

INFORMATION
ONLY

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**OU-1 HEALTH AND SAFETY PLAN
HOT SPOT REMOVAL**

REVISION 0

ROCKY FLATS PLANT

(OPERABLE UNIT NO. 1)

U.S. DEPARTMENT OF ENERGY

**ROCKY FLATS PLANT
GOLDEN COLORADO**

JUNE, 1994

ADMINISTRATIVE

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EG&G ROCKY FLATS
Health and Safety Plan for Operable Unit No. 1
Hot Spot Removal

Manual No.: RFP/ERM-94-00028
Revision: 0
Page: ii of xiv
Organization: Environmental Science & Engineering

**DEPARTMENTAL REVIEW AND APPROVAL OF THE OPERABLE UNIT NO. 1
HOT SPOT REMOVAL PROJECT HEALTH AND SAFETY PLAN:**

The following signature documents that this Department of EG&G Rocky Flats, Inc. has reviewed the Project Health and Safety Plan (HASP) and agrees that applicable federal, state, and local regulations and RFP policies and practices, as implemented by the signing Department, have been incorporated.

APPROVED BY:

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6/7/94
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EG&G ROCKY FLATS
Health and Safety Plan for Operable Unit No. 1
Hot Spot Removal

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**FINAL REVIEW AND APPROVAL OF THE PROJECT HEALTH AND SAFETY
PLAN:**

The Project Health and Safety Plan (HASP) has been written for the use of personnel associated with the environmental restoration site/task project. All personnel will comply with all aspects of this plan as it relates to health, safety, and emergency response.

APPROVED BY:


EG&G Project Manager

06-09-94
Date


Health and Safety Liaison Officer

6/3/94
Date


Environmental Restoration Health and Safety Officer

6/9/94
Date

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LIST OF ACRONYMS

AAC	-	Actual Area of Concern
ACGIH	-	American Conference of Governmental Industrial Hygienists
Am	-	Americium
cm ²	-	Square Centimeters
CFR	-	Code of Federal Regulation
COC	-	Contaminant of Concern
COOP	-	Conduct of Operations
CRT	-	Contractor Technical Representative
CRZ	-	Contamination Reduction Zone
DAC	-	Derived Air Concentration
dB	-	Decibels
dBA	-	Decibels, A-Scale
dpm	-	Disintegrations per Minute
DOE	-	Department of Energy
EG&G	-	EG&G Rocky Flats, Inc.
EM	-	Environmental Management
EMD	-	Environmental Management Division
EMRE	-	Environmental Management Radiological Engineer
EMRG	-	Environmental Management Radiological Guidelines
EOC	-	Emergency Operations Center
EOM	-	Environmental Operations Management

EPA	-	Environmental Protection Agency
EPM	-	Environmental Protection Management
ER	-	Environmental Restoration
ERHSPP	-	Environmental Restoration Health and Safety Program Plan
ERM	-	Environmental Restoration Management
ERHSO	-	Environmental Restoration Health and Safety Officer
EZ	-	Exclusion Zone
F	-	Fahrenheit
FP	-	Fire Protection
FO	-	Field Operations
H&S	-	Health and Safety
H&SAM	-	Health and Safety Area Management
HASP	-	Health and Safety Plan
HAZMAT	-	Hazardous Materials Team
HEPA	-	High Efficiency Particulate Airfilter
HSC	-	Health and Safety Coordinator
HSLO	-	Health and Safety Liaison Officer
HSO	-	Health and Safety Officer
HSP	-	Health and Safety Practice
HSS	-	Health and Safety Specialist
HSST	-	Health and Safety Specialist in Training
HWA	-	Hazardous Waste Area
HWRM	-	Hazardous Waste Requirements Manual

IC	-	Incident Commander
IDLH	-	Immediately Dangerous to Life and Health
IH	-	Industrial Hygiene
IH&S	-	Industrial Hygiene and Safety
IHSS	-	Individual Hazardous Substance Site
JSA	-	Job Safety Analysis
LEL	-	Lower Explosive Limit
LFL	-	Lower Explosive Limit
LS/DW	-	Life Safety/Disaster Warning
mrem/h	-	Millirems per Hour
MOU	-	Memorandum of Understanding
MSDS	-	Material Safety Data Sheet
NIOSH	-	National Institute for Occupational Safety and Health
OH	-	Occupational Health
ONC	-	Occurrence Notification Center
OS	-	Occupational Safety
OSA	-	Operational Safety Analysis
OSHA	-	Occupational Safety and Health Administration
OU	-	Operable Unit
pCi/g	-	Pico-Curies per Gram
PAC	-	Potential Area of Concern
PEL	-	Permissible Exposure Limit
PPE	-	Personal Protective Equipment

Pu	-	Plutonium
RCA	-	Radiologically Controlled Area
RCRA	-	Resource Conservation and Recovery Act
RCT	-	Radiological Control Technician
RE	-	Radiological Engineering
REL	-	Recommended Exposure Limit
RFP	-	Rocky Flats Plant
RO	-	Radiological Operations
ROI	-	Radiological Operating Instruction
RWP	-	Radiological Work Permit
SHSC	-	Site Health and Safety Coordinator
SOP	-	Safe Operating Practice
SOP	-	Standard Operating Procedure
SSO	-	Site Safety Officer
SZ	-	Support Zone
TLV	-	Threshold Limit Value
TUM	-	Training Users Manual
U	-	Uranium
VOC	-	Volatile Organic Compound
WEMS	-	Waste Environmental Management System
WO	-	Waste Operations Procedure
WRM	-	Waste Requirements Manual
WRPM	-	Waste Requirements Procedure Manual

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WSRIC - Waste Stream Residue Identification and Characterization

1.0 GENERAL INFORMATION

1.1 Scope and Applicability of the Site Health and Safety Plan (HASP)

The Occupational Safety and Health Administration (OSHA) specifies in the Hazardous Waste Operations and Emergency Response regulation (29 Code of Federal Regulations [CFR] 1910.120) that any hazardous waste investigation and remediation activities must maintain a site-specific health and safety plan. This site-specific (or project-specific) health and safety plan (HASP) is designed to meet these OSHA requirements. Rocky Flats Plant (RFP) Guidelines for compliance with 29 CFR 1910.120, under non-emergency response conditions, are described in RFP Health and Safety Practices Manual (HSP) 21.03, Hazardous Waste Operations. This HASP may be used in conjunction with the Environmental Restoration Health and Safety Program Plan (ERHSPP). The ERHSPP is in compliance with the Interagency Agreement, Attachment 2, III, Health and Safety Plan.

The scope of this project is to remove radioactively contaminated soil from OU 1. There are five hot spots in IHSS 119.1, one contaminated with Pu (SS100493) and four contaminated with U (881-16/17, 881-18/19, SS100193 and SS100293) (see Appendix E). There is also one hot spot in IHSS 119.2 contaminated with Pu (SS100393). This project is to excavate these spots, by hand if possible, or backhoe if necessary, and drum the soil for disposal. The depth of the excavation is unknown at this time because the excavation will continue until the radiation levels approach background. Table 1-1 identifies the areas addressed by this plan.

TABLE 1-1

OU OR BUILDING	IHSS/PAC/AAC	IHSS/PAC/AAC Name
OU - 1	119.1	Multiple Solvent Spills/ West Scrap Metal Storage Area
OU - 1	119.2	Multiple Solvent Spills/ East Scrap Metal Storage Area

PAC = potential area of concern
AAC = actual area of concern

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1.2 Companion Documents

The documents listed in Table 1-2 must be available for use with this HASP. Documents must be sufficiently available such that document requirements may be complied with consistently.

**Table 1-2
 APPLICABLE DOCUMENTS**

Document (check all that apply)	Location
<input checked="" type="checkbox"/> Health and Safety Practices Manual Volumes 1 & 2	EOM Trailer
<input checked="" type="checkbox"/> Hazardous Waste Requirements Manual (HWRM)	EOM Trailer
<input type="checkbox"/> Training Users Manual (TUM) Applicable Sections:	
<input checked="" type="checkbox"/> EMD Operating Procedures, Vol. 1,	EOM Trailer
<input type="checkbox"/> WSRIC	
<input type="checkbox"/> WEMS	
<input type="checkbox"/> OSA:	
<input type="checkbox"/> SOP:	
<input type="checkbox"/> Work plan	
<input checked="" type="checkbox"/> Environmental Management Radiological Guidelines Manual (EMRG)	EOM Trailer
<input type="checkbox"/> EMD Operating Procedures, Vol. II: Groundwater	
<input type="checkbox"/> EMD Operating Procedures, Vol. III: Geotechnical	
<input type="checkbox"/> EMD Operating Procedures, Vol. IV: Surface Water	
<input type="checkbox"/> EMD Operating Procedures, Vol. V: Ecology	
<input type="checkbox"/> SOP:	
<input type="checkbox"/> JSA:	
<input checked="" type="checkbox"/> Other: Lab Procedure L-3306, L-6245	EOM Trailer
<input checked="" type="checkbox"/> Other: On-Site Transportation Manual	EOM Trailer

- JSA = Job Safety Analysis
- OSA = Operational Safety Analysis
- SOP = Safe Operating Practice
- WEMS = Waste Environmental Management System (for the Waste Isolation Pilot Plant waste acceptance criteria)
- WSRIC = Waste Stream Residue Identification and Characterization

1.3 Visitors

All visitors to the contamination reduction zone and exclusion zone at this location will be required to read and verify compliance with the provisions of this HASP. In addition, visitors will be expected to comply with relevant OSHA requirements such as medical monitoring, training, and respiratory protection as applicable. Appendix A contains a visitor log.

In the event that a visitor does not adhere to the provisions of the HASP, she/he will be requested to leave the work area. All nonconformance incidents will be recorded in the site log.

1.3.1 Minimum Entry Requirements for Visitors

Table 1-3 identifies minimum entry requirements for exclusion zones or support zones for IHSSs, PACs, and AACs addressed in this plan. Minimum entry requirements include training, PPE, and medical surveillance.

TABLE 1-3
Minimum Entry Requirements for Visitors

EZ	SZ	Location	Minimum entry requirements for Visitors (No hands on work)
X		IHSSs 119.1 and 119.2	Comply with the provision of this HASP.

EZ = Exclusion Zone as described in Section 6.0

SZ = Support Zone as described in Section 6.0

1.4 Unit Descriptions

Table 1-4 provides a description of IHSSs, PACs, and AACs as identified in Section 1.1 above.

