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EG&G

ROCKY FLATS

HEALTH AND SAFETY PLAN FOR THE 1994 WELL ABANDONMENT AND REPLACEMENT PROGRAM

Rocky Flats Environmental Restoration Project

DOCUMENT CLASSIFICATION REVIEW WAIVER PER CLASSIFICATION OFFICE

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HEALTH & SAFETY PLAN

for the

1994 Well Abandonment and Replacement Program

April 1994

Rocky Flats Plant

Contract No. MTS352247PA3

prepared by:

JACOBS ENGINEERING GROUP INC.

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CONTROLLED DOCUMENT (3)
EG&G ROCKY FLATS PLANT
ENVIRONMENTAL MANAGEMENT DEPARTMENT

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Health and Safety Plan for the 1994
Well Abandonment and Replacement Program

Manual: RFP/ERM-94-00018
Section: Rev. 0
Effective Date: 5-2-94
Organization: Environmental Restoration Management

APPROVED BY:

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4.0	General Health & Safety Requirements	0	05/02/94
5.0	Hazard Evaluation	0	05/02/94
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11.0	Logs, Reports, and Record Keeping	0	05/02/94
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LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHSM	Corporate Health and Safety Manager
cm^2	square centimeters
CNS	central nervous system
cpm	counts per minute
CPR	cardiopulmonary resuscitation
CTR	Contractor's Technical Representative
DAC	derived-air concentration
dBA	decibels on the A-weighted scale
DOE	U.S. Department of Energy
dpm	disintegrations per minute
EG&G	EG&G Rocky Flats, Inc.
EMD	Environmental Management Division
EMRG	Environmental Management Radiological Guideline
ERHSO	Environmental Restoration Health and Safety Officer
ERM	Environmental Restoration Management
FIDLER	Field Instrument for Detection of Low-Energy Radiation
GIS	Geographic Information System
HASP	Health and Safety Plan
HEPA	High Efficiency Particulate Air
HiVol	High Volume
HSC	Health and Safety Coordinator

HSLO	Health and Safety Liaison Officer
HSO	Health and Safety Officer
HSP	EG&G Health and Safety Practices Manual
HSS	Health and Safety Specialist
HSST	Health and Safety Specialist in Training
IDLH	immediately dangerous to life and health
IHSS	individual hazard substance sites
IP	inhalable particles
Jacobs	Jacobs Engineering Group Inc.
JSA	job safety analysis
LEL	lower exposure limit
mg/l	milligrams per liter
mg/m	milligrams per meter
mg/m^3	milligrams per cubic meter
mg/m^2	milligrams per square meter
mm	millimeter
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
N/A	not applicable
NE	none given
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Health and Safety Administration
OU	Operable Unit
PA	Protected Area
pCi/g	picocuries per gram
PID	photoionization detector

PPE	personal protective equipment
ppm	parts per million
PRE	property/waste release evaluation
RCA	radiologically controlled area
RCRA	Resource Conservation and Recovery Act
RE	Radiological Engineering
REL	recommended exposure limit
RFP	Rocky Flats Plant
ROP	Radiological Operations Procedure
RWP	Radiological Work Permit
SOP	standard operating procedure
STEL	short-term exposure limit
TLV	threshold limit value
UEL	upper exposure limit
UNK	unknown
UV	ultraviolet
WARP	Well Abandonment and Replacement Program
WBGT	Wet-Bulb Globe Temperature
μCi/ml	microcuries per milliliter
μg/g	micrograms per gram
°F	degrees Fahrenheit

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1	3-8	Table 3-1	Add well numbers 24093, 24193, 24993, and 24393 to list of well abandonments.
2	3-8	Table 3-1	Add well numbers 11694 and 11794 to list of wells to be installed.
3	5-8	Table 5-4	Add Step (4), Multi-layer sampling with specific hazards and controls.
4	App. C	App. C	Add completed Appendix C tables for well numbers 24093, 24193, 24993, 24393, 11694, 11794.

12. Justification (Reason for Modification, EJO#, TP#, etc.)

Modification in WARP workplan requires modification in health and safety plan to reflect changes.

If modification is for a new procedure or a revision, list concurring disciplines in Block 13, and enter N/A in Blocks 14 and 15. If modification is for any type of change or a cancellation, organizations are listed in Block 13, then Concurror prints, and signs in Block 14, and dates in Block 15.

13. Organization	14. Print and Sign (if applicable)	15. Date (if applicable)
EOM	Tim Lovseth TP Lovseth	8/8/94
RE	Dave Hyder D S Hyder	8/9/94
IH	Peggy Schreckengast for PG Schreckengast	8/17/94
EQS	Mark Brooks	8-19-94
EOM	Keith D. Anderson for KD Anderson	8/9/94

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JUNE 11, 1991

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) presents requirements and guidelines for work specific to the implementation of the 1994 Well Abandonment and Replacement Program (WARP) for EG&G Rocky Flats, Inc. (EG&G) at the Rocky Flats Plant (RFP). It is in compliance with applicable sections of 29 Code of Federal Regulations (CFR) 1910.120, Hazardous Waste Operations and Emergency Response, and U.S. Department of Energy (DOE) Order 5480.11 Radiation Protection for Occupational Workers.

This HASP was prepared for employees of Jacobs Engineering Group Inc. (Jacobs) and its subcontractors and EG&G employees assigned to the project. This plan shall not be modified without written approval by the Project Manager or Corporate Health and Safety Manager (CHSM), the Program Health and Safety Manager, and EG&G as defined in the Environmental Restoration Health and Safety Program Plan. In addition, this plan will not be used by firms or persons not under contract to Jacobs without the written approval of Jacobs. This plan is not valid unless it is signed and dated by the Jacobs Project Manager, Program Health and Safety Manager, and CHSM.

2.0 HEALTH AND SAFETY PERSONNEL

2.1 INTRODUCTION

This section identifies personnel responsibilities for the management and implementation of this HASP. Figure 2-1 is an organization chart that includes health and safety personnel for the project.

2.1.1 Corporate Health and Safety Manager

The CHSM will provide oversight and review of activities conducted under this plan. CHSM duties include the following:

- review and approve significant changes and modifications to this plan;
- conduct audits on a periodic basis to ensure that the practices and procedures contained within this HASP are properly implemented;
- provide technical guidance as required;
- provide medical surveillance and health and safety records to the Program Health and Safety Manager; and
- provide final resolution for health and safety issues.

2.1.2 Program Health and Safety Manager

The Program Health and Safety Manager is responsible for ensuring that the policies and procedures of this HASP are implemented. This responsibility includes making certain that all personnel designated to work are qualified according to medical surveillance and health and safety training consistent with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120, DOE Order 5480.11 (DOE 1988), and EG&G site-specific training. Any significant changes to the HASP must be approved by the Program Health and Safety Manager. The Program Health and Safety Manager will investigate serious accidents onsite to determine causes and ways to prevent recurrence. The Program Health and Safety Manager will (1) review and approve the HASP; (2) ensure that all subcontractors comply with the specifications of this plan; (3) assist in planning, coordinating, and implementing project health and safety operations and services; (4) provide industrial hygiene/chemical safety and radiation safety guidance to the Health and Safety Specialist (HSS), and the Health and Safety Officer (HSO); (5) ensure that health and safety records are maintained and updated; (6) conduct regular site audits, including audits of subcontractors, to ensure compliance with the HASP; (7) help the site crews maintain the site in compliance with the HASP; (8) maintain a working knowledge of applicable federal and state safety and health standards; and (9) provide interpretation of those standards, when required.

The Program Health and Safety Manager is also responsible for ensuring that for all project activities conducted under this HASP, every reasonable effort will be made to limit radiation exposures of workers and the public, and releases of radioactive materials to the environment to levels that are as low as reasonably achievable (ALARA) in accordance with requirements set forth in DOE Orders 5400.5, 5480.11, and the DOE *Radiological Control Manual* (DOE 1994).

2.1.3 Jacobs Project Manager

The Jacobs Project Manager is responsible for overall operations during fieldwork onsite, including safety of personnel during site activities. The Project Manager is responsible for implementation of the HASP and protecting surrounding facilities and any potentially affected communities. These responsibilities are shared with the EG&G Project Manager. The Project Manager for the WARP project is identified in Figure 2-1.

The Project Manager's specific health and safety duties include the following:

- managing the development and implementation of the site-specific HASP;
- performing periodic onsite inspections to make certain that the HASP is being followed;
- coordinating with the HSS/HSO on health and safety matters;
- ensuring that resources are available for all health and safety requirements; and
- providing the appropriate monitoring and safety equipment necessary for implementing this HASP.

The Project Manager has the ability to authorize the following safety-related suspensions:

- temporary suspension of field activities if health and safety of personnel are endangered, pending an evaluation by the Program Health and Safety Manager; and

- temporary suspension of an individual from field activities for infractions of the HASP, pending an evaluation by the Program Health and Safety Manager.

2.1.4 Health and Safety Specialist/Health and Safety Officer

The EG&G title of HSS and the Jacobs title of HSO will be equivalent positions. EG&G's Radiological Engineering (RE) and Industrial Hygiene will make certain the Jacobs HSO meets the requirements for the position of HSS. Therefore, in this HASP, the title HSS/HSO is a combination of the two titles and refers to one position.

The HASP for the WARP at RFP is implemented by the HSS/HSO. The HSS/HSO and, ultimately, the Project Manager are responsible for the safe conduct of operations.

The HSS/HSO specific health and safety duties include the following:

- assisting the Project Manager and the Site Manager in implementing the HASP;
- reporting to the Program Health and Safety Manager on health and safety matters;
- providing a copy of the HASP to all field crews;
- assisting the Site Manager/Field Team Leaders with obtaining required health and safety equipment and maintaining equipment onsite;
- maintaining all site health and safety records and immediately reporting all safety-related incidents or accidents to the Project Manager;

- directing health and safety activities onsite and conducting staff training and orientation on these activities;
- ensuring that current medical clearance and training documentation is available;
- implementing radiological guidelines;
- monitoring compliance with the WARP HASP and conducting site audits;
- maintaining a copy of the Jacobs Standard Operating Procedures (SOPs) as contained in the Jacobs HASP;
- overseeing contamination exposure reduction;
- suspending work or otherwise limiting personnel exposures if this HASP appears to be unsuitable or inadequate, if the health or safety of personnel is endangered, or when he/she feels a work condition is radiologically unsafe.
- directing personnel to change work practices if existing practices are deemed to be hazardous to the health and safety of personnel;
- removing personnel from projects if their actions endanger their health and safety or the health and safety of coworkers, other workers, or the environment;
- overseeing personnel decontamination at each site;
- implementing emergency procedures as required;

- implementing radiological guidelines and coordinating and documenting activities to limit radiation exposures to levels that are ALARA; and

- monitoring and assuring that the HSST for the WARP is performing his/her duties correctly and is following all applicable procedures.

2.1.5 Site Manager

The Site Manager will be responsible for all administrative tasks at the facility. The duties of the Site Manager include (1) ensuring job site safety and implementing the HASP, (2) making certain that contract requirements are met, (3) informing facility personnel of activities that will be carried out in a particular month, (4) ensuring site permits are obtained before work begins at each site, (5) communicating with the project HSS/HSO about the schedule of work at the facility, and (6) verifying training/medical documentation and releases.

2.1.6 Health and Safety Specialist in Training

The Health and Safety Specialist in Training (HSST) will assist the HSS/HSO with implementing the HASP as deemed necessary by the Project Manager. The HSST's responsibilities are as follows:

- ensuring that each individual within the HSST's area of responsibility complies with the provisions of this plan, and documents safety practices;

- conducting prescreening for field radiological measurements to approve the area for fieldwork in Level D or modified Level D personal protective equipment (PPE) (An HSST

may only perform monitoring in an area that requires Level C or higher under the direct supervision of the HSS/HSO.);

- auditing safety practices used by onsite teams;
- providing onsite air monitoring for radiological and chemical contaminants during field activities (as required) using personal and real-time sampling instrumentation as outlined in this HASP;
- monitoring workers for heat or cold stress, and distributing health and safety equipment;
- communicating with command post for onsite activities;
- monitoring workers, equipment, and samples with radiation screening instruments; and
- initiating appropriate emergency procedures.

The HSST will have the authority to stop work in the case of an imminent safety hazard or potentially dangerous situation. After stopping work, the HSST will immediately consult with the HSS/HSO.

2.1.7 Subcontractors

Subcontractors will implement and follow this plan. The following specific responsibilities are included:

- Attend site-specific orientation and follow the requirements set forth in this plan.

- Provide to the HSS/HSO copies of Material Safety Data Sheets (MSDS) for all hazardous chemicals brought onsite.

- Provide copies of all training and medical authorizations required by 29 CFR 1910.120 to the HSS/HSO.

- Follow the direction of Jacobs health and safety personnel and take corrective actions on health and safety issues.

2.1.8 EG&G

The EG&G Health and Safety personnel and their responsibilities are listed below:

ENVIRONMENTAL RESTORATION H&S OFFICER (ERHSO) - Keith Anderson

The ERHSO's duties include the following:

- Manage and implement the Environmental Management Health and Safety Program.

- Ensure that a HASP is written for each Operable Unit (OU), and that subcontractors prepare site or task-specific HASPs.

- Provide support to Environmental Restoration Management (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.

HEALTH & SAFETY LIAISON OFFICER (HSLO) - Lisa Nelowet

The HSLO's duties include the following:

- Coordinate health and safety activities with the ERHSO and the ERM Site Project Managers.
- Supervise the EG&G Site H&S Coordinators (SHSC) at each OU.
- Coordinate health and safety guidance for hazardous waste operations in HWAs.
- Coordinate preparation and approval of HWA HASPs.
- Coordinate quarterly health and safety audits and inspections of health and safety programs and program documentations 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.

SITE HEALTH & SAFETY COORDINATOR - Cathy Scott

The Site Health and Safety Coordinator's duties include the following:

- 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, HSLO, and the ERHSO of health and safety violations at OUs.

- Provide health and safety support for EG&G employees.

3.0 FACILITY CHARACTERISTICS

The following text discusses the site description, history, and physical features.

