recalibrate. 2) Repeat analysis. 3) Flag data. 4) Inform EG&G project manager.
	Initial verification blank	Run at the beginning, middle, and end of daily run.	See Table 5-3.	1) Check calibration/recalibrate. 2) Repeat analysis. 3) Flag data. 4) Inform EG&G project manager.
	SRM	5 % or one per batch, whichever is more frequent.	See Table 5-3.	1) Check for system problems. 2) Repeat calibration.
	Reagent blank	5 % or one per batch, whichever is more frequent.	See Table 5-3.	1) Assess source of contamination. 2) Repeat analysis. 3) Flag data. 4) Inform EG&G project manager.
	Matrix spike analysis	5 % or one per batch, whichever is more frequent.	See Table 5-3.	1) Check calibration/recalibrate. 2) Reanalyze to confirm problem. 3) Flag data.
	Laboratory Replicate	5 % or 1 per batch, whichever is more frequent	See Table 5-3.	1) Evaluate other QC samples in the batch, repeat analysis if sufficient sample. 2) Flag data. 3) Inform EG&G project manager.

Table 5-6. Potassium Ferrate Treatability Study Calibration and Scheduled QC for Uranium

Parameter/Method	Procedure	Frequency	Acceptance Criteria	Corrective Action
Metals - ICP SW 6010	Initial mixed standard calibration	Daily.	Measured value within $\pm 5\%$ of the expected value.	1) Check for system problems. 2) Repeat calibration.
	ICP Interface Check	Run at the beginning, middle, and end of daily run, or once every eight hours.	80 - 120 % of the true value for EPA check sample of elements.	1) Check for system problems. 2) Recalibrate.
	ICP Linear Range Check	Quarterly.	Measured value within $\pm 5\%$ of the expected value.	Tests upper limit of linear range.
	Level of Detection (LOD) Check	Quarterly.	\leq Current LOD.	Verify current LOD.
	Calibration Check Standard (Includes ICV and CCV)	Initially, then 10 %.	Measured value within $\pm 5\%$ of the expected value.	1) Check for system problems. 2) Recalibrate.
	Calibration Blank	Initially, then 10%.	≤ 10 Times IDL.	1) Assess source of contamination. 2) Repeat calibration. 3) Repeat analysis.
	QC Check Sample	5 %	See Table 5-3.	1) Evaluate other QC samples in the batch, repeat analysis if sufficient sample. 2) Recalibrate.
	Matrix Spike analysis	5 %, or minimum of one per batch.	See Table 5-3.	1) Check calibration/recalibrate. 2) Reanalyze to confirm problem. 3) Flag data.
	Matrix Spike Duplicate	5 %, or minimum of one per batch.	See Table 5-3.	1) Check method blank. 2) Flag data.

5.13.1 Laboratory QC

The QC checks to be performed in the laboratory consist of LCSs, replicate analyses, laboratory blank analyses, determining MDAs, chemical recovery criteria, aliquot sizes and other instrumentation checks.

5.13.1.1 LCSs

- LCSs shall be analyzed at a frequency of 5% per batch.
- LCSs shall be prepared and analyzed in the same manner as the samples.
- LCSs shall have the same aliquot size as the samples.
- LCSs shall have the same PRGs as the samples.
- Using the Alpha Spectrometry Overall Counting Uncertainty, the observed value of the LCSs shall be within 1σ control limits of the expected LCS value and have a relative percent error that does not exceed 50%.
- LCSs shall be counted for the same count durations as the samples.
- LCS data shall be submitted with each data package and shall include the expected values for all isotopes for which the samples are being analyzed.
- An LCS with a deionized water matrix may be used as an LCS for samples with matrices other than that of water.