TABLE 1-4
RCRA Unit Descriptions

IHSS/PAC/AAC	Description:
119.1 and 119.2	This area is one of two sites used for scrap metal storage in the southeast portion of the 400 acre manufacturing area. PAC 900-119.1 was the western one located on a flat area just north of Southeast Perimeter Road. Pieces of scrap metal which came from various buildings on plantsite may have had residual oils and/or hydraulic coolants on them which could have dripped off into the soil.

Portions of OU-1, including IHSSs 119.1 and 119.2, have historically been used for disposal or storage of wastes. Between 1967 and 1972, two areas east of Building 881 and along the southern perimeter road were used for scrap metal and drum storage. These areas have since been designated as IHSSs 119.1 and 119.2. The drums stored at IHSSs 119.1 and 119.2 contained unknown quantities and types of solvents and wastes including scrap metal. The scrap metal may have been coated with residual oils and/or hydraulic coolants. Aerial photographs from 1969 to 1970 show material stored in piles and rows.

1.5 Identification of Health and Safety Responsibilities

Project management is responsible for the health and safety of personnel throughout an environmental investigation or restoration project site. Personnel health and safety is primarily a line management function. Each line manager is accountable to upper management for carrying out assigned work in a safe manner, protecting personnel from potential risks, and providing personnel with a healthy and safe environment as proscribed by this HASP.

The ERHSPP delineates roles and responsibilities for personnel on ERM sites. Appendix B shows lines of responsibility for each area. If line management found an imminent danger hazard and required that operations be stopped, then operations shall not resume until the same level of line management approves resumption.

Specific responsibilities for each of the operations and support organizations are described in HSP 21.03, pp. 13-25. Specific responsibilities for the Environmental Restoration Management (ERM) Health & Safety Officer (HSO), EM Radiological Engineer (EMRE), EM Project Manager, subcontractor Project Manager, subcontractor Site Safety Officer (SSO), subcontractor Health and Safety Specialist (HSS), and subcontractor Health and Safety Specialist In Training (HSST) are further described in the EMRG, guideline number one. Specific Health and Safety responsibilities for project personnel include the following:

EG&G Contract Technical Representative (CTR)

Responsibilities:

- Responsibilities of the CTR are defined by Procurement policy and contractual agreements with the subcontractor.

Authorities:

- Oversee all aspects in the completion and compliance of the subcontract. Inclusive are the authorities to rectify concerns related to compliance and procurement issues.

EG&G and Subcontractor Project Managers and Site Supervisors

Responsibilities:

- Ensure that the project is performed in a manner consistent with the health and safety program.
- Provide the SSO with the project information needed to develop health and safety plans.
- Ensure that the project health and safety plans are prepared/approved and properly implemented in a timely manner.
- Ensure that adequate funds are allocated to fully implement project health and safety plans.
- Ensure compliance with health and safety plans of subcontractor personnel.
- Coordinate with the SSO on health and safety matters.
- Inform subcontractors of EG&G H&S requirements.

Authorities:

- Assign an approved SSO to project and, if necessary, assign a suitably qualified replacement.
- Temporarily suspend field activities, if health and safety of personnel are endangered, pending an evaluation and approval for resumption of work by the SSO.
- Temporarily suspend an individual from field activities for infractions of the health and safety plan, pending an evaluation and approval for resumption of work by the SSO.

Subcontractor Site Safety Officer (SSO) (or EG&G Site Supervisor, where no subcontractor or SSO exists). The SSO will be appointed by the Project Manager with the approval of the ERHSO.

Responsibilities:

- Implement the applicable HASP and verify compliance with all applicable health and safety requirements.
- Ensure that updated copies of the Health and Safety Plan (HASP), EMRGs, and all documents referenced by the HASP and EMRG are available to subcontractor employees.
- Supervise HSSs in the performance of their responsibilities.

- Ensure HSSs and subcontractor employees are advised of the radiological hazards, both expected and suspected, by posting and controlling radiological areas according to EMRG instructions.
 - Ensure that HSP 18.19, "Criteria and Actions for Potential Intakes", is adhered to for the duration of the project.
 - Be first aid/CPR trained.
 - Evaluate results of monitoring/sampling and recommend modification of HASP as necessary.
 - Verify that performance testing of EG&G and subcontractor-owned instruments has been conducted in accordance with the manufacturer's recommendations. The SSO will also ensure that the test results are recorded daily in a calibration log specific to each instrument.
 - Review and approve completed survey reports/forms. If an unsatisfactory report/form is received, it will be returned to the appropriate individual(s) for correction. When conducting this review, the SSO will ensure that:
 - (1) the correct report/form is complete;
 - (2) the entries are reasonable; and
 - (3) the required signatures are affixed to the report.
 - Forward approved survey reports/forms to the EMRE and maintain a file of all completed Radiological Survey Forms. This file will be organized by survey areas, with an index placed in the front of the file.
 - Immediately contact the EMRE by phone when survey results indicate radiation levels exceeding 5 millirems/hour (mrem/h). For contaminant radiation levels requiring access controls not already established, or levels exceeding an established action level, the EMRE will also be notified.
 - Maintain an Instrumentation Field Log Book which documents the specific equipment used at the work site.
- Authorities:**
- Can temporarily suspend field activities, if health and safety of personnel are endangered, pending further consideration and approval for resumption of work by the SHSC.
 - Can temporarily suspend an individual from field activities for infractions of the health and

safety plan, pending further consideration and approval for resumption of work by the HSC.

Subcontractor Health & Safety Specialist (HSS) / Health & Safety Specialist in training (HSST) (where no subcontractor HSS or HSST exists the Site Supervisor has the responsibilities listed and will obtain assistance from Radiological Operations (RO) and Industrial Hygiene (IH))

The HSS/HSST must be approved by RE and IH. The HSS/HSST shall assist the SSO in implementing site Health and Safety Plans (HASP). An HSS/HSST will be present (in the immediate vicinity) during all activities involving potential exposure to hazardous waste. None of these activities shall be permitted in the absence of an HSS.

Responsibilities:

- Ensure that each individual within his/her jurisdiction complies with the provisions of the HASP.
- Implement the EMRG (for subcontractors) or ROI (for EG&G).
- Provide on-site air monitoring during field activities.
- Be first aid/CPR trained.
- Conduct radiological surveys and document the results.
- Audit safety practices used by on-site teams.
- Communicate with command post for on-site activities.
- Supervise decontamination, monitor workers for heat or cold stress, and distribute health and safety equipment.
- Document safety practices.
- Initiate appropriate emergency procedures.
- Forward completed survey reports/forms to the SSO.
- Notify the SSO of survey results that indicate radiation levels exceeding 5 mrem/h, levels requiring access controls not already established, or levels exceeding an established action level.

- Control access and advise all personnel when radiological precautions are required.
- Complete performance and operational checks required for radiation instruments and make entries in the Instrumentation Field Log Book.

Authority:

The HSS/HSST shall have the authority to stop work in case of an imminent safety hazard or potentially dangerous situation. After stopping work, the HSS/HSST shall immediately consult the SSO. The HSST must obtain HSS countersignatures on all survey reports.

SUPPORT SERVICES

Support services are provided by Health and Safety personnel from the following organizations:

- Criticality Engineering;
- Facilities Safety Engineering;
- Fire Department;
- Fire Protection;
- Industrial Hygiene and Safety;
- Occupational Health; and
- Radiological Protection.

Responsibilities for EG&G Health and Safety Liaison Officer, EG&G Health and Safety Coordinators (HSC), and the EG&G ERHSO follow.

EG&G Health & Safety Liaison Officer (HSLO)

Responsibilities:

- Coordinate health and safety activities with the Environmental Restoration HSO and the Environmental Restoration Management Site Project Managers.
- Supervise the EG&G Site H&S Coordinators at each OU.
- Coordinate health and safety guidance for hazardous waste operations in HWAs.

- Coordinate preparation and approval of HWA Health and Safety Plans.
- Coordinate quarterly health and safety audits and inspections of health and safety programs and program documentation for subcontractors for hazardous waste operations.
- Perform formal audits of EG&G Hazardous Waste Operations Training Courses on an annual basis. The purpose of these audits is to ensure compliance with OSHA requirements for hazardous waste operations training.
- Coordinate review and approval of HASP field changes.

EG&G Environmental Restoration Health & Safety Officer (ERHSO)

Responsibilities:

- Manage and implement the EM H&S Program.
- Ensure that a HASP is written for each OU, and that subcontractors prepare site or task-specific HASPs.
- Provide support to ERM Project Managers.
- Coordinate review of HASPs as required for ERM activities with the H&S Liaison Officer.
- Perform review and approval of ERM HASP field changes.

EG&G Site Health & Safety Coordinator (SHSC)

Responsibilities:

- Evaluate EG&G and subcontractor work to verify compliance with the requirements of HASPs.
- Perform inspections for proper and appropriate use of PPE, monitoring and decontamination procedures, site control, and all required documentation.
- Alert the OU Site Project Manager, H&S Liaison Officer, and the ERHSO of health and safety violations at OUs.
- Provide health and safety support for EG&G employees.
- Is appointed from the EG&G Industrial Hygiene department.

EG&G Radiological Operations

Responsibilities

- Perform radiological controls with concurrence of Radiological Engineering
- Write and enforce ROI RWP requirements

1.6 Field Change Form

The forms following shall be used to change or update the HASP. Anyone can initiate a change in the HASP by filling out the HASP Field Change Form and submitting it to the ERHSO. The ERHSO will review the change and submit to the affected H&S disciplines as needed for concurrence. The ERHSO will obtain final approval from the Project Manager and H&S Liaison Officer. Once interim approval is obtained by signatures of ERHSO, Project Manager, and H&S Liaison Officer, the Field Change Form will be submitted to the EG&G Document Control Officer to be annotated on a DMR.

Figure 1-6

EG&G HASP FIELD CHANGE FORM

Field Change Number: _____ Effective Date: _____

Requested by: _____
(Print Name) Signature/Date

Pen and Ink changes to be made to the HASP to alert the reader of this change:

Reason for the change to be incorporated into the HASP:

Text of change to be incorporated:

APPROVALS:

ERHSO/Date

H&S Liaison Officer/Date

Project Manager/Date

AS NEEDED CONCURRENCE:

Occupational Safety

Radiological Engineering

Industrial Hygiene

Occupational Health

Fire Department

Radiological Operations.