3.1 SITE DESCRIPTION

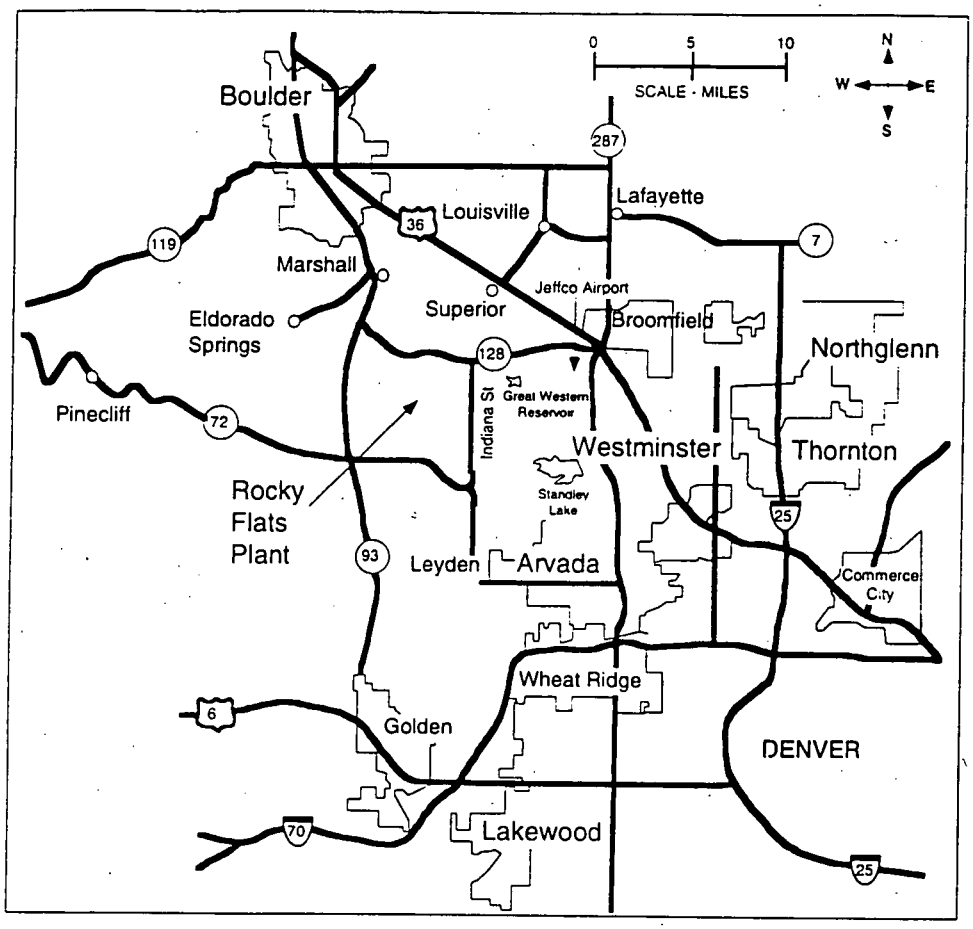
RFP is located northwest of Denver, Colorado. The plant consists of approximately 6,550 acres of federally owned land. Major process buildings are located within a Protected Area (PA) of approximately 400 acres. The PA is surrounded by a buffer zone of approximately 6,150 acres. The entire facility is bound by State Highway 93 on the west, State Highway 128 on the north, Indiana Street on the east, and State Highway 72 on the south.

The project's location in relation to the Denver area is shown in Figure 3-1. Major structures and roads are shown on the RFP General Map presented in Figure 3-2. Figure 3-3 is a map of RFP buildings and structures.

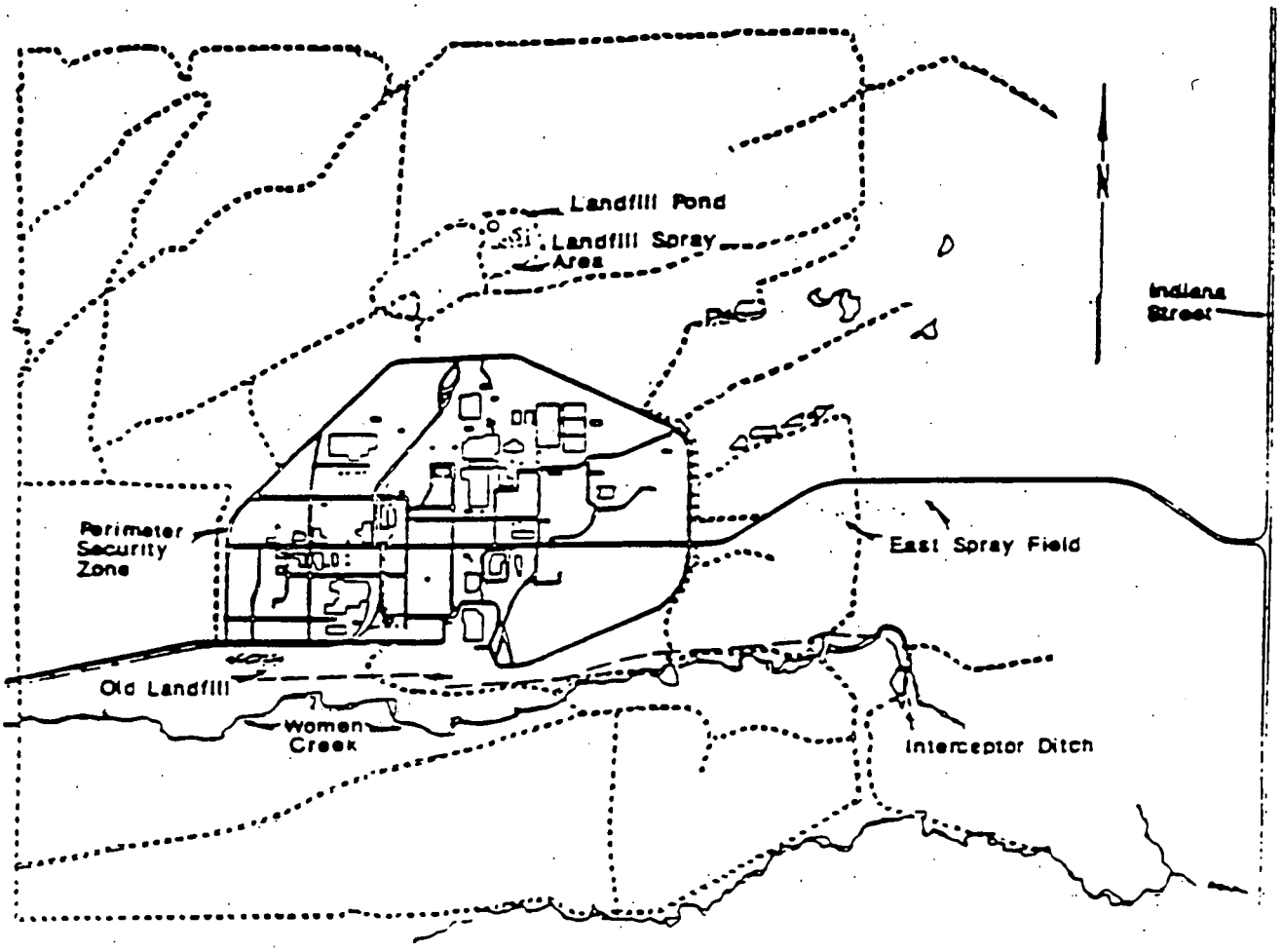
The wells to be abandoned, geophysically logged, and installed are located within the perimeter of RFP. Some of the WARP wells are located in areas of potential or known soil or groundwater contamination. Soil disturbance permits will be obtained for locations where intrusive work will be performed. Radiation Worker Permits will be obtained where required.

3.2 SITE HISTORY

RFP began operations in 1952 and is currently under the administration of DOE as part of the nationwide nuclear weapons development, production, and research complex. Primary production activities at the plant include fabrication of nuclear weapons components from beryllium, plutonium, stainless steel, and uranium; assembly of components; and chemical



JOB NO.: 05H60600	Figure 3-1 LOCATION MAP 1994 Well Abandonment and Replacement Program
PREPARED BY: K.W.	
DATE: 03/08/93	EG&G Rocky Flats Plant JACOBS ENGINEERING GROUP INC.



JOB NO.: 05H60600	Figure 3-2 GENERAL MAP
PREPARED BY: K.W.	1994 Well Abandonment and Replacement Program
DATE: 03/08/93	EG&G Rocky Flats Plant JACOBS ENGINEERING GROUP INC.

recovery and purification of recyclable transuranic radionuclides. The major classes of waste generated at the plant include hazardous waste, radioactive waste, low-level and transuranic mixed (radioactive and hazardous) waste, refuse, and sanitary waste.

Accidental releases of waste occurred during two major fires in 1957 and 1969; in 1974, when both plutonium and tritium were released into the air; and when cutting oil contaminated with plutonium leaked from corroded barrels stored outdoors.

The U.S. Environmental Protection Agency published the final decision to add RFP to the National Priorities List in the October 4, 1989 *Federal Register*. Cleanup at RFP is being conducted under two major environmental laws: (1) the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, better known as Superfund), which addresses inactive and radioactive areas at the plant; and (2) the Resource Conservation and Recovery Act (RCRA), which addresses past and active storage and disposal areas of the plant.

3.3 PHYSICAL FEATURES

The natural environment of RFP and vicinity is influenced primarily by its proximity to the Front Range of the Rocky Mountains. The plant is directly east of the Rocky Mountains at an elevation of approximately 6,000 feet above sea level. RFP is located on a broad, eastward-sloping plain of overlapping alluvial fans. These fans extend approximately 5 miles eastward from the Rocky Mountains. The Continental Divide is located approximately 16 miles west of the plant. The operational area of the plant is located near the eastern edge of the fans on a terrace between stream-cut valleys (North Walnut Creek and Woman Creek).

3.4 BIOLOGY

Animal life inhabiting RFP and its buffer zone consists of species associated with western prairie regions. These include a number of small carnivores such as coyote, red fox, striped skunk, and long-tailed weasel, which could be carriers of rabies. A profusion of small herbivores can be found throughout the plant site and buffer zone consisting of species such as the pocket gopher, white-tailed jackrabbit, and the meadow mole. Bull snakes and rattlesnakes are the most frequently observed reptiles. Eastern yellow-bellied racers and scorpions have also been seen, and western plains garter snakes are found in and around many of the ponds.

3.5 PROJECT DESCRIPTION

A WARP has been initiated by DOE under the direction of the Environmental Restoration Management (ERM) of EG&G. Jacobs has been contracted to perform the program in which selected wells will be abandoned or installed during fiscal year 1994.

Procedures exist for most of the tasks to be performed under this project. EG&G RFP procedures for field operations and geotechnical activities are in *Rocky Flats Plant Environmental Management Division Operating Procedures Manual, Volumes I and III*, respectively (EG&G 1994a; EG&G 1994b). Jacobs procedures are included in Appendix B. Jacobs and RFP SOPs are available at the Jacobs Denver office. RFP SOPs are also available at the EG&G Interlocken Library.

The scope of work for the WARP will include the following field activities: (1) abandoning 43 monitoring wells that have been determined to be no longer necessary or viable, (2) installing 16 groundwater monitoring wells, (3) geophysically logging/video taping 23 piezometers, and (4) land surveying the wells listed above. Soil samples will be collected from new boreholes

and waste characterization samples will be obtained from abandoned well materials that are contained in drums. Table 3-1 lists the well numbers, depth, and associated activity. Figure 3-4 shows the locations of the wells and boreholes in reference to the RFP area.

Many of the wells proposed for abandonment within the PA are in hard-to-access areas. Hazards are created by overhead pipelines, overhead electrical wiring, and building overhangs. Other hazards are created by subsurface utilities and the necessity to perform work in proximity to buildings. In outlying areas, uneven terrain and loose soils create hazards and make drill rig access difficult.

The specific tasks covered by the plan are as follows:

- traveling to and from monitoring well and borehole locations;
- conducting coring/drilling/abandoning at well locations;
- data collecting activities;
- geophysical borehole logging;
- well installation;
- surface soil sampling;
- land surveying;
- health and safety monitoring;
- personnel decontamination; and
- equipment decontamination.

This HASP does not include worker protection inside confined spaces or work inside buildings other than the field trailers. This plan only includes outdoor tasks performed during daylight hours.

TABLE 3-1
WELL ABANDONMENT AND REPLACEMENT SUMMARY

Well Installations	Well Abandonments		Geophysical Surveys and Downhole Video	Other Wells with Undefined Activities
Well Number	Well Number	Well Method	Well Number	
10094	0154	Pull	5074	To Be Developed (TBD)
10194	0254	Pull	5174	TBD
10294	0354	Pull	5274	TBD
10394	5070	Destroy Casing	5374	TBD
10494	5170	Abandon in Place	5474	TBD
10594	5270	Abandon in Place	5574	
10694	5370	No Action	5674	
10794	5470	No Action	5774	
10894	5570	Destroy Casing	5874	
10994	5670	Pull	5974	
11094	5071	Abandon in Place	6074	
11194	5171	Pull	6174	
11294	5271	Abandon in Place	6274	
11394	5371	No Action	6374	
11494	5471	No Action	6474	
11594	5571	No Action	6574	
11894	5671	Abandon in Place	6674	
11994	5771	Abandon in Place	6774	
11694	5871	Abandon in Place	B302989	
11794	5971	Abandon in Place	35691	
	6071	Abandon in Place	TBD	
	6271	Abandon in Place	TBD	
	6874	Destroy Casing	TBD	
	0587	Abandon in Place		
	4087	Abandon in Place		
	0188	Abandon in Place		
	0288	Abandon in Place		
	0388	Abandon in Place		
	0488	Abandon in Place		
	0588	Abandon in Place		
	0688	Abandon in Place		
	0788	Abandon in Place		
	0888	Abandon in Place		

TABLE 3-1
WELL ABANDONMENT AND REPLACEMENT SUMMARY

Well Installations	Well Abandonments		Geophysical Surveys and Downhole Video	Other Wells with Undefined Activities
Well Number	Well Number	Well Method	Well Number	
	0988	Abandon in Place		
	1088	Abandon in Place		
	45091	Abandon in Place		
	45191	Abandon in Place		
	45291	Abandon in Place		
	42893	Abandon in Place		
	24093	Pull		
	24193	Pull		
	24993	Pull		
	24393	Pull		

Note: If the TBD wells with undefined activities are in IHSSs not discussed in this HASP, the plan must be revised before activities are performed.

4.0 GENERAL HEALTH AND SAFETY REQUIREMENTS

4.1 PERSONNEL TRAINING REQUIREMENTS

All site personnel are required to be trained in accordance with the 29 CFR 1910.120 regulation covering Hazardous Waste Operations and Emergency Response and DOE Order 5480.11 (DOE 1988), Radiation Protection for Occupational Workers.