5.13.1.2 Replicate Analyses

- Replicate analyses shall be analyzed at a frequency of 10% or one per batch.
- Replicate samples shall be prepared and analyzed in the same manner as the samples.
- Replicate samples shall have the same aliquot size as the samples.
- Replicate samples shall have the same PRGs as the samples.
- Replicate analyses data shall be submitted with each data package.
- The replicate analyses shall be within the 3σ range of the weighted average and its associated standard error. "Hot" particles may be present in soils, sediments, and total waters and this will be taken into consideration when evaluating duplicates.

5.13.1.3 Laboratory Blank Analyses

- Laboratory blanks shall be analyzed at a frequency of 5% or one per batch.
- Laboratory blanks shall be prepared and analyzed in the same manner as the samples.
- Laboratory blanks shall have the same aliquot size as the samples.
- Laboratory blanks shall be counted for the same count duration as the samples.
- Deionized water may be used as a laboratory blank for the samples.

5.13.1.4 Determining MDAs

- Count durations for samples, replicates, blanks, and backgrounds shall be optimized so that the MDAs achieve the PRGs. Interfaces, contaminants, and other matrix problems may cause the sample MDAs to exceed the desired MDAs; however, the laboratory shall demonstrate that the MA could not be met due to the matrix and not because of inadequate count time, laboratory problems, or other limitations. Reanalysis due to matrix problems will be treated as an additional sample analysis. In all cases, MDAs which fail to achieve the required PRG shall be fully explained in the case narratives.
- The MDAs shall be reported on sample calculations sheet. The last background taken (1 month old or less) shall be used for calculations.
- The laboratories shall compile quarterly a history of RFP laboratory blanks used to perform the sample analyses. The analytical results shall be submitted on a quarterly basis.
- The MDA shall be calculated as shown in equation 5-5:

$$MDA \text{ (pCi/Aliquot in appropriate units)} = \frac{4.65 S_B + \frac{2.71}{TEY}}{a * \text{Aliquot}} \quad (5-5)$$

where:

S_B	=	Standard deviation of the population of quarterly RFP blank values (DPM)
T	=	Sample count duration in minutes
E	=	Detector efficiency
Aliquot	=	Aliquot in appropriate units
Y	=	Chemical recovery for the sample
a	=	2.22 conversion for Dams to pico Curies.

5.13.1.5 Chemical Recovery Criteria

- Chemical recovery for Pu and Am analyses shall be >20% but <105%. Chemical recoveries outside these limits require the affected samples to be reanalyzed.
- Chemical recovery shall be calculated based on the latest instrument efficiency value.
- Counts obtained for the tracer peak, Dams of tracer used, and aliquot of tracer used shall appear in the raw data.

5.13.1.6 Aliquot Sizes

- The aliquot size shall be optimized to achieve the PRGs. If the PRGs are not achieved and the aliquot sizes are less than 1.0 Liter for Am and Pu, then the problem shall be addressed in the Case Narrative.

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

Manual: RFP/ERM-94-00010
Document: Revision 0
Page: 0 of 24
Issue Date: July 18, 1994

APPENDIX C

"Control of Scientific Notebook Systems"

ROCKY FLATS PLANT

2-G06-ER-ADM-05.10

REVISION 0

CONTROL OF SCIENTIFIC NOTEBOOK SYSTEMS

APPROVED BY: S.G. Stiger / S.G. Stiger / 5-19-94
 Associate General Manager, Print Name Date
 EG&G Environmental Restoration Management

APPROVED BY: K. Bentzen / K. Bentzen / 6/18/94
 Quality Assurance Program Manager, Print Name Date
 EG&G Environmental Restoration Management

CONCURRENCE BY: NOT REQUIRED / /
 Assistant Manager, Print Name Date
 Environmental Restoration Division
 DOE Rocky Flats Field Office

Environmental Protection Agency Approval Required: Yes NoResponsible Organization: Environmental Restoration Management Effective Date: 7/15/94

CONCURRENCE BY THE FOLLOWING DISCIPLINES WILL BE DOCUMENTED IN THE PROCEDURE HISTORY FILE:

ERM Remediation Project Management
 ERM Environmental Engineering and Technology
 ERM Environmental Operations Management
 ERM Environmental Quality and Document Systems
 ERM Solar Pond Project
 ERM Sample Management
 ERM Program Integration and Reporting
 ERM Geosciences
 Standards, Audits, and Assurance

USE CATEGORY 4

ORC review not required

Periodic review frequency: 1 year from effective date

LIST OF EFFECTIVE PAGES

<u>Pages</u>	<u>Effective Date</u>	<u>Change Number</u>
1-24	<u>7 / 15</u> /94	

TOTAL NUMBER OF PAGES: 24

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1. PURPOSE

This procedure defines the requirements for identification, review, approval, modification, and documentation of the Scientific Notebook System (SNS) in experimental and research work. The SNS provides for the development of a Scientific Notebook Plan and the use of a Scientific Notebook to record methods and data in support of Environmental Restoration Management (ERM) activities in lieu of procedures.

2. SCOPE

This procedure applies to ERM quality-affecting experimental or research activities such as those requiring professional judgement, trial-and-error methods, or developing methodology. This procedure does not apply to activities that can be conducted effectively through utilization of procedures or instructions. This procedure does not apply to the field logbooks or notebooks used throughout the program but only to those Scientific Notebooks that use the controls of this SNS in lieu of other procedures and that are generated in accordance with this procedure. Subcontractors with approved Quality Assurance (QA) programs may operate to their own requirements rather than to this procedure.

This process may only be implemented under an existing ERM work plan (2-E20-ER-ADM-05.09, Work Plan Development to be issued) and the project-specific health and safety plan. All activities fall within the scope of the project-specific health and safety plan. Modifications to or deviations from the health and safety plan cannot be made under this procedure.

This procedure addresses the following topics:

- Selection of procedure approach
- Scientific Notebook Plan
- Scientific Notebook preparation
- Scientific Notebook review
- Conversion from the SNS
- Technical data record protection

3. DEFINITIONS

Experiments. Operations carried out under controlled conditions to establish characteristics or values not previously known.

Hold Point. A point in the procedure requiring independent verification (normally by quality control) before proceeding to the next step. This independent verification is normally documented on the applicable data sheet or notebook.

Quality Assurance Program Manager (QAPM). The manager designated by the Associate General Manager (AGM) for ERM who is responsible for the implementation of the ERM QA program.

Research. A systematic inquiry or extensive investigation into a subject area in order to discover, revise, or prove theories, knowledge, etc. Research often requires the development of new methodologies.

Scientific Notebook. A QA record maintained by an investigator and used to record the details of events, activities, and pertinent assessments made of an investigation in accordance with this procedure. The system may include computer-based files and bound records.

Scientific Notebook Plan. A controlled document that describes the experimental or research approach and requirements that are applicable to projects.

Scientific Notebook System (SNS). The flexible documentation of technical activities used in lieu of a technical procedure or instruction. The SNS is used to provide a record of the methodologies and results of scientific investigations and experiments when work involves professional judgement, trial-and-error methods, or emerging technologies developed as an investigative activity progresses.

Work Plan. A document that describes the technical nature of the work to be accomplished and that incorporates the appropriate QA requirements and methods.

4. RESPONSIBILITIES

4.1 ERM Document Control

Ensures that control numbers and an inventory of controlled documents are maintained.

Maintains control of the Scientific Notebook Plan.

4.2 Principal Investigator (PI) or Designee

Identifies the need for using the SNS, including the type of notebook.

Prepares the appropriate Scientific Notebook Plan and Scientific Notebook in accordance with this procedure.

Determines and documents the need for a revision or modification of the Scientific Notebook Plan.

Coordinates the review and approval process.

4.3 Project Manager (PM)

Concurs with the use of the SNS and signs the Scientific Notebook Plan.

Assigns the technical reviewer for the Scientific Notebook Plan and the notebook when the investigation is completed.

Resolves conflicts between the reviewer(s) and the PI.

Selects the PI for an activity, in conjunction with the Responsible Manager, based on the training and qualification requirements.