2.0 HEALTH AND SAFETY HAZARD ASSESSMENT

2.1 Task Analysis

Table 2-1 assigns task numbers to each discrete task at this (these) IHSS(s), PAC(s), or AAC(s). Tasks are broken down into steps. When Standard Operating Procedures (SOPs), or Operational Safety Analyses (OSAs) exist for any of the steps in a task, they are listed here. These documents may further clarify the steps in a particular task.

**TABLE 2-1
 TASK ANALYSIS**

TASK #	TASK TITLE	SOP/OSA if applicable	TASK DESCRIPTION	TASK STEPS
1	Soil removal and packaging	N/A	Soil removal by hand. Area is approx. 0.4 m ² . Soil to be packaged into drums. A backhoe may be used instead of shovels.	1. Pick up dirt with shovels 2. Dispose of dirt into drums 3. Rad survey of excavation 4. Close drums 5. Rad survey of drums 6. Decon personnel & equipment 7. Housekeeping per HSP 13.08

IHSS/PAC/AAC NUMBER(S) (if applicable) OR LOCATION: IHSSs 119.1 and 119.2

TASK #	TASK TITLE	SOP/OSA if applicable	TASK DESCRIPTION	TASK STEPS
2	Sampling	Lab Procedure L-3306 and L-6245.	Obtain sample by scooping soil into vials.	1. Per L-3306 and L-6245 2. Housekeeping per HSP 13.08

IHSS/PAC/AAC NUMBER(S) (if applicable) OR LOCATION: IHSSs 119.1 and 119.2

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TASK #	TASK TITLE	SOP/OSA	TASK DESCRIPTION	TASK STEPS
3	Waste Transfer	On-site Transportation manual and HSP 18.10.	Transfer sealed drums from site to permitted storage.	1. Transfer drums to truck 2. Load per procedures 3. Transport per procedures 4. Unload per procedures 5. Housekeeping per HSP 13.08

IHSS/PAC/AAC NUMBER(S) (if applicable) OR LOCATION: IHSSs 119.1 and 119.2

2.2 HAZARD ANALYSIS

Potential hazards associated with hazardous waste operations in the location(s) have been identified by reviewing the physical layout of each area, the tasks associated with each area, and, where available, the results of chemical and radiological monitoring during previous operations. Radiological, physical, chemical, and other hazards potentially encountered during routine tasks are presented in Table 2-2, sections one, two, three, four, and five and Appendix C. Where applicable, Operational Safety Analyses, Standard Operating Procedures, and pre-existing hazard analysis documents are referenced. Hazard analysis and control for non-routine activities may be described in applicable Job Safety analyses or Integrated Work Control Program packages.

**TABLE 2-2
 HAZARD ANALYSIS AND CONTROL WORKSHEET BY TASK**

Sections of Table 2-2 which are not applicable to this task should be marked N/A.

TASK #	TASK TITLE	IHSS, etc.
1	Soil removal and packaging	IHSSs 119.1 & 119.2
2	Sampling	IHSSs 119.1 & 119.2
3	Waste Transfer	IHSSs 119.1 & 119.2

**Table 2-2.1
 RADIOLOGICAL HAZARDS**

For Tasks #1 and #2:

Are radiological hazards fully described in (check all that apply): () OSA () WSRIC (X) OTHER:

ISOTOPE PRESENT	MEDIUM	% DAC*	FIXED CONTAMINATION dpm/100 cm ²	REMOVABLE CONTAMINATION dpm/100 cm ²	DOSE RATE NEUTRON	DOSE RATE BETA/GAMMA
Am 241	Soil	N/A	4260 pCi/g	**		
Pu 239	Soil	N/A	17400 pCi/g	2000		
U 238	Soil	N/A	122 pCi/g	**		

DAC = derived air concentration (hours)

dpm = disintegrations per minute

cm² = square centimeters

* based on % conc in soil and measured total conc in air

** No current data available

For Task #3:

Are radiological hazards fully described in (check all that apply): () OSA () WSRIC (X) OTHER:

ISOTOPE PRESENT	MEDIUM	% DAC*	FIXED CONTAMINATION dpm/100 cm ²	REMOVABLE CONTAMINATION dpm/100 cm ²	DOSE RATE NEUTRON	DOSE RATE BETA/GAMMA
N/A						

DAC = derived air concentration (hours)

dpm = disintegrations per minute

cm² = square centimeters

* based on % conc in soil and measured total conc in air

Table 2-2.2
CHEMICAL HAZARDS

For Task #1:

Are chemical hazards fully described in (check all that apply): (X) Workplan () WEMS () WSRIC
 () OTHER: () OTHER: _____

Complete Appendix C, then mark all of the following which apply to this task:

Hazard Type	Are concentrations greater than 1/2 PEL* or 10% LEL expected in this task?	Job Duty	Routes of Exposure During Task Inhalation (I), Body Splash (B), Face Splash (F), Hands (H), Other - specify
(X) VOC's	() Likely (X) Unlikely () Unknown	Waste Technician	I, B (dry particles), H
() Corrosives	() Likely () Unlikely () Unknown		
() Fire Hazard	() Likely () Unlikely () Unknown		
() Mercury	() Likely () Unlikely (X) Unknown	Waste Tech	I, B, H
(X) Other Toxins	() Likely (X) Unlikely () Unknown	Waste Tech	I, B, H

PEL = Permissible Exposure Limit * use Threshold Limit Value (TLV), or recommended exposure limit (REL) if more restrictive

LEL = Lower Explosive Limit

VOCs = Volatile Organic Compounds

For Task #2:

Are chemical hazards fully described in (check all that apply): (X) Workplan () WEMS () WSRIC

() OTHER: _____ () OTHER: _____

Complete Appendix C, then mark all of the following which apply to this task:

Hazard Type	Are concentrations greater than 1/2 PEL* or 10% LEL expected in this task?	Job Duty	Routes of Exposure During Task Inhalation (I), Body Splash (B), Face Splash (F), Hands (H), Other - specify
(X) VOC's	() Likely (X) Unlikely () Unknown	Waste Technician Samplers	I, B (dry particles), H I, H
() Corrosives	() Likely () Unlikely () Unknown		
() Fire Hazard	() Likely () Unlikely () Unknown		
(X) Mercury	() Likely () Unlikely (X) Unknown	Waste Tech Samplers	I, B, H I, H
(X) Other Toxins	() Likely (X) Unlikely () Unknown	Waste Tech Samplers	I, B, H H

PEL = Permissible Exposure Limit * use Threshold Limit Value (TLV), or recommended exposure limit (REL) if more restrictive

LEL = Lower Explosive Limit

VOCs = Volatile Organic Compounds

For Task #3:

Are chemical hazards fully described in (check all that apply): (X) Workplan () WEMS () WSRIC

() OTHER: _____ () OTHER: _____

Complete Appendix C, then mark all of the following which apply to this task: N/A

Hazard Type	Are concentrations greater than 1/2 PEL* or 10% LEL expected in this task?	Job Duty	Routes of Exposure During Task Inhalation (I), Body Splash (B), Face Splash (F), Hands (H), Other - specify
N/A	N/A	N/A	N/A

**Table 2-2.3
 BIOLOGICAL HAZARDS**

Are biological hazards present during the task? (X) Yes () No

If so, describe: Ticks, Snakes, and Poisonous spiders

Controls: Check for ticks after decon, wear long pants and shoes

TASK #	TASK TITLE	IHSS
1	Soil removal and packaging	119.1 and 119.2
2	Sampling	119.1 and 119.2
3	Waste Transfer	119.1 and 119.2

Table 2-2.4
CONFINED SPACES

For Tasks #1 and #2:

Confined space entries must comply with HSP 6.04 unless equally restrictive subcontractor plan is used.

List type/location of confined spaces associated with this task:

1. Excavation greater than 5 feet.	2. N/A
------------------------------------	--------

For Task #3:

Confined space entries must comply with HSP 6.04 unless equally restrictive subcontractor plan is used.

List type/location of confined spaces associated with this task:

1. N/A	2. N/A
--------	--------

**Table 2-2.5
 PHYSICAL HAZARDS**

For Tasks #1 and #2:

Are the physical hazards of this task fully described in (check all that apply): (X) Workplan () SOP () OSA
 () OTHER: _____

If not, check all that apply and complete the following:

	HSP SECTION	CONTROL MEASURES
(X) Excavations and Trenching Describe: Hot Spot removal creates excavation	HSP 12.08	Appropriate sloping or shoring required if excavation exceeds 4 ft. or as required by occupational safety.
(X) Ladders Describe: Potentially required to enter excavation	HSP 22.02	Inspect all ladders before use. No metal ladders.
(X) Heat Stress () Cold Stress Describe: Ambient Temperature exceeds 70° F	N/A	Monitor pulse and temperature if temperature exceeds 70° F per Appendix G. Provide cool area for breaks. Drinking water provided in support zone.
(X) Noise Describe: Possible if a backhoe is utilized	HSP 7.06	Hearing protection provided if sound level exceeds 85 dB.
(X) Other Describe: Potential underground utilities	N/A	Underground utilities shall be marked prior to excavation.

For Task #3:

Are the physical hazards of this task fully described in (check all that apply): (X) Workplan () SOP () OSA
 () OTHER: _____

If not, check all that apply and complete the following:

	HSP SECTION	CONTROL MEASURES
(X) Other Describe: Physical hazard as a result of moving the drums such as lifting or pinching	N/A	Work performed per Traffic procedure.

3.0 HEALTH AND SAFETY HAZARD CONTROL

Hazard control includes administrative, engineering and personal protective equipment methods. Table 2-2 and associated tables identify control measures for each physical hazard. Table 3-1 and associated tables define administrative and engineering controls, personal protective equipment, and monitoring requirements for radiological and chemical hazards. Radiological hazards will be controlled by the RWP to be issued by the RO Foreman.

3.1 Personal Protective Equipment (PPE)

The criteria used to determine appropriate levels of personal protective equipment include the work being conducted; potential chemical, radiological and physical hazards at the site; availability of monitoring data; effectiveness of engineering or administrative exposure controls; and applicable regulations. As stated in HSP 8.01, Safe Work Apparel, Occupational Safety and Industrial Hygiene will identify to supervisors the required job-specific protective clothing. Rad Operations identifies job-specific protective clothing for radiological hazards in the Radiological Work Permit (RWP). This selection will be based upon the site hazards as specified in Table 2-2 and Appendix C. Industrial Hygiene, Radiological Engineering, and Radiological Operations shall evaluate the requirements and modifications according to the site monitoring results.