4.1.1 Supervisor Training

The HSS/HSO and Site Manager must complete the basic 40-hour training course; three days of on-the-job training; first aid training; and at least eight hours of supervisor training, which is specialized training for managing hazardous waste operations. The eight hours of specialized training will include instruction covering the Jacobs health and safety program, employee training program, PPE program, spill containment procedures, and health hazard monitoring procedures and techniques.

4.1.2 Preassignment Training

All field employees must complete the 40-hour basic health and safety training required under 29 CFR 1910.120 and an eight-hour annual refresher training course thereafter. Certificates verifying completion of these training courses will be maintained in the health and safety files for each individual working onsite.

4.1.3 First Aid and Cardiopulmonary Resuscitation Training

At least one site employee must have first aid and cardiopulmonary resuscitation (CPR) training consistent with the requirements of the American Red Cross Association, and blood-borne pathogens control training.

4.1.4 Three-Day On-The-Job Training

All employees will be required to receive a minimum of three days of on-the-job training documented by an experienced supervisor. This training will include, but is not limited to, the following:

- work practices by which the employee can minimize the risk from hazards;
- a site orientation tour;
- identification of Contamination Reduction and Exclusion Zones;
- identification of potential hazards associated with the performance of tasks assigned to the individual;
- applicable hazard mitigation requirements; and
- emergency procedures including location and use of emergency communications, first aid, spill procedures, fire equipment, and eyewash.

Supervised onsite training time will be documented in the Site Manager's logbook and on a data sheet to be kept in the individual's onsite health and safety file. A copy will be forwarded to K. Ohara, Health and Safety Administrator in the Jacobs Corporate Health and Safety Office.

4.1.5 Site-Specific Safety Orientation Meeting

A site-specific safety orientation meeting will be conducted for all field employees, including subcontractors, before starting field or laboratory activities. The following topics will be discussed at this meeting:

- names of health and safety personnel and alternates responsible for site health and safety;
- health and safety organization;
- locations where the site-specific health and safety plan can be found;
- hazards at the site;
- hazard communication program;
- exposure risk;
- PPE to be used;
- personnel and equipment decontamination procedures;
- air monitoring; and
- emergency procedures.

All field personnel must be provided a copy of this HASP and are responsible for reading it. At the end of the meeting, attendants will be informally quizzed to assess their understanding of the health and safety requirements. In addition, they will sign a safety compliance agreement form stating that they have read, understand, and agree to comply with the provisions of the HASP. Anyone refusing to sign the form will be prohibited from working at the site.

When a new employee has been assigned to the site, the HSS/HSO must present a similar briefing to the new employee before he or she participates in any field activities. All new employees must sign the safety compliance agreement form before beginning fieldwork at RFP.

4.1.6 EG&G Training

Before beginning work on WARP sites, all site personnel must receive the appropriate training provided by EG&G that is discussed in the following sections.

4.1.6.1 Radiation Training

Before beginning work on WARP sites, all site personnel who perform fieldwork at RFP must successfully complete the Radiation Worker Training Course (or equivalent) provided by EG&G. The training will be commensurate with job assignments and in accordance with DOE Order 5480.11 (DOE 1988) requirements. The DOE *Radiological Control Manual* (DOE 1994) may be an additional reference for radiation training requirements.

4.1.6.2 General Employment Training

Before beginning work on WARP sites, all Jacobs employees and subcontractors who perform fieldwork at RFP must successfully complete the eight-hour Site Orientation General Employee Training Course provided by EG&G.

4.1.6.3 Site Visitors

Site visitors may include EG&G personnel, regulators, or other people who wish to observe the fieldwork with the permission of the EG&G WARP Project Manager. Access to the site by visitors not directly involved with routine integrated operations will be restricted as follows:

- All site visitors must sign in at a site security station located at the site boundary or give their names to the site geologist and HSS/HSO, who will record them in log books (permanent field record).

- All site visitors must be cleared at the site security station by the Site Manager or the EG&G WARP Project Manager before obtaining access to the Support Zone.

- Site visitors entering the Exclusion Zone will be strictly limited. The Site Manager and HSO/HSS must approve entry, and the visitor must provide medical, training, and fit test documentation.

- All visitors will receive a site-specific safety briefing and will be escorted to sites. Visitors in areas requiring Level A or B PPE will not be allowed. Visitors in areas requiring Level C PPE must have 24-hour OSHA with eight-hour annual refresher training, site-specific health and safety training, a current fit test, and the Project Managers' and Health and Safety Coordinator's concurrence in addition to the requirements already listed.

- All site visitor access must be clearly documented, and visitors must comply with all provisions of the 1994 WARP HASP.

4.1.7 Record Keeping

Original records required by 29 CFR 1910.120 are maintained in the Jacobs Corporate Health and Safety Office and the Jacobs support trailers. The Site Manager is responsible for verifying required training, medical monitoring, and maintaining auditable copies of the records at RFP. This information can be verified on the Health and Safety Training and Medical Monitoring Summary Wallet Card or Health and Safety Training and Medical Monitoring Summary Report carried by the employee. Copies of current motor vehicle licenses will also be maintained for all personnel operating motor vehicles.

4.2 MEDICAL MONITORING

All field employees will be active participants in the medical monitoring program. All medical examinations will be performed by or under the supervision of an occupational physician approved by Jacobs. The medical monitoring program is described in the Jacobs SOP 1.1, Medical Monitoring Program (Appendix A). Radiological exposure monitoring will be conducted in accordance with the requirements of DOE Order 5480.11 (DOE 1988) and the procedural guidance (or equivalent) in EG&G *Health and Safety Practices Manual* (HSP) (EG&G 1994c) HSP 4.05, Access to Employee Medical and Exposure Records; HSP 18.07, External Radiation Dosimetry; and HSP 18.19, Criteria and Actions for Potential Intakes.

4.2.1 Baseline Examination

Before being assigned to a hazardous or a potentially hazardous activity involving exposure to toxic materials, each employee must receive a baseline examination. The examination is intended to determine whether the employee is able to perform his or her job without undue risk to himself or herself, fellow employees, or to the public; and to provide a baseline against which

future examinations can be measured. Specific elements of the examination are detailed in SOP 1.1 (Appendix A). A "fit for work duty" medical clearance and a clearance to wear a respirator are required for fieldwork.

4.2.2 Annual Examinations

Each individual will receive an interim medical review or periodic medical examination annually as designated by the CHSM. These examinations are to be used for comparison with the baseline examination to detect any early indication of changes in health status, whether work related or of a nonoccupational origin. These examinations will also be performed when an overexposure may have occurred or when an employee exhibits symptoms of overexposure.

The interim medical review includes an interim questionnaire, updated Hazardous Materials and Site Activity report, and laboratory analysis to compare with the baseline examination. The physician may request approval from the CHSM for special examination procedures for additional testing if he or she finds it necessary. The interim medical review will be given the first year after the baseline examination and every other year thereafter. Specific protocol for this examination is listed in SOP 1.1 (Appendix A).

The periodic medical examination includes a thorough examination similar to the baseline examination but not including an electrocardiogram or chest X-ray, except where noted. The periodic medical examination will be given the second year after the baseline examination and biennially thereafter. Specific protocol for this examination is listed in SOP 1.1 (Appendix A).

A baseline bioassay program will be implemented. Jacobs and its subcontractors will follow Section 5.7 of HSP 18.20 which establishes baseline bioassay requirements. Note that the "Contract Coordinator" and RE are responsible for determining the requirements for baseline

bioassay. For "special projects," the RWP will specify the requirement. It is understood that EG&G Internal Dosimetry department will provide the necessary medical, laboratory, tracking, and notification services.

4.2.3 Exit Examination

Enrollment in the medical monitoring program will end when the employee terminates the program or the company. At that time, an exit examination for the employee is required. The exit examination is identical to the baseline examination except it does not include the respirator fit test. Specific protocol for this examination is listed in SOP No. 1.1 (Appendix A). The CHSM must be contacted with any requests for waivers.

5.0 HAZARD EVALUATION

The activities included in this HASP present potential chemical, physical, radiological, and biological exposure hazards, which may be encountered during the conduct of work at RFP. The following sections discuss those hazards and means of controlling them.

5.1 HAZARD ASSESSMENT

The potential hazards for chemicals of concern are discussed in this section. These chemicals are located primarily within the soils and groundwater in the areas to be investigated.

Historical information was obtained from the RFP *Historical Release Report* (EG&G 1992) and data furnished to Jacobs by the EG&G 1994 WARP Project Manager, including previous groundwater sampling data.

A summary of suspected contaminants of concern along with OSHA, American Conference of Government Industrial Hygienists, and National Institute of Occupational Safety and Health (NIOSH) exposure limits for each contaminant of concern are presented in Table 5-1. Table 5-2 presents the target organs, routes of expected exposure, and acute and chronic overexposure symptoms. Table 5-3 provides the same information for radionuclides. For ease of employee use, all information is presented in tabular format.

5.2 PROJECT TASK ANALYSIS

To generate the analysis for the WARP, the following assumptions were used to qualify the magnitude of the chemical and radiological hazards:

TABLE 5-1
CHEMICAL HAZARD SUMMARY

CHEMICAL NAME	OSHA PEL (ppm)	ACGIH TLV (ppm)	NIOSH REL (ppm)	STEL (ppm)	CEILING (ppm)	IDLH (ppm)	SKIN NOTA-TION	IP (eV)	BOILING POINT (°F)	VAPOR PRESSURE (mm)	FLASH POINT (°F)	UEL (%)	LEL (%)
Chloroform (Trichloromethane)			(A)	2		1,000		11.42	143	160	N/A	N/A	N/A
Carbon Tetrachloride		5 (B)	(A)	2		300	X	11.47	170	91	N/A	N/A	N/A
PCBs (Arochlor-1260)		0.5 mg/m3	.001 mg/m3 (A)			5 mg/m3 (A)	X	UNK	689-734	.00006	UNK	UNK	UNK
Beryllium	.002 mg/m3		(A)		.025 mg/m3	10 mg/m3		N/A	4532	1	N/A	N/A	N/A
Chromium	1 mg/m3		1 mg/m3			NE		N/A	4788	0	N/A	N/A	N/A

NOTES:

Units are as specified in the column headings unless otherwise noted.
(A) NIOSH Identified Carcinogen
(B) ACGIH Carcinogen

ABBREVIATIONS/ACRONYMS:

ACGIH = American Conference of Government Industrial Hygienists
eV = electron volt
IDLH = Immediately Dangerous to Life or Health
IP = Inhalable Particles
LEL = Lower Exposure Limit
mg/m3 = milligrams per cubic meter
mm = millimeters
N/A = not applicable
NE = none given
NIOSH = National Institute of Occupational Safety and Health
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Limit
ppm = parts per million
REL = Recommended Exposure Limit
STEL = Short-term Exposure Limit
TLV = Threshold Limit Value
UEL = Upper Exposure Limit
UNK = unknown
°F = degrees Fahrenheit

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TABLE 5–2
OVEREXPOSURE SYMPTOMS

CHEMICAL NAME	TARGET ORGANS	ROUTES OF EXPOSURE	IRRITANT	ACUTE OVEREXPOSURE SYMPTOMS INCLUDE:	CHRONIC OVEREXPOSURE SYMPTOMS INCLUDE:
Chloroform	Liver, Kidneys, Heart, Eyes, Skin	Inhalation, Contact	X	Dizziness, mental dullness, nausea, headache, and fatigue. Anesthesia.	Liver damage. An experimental teratogen and tumorigenic agent.
Beryllium	Lungs, Skin, Respiratory System	Inhalation, Contact	X	Weakness, skin eruption, pulmonary edema, skin ulcers, and rhinitis.	Berylliosis; an experimental carcinogen; neoplastigen and tumorigen.
Carbon Tetrachloride	CNS, Eyes, Lungs, Liver, Kidneys, Skin	Inhalation, Absorption, Contact	X	CNS depression, nausea, vomiting, headache, dizziness, and confusion.	Liver, lung, and kidney damage. Dermatitis and cancer.
Chromium (metal)	Respiratory System	Inhalation		Fibrosis of lungs.	An experimental tumorigen and carcinogen.
PCBs (Arochlor–1260)	Skin, Eyes, Liver	Inhalation, Absorption, Contact	X	Acne, dermatitis.	Liver damage.

NOTES:

CNS = Central Nervous System
PCBs = polychlorinated biphenyls

Recycled

TABLE 5–3
RADIONUCLIDE HAZARD SUMMARY

	Matrix	OSHA PEL (1)	ACGIH TLV (2)	NIOSH REL (3)	STEL	IDLH	BOILING POINT (°F)	VAPOR PRESSURE (mm)	DAC (μCi/ml)
Americium(4)(5)	S	–	–	–	–	–	2,607	N/A	2E–12
Plutonium(4)(5)	S	–	–	–	–	–	3,232	N/A	2E–12
Tritium(6)	S/W	–	–	–	–	–	212	1 mm @ 34 °F	2E–05
Uranium(4)(7)	S	.2 mg/m3	.2 mg/m3	.2 mg/m3	.6 mg/m3	30 mg/m3	3,818	N/A	2E–11

NOTES:

(1) OSHA Exposure Limit
(2) ACGIH Exposure Limit
(3) NIOSH Exposure Limit
(4) 1 μm AMAD particles
(5) Lung Retention Class W
(6) HTO
(7) Lung Retention Class Y

ACGIH = American Conference of Government Industrial Hygienists
atm = atmosphere
DAC = Derived Air Concentration
IDLH = Immediately Dangerous to Life or Health
LEL = Lower Explosive Limit
mg/m3 = milligrams per cubic meter
mm = millimeter
NIOSH = National Institute of Occupational Safety and Health
N/A = not applicable
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Limit
ppm = parts per million
S = soil
STEL = Short–Term Exposure Limit
TLV = Threshold Limit Value
UEL = Upper Explosive Limit
W = water
°F = degrees Fahrenheit
μCi/ml = microcuries per milliliter

TABLE 5-4
TASK HAZARD ANALYSIS
(continued)

Step	Hazard	Controls
(2) Borehole geophysical logging	Use of radioactive source tools	Monitoring per Section 6.0.
	Contact with potentially contaminated groundwater and soils	Personnel will use PPE as required by Section 8.0.
	Additional hazards as listed in Step 1	Controls as provided in Step 1.
(3) Equipment decontamination	Contact with potentially contaminated rinse water	Personnel will use PPE as required by Section 8.0.
	Additional hazards as listed in Step 1	Controls as provided in Step 1.
	Radioactive contamination	Screening for release per Section 6.0.
	High pressure steam cleaning	Personnel will use PPE as required in Section 8.0.
		Attend Main Decontamination Facility Standard Operating Procedure Training.
		Follow instruction provided by the sub-contractor operating the decontamination facility.
(4) Multi-layer sampling	Exposure to airborne radioactive and chemical contaminants	Real-time and integrated sampling per subsections of Section 6.0.
	Contact with potentially contaminated groundwater	Personnel will use PPE given in Section 8.0.
	Mechanical hazards operating winch	Heavy equipment procedures per Section 5.4.1.