Ensures that all personnel working under the SNS are trained in the applicable requirements of this procedure and any procedures or instructions associated with the implementation of this activity.

Ensures that all personnel have read the applicable Scientific Notebook Plan.

4.4 **QAPM**

Reviews and approves the use of the SNS and the Scientific Notebook Plan.

4.5 **Technical Reviewer**

Conducts and documents a peer review of the Scientific Notebook Plan and the contents of the Scientific Notebook.

4.6 **Responsible Manager**

Provides management support to the PM in the implementation of this procedure, including:

- Preparation of documentation.
- Conflict resolution.
- Training and qualification of personnel.
- Other support, as necessary.

4.7 **Environmental Operations Management (EOM)**

Reviews the Scientific Notebook Plan.

5. INSTRUCTIONS

5.1 Selection of Procedure Approach

NOTE *Three systems may be used for the quality assurance documentation and control of scientific work implemented as specified in the applicable ERM work plan:*

- *The procedure as described in 2-E95-ER-ADM-05.01, Procedure Development*
- *The instructions as described in 2-G07-ER-ADM-05.11, Preparation of Instructions*
- *The SNS*

This procedure addresses the SNS system. Even when implementing the SNS system, existing or new procedures or instructions are used to the extent practicable to implement the activities.

PM and Responsible Manager

- [1] Select a PI for the activity based on the qualification requirements.

Qualification requirements include:

- A college degree (BS, MS, or PhD) and at least 1 yr of field experience relating to the area of scientific investigation being addressed by the SNS.
- Training in the implementation of this procedure before initiating the SNS process.

PI

- [2] Evaluate the activity before beginning technical work on quality-related activities to determine which type of documentation and control system will be used for the technical work.

The evaluation is based on the work plan and/or other available information.

5.1 Selection of Procedure Approach (continued)

PI (continued)

- [3] Identify the decision to use the SNS process in the work plan or in a modification of the work plan.

Such a modification requires a review by the applicable regulatory oversight agencies (U.S. Department of Energy [DOE], U.S. Environmental Protection Agency [EPA], or the Colorado Department of Health [CDH]) in accordance with 2-E04-ER-ADM-05.07, Preparation of Document Modification Requests or 2-E20-ER-ADM-05.09, Work Plan Development.

5.2 Scientific Notebook Plan

PI

- [1] Prepare a Scientific Notebook Plan.

An example is provided in Appendix 1, ERM Scientific Notebook Plan. As appropriate, the topics listed below will be addressed to justify the use of the SNS process and to document the necessary planning for implementation. The topics will be addressed by reference to existing documents. The detail to which topics are addressed is limited to the information existing during the planning process, as follows:

- Title of the experiment or research
- Description of the experiment's purpose and objectives (Section 1, Appendix 1)
- Description of the proposed approach or methods and required prerequisites to the activity (Section 2, Appendix 1) (The description may include references to the appropriate work plan and other implementing documents and may identify exceptions taken to existing control system such as those for sample control.)
- The analytical models which are currently identified for use in this investigation (Section 2, Appendix 1) (2-G03-ER-ADM-03.01, Verification and Control of Calculations and Technical Reports.)
- Applicable hold points, if any (Section 2, Appendix 1)
- Ongoing table of contents of the SNS, such as which portions of the SNS are computerized and/or digital file directories/subdirectories in 3-ring binders. (Section 2, Appendix 1)
- Name(s) of qualified individual(s) performing the work activity (Section 3, Appendix 1)
- Special personnel qualifications or training requirements (Section 3, Appendix 1)

5.2 Scientific Notebook Plan (continued)

PI (continued)

- Equipment and materials to be employed during the experiment or research, including any necessary fabrication of experimental equipment and any other needed materials (Section 4, Appendix 1)
- Calibration requirements (Section 4, Appendix 1)
- Potential sources of uncertainty and error in data or measurements (Section 5, Appendix 1)
- Historical data that are suspect or whose quality is beyond the control of the PI (Section 6, Appendix 1)
- The data reduction and qualification procedures to be used based on available data (2-G03-ER-ADM-03.01), (Section 6, Appendix 1)
- Required levels of precision and accuracy in data and measurements (Section 6, Appendix 1)
- Documentation of suitable and controlled environmental conditions (Section 7, Appendix 1)
- Dated signature of the preparer of the plan

QAPM, EOM, and Technical Reviewer

- [2] Review and approve the Scientific Notebook Plan, in accordance with 2-E02-ER-ADM-05.05, Document Review.