HSP 7.03, Respiratory Protection, and HSP 7.05, Breathing Air, detail plant policy for respiratory protection. Refer to these practices for guidance on respiratory protection selection, issue and return, training, fit testing, medical evaluation, and limitations during temperature extremes.

Industrial Hygiene and Radiological Engineering shall evaluate control requirements and modifications according to the site monitoring. In the event of an emergency, the Radiological Control Technician (RCT) and Radiological Engineering have authority to modify PPE for radiological hazards. The Industrial Hygienist may modify PPE requirements for non-radiological hazards. PPE upgrades shall be implemented when site monitoring indicates exposure limits meet or exceed the appropriate action levels of the specific contaminant(s) being monitored.

Action levels are specified in Table 3-1, Section 4. PPE donning steps should be performed as specified in the order listed in the donning procedure as follows. PPE should be inspected as described in the inspection procedure as follows.

Figure 3-1

DONNING PROCEDURE

(Check all that apply, to reflect PPE to be used on each task)

Task #:		Donning Step:		
1	2			Don tyvek over cotton coveralls
1	2			Don latex undergloves
1	2			Don chemical resistant outer gloves
1	2			Don disposable shoe covers
1	2			Don full-face respirator

Use additional sheets as necessary.

PPE Inspection Checklists (Check all that apply)

(X) CLOTHING

Before use:

- Determine that the clothing material is correct for the specified task at hand per HASP.
- Visually inspect for: imperfect seams, non-uniform coatings, tears, malfunctioning closures.
- Hold up to light and check for pinholes.
- Flex product: observe for cracks; observe for other signs of shelf deterioration.
- If the product has been used previously, inspect inside and out for signs of chemical attack: discoloration, swelling, stiffness.
- During the work task, periodically inspect for: evidence of chemical attack such as discoloration, swelling, stiffening, and softening. Keep in mind, however, that chemical permeation can occur without any visible effects.
- Closure failure, tears, punctures, seam discontinuities.

(X) GLOVES

Before use, pressurize glove to check for pinholes. Roll gauntlet towards fingers or inflate glove and hold under water. In either case, no air should escape.

(X) AIR-PURIFYING RESPIRATORS

- Inspect air-purifying respirators: before each use to be sure they have been adequately cleaned; after each use; during cleaning; monthly if in storage for emergency use.
- Check material conditions for: signs of pliability, signs of deterioration, signs of distortion.
- Examine cartridges or canisters to ensure that: they are the proper type for the intended use; the expiration date has not been passed; they have not been opened or used previously.
- Check faceshields and lenses for: cracks, crazing, fogginess.

3.2 Monitoring

The procedures for monitoring for hazards may include direct-reading instrumentation, radiation and contamination surveys, personal monitoring, and area sampling for chemical, radiological, biological and/or physical hazards.

The objectives of this monitoring program are:

- To characterize the work area for the presence of gases, particulates (dusts, mists, fibers, smoke and fumes), and vapors in the atmosphere.
- To record background levels of contaminants and document possible releases.
- To obtain sufficient quantitative measurements for ascertaining the correct site control assessments and boundaries, the appropriate levels of PPE for personnel, and decontamination procedures.

- To collect a sufficient number of samples to characterize personal exposure levels.
- To recognize conditions that may be immediately dangerous to life and health.
- To evaluate overall effectiveness of exposure controls implemented at the site.

Table 3-1.2 and 3-1.4 describe frequency and type of monitoring based upon the site hazards as specified in Table 2-2 and Appendix C. Industrial Hygiene and Safety identifies non-radiological and physical hazard monitoring; Radiological Engineering defines radiological hazard monitoring requirements.

The Industrial Hygiene Procedures Manual, Section 1.2, 1.3, 1.4, 1.5, and 2.2 describe quality assurance/quality control and recordkeeping SOPs for non-radiological Industrial Hygiene samples. The Radiological Operation Instructions specifies recordkeeping for radiological samples.

3.3 Other Control Measures

Standard 29 CFR 1910.120(g) requires that "Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits... except to the extent that such controls and practices are not feasible." Such control measures including engineering controls are specified in Table 3-1.3. Eating, drinking, or smoking is not permitted in contaminated areas.

3.4 Confined Spaces

Confined space entries must comply with HSP 6.04, Confined Space Entry Program. All confined spaces associated with this task are listed in Table 2-2.4.

3.5 New Technologies

The H&S Liaison Officer will coordinate evaluation of new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations for implementation at this site. The H&S Liaison Officer will coordinate evaluation of these technologies with the assistance of resources in each of the H&S departments as applicable. Any employee may introduce such a new technology to the H&S Liaison Officer.

Table 3-1
RADIATION AND NON-RADIOLOGICAL CHEMICAL HAZARD CONTROL
BY TASK

Sections of Table 3-1 which are not applicable to this task should be marked N/A.

TASK #	TASK TITLE	IHSS
1	Soil removal and packaging	119.1 and 119.2
2	Sampling	119.1 and 119.2
3	Waste Transfer	119.1 and 119.2

Table 3-1.1
RADIOLOGICAL POSTINGS

For All Tasks:

RADIOLOGICAL POSTINGS REQUIRED	(X) See RWP
<input type="checkbox"/> Radiation Work Permit Required for Access	<input type="checkbox"/> Very High Radiation Area
<input type="checkbox"/> Dosimeter Badge	<input type="checkbox"/> Self Contained Breathing Apparatus
<input type="checkbox"/> Radiological Controlled Area	<input type="checkbox"/> Respirator Ready for Use
<input type="checkbox"/> Enter Only at Step-Off Pad	<input type="checkbox"/> Full-Face With Charcoal/HEPA Cartridges
<input type="checkbox"/> No Consumables	<input type="checkbox"/> Supplied Breathing Air
<input type="checkbox"/> White or Visitor Coveralls/Shoe Covers	<input type="checkbox"/> Air-Line Respirators
<input type="checkbox"/> Whole Body Monitoring	<input type="checkbox"/> Airborne Radioactivity Area
<input type="checkbox"/> Radiation Area/High Radiation Area	<input type="checkbox"/> Dose Rate Ranges

Table 3-1.2
RADIOLOGICAL MONITORING

For Tasks #1 and #2:

RADIOLOGICAL MONITORING REQUIRED	FREQUENCY AS PER RWP	TYPE	EQUIPMENT
ROUTINE CONTAMINATION SURVEY	In Process	Alpha, Beta, Gamma	As required by ROIs
ROUTINE RADIATION SURVEY	In Process	Gamma, Neutron	As required by ROIs
CONTINUOUS MONITORING	As directed by RE	As directed by RE	As required by ROIs

Table 3-1.3
ENGINEERING OR ADMINISTRATIVE CONTROLS

For Tasks #1 and #2:

ENGINEERING OR ADMINISTRATIVE CONTROLS EMPLOYED	DESCRIBE
(X) Dust Suppression	Manual misting utilizing clean water sprayed on excavation site to minimize the possibility of dirt being blown out of the IHSS

**Table 3-1.4
 NON-RADIOLOGICAL CHEMICAL MONITORING**

For Tasks #1 and #2:

NON-RADIOLOGICAL CHEMICAL MONITORING REQUIREMENTS:			(ACTION LEVEL)	
Contaminant:	Type of Real Time Instrument or Analytical Method:	Frequency / Locations:	Action:	Action:
Mercury	Jerome dosimeter method, NIOSH or OSHA validated procedure	During excavation of SS100193	Evacuate	
Mercury	Jerome real-time	During excavation of SS100193	0.25 mg/m ³	

**Table 3-1.5
PERSONNEL PROTECTIVE EQUIPMENT**

For Tasks #1 and #2:

PERSONAL PROTECTIVE EQUIPMENT:					
Job Duty	Safety Shoes & Safety glasses	Body Covering Type	Glove Type	Respirator Type (Specify cartridge if applicable)	Other (i.e., hard hat, earplugs)
Sampler	(X) yes () no and disposable shoe covers	Tyvek	latex and silver shield*	mersorb-H full-face	Hard hat and hearing protection if heavy equipment in operation
Waste Tech	(X) yes () no and disposable shoe covers	Tyvek	latex and silver shield*	mersorb-H full-face	Hard hat and hearing protection if heavy equipment in operation

* Silver shield required in SS100193 and SS100393; nitrile acceptable in SS100293 and SS100493; see App. E

4.0 PERSONNEL HEALTH AND SAFETY TRAINING REQUIREMENTS

HSP 21.03 specifies Hazardous Waste Operations and Emergency Response Training requirements for hazardous waste activities. Additionally, the following training is necessary for personnel performing hands-on work in each of the tasks indicated. Training requirements for visitors is described in Table 1-3.

**Table 4-1
 TRAINING REQUIREMENTS**

REQUIRED TRAINING	TASK NUMBER:		
	#1	#2	#3
• General Employee Training #019-235-01	C	C	C
• Hazard Communication #019-750-01	C		
• Radiation Worker Level 1 #023-480-01			C
• Radiation Worker Level 2 #023-482-01	C	C	
• Respirator Indoctrination #056-284-01	C	C	
• Respirator Fit #056-284-02	C	C	
• 40 Hour OSHA #018-691-03	C	C	C
• 8 Hour OSHA Refresher #018-691-05	C	C	C
• OSHA Field Experience Checklist #018-691-07	C	C	C
• RFEDS Sample Management #428-06-94		X	
• RFEDS No Number		X	
• DOT Awareness Training #023-434-01		X	
• DOT Job Specific No Number		X	
• ERM QA Overview #420-06-94		X	
• Site Specific Briefing No Number	C	C	C
• 8 Hour OSHA Supervisor #018-691-01	X	X	
• RCRA CBT #023-435-01	C	C	C
• RCRA Supervisors Checklist #018-442-01	C	C	C
• Waste Determination & Waste Stream & Residue ID #125-574-01	X		
• Waste Generator Solid Radioactive #067-285-01	X		
• Waste Generator Qualification Process #067-291-01	X		

C-Items required for controlled area entry (Hands on work)
 X-Items required by specific job classification

5.0 MEDICAL SURVEILLANCE REQUIREMENTS

The EG&G Medical Surveillance program is described in HSP 4.00, Medical Program, Chapters 4.02 -4.17. Subcontractor Medical Surveillance Programs should comply with the requirements of 29 CFR 1910.120(f).