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TABLE 5-4
TASK HAZARD ANALYSIS
(continued)

Step	Hazard	Controls
	Pedestrian traffic	Site control will be maintained per Section 7.0.
	Aboveground utilities	Utility clearance will be maintained per Section 5.4.2.
	Manual material handling	Personnel will follow safe lifting practices per Section 5.4.5.
	Heat stress	Heat stress monitoring per Section 5.4.9.1.
	Cold stress	Cold stress monitoring per Section 5.4.9.2.

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- The work to be conducted under this HASP is in open areas with no impediments to natural ventilation. Exceptions to this assumption include those activities conducted adjacent to buildings.

- All engineering, PPE, and procedural requirements will be followed and enforced to limit radiation exposure to ALARA and chemical exposure not to exceed the levels in Table 5-1.

- Inhalation and dermal contact with contaminated particulates resuspended in the atmosphere, either by work conducted under this plan or natural forces, will be the primary routes of exposure for chemical contaminants and alpha radiation. Airborne alpha radioactivity will be sampled during work activities. If sampling results are equal to or greater than 10 percent of the derived-air concentration (DAC) defined in DOE 5480.11 and the DOE Radiation Control Manual, actions to be taken will be determined with EG&G RE.

- Alpha, beta, and gamma radiation levels will be noted during preactivity surveys. If levels of each type of radiation are within acceptable limits as defined in DOE 5480.11 and the DOE Radiation Control Manual, work will proceed unimpeded. Actions to be taken when unacceptable radiation levels are noted will be determined in conjunction with EG&G RE.

5.3 TASK HAZARD ANALYSIS

Following is a discussion of hazards associated with tasks to be performed under this plan. The discussion is presented in Table 5-4. Tasks have been separated into discrete steps and for each step identified, hazards and corresponding hazard control methods are listed. Hazards associated with individual industrial hazardous substance sites (IHSSs) and activities, as well as other health and safety issues, will be reviewed in daily tailgate safety meetings.

5.4 PHYSICAL HAZARDS

Potential physical hazards associated with field activities at the site include heavy equipment; electrical; utilities; noise; lifting; slips, trips, and falls; splashes and spills; precariously positioned objects; heat and cold stress; ultraviolet light; adverse weather; confined space entry; and illumination. The following sections outline the methods of control to be used for the hazards associated with the WARP.

5.4.1 Heavy Equipment

Heavy equipment, primarily drill rigs, used onsite is under the direct control of the subcontractor performing the work. The subcontractors will provide a copy of their company's Health and Safety Program Plan to the site HSS/HSO, as stated in the subcontract. The subcontractor is responsible for maintaining the equipment in good working order and operating it safely. All heavy equipment will have audible backup alarms in working condition, moving parts will be guarded, and hydraulics and rigging will be in good condition. Jacobs personnel will not work near equipment judged to be unsafe because of deterioration, missing parts, obvious defects, or improper operation. Jacobs personnel will report any unsafe condition to the HSS/HSO or the Site Manager. The HSS/HSO is responsible for ensuring that the subcontractor promptly corrects reported problems. Drill rig operation will be discussed in daily safety meetings (required by EG&G Construction Management) to include the location of "Kill Switches."

The subcontractor will be responsible for making provisions to ensure the safety of the equipment operator and other personnel operating equipment in areas with steep embankments or unstable ground. Operation of heavy equipment in such areas will be avoided whenever possible.

TABLE 5-4
TASK HAZARD ANALYSIS

Step	Hazard	Controls
(1) Piezometric and well installation/abandonment	Exposure to airborne radioactive and chemical contaminants	Real-time and integrated sampling per subsections of Section 6.0.
	Dermal contact with radioactively and chemically contaminated soil and water	Personnel will use PPE given in Section 8.0.
	Mechanical and hydraulic hazards	Heavy equipment procedures per Section 5.4.1.
	Noise exposure	Noise monitoring will be conducted and hearing protection provided as needed per Section 6.5.
	Vehicular and pedestrian traffic	Site control will be maintained per Section 7.0.
	Electrical	Clearances will be maintained per Section 5.4.2.
	Underground and aboveground utilities	Utility clearance will be performed per Section 5.4.3.
	Manual material handling	Personnel will follow safe lifting practices per Section 5.4.5.
	Falling objects	Hard hats, steel-toed boots, and safety glasses will be worn per Section 8.0.
	Heat stress	Heat stress monitoring per Section 5.4.9.1.
	Cold stress	Cold stress monitoring per Section 5.4.9.2.

TABLE 5-4
TASK HAZARD ANALYSIS
(continued)

Step	Hazard	Controls
(2) Borehole geophysical logging	Use of radioactive source tools Contact with potentially contaminated groundwater and soils Additional hazards as listed in Step 1	Monitoring per Section 6.0. Personnel will use PPE as required by Section 8.0. Controls as provided in Step 1.
(3) Equipment decontamination	Contact with potentially contaminated rinse water Additional hazards as listed in Step 1 Radioactive contamination	Personnel will use PPE as required by Section 8.0. Controls as provided in Step 1. Screening for release per Section 6.0.
	High pressure steam cleaning	Personnel will use PPE as required in Section 8.0. Attend Main Decontamination Facility Standard Operating Procedure Training. Follow instruction provided by the sub-contractor operating the decontamination facility.

Drilling activities involve a number of hazards including, but not limited to, the following: injuries from flying debris, being caught in machinery, hydraulic failures, unguarded points of operation, airborne particulates, equipment rollover, and other hazards associated with the transportation and use of drill rigs. The Jacobs SOPs for drilling equipment are included in Appendix B. All drilling equipment will undergo an OSHA inspection by EG&G Occupational Safety before use in the field.

5.4.2 Electrical

Aboveground electrical lines may present a hazard to team members during field activities. A safe distance (minimum of one mast length) from overhead lines must be maintained at all times. If overhead lines are encountered, EG&G Occupational Safety or Construction Management will be contacted for guidance on EG&G acceptable clearance distance. However, minimum distances will be determined by OSHA and the *Jacobs Safety Manual,* Section 10, General Work Practices (Jacobs 1991). Belowground electrical lines should not pose a hazard as long as the excavation or drilling permit is obtained through the correct process. All hard-line electrical outlets will require a ground fault circuit interrupter.

5.4.3 Other Underground and Aboveground Utilities

Utility lines and gas pipelines, both underground and aboveground, may pose a safety hazard to team members. Workers must not rest on any pipelines or place any equipment on the pipelines at any time. The location of utility lines must be determined before hand augering. This will be done by EG&G Construction Management. A soil disturbance permit or land use permit is issued to confirm this. No hand augering or soil-gas survey will take place before identification of underground utility lines in conjunction with EG&G RFP personnel (EG&G excavation specialist) and appropriate representative(s) of the utility company(ies). All lines will

be considered live unless proven otherwise. Utility clearance will be completed before work begins at each hand-augering site or soil-gas sampling location. The Jacobs SOP for utility clearance (SOP 7.7), which uses hand augering to confirm the absence of buried utilities, will be used as directed by the HSS/HSO. A copy of the Jacobs SOP 7.7 is provided in Appendix B.

5.4.4 Noise

The main sources of noise for this project are concrete saws/corers, heavy equipment, vehicles, and electric generators. Sound level monitoring equipment will be used during operations to determine actual noise levels. The personal exposure limit for noise is 85 decibels on the A-weighted scale (dBA). Hearing protection will be used when noise levels are greater than 85 dBA. Employees will participate in the Jacobs Hearing Conservation program defined in the Jacobs Hearing Protection Conservation Policy (Appendix B).

5.4.5 Safe Lifting

Improper lifting can result in injuries to the person performing the lift as well as damage to property and equipment. To prevent injuries and property damage from occurring, the following practices shall be followed:

- Lifting shall be performed with the back in a natural position, the load positioned close to the body, using the legs to lift.

- When objects weigh more than 60 pounds, two or more people shall perform the lift or material handling equipment shall be used.

- Lifting or "weight" belts shall be used when performing repeated or heavy lifting.

- Lifting techniques and practices will be discussed during site orientations and repeated during safety briefings as needed.

5.4.6 Slips, Trips, and Falls

During the course of the project, hazards that could result in slips, trips, and falls will be present. Examples of slip, trip, and fall hazards include walking in areas with uneven open terrain and areas with trash and clutter or other obstacles. The following subsections detail these hazards and provide the practices to be followed for controlling each type.

5.4.6.1 Walking and Working in Open Terrain

Typical hazards found in open work areas include the following:

- holes, small ditches, and mounds of soil;
- vegetation clumps;
- trash and debris;
- tools and equipment; and
- ice, snow, mud, or other slippery surfaces.

To prevent injury caused by inadvertent encounters with the above hazards, the following practices shall be followed:

- Upon arrival at a worksite, the area will be inspected to identify tripping or slipping hazards.

- Upon identification, identified tripping and slipping hazards shall be moved, as practical, from the work area or be conspicuously marked.

- Marked hazards will be reviewed with other members of the field crew.

- Good housekeeping with personnel cleaning as work progresses will be practiced to prevent tripping over tools, equipment, or trash.

- Footwear appropriate for site conditions will be worn.

5.4.6.2 Housekeeping

Daily housekeeping shall be performed to remove trash and clutter. To perform housekeeping duties, the following practices shall be followed:

- Work areas and sites shall be kept free of trash and clutter as work progresses through each day.

- The Site Manager shall schedule weekly or daily housekeeping duties as necessary to maintain work areas and keep the support site free of clutter or trash.

- Building exits, fire extinguishers, electrical disconnects, and breaker boxes shall be maintained free of obstructions. When observed, obstructions shall be removed immediately.

- Chemicals, samples, or other hazardous substances are prohibited within eating and drinking areas.

- Trash containing food or other similarly spoilable refuse shall be bagged and disposed of daily.

- Snow and ice shall be removed daily or more often, as necessary, from steps, walkways, porches, and other areas before the area is used.

5.4.7 Splashes and Spills

Field personnel will wear appropriate PPE as described in Section 8.0 of this HASP to prevent potential dermal exposure to accidental splashes and spills that may occur during drilling and decontamination activities.

Spill Control. Precautionary measures (e.g., polyfilm, dike, berm) will be taken to contain spills as part of site preparation. A supply of spill control materials and equipment, such as sorbent material, shovels, drums, and plugs, will be maintained onsite. All personnel have received training in spill control and emergency response as part of the required 40-hour training.

5.4.8 Precariously Positioned Objects

Field personnel will become familiar with the general area and the potential physical hazards that would be associated with debris or objects that may be piled or scattered around the sites. If objects are stacked in an unsafe manner, the HSS/HSO will notify the EG&G Contractor's Technical Representative (CTR). Field activities will not begin until facility personnel remove or restack the objects in a safe manner.

5.4.9 Heat and Cold Stress

Season-dependent heat and cold stress are anticipated hazards for the work performed at RFP.

5.4.9.1 Heat Stress

Site employees must learn to recognize and treat various forms of heat stress through preventive heat stress management, especially when higher levels of PPE are required. In temperatures above 75 degrees Fahrenheit (°F), the following rules shall be followed and will be monitored by the HSS/HSO:

- Have workers drink 16 ounces of water before beginning work (e.g., in the morning or after lunch). Provide disposable, 4-ounce cups and water that is maintained at 50 to 60°F. Urge workers to drink 1 to 2 cups of water every 20 minutes, for a total of 1 to 2 gallons per day. Provide a cool area for rest breaks. Discourage consumption of alcohol during nonworking hours, and discourage the intake of coffee during working hours. Monitor for signs of heat stress.

- Acclimate workers to site work conditions by slowly increasing workloads (i.e., do not begin site work with extremely demanding activities).

- Ensure that adequate shelter is available to protect personnel against heat, which can decrease physical efficiency and increase the probability of heat stress. If possible, set up the command post in the shade.

The following are examples of heat-related stress that may be encountered:

- Heat rash is caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Symptoms include a decreased ability to tolerate heat and obvious signs of discomfort.

- Heat cramps are caused by profuse perspiration with inadequate fluid intake and salt replacement. Symptoms include muscle spasm and pain in the extremities and abdomen.

- Heat exhaustion is caused by increased stress on various organs to meet increased demands to cool the body. Signs and symptoms include shallow breathing; pale, cool, moist skin; profuse sweating; dizziness; and lassitude.

- Heat stroke is the most severe form of heat stress. The body must be cooled immediately to prevent severe injury or death. Symptoms include red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; and coma.

Heat Stress Monitoring and Work Cycle Management. For strenuous field activities that are part of ongoing site work activities in hot weather, the following procedures will be used to monitor the body's physical response to heat and manage the work cycle, even if workers are not wearing impervious clothing. These procedures are instituted when the temperature exceeds 70°F.

Work-rest regimes are based on ambient temperature and level of protective equipment worn. A Wet-Bulb Globe Temperature (WBGT) index will be calculated for Level D applications. Unfortunately this index is neither valuable nor valid when higher levels of protection are worn. The following physiologic parameters will be used in these cases.

Heart rate is measured by monitoring the radial pulse for 30 seconds as early as possible in the resting period. The heart rate at the beginning of the rest period should not exceed 110 beats per minute. If the heart rate is higher, the next work period is shortened 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats per minute at the beginning of the next rest period, the following work cycle is further shortened by 33 percent. The procedure is continued until the rate is maintained below 110 beats per minute.

Procedures for heat stress monitoring are found in the Jacobs SOP 7.1 (Appendix B).