The reviewers address the applicability of the SNS and the adequacy of the Scientific Notebook Plan.

PM

- [3] Resolve conflicts between the reviewer(s) and the PI.

In some cases the PI and the PM may be the same individual. When this occurs, the Responsible Manager will resolve conflicts between the reviewer(s) and the PI. The Responsible Manager's concurrence is required to use the SNS.

ERM Document Control

- [4] Issue the approved Scientific Notebook Plan as a controlled document in accordance with 2-G01-ER-ADM-06.01 to the user, the QAPM, and the PI and/or the PM before commencing technical work.

5.2 Scientific Notebook Plan (continued)

PM

- [5] Ensure that all personnel are trained in the use of this procedure and the applicable Scientific Notebook Plan.

PI

- [6] Place a controlled copy of the approved Scientific Notebook Plan and the Scientific Notebook in the work area or in another accessible location.
- [7] Implement the task as described in the Scientific Notebook Plan and document the tasks in the Scientific Notebook.
- [8] Reference in the Scientific Notebook any applicable documents supplementing the activity.
- [9] Document modifications to the process described in the Scientific Notebook Plan while the investigation is in progress.
- [A] Record the full details of the modification in the Scientific Notebook, including justification for this change.
- [B] **IF** the in-process modification is **NOT** within the scope of any applicable work plan which establishes the applicable requirements, **THEN** revise the work plan in accordance with 2-E04-ER-ADM-05.07 before implementing the change.

5.3 Maintenance of Scientific Notebooks

PI

- [1] Ensure that computer-based portions of the Scientific Notebook have an access control system accessible only to trained and authorized personnel.
- [2] Provide the following information to all activity personnel:
- Location and, if applicable, access procedures for the Scientific Notebook
 - Location of the Scientific Notebook Plan and any supplemental documents
- [3] Number pages of bound portions of the Scientific Notebook consecutively up to the last page used.

5.3 Maintenance of Scientific Notebooks (continued)

PI(continued)

- [4] Ensure that the control number (Section 6, Step [2]) and the title are displayed on the first page of each volume of the Scientific Notebook or within each individual file for computerized data as the header or footer information.
- [5] **IF** more than one volume is required,
THEN obtain the additional control number from the ERM Document Control Center (DCC).

DCC

- [6] **WHEN** the PI indicates that more than one volume is required for a Scientific Notebook,
THEN assign each volume the original control number followed by -V and the volume number.

PI

- [7] Reference the new volume in the last entry of the old volume, and the old volume in the first entry on the new volume.
- [8] Retain all volumes as a single document until they are returned to the ERM DCC.
- [9] Record the following information in the Scientific Notebook, as appropriate (reference existing documents to provide this information where feasible):
 - Date and signature of the individual making the entry
 - Detailed, step-by-step description of the experiment or research being performed followed by either a reference to an implementing procedure or instruction or by an actual entry into the notebook
 - The basis for ensuring that prerequisites have been met
 - Conditions which may adversely affect the results of the experiment or research investigation
 - Identification of the samples collected or used
 - Identification of the additional quality-affecting equipment and materials, that are not included as part of the initial entries
 - Computer software used
 - Interim conclusions

5.3 Maintenance of Scientific Notebooks (continued)

PI (continued)

- Documentation of the disposition of facilities and equipment after completion of the activity/project, particularly any contaminated equipment, facilities, or wastes
- A reference in the physical notebook of computer-based entries
- Unique identification for unbound documentation

[10] Document activities in sufficient detail to allow another qualified researcher to:

- Retrace the investigation
- Confirm the results
- Repeat the experiment and achieve the same results without recourse to the PI

[11] Make any changes to entries in the notebook in accordance with 2-G18-ER-ADM-17.01, Quality Assurance Records Management.