Physical examination practices are described in HSP 4.09, Physical Examinations. HSP 21.03 defines hazardous waste workers for purposes of medical surveillance. According to that definition, the persons or positions described in Appendix D are enrolled in the RFP Medical Surveillance program for hazardous waste workers.

6.0 SITE CONTROL MEASURES

Specific work zones shall be designated on the site during invasive activities which create potential exposures (opening drums, etc.) or during spills. Site control and posting for radiation control shall be in accordance with EMRG 1.3/ROI 1.3 and guidance as provided by Radiological Engineering. Zones will be designated by physical barriers such as cones and tape. The area immediately impacted will be declared the Exclusion Zone. This zone is where contamination is either known or expected to occur and where the greatest potential for exposure exists.

The Exclusion Zone will encompass a radius of sufficient distance from the product to allow for adequate materials handling and logistical needs prior to decontamination. The outer boundary of the Exclusion Zone is called the Hotline.

Site workers shall establish a Contamination Reduction Zone (CRZ), which may include a step-off pad. The CRZ is immediately adjacent to the Exclusion Zone, and will serve as the site for the decontamination of personnel and equipment when exiting the Exclusion Zone. The area will be secured by either posting signs establishing a barricade, or stationing a site employee at the access point. The area beyond the Exclusion Zone and CRZ will serve as the Support Zone.

The Support Zone is an uncontaminated area where workers are unlikely to be exposed to hazardous substances or dangerous conditions.

Table 6-1
SITE CONTROL PROGRAM ELEMENTS

Standard 29 CFR 1910.120 (d) requires the following elements in the site control program:

REQUIREMENT:	RESPONSE:
Site Map	Appendix E
Site work zones	Appendix E depicts exclusion zone ("hot zone" for Rad or Non-Rad), contamination reduction zone ("warm zone," also radiological step-off pad), and support zone ("cold zone").
Use of a "Buddy System"	29 CFR 1910.120 states that "two or more people are required at all times when performing hazardous work." Hazardous work as defined includes "work with non-radioactive hazardous materials" and "work with radioactive materials in quantities that could result in radiation exposures in excess of established guidelines." Furthermore, buddy system should be used where temperature stress is a significant hazard.
Site Communications	<p>The following communication methods are available:</p> <p><input checked="" type="checkbox"/> Voice contact <input checked="" type="checkbox"/> Radio contact <input checked="" type="checkbox"/> Visual contact <input type="checkbox"/> Alarm pull box,, located: _____</p> <p><input type="checkbox"/> Hand Signals <input type="checkbox"/> Telephone, located: _____</p> <p><input type="checkbox"/> Fire Phone, located: _____ (emergency dial X2911)</p>
SOPs or Safe Work Practices	SOPs and safe work practices are described in Section 3.0, Hazard Control; Table 2-2, Hazard Analysis and Control; and Table 3-1, Radiation & Non-Radiological Chemical Hazard Control.
Identification of the nearest medical assistance	Medical assistance is available at Building 122, Occupational Health, during normal work hours. For emergencies call Extension 2911. Appendix F shows the location of Building 122.

7.0 DECONTAMINATION PLAN

HSP 18.02, Personnel Contamination Control Requirements for Radiological Controlled Areas, describes requirements for decontamination. The objective of decontamination is to remove hazardous substances (chemical or radiological) from workers and equipment used in hazardous waste operations, to assure compliance with DOE Order 5480.11, Radiological Operating Instructions, and OSHA standard 1910.120, and to preclude the occurrence of related adverse health effects. This chapter specifies decontamination techniques for applicable areas identified in Table 1-1.

7.1 Decontamination Procedures and Location

The decontamination process shall take place within the RCA, if applicable (or outside of the contaminated area) in an area identified as the CRZ which consists of the following items:

- Barrier to prevent unauthorized traffic through the area
- Step off pad, decontamination rooms, and ancillary decontamination equipment
- Designated entry and exit to prevent cross contamination

**Table 7-1
DECONTAMINATION ITEMS**

These items are described in the following table:

Task #	Type of Barrier (door, tape, etc.)	Decontamination Equipment	Decontamination Steps
1	Tape Barrier	Container for disposables Wet wipes for washing hands and face at the site. Shower at the contractor's yard	1. Rad monitor 2. Remove PPE 3. Wash hands and face 4. Shower
2	Tape Barrier	Container for disposables Wet wipes for washing hands and face at the site. Shower at the contractor's yard	1. Rad monitor 2. Remove PPE 3. Wash hands and face 4. Shower

All employees leaving a contaminated area shall be appropriately decontaminated for the suspected contaminants. The extent of decontamination will be dependent on the level of contamination. Doffing procedures must be performed in the order listed to minimize the potential for personnel contamination during the doffing activity.

Decontamination for environmental investigation and restoration activities will take place as described in EMD Operating Procedures, Vol. 1, Field Operations, FO.03, FO.04, FO.07, and FO.12.

Reusable products will be monitored for radiological contaminants and visible contamination to verify that they have been adequately decontaminated. The absence of radiological contamination is defined in HSP 18.10, Release of Property/Waste for Conditional and Unrestricted Use, as per DOE Order 5480.11, and measured with radiation survey instruments capable of detecting Alpha and Beta/Gamma radiation at these levels.

Figure 7-1

DOFFING PROCEDURE

(Check all that apply)

Task #:

1	2			Remove boot covers
1	2			Remove outer gloves
1	2			Remove Tyvek
1	2			Remove respirator
1	2			Remove inner gloves

Use additional sheets as necessary.

Table 7-2
SURFACE CONTAMINATION LIMITS

HSP 18.10 Surface Contamination Limits for Unrestricted Release

Radionuclides ²	Average ^{3,4} Total (Fixed Plus Removable) (dpm/100 cm ²) ¹	Maximum Total (Fixed 1 Plus Removable) (dpm/100 cm ²) ¹	Removable ^{1,4,6} (dpm/100 cm ²)
Transuranics, I-125, I-129, Ra-226, Ac-227, Ra-228, Th-228, Th-230, Pa-231	100	300	20
Th-Natural, Sr-90, I-126, I-131, I-133, Ra-223, Ra-224, U-232, Th-232	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay product, alpha emitters	5,000	15,000	1,000
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above) ⁷	5,000	15,000	1,000

NOTES:

1. As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
2. Where surface contamination by both alpha- and beta-gamma radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.
3. Measurements of average contamination should not be averaged over an area of more than 1 m². For objects of less surface area, the average should be derived for each object.
4. The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively at 1 cm.
5. The maximum contamination level applies to an area of not more than 100 cm².

6. The amount of removal material per 100 cm² of surface area should be determined by wiping an area of that size with a dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm² is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.
7. This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

7.2 Disposal of Decontamination Equipment and Solutions

All contaminated clothing and equipment leaving the contaminated area shall be appropriately contained to prevent the spread of the contaminant and shall be properly managed or decontaminated in the appropriate decontamination area.

All wash solutions used for decontamination shall be contained in tubs, pans, four-liter jugs or drums and used as process water. Containers will be designated for process waste use only and will not be used for any other purpose. All solutions shall be sampled for chemical constituents and radiological constituents for proper waste identification and stored or treated per plant policies and RCRA permits.

All wastes collected during decontamination procedures shall be stored and managed according to applicable waste requirements procedures. FO.07 describes the handling of decontamination water and wash water for environmental investigation and restoration projects. FO.06 describes handling of used PPE.

8.0 EMERGENCY RESPONSE

8.1 Pre-Emergency Planning

Incidental Release: An incidental release is a release of hazardous substance which does not pose a significant safety or health hazard to employees in the immediate vicinity or to the employee cleaning it up, nor does it have the potential to become an emergency within a short time frame. Incidental releases are limited in quantity, exposure potential, or toxicity and present minor safety or health hazards to employees in the immediate work area or those assigned to clean them up.

Releases that Require an Emergency Response Regardless of the Circumstances: There are releases of hazardous substances that pose a significant enough threat to health and safety that, by their very nature, require an emergency response regardless of the circumstances surrounding the release or the mitigating factors. An employer must determine the potential for an emergency in a reasonably predictable worst case scenario [or "anticipated emergencies," 29 CFR 1910.120(q)(1)], and plan response procedures accordingly.

Emergency Response: An emergency response includes, but it not limited to, the following situations:

- The response comes from outside the immediate release area;
- The release requires evacuation of employees in the area;
- The release poses, or has the potential to pose, conditions that are IDLH;
- The release poses a serious threat of fire or explosion (exceeds or has the potential to exceed the LEL or lower flammable limit);
- The release requires immediate attention because of imminent danger;
- The release may cause high levels of exposure to toxic substances;
- There is uncertainty that the employee in the work area can handle the severity of the hazard with the PPE and equipment that has been provided and the exposure limit could

- easily be exceeded; and
- The situation is unclear, or data is lacking on important factors.

The purpose of this Emergency Response Plan is to have a detailed pre-determined strategy for handling incidental or emergency incidents and potential problems. This pre-emergency planning will aid in immediate response and abatement of problems and will likely reduce the severity and impact of hazardous situations. The plan is designed to protect site personnel from potential hazards created by an emergency situation. In addition to safeguarding site personnel, the plan is designed to protect plant personnel and the public from contaminants that could potentially move off-site, protect property adjacent to the storage areas from potential hazards within the storage areas, and prevent equipment loss as a result of fire, explosion, or contamination.

8.2 Emergency Contact/Notification

- If a release is observed, then the employee observing the release immediately warns coworkers in the contaminated area and notifies supervision.
- Employees in the area of a release move to a safe location and secure the area to prevent unauthorized personnel from entering the contaminated area.
- If at any time a potentially life threatening emergency or uncontrolled release exists, then immediately call the RFP emergency number at X2911 or the RADIO CHANNEL labeled 2911.
- If supervision cannot be notified immediately, then the employee continues notifying higher levels of supervision until communication has been achieved with one of the following authorities:
 - (1) Shift Manager.
 - (2) Operations Manager or Designee.