5.4.9.2 Cold Stress

Cold injury (frostbite and hypothermia) and the impaired ability to work are dangers at low temperatures when the wind-chill factor is high. Persons working outdoors in temperatures at or below freezing may become frostbitten. Extreme cold for a short time may cause injury to the surface of the body, or result in profound generalized cooling. Areas of the body that have high surface-area-to-volume ratios such as fingers, toes, and ears, are the most susceptible.

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized in the following manner:

- Frost nip or incipient frostbite: characterized by sudden blanching or whitening of skin.
- Superficial frostbite: skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- Deep frostbite: tissues are cold, pale, and solid. These symptoms indicate an extremely serious injury.

Systemic hypothermia is caused by exposure to cool or cold temperatures causing a drop in body core temperatures. Symptoms of systemic hypothermia include: shivering, apathy, listlessness, sleepiness, cooling of the body core temperature, unconsciousness, glassy stare, slow pulse, and slow respiratory rate.

One or more of the following recommendations will help reduce cold stress:

- Install heaters in the Support Zone and/or onsite trailers to provide a warming area for response personnel.
- Dry coveralls will be available in the event worker clothing becomes wet.
- Provide warm sweet drinks and/or soups at the work site to provide caloric intake and fluid volume. Note, the intake of coffee should be limited because of diuretic and circulatory effects.
- Carefully schedule work and rest periods.
- Monitor workers' physical conditions.

Procedures for cold stress monitoring are found in the Jacobs SOP 7.2 (Appendix B).

5.4.10 Ultraviolet Light

The sun emits ultraviolet (UV) radiation that may be harmful to human skin in excessive amounts. The skin's natural defense mechanisms attempt to reject the UV radiation by distributing melanin pigmentation where needed. However, overexposure to direct sunlight can

cause inflammation or blistering of the skin (sunburn). The use of sunscreen barrier creams, long-sleeved shirts, and wide-brimmed hats can help prevent sunburn. Chronic exposure to UV radiation is known to cause skin cancer. In case of sunburn, do not apply burn ointment, cold cream, or butter to relieve pain. Use a dry dressing and get medical attention for severe, blistered, and extensive burns.

5.4.11 Adverse Weather

In the event of adverse weather, the Site Manager and HSS/HSO will determine whether work can continue without compromising the health and safety of site personnel. Some of the items to be considered before determining whether work should continue include the following:

- high winds;
- heavy rainfall or hail;
- potential for heat stress;
- potential for cold stress;
- tornadoes;
- limited visibility;
- electrical storms;
- potential for accidents; and
- the malfunctioning of monitoring equipment.

Electrical storms commonly occur in the Denver region during spring, summer, and fall. The resulting lightning poses a safety hazard to field personnel. Because the storms are often fast moving, field personnel should watch for indications of electrical storms (weather forecasts should be discussed in the daily health and safety meeting). The distance to an electrical storm can be estimated by observing the interval between the lightning flash and the sound of thunder.

Because sound travels approximately 1,100 feet per second, an interval of five seconds corresponds to a storm distance of approximately 1 mile. If an electrical storm is observed within 3 miles of the site, field personnel should stop outside activities and proceed to the site office for further instructions. If caught in the open during an electrical storm, all personnel will immediately seek shelter in their vehicle and return to the field office. In the event that vehicles are inaccessible, personnel will move to a topographically low area away from tall objects and conductors (e.g., transformers, power lines, metal sheds) and wait for the storm to leave the area.

Thunderstorms and Tornadoes. Meteorological conditions will be closely watched, especially in the spring when severe thunderstorms and tornadoes are most likely to occur. Thunderstorms and tornadoes often occur late in the afternoon on hot spring days but can occur at any time of the day in any season of the year. Tornadoes are usually preceded by severe thunderstorms with frequent lightning, heavy rains, and strong winds.

A severe thunderstorm watch or a tornado watch announcement on radio or television indicates that a severe thunderstorm or tornado is possible. Work will continue at the work site during severe thunderstorm watches or tornado watches (unless wind exceeds standards or lightning has been identified in the area). A severe thunderstorm warning or a tornado warning signifies that a severe thunderstorm or a tornado has been sighted or detected by radar and may be approaching. All work onsite will stop during a thunderstorm, severe thunderstorm warning, or tornado warning.

Personnel onsite during a tornado will take the following steps:

- Evacuate office trailers or vehicles.
- If outdoors, lie flat in a nearby ditch.

- Stay away from power poles, electrical appliances, and metal objects.
- Do not try to outrun a tornado.

5.4.12 Confined Space Entry

Confined space entries will not be conducted during this project. If confined space entry becomes necessary, the procedures in Appendix B will apply.

5.4.13 Illumination

All operations will be conducted during daylight hours. If circumstances require work to be performed during periods of diminished lighting or darkness, artificial lighting will be used. Lighting will be of sufficient quantity to provide a minimum of five foot-candles in the work area(s) in accordance with 29 CFR 1926.56.

5.5 BIOLOGICAL HAZARDS

The following biological hazards that may be encountered at RFP are discussed in this section: (1) poisonous plants, (2) insects and ticks, (3) poisonous snakes, and (4) scorpions.

5.5.1 Poisonous Plants

Poison ivy, poison oak, and poison sumac may be encountered at RFP. These plants may be found in low-lying areas, wetlands, ditches, and creeks.

5.5.1.1 Poisonous Plant Avoidance Procedures

Poison ivy, poison oak, and poison sumac are identified by three or five leaves radiating from a stem. Poison ivy is a vine; poison oak and sumac are bush-like. The plant tissues have an oleoresin that is active in live, dead, and dried parts. The oleoresin may be carried via smoke, dust, contaminated clothing, and animal hair.

5.5.1.2 First Aid for Poisonous Plants

Signs and symptoms of exposure to poisonous plants include redness, swelling, and sometimes intense itching. Blisters form during the subsequent 24 hours. Crusting and scaling occurs within a few days. In the absence of complications, healing is complete in about 10 days. Wash any exposed skin with mild soap and water, but do not scrub the area.

5.5.2 Insects and Ticks

A variety of insects and ticks may be encountered at RFP. Caution needs to be used when encountering insects and ticks during field activities.

5.5.2.1 Ants, Bees, Wasps, and Hornets

Stings of ants, bees, wasps, and hornets are responsible for more deaths in the United States than bites and stings of all other venomous creatures combined. The deaths result from sensitization by the victim to the venom, which can result in anaphylactic reactions upon subsequent stings. The stinger may remain in the skin and should be removed by scraping rather than pulling. An ice cube placed over the sting will reduce pain. An analgesic-corticosteroid

lotion is often useful. People with known hypersensitivity to such stings should carry a kit containing an antihistamine and epinephrine.

5.5.2.2 Lyme Disease and Ticks

Lyme disease is an illness caused by a bacterium that may be transmitted through the bite of the *tick Ixodes dammini*, commonly referred to as the deer tick. Not all ticks are infected with the bacterium; however, when an infected tick bites, the bacterium is passed into the bloodstream of the host where it multiplies. The deer tick is commonly found onsite living in grassy and wooded areas feeding on mammals such as mice, raccoons, deer, and humans.

The illness typically occurs in the summer and is characterized by a slowly expanding red rash that develops a few days to a few weeks after the bite of an infected tick. This rash may be accompanied by flu-like symptoms along with a headache, stiff neck, fever, muscle aches, or general malaise. At this stage, treatment by a physician usually is effective. If left untreated, these early symptoms may disappear but more serious problems may follow. Other problems that may occur include meningitis, neurological abnormalities, and cardiac abnormalities. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

Tick Avoidance. When in an area suspected of harboring ticks (grass, brushes, woodland), the following precautions can minimize the chances of being bitten:

- Wear light-colored clothing so ticks can be easily spotted.
- Wear tick repellent.

- Inspect clothing frequently while in tick habitat paying special attention to the insides of seams and cuffs.

- Do not pick up dead mammals.

The procedure for performing first aid for tick bites is to inspect your head and body thoroughly when returning from the field. Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp the body and tug gently, but firmly, until it releases its hold on the skin. Wipe the bite thoroughly with an antiseptic and seek medical attention if needed.

5.5.2.3 Spiders

Almost all of the 30,000 species of spiders are venomous, but only a relatively small number have fangs both long and strong enough to penetrate human skin. Spiders are generally found in dark protected areas such as access ways to sanitary sewers, under ledges, in protective casings of monitoring wells, pump houses, buildings, portable toilets, and manhole covers. The black widow spider ranges in color from gray to brown to black, depending on the species. The abdomen is shiny black with a red hourglass or red spots. Although both male and female are venomous; however, only the latter has fangs both large and strong enough to penetrate human skin. Mature females range in body length from 10 to 18 millimeters (mm).

A spider-bite victim may recall receiving a sharp, pinprick-like bite; but in some cases, the bite is so minor that it goes unnoticed. Rarely is there any local skin reaction. The initial pain is sometimes followed by a dull, occasionally numbing pain in the affected extremity, and by pain and cramps in one or several of the large body muscles. Sweating, weakness, and varying degrees of headache and dizziness are common. The lymph nodes in the region of the bite will

often be tender or painful. In severe cases, there is rigidity of the abdominal muscles and pain in the lower back, thighs, or abdomen. There is no effective first aid treatment. Treat for shock and transport to the nearest medical facility.

The brown recluse or violin spider has an abdomen that ranges in color from grayish to orange and reddish-brown to dark brown. The back shell of the "violin" is brown to black and distinct from the pale yellow to reddish-brown background of the head and chest. This spider has six eyes grouped in three dyad. Both male and female are venomous. They average 6 to 12 mm in body length. The bite of this spider produces about the same degree of pain as the sting of an ant. In most cases, a localized burning sensation develops that may last for 30 to 60 minutes. The area around the bite often itches, becomes red and warm, with a small blanched area around the puncture wound. The reddened area enlarges and becomes purplish during the subsequent one to eight hours. A small blister forms at the wound, increases in size, and may rupture. The whole area may become swollen and painful. Other signs and symptoms include fever, malaise, stomach cramps, nausea, and vomiting. In severe cases, there may be breakdown of the red blood cells, renal failure, or death. All first-aid measures should be avoided as the natural appearance of the bite is most important in determining the diagnosis. A cube of ice may be placed on the wound, and medical attention should be sought.

The first-aid procedure for spider bites is to apply ice to the wound and position it, if possible, below the heart level to slow circulation of the venom. The individual should seek medical attention.

5.5.3 Poisonous Snakes

The most frequently observed reptiles at RFP are bull snakes and rattlesnakes. Eastern yellow-bellied racers have also been seen. Western plains garter snakes are found in and around many of the ponds.

5.5.3.1 Snake Recognition and Avoidance Procedure

Of the mentioned reptiles, rattlesnakes are the only poisonous variety. To help identify a potentially poisonous snake from a nonpoisonous snake, descriptions of both species are presented.

Rattlesnakes have a triangular-shaped head with vertical pupils and typically have a blotched/camouflage pattern on their back. They have a distinctive "buzz" made by rattling their tail. Rattlesnakes will not always rattle before striking.

Nonpoisonous snakes have an oblong-shaped head with round pupils. Typically, nonpoisonous snakes are a uniformly dark solid color or solid color with stripes running lengthwise down the body. The one exception at RFP is the bull snake. Bull snakes mimic rattlesnakes in appearance and are capable of "rattling" their tail, but they are nonpoisonous and do not have a triangular-shaped head or vertical pupils.

The best procedure for avoiding snakes is to be familiar with snake habitat and observant in the field. Snakes can be found under debris, manhole covers, or overgrown vegetation. Be especially careful walking at night or in grass and underbrush. Do not climb rocky ledges before visually inspecting them. Wear boots and heavy pants; more than half of all bites are on

the lower parts of the legs. Do not attempt to kill snakes unnecessarily; many people are bitten in such an attempt.

5.5.3.2 First Aid for Snakebites

All reactions from snakebites are aggravated by acute fear and anxiety. The severity of local and general reaction from poisonous snakebites depends on the amount of venom injected and the speed with which venom is absorbed into the victim's circulation, the size of the victim, the protection from clothing, how quickly antivenom therapy can be provided, and the location of the bite.

The extremely painful characteristics of a rattlesnake bite include rapid swelling that can be identified by one or more puncture wounds created by the fangs. The skin is usually marked with general discoloration. Symptoms may include general weakness, rapid pulse, nausea and vomiting, shortness of breath, dimness of vision, and shock.

There are three objectives when administering first aid for snake bites. The first is to reduce the circulation of blood through the bite area; the second is to delay the absorption of the venom; and the third is to prevent aggravation of the local wound and to sustain respiration.

Emergency treatment does not include incision through the fang marks. Typically, more harm than good is done this way. Immobilize the person and the bite wound in a horizontal position. Wash the bite with water, but avoid manipulation of the bite area. Do not allow the person to walk, run, or drink alcoholic beverage or stimulants (soda or coffee). Do not apply ice or give aspirin. Treat for shock and transport to the nearest medical facility.

5.5.4 Scorpion Avoidance Procedure and First Aid for Stings

Scorpions may also be found at RFP. The best procedures for avoiding scorpions are to (1) be familiar with scorpion habitat, and (2) be observant in the field. Scorpions can be found under debris, manhole covers, or overgrown vegetation. Be especially careful walking at night or in grass and underbrush. Do not climb rocky ledges before visually inspecting them. Wear boots and heavy pants because more than half of all bites are on the lower parts of the legs.

A sting will cause persistent pain, numbness, and tingling. Signs and symptoms may include local pain, rash, redness, blisters, headache, and fever. If the scorpion stinger remains embedded, remove the stinger with tweezers or by scraping with a credit card. Wash the area with soap and water and apply cold packs to the affected area. Treat for shock and transport to the nearest medical facility.

5.6 HAZARD COMMUNICATION PROGRAM PROCEDURES

All field personnel will receive hazard communication training before beginning work. The goal of the training is to provide employees with the knowledge to work safely, be aware of potential hazards, and be able to implement appropriate precautions when working with hazardous chemicals. Training will comply with the OSHA Hazard Communication Standard, 29 CFR 1910.1200, and will include the following topics:

- a review of employees right to know and the locations of hazardous material information onsite (e.g., MSDSs and hazard labels);
- a review of how to interpret MSDSs and hazard labels;

- a review of site operations and the hazardous chemical products associated with each operation;
- a review of safety and health hazards present on the site;
- methods for detecting hazards; and
- control measures and emergency procedures for employee protection.

6.0 PERSONNEL AND AIR MONITORING

6.1 INTRODUCTION

Ambient air monitoring and personal sampling will be conducted during work under this HASP. Appendix C provides a list of contaminants, monitoring methods, PPE, and action levels by well number.