[12] Make ongoing entries continuous on the page with no open spaces left for subsequent entries.

Tables or similar formats used to record ongoing data are exempted from the requirement for continuous entries in Step 5.3[12].

[13] Draw lines or use a similar method to fill any blank sections in the continuous entries caused by tables or other entries in similar format, including table entries once the table is completed.

NOTE *Open space in the text could allow undetected alteration of this legal record. Steps 8 and 9 do not apply to computer-based Scientific Notebooks.*

[14] Record all entries in the Scientific Notebook (not computer based) in permanent black ink.

Permanent colored ink pens may be used for drawing schematic diagrams.

5.3 Maintenance of Scientific Notebooks (continued)

PI (continued)

[15] WHEN the work described in the Scientific Notebook Plan has been completed, THEN close out the notebook by adding a brief summary of the work, or a statement that this concludes the Scientific Notebook, including:

- The name of the designated technical reviewer (Section 5.4).
- The date and signature of the PI.
- Technical review as described in Section 5.4.

[16] Print the contents of computer-based Scientific Notebooks upon completion of the task for use in the review process.

[17] Sign and date all the components of the Scientific Notebook before it is distributed for peer review.

5.4 Scientific Notebook Review

NOTE *The reviews specified below are those specifically related to Scientific Notebooks and do not replace any other reviews required under other Rocky Flats Plant (RFP) procedures or policies e.g., classification and patent office.*

Technical Reviewer

[1] Review the completed Scientific Notebook for technical adequacy.

NOTE *Reviewers will not write in the Scientific Notebook except to:*

- *Indicate that the reviewer has reviewed the documents.*
- *Concur that the Scientific Notebook is consistent with the requirements established in this procedure and is technically correct.*
- *Document concerns (via signatures and dates).*

[2] Determine if the notebook adequately documents the investigations as required by this procedure and as specified in the Scientific Notebook Plan.

[3] Verify that the contents of Section 5.3 have been appropriately addressed.

PI and Technical Reviewer

[4] Discuss the comments and establish a consensus markup of the notebook.

5.4 Scientific Notebook Review (continued)

PI

- [5] Document markups in the notebook with an annotation indicating the source and the basis of the change.
- [6] Ensure that any corrections made to the Scientific Notebook with concurrence by the reviewer are completed in a manner consistent with 2-G18-ER-ADM-17.01.

Technical Reviewer

- [7] **IF** the reviewer and the PI do **NOT** agree on the resolution,
THEN document the point of disagreement and sign and date the entry.

PM or Responsible Manager

- [A] Determine resolution of the discrepancies.
- [B] Sign and date the entries.
- [8] Arrange a QA review and approval of the SNS with the QAPM.

QAPM

- [9] Review and approve the SNS.

PI

- [10] Submit the reviewed and completed Scientific Notebook to ERM DCC in accordance with 2-G18-ER-ADM-17.01.

ERM Document Control

- [11] Document closure of the controlled SNS as a field document.
- [12] Submit the document to the ERM Central Records Center (CRC) in accordance with 2-G01-ER-ADM-6.01.

5.5 Conversion from the SNS (as necessary)

The SNS may be used throughout the activity. However, if the activity or an individual process within the activity has reached a mature stage, i.e., the methods will be adopted for routine use, this system will be converted to an instruction or procedure.

PI

- [1] Determine the stage at which the SNS can be converted to a technical procedure or instruction.
- [2] **IF** the activity or a significant associated process can be established as a routine, activity or process,
THEN request that the Responsible Manager generate an instruction or procedure for the activity.