- (3) Shift Superintendent, X2914 or the RADIO CHANNEL labeled S SUPER.
- The contacted authority ensures that the following notification have been made:
 - (1) If a potentially life threatening emergency exists and X2911 has not been called, then immediately call X2911 or the RADIO CHANNEL labeled 2911.
 - (2) If the release contains or potentially contains fissile materials, then immediately contact Nuclear Safety Engineering.
 - (3) Notify the Operations Manager.
 - If release requires an emergency response, the contacted authority makes the following notifications:
 - (1) Request HAZMAT assistance from one of the following organizations:
 - (a) Shift Superintendent X2914 or the RADIO CHANNEL labeled S SUPER.
 - (b) Fire Department Dispatch X4337 or X4338 or the RADIO CHANNEL labeled FIRE.
 - (2) Promptly report the release to the Shift Superintendent X2914 or the RADIO CHANNEL labeled S SUPER (in accordance with 1-100000-HWR). Instruct the Shift Superintendent to notify the Emergency Operations Center Notification Officer at X3456.

WARNINGS: To avoid potential for nuclear criticality, do not collect, control, divert, dam, or otherwise cause liquids containing or potentially containing fissile materials to accumulate.

To avoid the potential of personal injury, only employees trained as a Hazardous Materials Technician may take actions to stop a release requiring an emergency response.

TABLE 8-2
EMERGENCY NUMBERS

Department/Group	Name	Phone #	Pager #	Home Phone
Shift Superintendent (Incident Commander)		2911		
HSC	Peggy Schreckengast	6790		
Occupational Health		2594		
Occupational Safety	Don Harlow	4165	1637	469-6928
On-site Supervisor	Waste Tech Foreman			
Project Manager	Wayne Sproles	8598	1245	
Radiological Engineering	Jerry Anderson	6947	3518	
Radiological Operations	Gerry McKenna	2062	5520	
Operations Manager	Marla Broussard	8517	4010	
Release, Response & Reporting				
Security		2464		
On-call Waste Regulatory Program Reps	Shift Super has current list			
ERHSO	K. D. Anderson	6979	3296	
HSLO	Peggy Schreckengast	6790		
Criticality Safety Eng.	N/A			
Nuclear Safety Eng.	Art Stithem	3784	7894	

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94-DMR - ERM - 0110

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

- (1) Call X2911 or Radio Channel #1 for emergency assistance for life threatening emergencies to access:
 - Incident Commander (Shift Supervisor);
 - Plant Protection Central Alarm Station;
 - Fire Department Dispatch Center; and
 - Occupational Health.

- (2) 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; and
 - Hazmat Response Vehicle;

- (3) Provide the following information, upon request, to the qualified Emergency Dispatcher:
 - Exact location of the emergency (nearest road, etc.);
 - 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; and
 - Any other information requested.

- (4) 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 and notify departments that have an advisory role in the situation. The IC will determine if additional help from off-site agencies (police, hospitals, etc.) is required. The IC will then notify the following groups when appropriate:

Radiological Engineering	Industrial Hygiene	Criticality Safety Engineering
Radiological Operations	Traffic	Facilities Safety Engineering
Occupational Safety	H&S Administrator	Occupational Health
Event Notifications Officer	Hazardous Waste Operations	

Radiological Engineering and Industrial Hygiene will assess any hazards associated with the release of spilled product; Fire Department will be first responders. Hazardous Waste Operations will evaluate the incident for RCRA/CERCLA reporting requirements. Notification shall also be made to Response and Reporting at X7264. Industrial Hygiene and Radiological Engineering shall advise on the type of PPE, including respiratory protection, in the event of an emergency.

8.3 Emergency Equipment Location

The work sites shall be equipped with incidental release response equipment; minimum response equipment needed is as follows:

- Communication equipment - Portable radios.
- Personal protective equipment - Personal protective equipment must be kept in reserve and maintained for emergency use. This equipment may be from the same stock that is used for daily operations, provided the portion of stock reserved for emergency use is not depleted.
- Medical and fire safety equipment - First aid kits and Fire extinguishers and blankets.

The following equipment is not required at the field site but may be used by Emergency Response personnel:

- Fifteen (15) minute eye wash and quick drench shower;
- Ten (10) gallons of water, in portable containers; and
- Decontamination solutions appropriate for the on-site hazards.

Additionally, recommended field communication devices are:

- Megaphone/Bullhorn devices; and
- Alarm devices (air-horns, sirens, whistles, etc.).

8.4 Spill Response & Control Procedures

Spill response procedures are described in HSP 21.04, Emergency Response and Spill Control, and in Hazardous Waste Requirements Manual (HWRM) Section 4.

ALL POTENTIALLY UNCONTROLLED SPILLS SHALL BE REPORTED TO THE EMERGENCY COORDINATOR AT X2911 OR RADIO CHANNEL #1.

Incidental spill response procedures: No liquid spills anticipated. If soil is spilled contact EG&G Project Manager. Project Manager follows reporting and other requirements in Hazardous Waste Requirements Manual, Section 4.0.

8.5 Fire or Explosion Response

Notify the Fire Department in the event of a fire, no matter how minor. **REPORT FIRES AND EXPLOSIONS TO X2911 OR THE DIGITAL RADIO CHANNEL 2911.** Contact area supervisor after calling X2911.

Other fire response procedures: Evacuate in case of fire.

Contacted authority (supervisor, etc.) must also ensure SS or EOC Notification Officer notifies on-call WRP representative.

8.5.1 Post-Emergency Response

Equipment will be decontaminated at the Decontamination Facility or by wiping with a soap solution. Non-reusable items used for decontamination and decontamination wash water will be handled using FO.03, FO.04, FO.06, and FO.07. Emergency equipment will be restocked. Report accidents resulting in injury/illness or property damage in accordance with 1-66100-HSP-3.03 Reporting Occupational Injury or Illness and Vehicle or Property Damage.

8.6 Evacuation Plan

Personnel and visitors to this IHSS will not respond to the incident and will evacuate the areas if any of the following occur:

- Fire, explosion;
- Spill;
- If instructed by the Life Safety/Disaster Warning (LS/DW) Public Address System; or
- If instructed by site supervision.

Assembly areas are taught in the site briefings and are shown in Appendix E. After an evacuation the supervisor is required to verify that all employees under his/her supervision are accounted for.