Discussions of instrument calibration, ambient air monitoring, and personal sampling for nonradioactive contaminants are provided in Sections 6.2 and 6.3. Radiation monitoring requirements are given in Section 6.4.

6.2 INSTRUMENT CALIBRATIONS

All instrumentation used to monitor employees' nonradioactive exposure will be calibrated and maintained as directed by the instrument manufacturer. The following guidelines will be used:

1. Instruments will be calibrated before and after use or maintenance in accordance with the manufacturer's instructions as discussed in the Jacobs SOP 6.0, Operation, Calibration, and Maintenance of Field Monitoring Equipment Without Specific SOPs (Appendix B). Calibration data will be recorded in an instrumentation calibration logbook. Pertinent information to be recorded includes type of instrument, manufacturer and serial number, calibration standard used and lot number or other unique identifier, initial readings, adjustments made, and final reading.

2. Calibration standards will be traceable to a National Institute of Standards and Technology primary standard or be a recognized primary standard. Copies of calibration standard certificates will be maintained at the project site.

6.3 AMBIENT AIR AND PERSONAL MONITORING

Ambient air monitoring and personal sampling will be conducted during activities included in this HASP. This monitoring will be used to document employee exposure and provide a reference for future activities.

6.3.1 Ambient Monitoring Methods

Ambient air monitoring for nonradioactive contaminants will be conducted for activities covered by this plan using colorimetric tubes, a photoionization detector (PID), and a real-time aerosol monitor.

A PID using an 11.7 electron volt lamp in the total response mode will be used to monitor sites, as presented in RFP FO.15. Upon arrival at a work site, the PID will be zeroed relative to ultra zero air. After the PID has been zeroed, a background reading will be taken upwind of the work site. Additional measurements will be taken at the work site at least every 15 minutes. If an action level, is reached, readings will be monitored continuously. Background readings will be repeated whenever weather or wind direction changes. A sustained reading in the breathing zone is defined here as a reading measured using the PID where air is being inhaled during a 5-minute interval.

Colorimetric tubes will be used, after an action level is reached with real-time instrumentation or if free liquids are observed. When colorimetric tubes are required, an upwind sample will be

collected for each contaminant and be recorded as the background. Additional measurements will be obtained at the work site with each soil sample collected. If an action level is reached, additional measurements will be taken every 15 minutes. Background measurements will be repeated if weather conditions or wind direction changes. If no compounds are detected by photoionization and personal sampling results provide no indication of overexposure, colorimetric tubes will not be used.

Real-time dust monitoring will be conducted at all work sites to determine background particulate levels and monitor particulate resuspension as work is conducted. Readings will be measured at the worker breathing zone. Particulate contaminants will be monitored by a real-time aerosol monitor (MIE Miniram) (RFP FO.1). Action levels for dust monitoring are based on a nuisance dust standard of 10 milligrams per cubic meter (mg/m^3). For Level D activities, concentrations of 25 percent of the standard (2.5 mg/m^3) are allowed and up to 50 percent (less than 5 mg/m^3) for Level C. For concentrations in excess of 50 percent (>5 mg/m^3), Level B will be used. Action levels are based on the average concentration obtained during a 5-minute sampling period. Upon arrival at a site, a background reading will be obtained from an upwind location. Additional measurements will be collected upon arrival at the work site and with each sample taken during sampling activities. If an action level is reached, readings will be measured continuously.

These action levels for dust monitoring will also be used to establish PPE requirements for protection from airborne radioactivity in areas with soil radioactivity concentrations up to 90 picocuries per gram (pCi/g). This is a conservative approach assuming that respirable suspended particulates in a worker's breathing zone have the same specific activity as those in soil. An airborne dust concentration of 2.5 mg/m^3 in an area where the soil concentration is 90 pCi/g can be calculated by this method to be equivalent to 10 percent of the most limiting DAC listed in DOE 5480.11, the DOE criterion for implementing respiratory protection. For areas with higher

soil concentrations, the dust action levels will be lowered by the ratio of 90 pCi/g to the determined soil concentration. The assessment of the worker's intake of airborne radioactivity will be as described in Section 6.4.4.

The fact that contaminants are listed for monitoring is not intended to reflect and should not be construed to reflect a readout of actual exposure for a given contaminant. It is only an indication of particulate suspension. Employee exposure will be determined through integrated sampling, and any adjustments to action levels will be based on data obtained from analysis of those samples. This approach is necessary because no data are available on soil concentrations of contaminants within the areas to be investigated. Where elevated levels of radioactivity have been noted in historical reviews, area sampling will be conducted to determine current exposure before activities begin.

Action Levels for Suspect Contaminants. Action levels for nonradioactive contaminants are established by individual locations and documented in Appendix C. In setting the levels for which contaminants are known and for which specific monitoring methods are available, the personal exposure limit or American Conference of Government Industrial Hygienists threshold limit value (TLV) for a contaminant was used as the action level for Level C protection. Maximum use concentrations for Level C work were determined by multiplying the action level by a respiratory protection factor. A conservative factor of 10 was used for full-face respirators. Additional considerations include availability and service limits of air-purifying cartridges for a given contaminant. Where cartridges are unavailable or contaminant levels exceed service limits, demobilization or transition from Level D modified to Level B will be required.

Documentation. All monitoring results and other pertinent actions will be recorded in the HSS/HSO's field logbook. In addition, each instrument's name, model, serial number, and site conditions will be recorded once before the first entry of monitoring results.

6.3.2 Personal Sampling

Personal sampling will be conducted to document personnel exposure during work activities and provide a characterization of exposure for activities conducted under the plan. Available data obtained from the *Historical Release Report* were used to review the potential for adverse exposure at each site (EG&G 1992). As a result, two sites will require the use of integrated sampling. The sites and sampling methods are listed in Appendix C. Additional sampling will be conducted only if Level C action levels are reached. Sampling results will be used to determine personnel exposure and revise monitoring requirements. Where mixtures of chemicals are detected, the computational formula for mixed contaminants will be used to assess exposure. An action level of 50 percent of the time weighted average for single contaminants or mixtures will be used to initiate additional contaminant controls. Modifications to sampling requirements for detected contaminants will be based on the documented exposure level on a case-by-case basis. Additional information from soil sampling results may also be considered for modifying sampling requirements.

Sampling will be conducted with personal air pumps using solid sorbent or filtration media and NIOSH- or OSHA-approved analytical methods. Analysis will be completed by an American Industrial Hygiene Association accredited laboratory. Appendix C provides a summary of methods to be used at each location. Chain-of-custody seals and forms will be generated for each sample. Field blanks will also be prepared and will be submitted concurrently with exposed media. Sampling strategies that determine which employees will be sampled are described in Jacobs SOP 9.4, Personnel Monitoring (Appendix B). Specifically, employees involved in activities with the highest potential for exposure will be selected for monitoring.

6.4 RADIOLOGICAL MONITORING

The following text describes the radiological monitoring requirements for personnel on the WARP project.

6.4.1 Personnel and Equipment Approvals

Personnel with radiological monitoring responsibilities will be approved by the EG&G RE Office, EG&G Health and Safety Coordinator (HSC), and the ERHSO. After approval, substitutions will not be made without EG&G review and approval. Equipment to be used will be approved by the Rocky Flats Health Physics Instrumentation Committee.

6.4.2 Equipment Calibrations

The following requirements will be practiced to ensure equipment is calibrated and functioning properly:

- Calibrations of radiological instruments and equipment will be performed by either EG&G Radiation Instrumentation personnel or an outside calibration service in accordance with American National Standards Institute N323 using standards traceable to U.S. National Institute of Standards and Technology primary standards. A calibration sticker showing an expiration date will be affixed to each instrument or piece of equipment. Jacobs personnel will submit the instrument for recalibration before the expiration date or take the instrument out of service after the expiration date until a recalibration has been performed.

- Performance tests of radiological instruments will be conducted before use during normal operation. The results of the performance check will be recorded in a daily source check

log by the HSS/HSO or HSST. The logs will be maintained for inspection. All performance tests will be conducted in accordance with manufacturer's recommendations and approved written procedures.

6.4.3 Surface Contamination Monitoring of Personnel

This section provides the practices Jacobs personnel will use to implement Environmental Management Radiological Guideline (EMRG) 2.1, Personnel Contamination Monitoring. Instrumentation requirements, methods of monitoring, action levels, control of contaminated personnel, and documentation of contamination occurrences are addressed in this section.

Personnel will be monitored for contamination in a Contamination Reduction Corridor when leaving an IHSS Exclusion Zone that may contain radioactive contaminants, when exiting a radiologically controlled area (RCA), following personnel decontamination, and when directed by the HSS/HSO. Table 6-1 provides a listing of radiological instrumentation and target radiation types to be monitored. In accordance with EMRG 2.1, the head, neck, front, back, legs, and boots will be monitored by moving the detectors over outer clothing and exposed skin areas at a rate not to exceed 2 inches per second at a distance within 1/4 to 1/2 inch of the surface. Clothing will be considered contaminated if the alpha radioactivity detected exceeds an average of 100 disintegrations per minute (dpm)/100 square centimeters (cm^2) or a maximum of 300 dpm for a 100-cm^2 area, or if the beta/gamma radioactivity detected is 100 counts per minute (cpm) or greater above background (detected by Ludlum 31). Skin will be considered contaminated if any level of radioactivity above background is detected. Equivalent action levels will be established if other approved instrumentation is used.

TABLE 6-1
PERSONNEL SURVEY INSTRUMENTATION

Instrument	Target Radiation
Ludlum 12-1A with 44-5 Detector (or equivalent)	Alpha contamination
Ludlum 31/12 with 44-9 GM Pancake Detector (or equivalent)	Beta/Gamma contamination

In the event that personnel contamination is detected, field decontamination will be attempted as outlined in Section 9.1. If contamination is detected, Jacobs personnel will maintain the site zone boundary and the HSS/HSO will notify the EG&G ERHSO, EG&G RE, and the EG&G CTR. All radiological occurrences will be documented in accordance with EMRG 10.1, Radiological Deficiency Reporting Program.

6.4.4 Personal Sampling for Airborne Activity

Representative personal sampling from each field team working in radiologically contaminated areas (greater than or equal to 25 percent of personnel) will be conducted for airborne alpha radioactivity using the Jacobs Radiological Operations Procedure (ROP) 10.02, Personal Air Particulate Sampling (reviewed by EG&G) under the guidance and instruction of EG&G RE. A type A-E, glass fiber filter will be used to collect airborne particulates. At the end of the shift, the filter will be removed and counted in accordance with the Jacobs ROP 10.03, Performance Check and Operation of Alpha Smear/Filter Counting Instrumentation. The resulting data will be compared with the DAC that is the most conservative for the contaminants suspected of being present, to gauge employee exposure. DACs for suspect contaminants are given in DOE 5480.11. Sampling results equal to or greater than 10 percent of the DAC will be reported to the ERHSO. After the first five samples are analyzed, a review of the data will

be conducted to make a determination whether to continue airborne alpha radioactivity monitoring. If the levels are below the guidelines stated in the Jacobs ROP 10.02, the monitoring will be discontinued.

6.4.5 External Dosimetry

Jacobs employees and subcontractors will participate in the EG&G Rocky Flats External Dosimetry Program as outlined in EG&G HSP 18.07, External Radiation Dosimetry. Jacobs personnel will wear EG&G-supplied thermoluminescent dosimeters while in the field to assess beta, gamma, neutron, and X-ray exposure while working at RFP. When not in use, the dosimeters will be kept on a board in the support trailers. Dosimeters will be exchanged quarterly.

6.4.6 Ambient Air Monitoring for Radionuclides

Ambient air sampling for airborne alpha radioactivity also will be conducted with high-volume air samplers using the Jacobs ROP 10.01, High Volume Air Particulate Sampling. Samples will be counted in accordance with the Jacobs ROP 10.03. Grab samples will be collected in the immediate vicinity of the work being performed in radiologically contaminated areas to determine (1) whether the area is an airborne radioactivity area requiring additional work controls and (2) whether personal breathing-zone air sampling is necessary to assess the workers' intake of airborne radioactive materials. In accordance with the protocol for personal sampling in Section 6.4.4, high-volume sample results will be compared with the most conservative DACs given in DOE 5480.11, and results greater than 10 percent DAC will be reported to the ERHSO. Depending on adjacent IHSS logistics, radionuclide air monitoring locations may be chosen to represent more than one IHSS.

6.4.7 Surface Contamination Monitoring of Work Areas

Prework area monitoring will be accomplished in accordance with EG&G Environmental Management Division (EMD) FO.16 (EG&G most recent edition) by making direct surface soil measurements with a Bicron Analyst Field Instrument for the Detection of Low-Energy Radiation (FIDLER). Measurements of 1,500 to 1,700 cpm or less generally indicate that background radioactivity only is present. When readings indicate the potential for radiation exposure, EG&G RE personnel will be consulted to determine if a Radiation Work Permit is required to ensure adequate protection during completion of activities.

6.4.8 Surface Contamination Monitoring of Property and Materials

This section describes the practices to be followed by Jacobs personnel in implementing EMRG 3.02, Survey Requirements for Conditional and Unrestricted Use, and EG&G HSP 18.10, Release of Property/Waste for Conditional and Unrestricted Use. Instrumentation requirements, methods of monitoring, action levels, control of contaminated property or material, and documentation of contamination levels are addressed in this section.

All equipment, materials, and property used in an RCA will be considered as potentially contaminated. None of these items will be released from the area until they have been surveyed and meet the unconditional release or conditional release limits listed in EG&G HSP 18.10, depending on whether they will be transferred to a non-RCA for uncontrolled use or another RCA. Property release evaluations are required for all property releases considered for unconditional releases. Only an HSS/HSO is allowed to release property/equipment/waste from a posted RCA. Surveys for fixed-plus-removable and removable alpha and beta/gamma contamination will be conducted using the radiological instrumentation listed in Table 6-2. The contamination action levels for unconditional release are listed in Table 6-3, and the conditional

release action levels are listed in Table 6-4. If the property or material either cannot be monitored using standard survey techniques required by EMRG 3.02 or is a volume or bulk material, such as liquids, soils, etc., it will be considered potentially contaminated and RE will perform a property/waste release evaluation before release. This evaluation is documented by EG&G HSP 18.10 and its Property/Waste Release Evaluation form.