Responsible Manager

- [3] Prepare the procedure or instruction in accordance with 2-E95-ER-ADM-05.01 or 2-G07-ER-ADM-05.11.
- [4] Arrange for the review and approval of the procedure or instruction in accordance with 2-E02-ER-ADM-05.05.
- [5] Reference the superseded Scientific Notebook in the new procedure or instruction.
- [6] Reference the new procedure or instruction as the final entry of the Scientific Notebook.

5.6 Technical Data Record Protection

ERM DCC

- [1] Maintain the Scientific Notebook(s) in bound hardcopies.
- [2] Maintain the Scientific Notebook Plan as a controlled document.
- [3] Ensure that the Scientific Notebook Plan and the Scientific Notebook are identified with unique numbers issued by DCC.

5.6 Technical Data Record Protection (continued)

ERM DCC (continued)

A specific unique number may be requested by the Project Manager; otherwise, these numbers will be in the form of:

- ERM-SNBP-YY-### for the plan and ERM-SNB-YY-### for the notebook, where YY is the year of issuance and ### is a unique number for the plan/notebook set.
- The existing Rocky Flats Plant data book system number may also be used to establish the control number of the notebook.

PI

- [4] Make a copy (electronic backup for computer-based SN) of the Scientific Notebook entries quarterly following the first entry or more frequently when required by the Scientific Notebook Plan.

Closed notebooks do not need to be recopied, as discussed in Step 5.6[4].

- [5] Ensure that the copies are stored in a physically separate location from the ERM CRC in accordance with 2-G18-ER-ADM-17.01.

6. **RECORDS**

Management of all records is consistent with 1-77000-RM-001, Records Management Guidance for Records Sources.

The Scientific Notebook Plan, the Scientific Notebooks, and any related document modifications to the SNS generated as a result of this procedure are considered quality records. These records are managed in accordance with 2-G18-ER-ADM-17.01.

When the activity being addressed by the Scientific Notebook is an IAG activity, then the corresponding Scientific Notebook records are part of the Administrative Record

In addition to 2-G18-ER-ADM-17.01, administrative records are managed in accordance with 3-21000-ADM-17.02, Administrative Records Screening and Processing.

6.0 RECORDS (continued)

PI

- [1] Ensure that the following quality-related records are transmitted to the ERM CRC in accordance with 2-G18-ER-ADM-17.01:
 - Scientific Notebook Plan
 - Scientific Notebook and revisions
 - Documented modifications to the SNS

- [2] IF the activity being addressed by the Scientific Notebook is an IAG activity, THEN ensure that the associated records listed below are managed in accordance with 3-21000-ADM-17.02, AND transmitted to the ERM CRC in accordance with 2-G18-ER-ADM-17.01:
 - Scientific Notebook Plan
 - Scientific Notebook and revisions
 - Documented modifications to the SNS

7. REFERENCES

2-G03-ER-ADM-03.01, Verification and Control of Calculations and Technical Reports
(Until issued, use 3-21000-ADM-03.01.)

2-E95-ER-ADM-05.01, Procedure Development

2-E02-ER-ADM-05.05, Document Review

2-E04-ER-ADM-05.07, Preparation of Document Modification Requests

2-E20-ER-ADM-05.09, Work Plan Development (Until issued, use 3-21000-ADM-05.09.)

2-G07-ER-ADM-05.11, Preparation of Instructions (Until issued, use 3-21000-ADM-05.11.)

2-G01-ER-ADM-06.01, Document Control (Until issued, use 3-21000-ADM-06.01.)

2-G18-ER-ADM-17.01, Quality Assurance Records Management (Until issued, use 3-21000-ADM-17.01.)

3-21000-ADM-17.02, Administrative Records Screening and Processing

Title: _____

1. Description:

- Notebook Plan Title _____

- Governing Work Plan No. _____
- Governing Work Plan Title _____

- Scientific Notebook Plan purpose and objective (Provide sufficient detail to permit reviewers and others to understand what the work is to accomplish.)