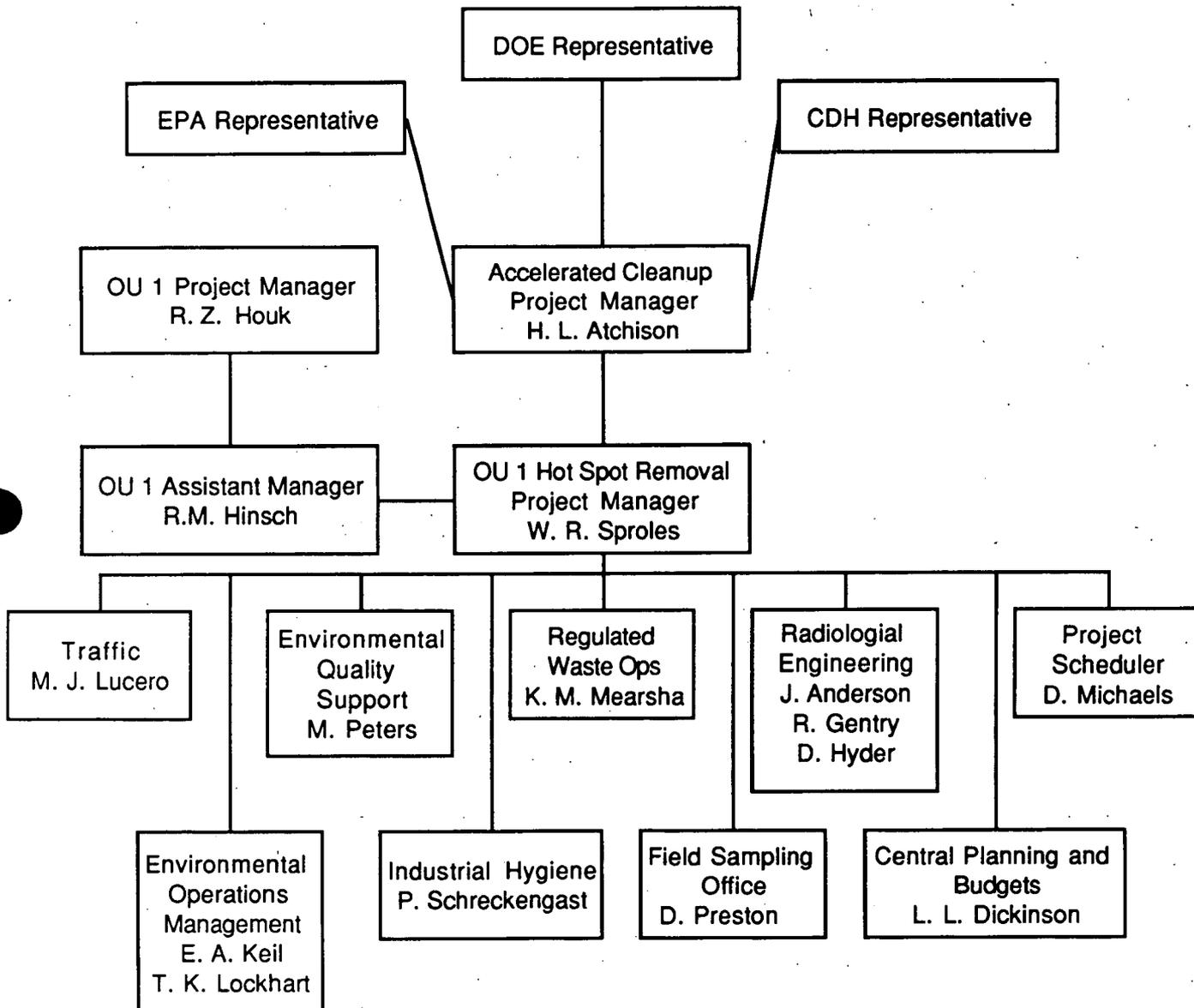
APPENDIX A

VISITOR LOG

APPENDIX B

LINES OF RESPONSIBILITY

Environmental Restoration Management OU 1 Hot Spot Removal Organizational Chart



94 - DMR - EMR - 0110

APPENDIX C

CHEMICAL HAZARDS

Appendix C

Chemical Hazards Posed by Site Contaminants and Route of Exposure

Tasks Involving Contaminant	Maximum Expected Concentration (a) air or other medium (specify)	Contaminant (Synonyms) (Abbreviations)	OSHA PEL, ACGIH TLV or NIOSH REL <IDLH>	Hazard Type	Physical/Chemical Characteristics	Routes of Exposure	Exposure Symptoms/ <Target Organs>
1,2	50 UG/L (SOIL)	Acetone	750 ppm NIOSH 250 ppm <20,000 ppm>	VOC Fire	Colorless liquid with a fragrant mint-like odor. Fl pt 0 F LEL: 2.5% UEL: 13% VP: 180 mm Hg (@ 77 F)	Inhalation Ingestion Contact	Eye, nose, and throat irritation; headache; dizziness; dermatitis <respiratory system, skin>
1,2	23,300 MG/KG (SOIL)	Aluminum	10 mg/m3 (Total) 5 mg/m3 (Respirable) <NA>	Toxic	Silvery ductile metal	Inhalation	Pulmonary fibrosis, possibly Alzheimer's
1,2	58.7 MG/KG (SOIL)	Antimony	0.5 mg/m3 <80 mg/m3>	Toxic	Silvery white metal	Inhalation Contact	Irritates eyes, nose, throat; cramps, vomiting, diarrhea; affects sleep and appetite <respiratory system>
1,2	6.2 MG/KG (SOIL)	Arsenic	0.010 mg/m3 NIOSH .002 mg/m3 (ceiling) <100 mg/m3>	Carcinogen Toxic	Silver-gray or tin-white brittle, odorless solid	Inhalation Absorption Contact Ingestion	Nasal ulceration; GI disturbances; respiratory irritation <Liver, kidneys, skin, lungs, lymphatic system>
1,2	299 MG/KG (SOIL)	Barium	0.5 mg/m3 <1,100 mg/m3>	Toxic	White, odorless solid	Inhalation Ingestion Contact	Irritates eyes, nose, throat, upper respiratory; GI; muscle spasm; slow pulse; skin burns <Heart, CNS, skin, respiratory system, eyes>
1,2	1.4 MG/KG (SOIL)	Beryllium	0.002 mg/m3 NIOSH .0005 mg/m3 <10 mg/m3>	Carcinogen Toxic	Metal: a hard, brittle, grey-white solid; noncombustible; slight explosion hazard in dust or powder form	Inhalation	Respiratory symptoms; fatigue, weakness; weight loss <Lungs, skin, eyes>
1,2	24.4 MG/KG (SOIL)	Chromium	0.5 mg/m3 <No evidence>	Carcinogen Toxic	Blue-white to steel-gray, lustrous, brittle, hard solid	Inhalation Ingestion	Corrosive to skin and mucous membranes; carcinogen of the lungs, nasal cavity, stomach, larynx

Tasks Involving Contaminant	Maximum Expected Concentration (a) air or other medium (specify)	Contaminant (Synonyms) (Abbreviations)	OSHA PEL, ACGIH TLV or NIOSH REL <IDLH>	Hazard Type	Physical/Chemical Characteristics	Routes of Exposure	Exposure Symptoms/ <Target Organs>
1,2	27.1 MG/KG (SOIL)	Copper	1 mg/m ³ <No evidence>	Toxic	Reddish, lustrous malleable odorless solid	Inhalation Ingestion Contact	Irritation of eyes and mucous membranes, pharynx; poison by ingestion; metal taste <respiratory system, kidneys, liver>
1,2	34.6 MG/KG (SOIL)	Lead	0.050 mg/m ³ <700 mg/m ³ >	Toxic	Heavy, ductile, gray, soft metal	Inhalation Ingestion Contact	Weakness, insomnia, nervous irritability, tremors, muscle pain <CNS, PNS, GI tract, blood, kidneys>
1,2	428 MG/KG (SOIL)	Manganese	5 mg/m ³ <No evidence>		Silvery or reddish gray solid; lustrous, brittle; combustible	Inhalation Ingestion	Parkinson's-type symptoms; sleepiness; vomiting; weakness; tremors <CNS, lungs>
1,2	2.4 MG/KG	Mercury	0.01 mg/m ³ - alkyl compounds "S" 0.05 mg/m ³ - other forms (vapor) <10 mg/m ³ > - alkyl compounds 28 mg/m ³ - other forms (vapor)		Silver-white, mobile, heavy, odorless liquid	Inhalation Contact Absorption	Eye and skin irritant; poison by inhalation; cough, tremor, headache, irritability <GI tract, CNS>
1,2	13 UG/L (SOIL)	Methylene Chloride (Dichloromethane) (Methylene Dichloride)	50 ppm <5,000 ppm>	Carcinogen VOC	Colorless liquid with chloroform-like odor BP: 104 F LEL: 14% UEL: 22%	Inhalation Ingestion Contact	Fatigue, weakness, sleepiness, lightheadedness, numbness and tingling in limbs, nausea, eye and skin irritation <CNS, CVS, eyes, skin>
1,2	20.9 MG/KG (SOIL)	Nickel	1 mg/m ³ (Insoluble) 0.1 mg/m ³ (Soluble) <No evidence>	Carcinogen Toxic	Silvery-white, hard, malleable, and ductile metal	Inhalation Ingestion Contact	Nasal, lung, and skin irritant; carcinogenic <respiratory system, CNS>

Tasks Involving Contaminant	Maximum Expected Concentration (a) air or other medium (specify)	Contaminant (Synonyms) (Abbreviations)	OSHA PEL, ACGIH TLV or NIOSH REL <IDLH>	Hazard Type	Physical/Chemical Characteristics	Routes of Exposure	Exposure Symptoms/ <Target Organs>
1,2	120 UG/KG (SOIL)	Toluene (Methyl Benzene) (Methyl Benzol)	100 ppm 150 ppm (st) <2,000 ppm>	VOC Fire	Colorless liquid with a sweet, pungent benzene-like odor. LEL :1.2% UEL: 7.1%	Inhalation Ingestion Absorption Contact	Fatigue, weakness, confusion, dizziness, headache; dilated pupils, nervousness, insomnia <CNS, liver, kidneys, skin>
1,2	17,400 pCi/g	Plutonium	N/A 1.0 rem/yr, RFP	Carcinogen	Radiation source	Penetration Inhalation Ingestion Absorption Injection	Blood cell changes, hair loss, burns, nausea, vomiting <respiratory system, liver, bone marrow, blood> None detectable at
1,2	170 UG/KG (SOIL)	Tetrachloroethene (Perchloroethylene) Perk	25 ppm <500 ppm>	Carcinogen	colorless liquid, mild chloroform-like odor, LEL: N/A, VP: 14mm Hg	Inhalation Ingestion Contact	Irritant, nausea, flush face, dizzy, headache <liver, kidneys, eyes, upper respiratory, CNS>
1,2	460 UG/KG (SOIL)	Aroclor 1254 (Polychlorinated Bi-phenyl -PCB)	0.05 mg/m3 "S" 5 mg/m3 >	Carcinogen	colorless to pale yellow viscous liquid with mild hydrocarbon odor, LEL: N/A VP: 0.00006mm Hg	Inhalation Absorption Ingestion Contact	Irritant, dermatitis <skin, eyes, liver>
KEY:							
ACGIH	American Conference of Governmental Industrial Hygienists						
BP	Boiling point						
CNS	Central nervous system						
Fl pt	Flash point - closed cup, unless otherwise noted						
IDLH	Immediately Dangerous to Life and Health - Maximum concentration from which one could escape within 30 minutes without experiencing any irreversible health effects						
LEL	Lower explosive limit						
mg/m3	Milligrams per cubic meter						
NA	Not applicable						
OSHA	Occupational Safety and Health Administration						
PEL	Permissible exposure limit - Concentration that nearly all workers may be repeatedly exposed, day after day, without adverse effect. (Based on an 8-hour workday and 40-hour workweek).						
ppm	Parts per million						

Tasks Involving Contaminant	Maximum Expected Concentration (a) air or other medium (specify)	Contaminant (Synonyms) (Abbreviations)	OSHA PEL, ACGIH TLV or NIOSH REL * <IDLH>	Hazard Type	Physical/Chemical Characteristics	Routes of Exposure	Exposure Symptoms/ <Target Organs>
st	15 minute short term exposure limit						
TLV	Threshold limit value - Concentration that nearly all workers may be repeatedly exposed, day after day, without adverse effect.						
	(Based on an 8-hour workday and 40-hour workweek).						
UEL	Upper explosive limit						
ug/m3	Micrograms per cubic meter						
VP	Vapor pressure at 68 F in millimeters (mm) mercury (Hg) unless otherwise noted.						
REFERENCES:							
Air Contaminants - Permissible Exposure Limits (29 CFR 1910.1000)							
American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1990 to 1991							
National Institute of Occupational Safety and Health, Pocket Guide to Chemical Hazards, June 1990							
Sax, N. Irving, Dangerous Properties of Industrial Materials, Van Nostrand Reinhold Company, New York, 1979							

APPENDIX D

INVOLVED PERSONNEL

APPENDIX E

PROJECT SITE MAPS

881 Hillside Area Operable Unit No. 1

OU-1 Hot Spot Removal Project

Figure 1-1

EXPLANATION

-  Hot Spot Sampling Location
-  OU-1 IHSS location
-  Buildings or other structures
-  Lakes and ponds
-  Streams, ditches, or other drainage features
-  Fences
-  Paved roads
-  Dirt roads