Radiological contamination documentation, labeling, and tagging requirements of EMRG 3.02 and EG&G HSP 18.10 will be followed for all property or material released from an RCA. This includes completion of a Record of Property Leaving Radiologically Controlled Areas, a Material Transfer Tag, and either a Property Release Approval for Unrestricted Use form or a Property Conditional Release form, depending on the release mode.

TABLE 6-2
PROPERTY/MATERIAL SURVEY INSTRUMENTATION

Instrument	Target Radiation
Bicron Frisk-Tech with A-100 detector (or equivalent)	Fixed plus Removable alpha contamination
Bicron Frisk-Tech with B-50 detector (or equivalent)	Fixed plus Removable beta/gamma contamination
Ludlum 2929 Alpha and Beta/Gamma Counter or Ludlum 2000/43-10 Alpha Counter (or equivalent[1])	Removable alpha contamination
Ludlum 2929 Alpha and Beta/Gamma Counter or Ludlum 2000/44-1 Beta/Gamma Counter (or equivalent[1])	Removable beta/gamma contamination

NOTES:

[1] As approved by the Rocky Flats Health Physics Instrument Committee

TABLE 6-3
RADIOACTIVE SURFACE CONTAMINATION LIMITS FOR UNRESTRICTED RELEASE

Radionuclides	Average Total Fixed Plus Removable (dpm/100 cm^2)	Maximum Total Fixed Plus Removable (dpm/100 cm^2)	Removable (dpm/100 cm^2)
Transuranics, Ra-226, Ac-227, Ra-228, Th-228, Th-230, Pa-231	100	300	20
Th-Nat, Sr-90, Ra-223, Ra-224, U-232, Th-232	1,000	3,000	200
U-Nat, U-235, U-238, and associated decay products, alpha emitters	5,000	15,000	1,000
Beta-gamma emitters (other than alpha emitters/spontaneous fission) except Sr-90 and others above	5,000	15,000	1,000

NOTES:
dpm = disintegrations per minute per gram
cm^2 = square centimeter

TABLE 6-4
RADIOACTIVE SURFACE CONTAMINATION LIMITS FOR CONDITIONAL RELEASE/TRANSFER

Radioactivity Type	Removable (dpm/100 cm^2)	Total (Fixed Plus Removable) (dpm/100 cm^2)
Transuranic alpha	20	833
Beta-gamma and uranium alpha	1,000	5,000
Tritium (HT, HTO)	10,000	10,000

NOTES:
dpm = disintegrations per minute per gram
cm^2 = square centimeter

6.5 NOISE

The main sources of noise for this project will be produced by asphalt coring/sawing, heavy equipment, vehicles, and electric generators. A sound-level meter will be used to monitor noise levels around heavy equipment to establish appropriate guidelines for hearing protection. Hearing protection will be used when noise levels exceed 85 dBA.

6.6 EQUIPMENT DECONTAMINATION

If a vehicle is suspected of being radiologically contaminated, the HSS/HSO shall be contacted immediately for guidance. The HSS/HSO will provide instructions regarding monitoring to determine whether contamination is present and, if warranted, instructions for conducting decontamination procedures. If a vehicle is contaminated, the HSS/HSO will notify RE, and a property/waste release evaluation (PRE) will be required for the vehicle.

EG&G HSP 18.10 indicates that RE will perform a PRE on all property/waste generated during decontamination activities that either cannot be monitored using standard survey techniques required by EMRG 3.02 or is a volume or bulk material, such as liquids, soils, etc. This evaluation is documented by EG&G HSP Procedure 18.10 and its Property/Waste Release Evaluation form. If the surface contamination levels of this property/waste are equal to or less than the limits in Table 6-3, then it may receive an unrestricted release designation. This material may then be released from anywhere within the RFP boundary without restrictions on future movement or disposal, in accordance with the guidelines and requirements of DOE Orders 5400.5 and 5480.11 and the DOE *Radiological Control Manual* (DOE 1994).

If the surface contamination levels of the property/waste generated during decontamination activities are greater than or equal to those in Table 6-3, then this material must be transferred

to an RCA for further evaluation. Access to RCAs is controlled to protect individuals from exposure to radiation and radioactive materials.

Conditionally releasing materials involves the controlled transfer of property from an RCA through uncontrolled areas to another RCA. Conditionally released property shall not be used in non-RCAs except when specifically authorized by a Radiological Work Permit (RWP), Radiological Operations supervision, or RE supervision. Property/waste in this category is required to be tagged with a properly completed Material Transfer Conditional Release Only Tag (RF-47470) and transported in accordance with the On-Site Transportation Manual. Surface contamination limits for this material are presented in Table 6-4.

6.7 EQUIPMENT RELEASES

Equipment decontamination and property/waste releases will be conducted as described in Section 6.5, Equipment Decontamination. Before returning rented or leased equipment that has been used in the field, it will be wipe-tested for radionuclides according to EG&G HSP 18.10 and the results will be furnished to the HSS/HSO. The HSS/HSO will determine whether the item is suitable for return to the owner. PRE's are required for all material/property/waste being released for unrestricted usage.

As Section 6.5 describes, RE will perform a PRE, according to EG&G HSP 18.10 procedures, on all property/waste generated during decontamination activities that either cannot be monitored using standard survey techniques required by EMRG 3.02 or is a volume or bulk material, such as liquids, soils, etc. This evaluation will determine whether the material can receive an unrestricted release designation.

6.8 CALIBRATION LOGS

Calibration records for instruments used to monitor employee nonradioactive contaminant exposure will be maintained in a calibration log. Refer to Section 6.2 for an explanation of contents and procedures. Radiological instrumentation performance checks will be maintained in a daily source check log as described in Section 6.4.2.

7.0 WORK ZONES

By establishing work zones where different types for operations will occur, the potential for workers to spread contamination from more contaminated areas to less contaminated areas may be minimized. Clearly delineated work zones also help ensure that (1) site personnel are adequately protected from existing hazards, (2) specific activities and hazards are confined to the appropriate areas, and (3) personnel may be accurately and quickly located and evacuated during an emergency.

7.1 CONTROL AT THE SITE

Site control to reduce the possibility of employee exposure to potential hazards and the transport of contaminants includes the following measures:

- limiting access to the work site(s) and posting appropriate warning signs;
- preparing the site for subsequent activities;
- maintaining a copy of this HASP so that it is readily available to employees who may be exposed during site work;
- establishing onsite communications consisting of sight/hand signals, horn, or two-way radio or cellular telephone;
- establishing offsite communications;

- establishing decontamination and waste disposal procedures and ensuring that activities strictly adhere to procedures; and

- enforcing safe work practices.

7.1.1 Buddy System

Personnel in contaminated or hazardous areas will work with a buddy who is capable of the following:

- assisting his or her partner;
- monitoring the partner for signs of chemical or other exposures (e.g., heat or cold);
- periodically verifying the integrity of the partner's PPE; and
- notifying the HSS/HSO if emergency help is needed.

As personnel enter the Exclusion Zone through the access control point, the Field Team Leader will ensure that each employee will be working with a buddy.

7.1.2 Communication

Verbal communication at the sites may be impaired by onsite background noise caused by heavy equipment and the use of PPE. Hand signals to be used between personnel within the Exclusion Zone will be reviewed during site safety meetings conducted before starting work at the individual sites. Verbal communication between onsite and offsite personnel will be conducted using two-way radios.

7.1.3 Security

Site security is essential to (1) prevent unauthorized, unprotected, or unqualified people from exposure to site hazards; (2) prevent vandalism; and (3) protect established and safe working procedures. Site security will be maintained in the following ways:

- limiting access at control points to authorized personnel;
- assigning the responsibility for enforcing exit and entry requirements; and
- limiting the work area to essential personnel and giving the Field Team Leader the authority to approve all visitors to the site.

7.1.4 Site Logs and Records

The site entry log will document which personnel are onsite and will accurately reflect site staffing at all times. Signing in when entering the site and signing out when leaving the site will be strictly enforced. Other records maintained onsite will include training certification, accident records, and equipment calibration records.

7.1.5 Site Visitors

Access to the site by visitors not directly involved with routine integrated operations will be restricted as follows:

- All site visitors must sign in at a site security station located at the site boundary.

- All site visitors must be cleared at the site security station by the Site Manager or his/her designee before obtaining access to the Support Zone.

- Site visitors entering the Exclusion Zone will be strictly limited. The Site Manager and HSS/HSO must approve entry, and the visitor must provide medical, training, and respirator fit test documentation.

- All visitors will receive a site-specific safety briefing and will be escorted to sites. Visitors in areas requiring Level A or B PPE will not be allowed. Visitors in areas requiring Level C PPE must have received the 24-hour OSHA training and the 8-hour annual refresher training, site-specific health and safety training, a current respirator fit test, and the Project Manager's and Program Health and Safety Manager's concurrence in addition to the requirements already listed.

- All site visitor access must be clearly documented, and visitors must comply with all provisions of the site HASP.

7.2 DESIGNATION OF WORK ZONES

Moving personnel and equipment between work zones and onsite and offsite will be limited to controlled access points. Therefore, contamination will be contained within certain relatively small areas, and the potential for translocation will be minimized. The following three contiguous zones will be used where heavy equipment or significant contamination potential exists:

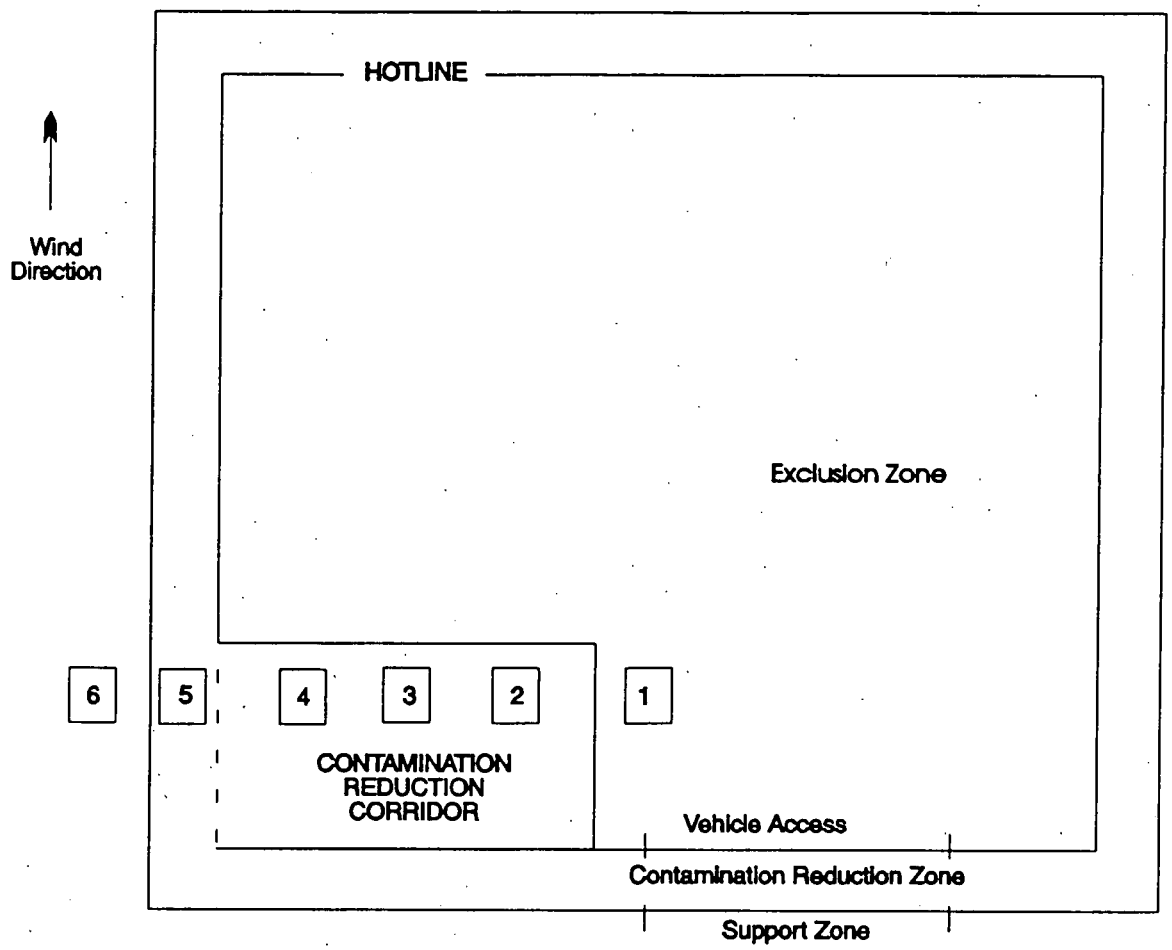
- Zone 1: Exclusion Zone;
- Zone 2: Contamination Reduction Zone; and
- Zone 3: Support Zone.

It is anticipated that these zones will not be required for all activities. The HSS/HSO may authorize the use of single or no zones depending on activities. In making this decision, the following criteria will be reviewed: the hazards present; the area's current use, postings, and location; and whether the activities will introduce or increase hazards.

For work areas where the potential exists for exposure to radiation or radioactive contamination, an RCA will be established at the Contamination Reduction Zone/Support Zone boundary. The Contamination Reduction Zone also will serve as a radiological buffer area if airborne radioactivity or radiation contamination areas are established in the Exclusion Zone. Radiological areas inside the Exclusion Zone will be established and posted as specified in EMRG 1.3, Posting of Radiation Protection Requirements.

7.2.1 Exclusion Zone

Figure 7-1 provides a graphical representation of each zone and the physical relationship to one another. The Exclusion Zone (Zone 1) is the innermost of three concentric areas and is the zone where contamination is known to or could occur. All personnel entering the Exclusion Zone will wear the prescribed level of protection for the specific site. An entry and exit checkpoint will be established at the perimeter of the Exclusion Zone to regulate the flow of personnel and equipment into and out of the zone and to verify that established entry and exit procedures are followed. All personnel, equipment, and materials exiting the Exclusion Zone will be considered contaminated and will be required to undergo decontamination procedures before leaving the site. Materials from potentially radioactive contaminated areas must be monitored



1. Equipment drop
2. Gross decontamination
3. Wash and rinse gloves and boots
4. Remove and dispose of gloves and coveralls
5. Wash hands with disposable wipes
6. Monitor for radioactive contamination (if applicable)

Note: Field modifications of decontamination layout are typically based on wind direction, access to the site, and placement of the equipment.