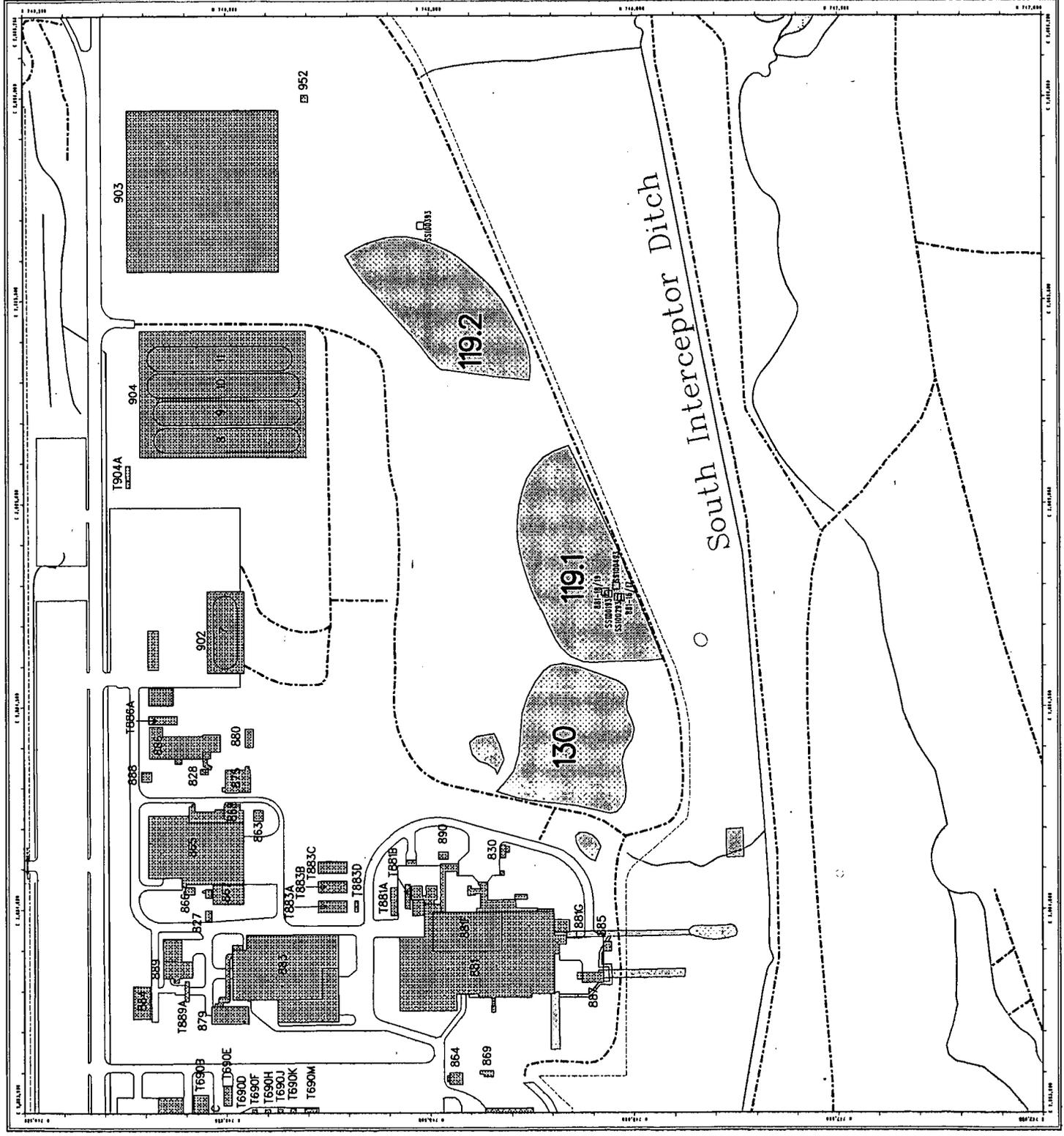
OU-1 Hot Spot locations are per the field survey shown. Building footprints are provided by ERM Rocky Flats, Inc. - 1991. Hydrology provided by USGS - (data unknown)



U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
EG&G ROCKY FLATS
Rocky Flats Environmental Technology Site
P.O. Box 404
Golden, Colorado 80402-0404

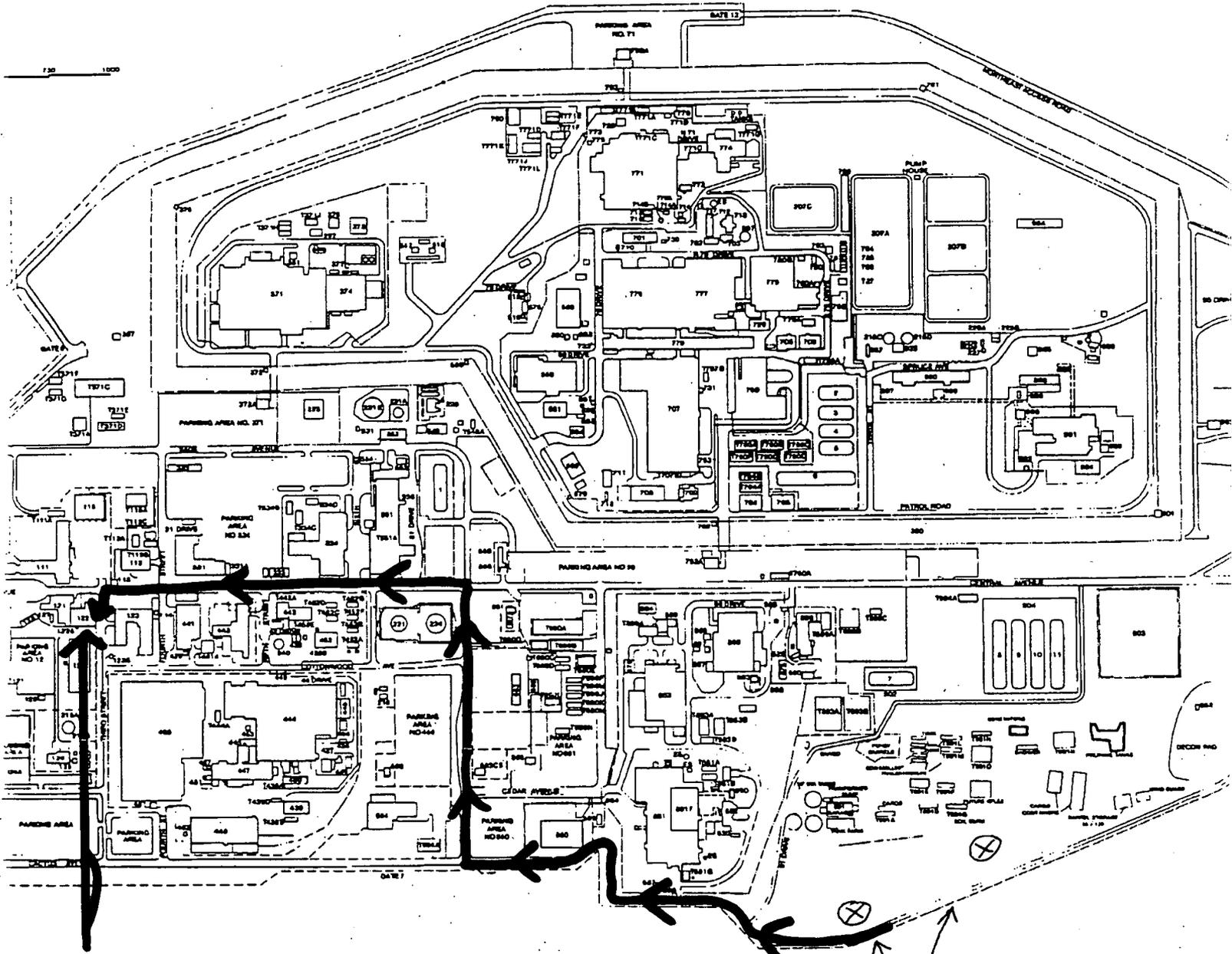
MUP ID: 001-89-4402-01 August 15, 1994



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APPENDIX F

LOCATION OF MEDICAL ASSISTANCE



Occupational Health

Job Site

APPENDIX G

HEAT STRESS MONITORING

- For workers wearing semipermeable or impermeable encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C) (6).

To monitor the worker, measure:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.
 - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
 - If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third (12).
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
 - If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
 - If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third (12).
 - Do *not* permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C)(12).
- Body water loss, if possible. Measure weight on a scale accurate to ±0.25 lb at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, is nude. *The body water loss should not exceed 1.5 percent total body weight loss in a work day* (12).

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 8-10). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Prevention

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, management should take the following steps:

- Adjust work schedules:
 - Modify work/rest schedules according to monitoring requirements.
 - Mandate work slowdowns as needed.

¹Although no protective ensemble is "completely" impermeable, for practical purposes an outfit may be considered impermeable

Rotate personnel: alternate job functions to minimize overstress or overexertion at one task.

Add additional personnel to work teams.

Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.

- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain workers' body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, i.e., 8 fluid ounces (0.23 liters) of water must be ingested for approximately every 8 ounces (0.23 kg) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat (14). When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:
 - Maintain water temperature at 50° to 60°F (10° to 15.6°C).
 - Provide small disposable cups that hold about 4 ounces (0.1 liter).
 - Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.
 - Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
 - Weigh workers before and after work to determine if fluid replacement is adequate.
- Encourage workers to maintain an optimal level of physical fitness:
 - Where indicated, acclimatize workers to site work conditions: temperature, protective clothing, and workload (see *Level of Acclimatization* at the end of this chapter).
 - Urge workers to maintain normal weight levels.
- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:
 - Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.
 - Cooling jackets, vests, or suits (see Table 8-5 for details).
- Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress (see Table 8-11).

Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This section discusses the demonstrated physiological responses to PPE, the individual

Table 8-10. Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers*

ADJUSTED TEMPERATURE ^b	NORMAL WORK ENSEMBLE ^c	IMPERMEABLE ENSEMBLE
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° - 90°F (30.8° - 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° - 87.5°F (28.1° - 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5° - 82.5°F (25.3° - 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° - 77.5°F (22.5° - 25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Source: Reference [13].

*For work levels of 250 kilocalories/hour.

^bCalculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F - (13 × % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

^cA normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Table 8-11. Signs and Symptoms of Heat Stress^a

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
 - muscle spasms
 - pain in the hands, feet, and abdomen
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
 - pale, cool, moist skin
 - heavy sweating
 - dizziness
 - nausea
 - fainting
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:
 - red, hot, usually dry skin
 - lack of or reduced perspiration
 - nausea
 - dizziness and confusion
 - strong, rapid pulse
 - coma

^aSource: Reference [6].

responses, and some of the precautionary and training measures that need to be taken to avoid PPE-induced injury.

The physiological factors that may affect worker ability to function using PPE include:

- Physical condition.
- Level of acclimatization.
- Age.
- Gender.
- Weight.

Physical Condition

Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work, a fit person, relative to an unfit person, will have [5,8,15,16]:

- Less physiological strain.
- A lower heart rate.
- A lower body temperature, which indicates less retained body heat (a rise in internal temperature precipitates heat injury).
- A more efficient sweating mechanism.
- Slightly lower oxygen consumption.
- Slightly lower carbon dioxide production.

Level of Acclimatization

The degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions affects his or her ability to do work. Acclimatized individuals generally have lower heart rates and body temperatures than unacclimatized individuals [17], and sweat sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work loads than unacclimatized workers [18]. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss [19].