FIGURE 7-1
TYPICAL SITE CONTROL LAYOUT
1994 WELL ABANDONMENT REPLACEMENT PROGRAM
ROCKY FLATS PLANT

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and released in accordance with EMRG 3.1, Performance of Surface Contamination Surveys; EMRG 3.02, Survey Requirements for Conditional and Unrestricted Use; and EG&G HSP 18.10, Release of Property/Waste for Conditional and Unrestricted Use. (See Section 9.4.)

The outer boundary of the Exclusion Zone is the Hotline. It will be established by visually surveying the immediate area and determining where the hazardous substances are located; where any drainage, leachate, or spilled material is found; and whether any discolorations are visible. Additional factors that will be considered include the distances needed to prevent fire or an explosion from affecting personnel outside the zone, the physical area necessary to conduct site operations, and the potential for contaminants to be blown from the area. When the Hotline is determined, it will be well marked. During subsequent site operations, the boundary may be modified and adjusted as additional information becomes available. All personnel within the Exclusion Zone must wear the specified level of protection detailed in Section 8.0.

7.2.2 Contamination Reduction Zone

The Contamination Reduction Zone (Zone 2) provides a transition area between contaminated and clean areas. This zone will serve the following functions:

- a buffer to further minimize the probability of the Support Zone from becoming contaminated or being affected by other existing hazards;
- an area for the monitoring and decontamination of equipment, supplies, samples, and personnel;
- an emergency first-aid station for injured personnel;

- an equipment (i.e., air tank, personal protective clothing, sampling equipment, and tools) resupply station;

- an area used for packaging and preparing samples for onsite or offsite laboratories; and

- a temporary rest area for personnel.

The Contamination Reduction Zone provides additional assurance that the physical transfer of contaminants by personnel, equipment, or air is limited through a combination of decontamination, distance between Exclusion and Support zones, air dilution, and zone restriction.

7.2.3 Support Zone

The Support Zone (Zone 3) is considered a noncontaminated or clean zone; therefore, potentially contaminated personal protective clothing, equipment, and samples are not permitted in this area. Normal work clothes are appropriate attire within the zone. This zone will serve as the following:

- medical station and command post;
- equipment and supply center; and
- administrative center.

8.0 PERSONAL PROTECTIVE EQUIPMENT

PPE is specified to provide employees with protection against inadvertent contact with chemical contaminants. Although this additional protection is a precaution, it is emphasized that PPE is not issued as a replacement for engineered or administrative controls. Adherence to these controls is vital to keep the rate of exposure as low as possible.

PPE has been selected for work at specific locations taking into account the chemical and radiological hazards unique to each site. In doing so, the type of work activities are also considered.

This section addresses the levels of protection, limitations of each, and the rationale to be used in downgrading PPE levels.

8.1 LEVELS OF PROTECTION

The level of PPE required for activities covered by this HASP will be continually reevaluated as fieldwork progresses. It is expected that there will be variations in requirements to meet workers' needs at specific locations.

The HSS/HSO will (1) authorize modifications, (2) post-PPE requirements in the crew trailer, and (3) announce changes and justification for those changes at a site safety meeting. The HSST will receive a copy of the PPE requirements. A change will be published to this plan if PPE changes are permanent and if the HSS/HSO considers the changes significant. These changes will be coordinated with the EG&G HSC.

8.1.1 Base Levels of Protection

For activities to be conducted under this plan, two basic ensembles of protective clothing will be used. These ensembles will be determined on the basis of the work to be performed at each site. The requirements for each are given below.

Uncontaminated Areas. Areas considered to be uncontaminated under this plan include areas not in an IHSS or where existing sampling data indicate minimal contamination. Personnel involved with activities in these areas will wear Level D work clothing as defined in Section 8.1.3. The limitations provided by that section will apply.

Contaminated Areas. Areas considered to be contaminated under this plan are those located in IHSSs or where previous sampling data indicate elevated chemical or radiological contamination. The base level of protection at all sites in these areas will be Level D Modified, as defined in Section 8.1.3, using chemical protective boots, uncoated Tyvek coveralls, and 11-mil thickness nitrile gloves. This PPE will be used to protect against particulates generated during work activities. (Viton or silvershield and nitrile gloves will be used during polychlorinated biphenyl [PCB] sampling.) This PPE may be modified through the use of the EG&G Radiation Work Permit and the concurrence of the EG&G Radiological Engineer and EG&G HSC.

Protective clothing will be upgraded in the event that (1) free liquids or surface liquids are encountered, (2) gases or vapors reach or exceed Level C action limits, or (3) unexpected hazards requiring increased skin protection are encountered. Upgraded clothing will consist of polycoated Tyvek or Saranex-coated Tyvek. If upgrading is necessary, personnel will demobilize and contact the HSS/HSO. Upgrading will be done with the concurrence of the EG&G HSC.

8.1.2 Level C

The following equipment will comprise Level C protection:

- full-face, air-purifying, cartridge-equipped respirator (Mine Safety and Health Administration [MSHA]/NIOSH approved) with organic vapor/High-Efficiency Particulate Air (HEPA) cartridges unless otherwise designated in Appendix C.
- chemical-resistant clothing (polyethylene-coated Tyvek or Saranex coveralls);
- chemical-resistant outer gloves;
- latex or nitrile inner gloves;
- boots, chemical-resistant, steel toe and shank;
- booties (outer), chemical-resistant, disposable;
- hard hat (if needed);
- hearing protection (as required); and
- two-way radio communications (intrinsically safe).

Meeting all of the following criteria permits the use of Level C protection:

- Measured air concentrations of identified substances are reduced by the respirator to a level at or below the substance's permissible exposure limit (PEL), and the concentrations are within the service limit of the chemical cartridges.

- Atmospheric contaminant concentrations do not exceed immediately dangerous to life and health (IDLH) levels.

- Atmospheric contaminants, liquid splashes, or other direct contact does not adversely affect the small area of skin left unprotected by chemical-resistant clothing.

- Job functions are determined not to require self-contained breathing apparatus.

- Air quality is continuously monitored.

The main selection criterion for Level C is that conditions permit wearing air-purifying devices. The air-purifying device must be on a full-face mask (MSHA/NIOSH approved) equipped with cartridges specified in Appendix C.

In addition, use of a full-face air-purifying mask is approved only if the following circumstances occur:

- Substances are identified and their concentrations measured.
- Substances have adequate warning and adsorption properties.
- Individuals pass a qualitative fit test for the mask.
- The appropriate cartridge is used, and its service limit concentration is not exceeded.

It is particularly important that the air be monitored effectively when personnel are wearing air-purifying respirators (Level C). Constant surveillance using direct-reading instruments is needed to detect changes in air quality that might necessitate a higher or lower level of respiratory protection.

8.1.3 Level D

The following equipment will be considered Level D protection:

- coveralls or work clothes;
- boots (steel toe and shank and chemical resistant);
- work gloves (optional);
- safety glasses with side shields or chemical splash goggles when splash/eye hazards are present;
- hard hat (when appropriate);
- air-purifying respirators (available for use - kept in plastic bags in the field vehicles at each site);
- hearing protection (when appropriate);

- two-way radio communications (intrinsically safe) if line of sight is not maintained; and

- dosimeter badge (when appropriate).

Meeting all of the following criteria allows the use of Level D protection:

- No hazardous air pollutants are measured.

- Work functions preclude splashes, immersion, contact, or potential for unexpected inhalation of any chemicals.

Level D protection is primarily a work uniform and will be worn only in areas where the potential for exposure to toxic substances does not occur. As data become available, PPE can be modified to Level D protection for a specific IHSS.

8.1.4 Level D Modified

The equipment considered to be Level D Modified includes equipment outlined in Section 8.1.3, with the following changes:

- outer disposable boots (optional);
- chemical-resistant clothing (Tyvek, polyethylene-coated Tyvek or Saranex coveralls);
- chemical-resistant outer gloves; and
- latex or nitrile inner gloves (surgical).

Level D Modified will be used when no measurable concentrations of air contaminants are detected but physical contact with contaminants is possible. It also permits rapid upgrading to Level C if air contaminants in excess of action levels are measured.

8.2 PROCEDURE AND JUSTIFICATION FOR UPGRADING OR DOWNGRADING PERSONAL PROTECTIVE EQUIPMENT

Decisions concerning upgrading or downgrading the level of protection will be made by the HSS/HSO who will then provide appropriate documentation to the Field Team Leaders and EG&G HSC. As data become available, PPE can be modified to Level D protection for a specific IHSS. Criteria addressed will include the following:

- personal sampling results;
- real-time monitoring results;
- sample analysis results; and
- physical conditions and hazards.

8.3 UPGRADING LEVELS OF PROTECTION

Levels of protection will be upgraded in response to site conditions. A PPE upgrade will be completed under the following conditions:

- detection of an airborne contaminant at a concentration requiring Level C PPE or higher;
- presence of free product or liquid at a work location;
- unexpected dermal hazards are encountered; or
- upon employee request.

8.4 PERSONAL PROTECTION EQUIPMENT INSPECTION

PPE should be inspected before use and the following checks made:

- Determine that the clothing material is correct for the specific task at hand.
- Visually inspect the clothing for imperfect seams, tears, and malfunctioning closures.
- Hold the clothing up to the light and check for pinholes.

During the work task, periodically inspect the clothing for the following:

- 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; and
- seam discontinuities.

Before using gloves, pressurize each glove to check for pinholes. Introduce air into each glove (do not blow into the glove), then seal and roll the gauntlet toward the fingers, or inflate the glove and hold it under potable water. In either case, no air should escape.

8.5 CONTAMINATION EXPOSURE REDUCTION

The HSS/HSO or HSSTs will be responsible for overseeing personnel decontamination at each site. Personnel decontamination will be performed in a separate area from equipment decontamination. Onsite personnel may become contaminated in the following ways:

- being splashed by contaminated liquids while sampling or handling liquids;
- coming in contact with contaminated solids or liquids;
- walking through contaminated materials, either in solid or liquid state;
- being in contact with contaminated equipment;
- being in contact with contaminated solid substances in IHSSs or on the soil surface; and
- sitting or kneeling on the ground, especially damp/muddy areas near data collection sites.

Care will be taken to prevent equipment contamination as much as possible. Sampling and monitoring equipment will not be placed on contaminated surfaces. Monitoring equipment that cannot be decontaminated easily will be bagged, and the bag will be taped and secured around the instrument.

9.0 DECONTAMINATION PROCEDURES

This section describes the procedures for decontaminating personnel and equipment. In addition, requirements for clearance of the equipment for use are also described.

9.1 PERSONNEL DECONTAMINATION

Decontamination procedures will be followed by all personnel exiting the Exclusion Zone at areas where an Exclusion Zone is necessary. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the site before decontamination. The HSS/HSO may simplify the procedures in the field if minimal contamination has occurred to specific protective equipment. Figure 7-1 shows a typical zone and decontamination configuration.

9.1.1 Chemical Contamination

Personnel decontamination for chemical contamination consists of these steps:

1. Personnel drop off equipment to be decontaminated.

2. Perform gross decontamination (i.e., removal of large contamination deposits from outer clothing by gently brushing or washing).

3. Wash and rinse gloves and boots with a nonphosphate detergent and water.

4. Remove and dispose of gloves and coveralls.

5. Remove respirator (for Level C) and clean.

6. Wash hands with disposable wipes.

9.1.2 Radioactive Contamination

Personnel with identified radioactive contamination that cannot be readily removed in the field will be transported to the designated RFP Occupational Health facility (Building 122) for decontamination. Decontamination will be performed in accordance with EG&G EMRG 2.3, Wounds and Skin Contamination, in consultation with EG&G Environmental Management Radiological Engineer.

9.2 HEAVY EQUIPMENT

Heavy equipment decontamination will be performed at the designated RFP decontamination pad. Level C PPE is required for decontaminating heavy equipment such as field vehicles, augers, and drill rigs. Personnel Level C decontamination will be accomplished as described in RFP *EMD Operating Procedures Manual Volume I, Field Operations*, FO.12, Decontamination Facility Operations, Revision No. 2 and FO.4, Heavy Equipment Decontamination (EG&G 1994a).

9.3 SMALL EQUIPMENT

Small instruments and equipment will be protected from contamination by draping, masking, or otherwise covering as much of the instruments as possible with plastic, without hindering the operation of the unit.

Contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in the appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped with damp disposable wipes, and dried. The units will be checked, field calibrated, and recharged, if necessary, for the next day's operation. Decontamination will be performed in accordance with FO.3, General Equipment Decontamination.

9.4 CLEARANCE FOR USE

Equipment decontamination will be performed as described in Sections 9.2 and 9.3. Equipment that is used to perform intrusive activities in the field will be sent through the Main Decontamination Facility before its final release from the plant site. Before rented or leased equipment that has been used in the field is returned, it will be wipe-tested for radioisotopes, and the results will be furnished to the HSS/HSO. RE will determine whether the item meets the release criteria before the equipment is returned to the owner. Sampling and releases for conditional and unconditional use will follow EMRG 3.1, Performance of Surface Contamination Surveys; EMRG 3.02, Survey Requirement for Conditional and Unrestricted Use; and EG&G HSP 18.10, Release of Property/Waste for Conditional and Unrestricted Use. The radioactive contamination limits for unrestricted use are provided in Table 9-1.

TABLE 9-1
RADIOACTIVE CONTAMINATION LIMITS

	Removable	Fixed Plus Removable
Alpha	20 dpm/100 cm^2	300 dpm/100 cm^2
Beta and Gamma	200 dpm/100 cm^2	1,000 dpm/100 cm^2

NOTES:
dpm = disintegrations per minute per gram
cm^2 = square centimeter

10.0 EMERGENCY RESPONSE PLAN

This section describes the procedures to be followed in the event of an emergency.

10.1 SITE EMERGENCIES

In the event of an injury, accident, or other emergency, all personnel are responsible for following the provisions of the HASP. When personnel are working in the field, they will have a copy of this HASP with them. Emergency contact numbers will be conspicuously posted onsite to allow easy access for all personnel. Emergency telephone numbers are listed in Table 10-1. The HSS/HSO, with assistance from the Site Manager, has responsibility and authority for coordinating all emergency response activities until proper authorities arrive.

10.2 EMERGENCY PROCEDURES

The following standard emergency procedures will be used by onsite personnel.

10.2.1 Call for Emergency Response

For onsite emergency response, use the EG&G handheld radio (which will be provided to all field crews) and dial channel 1, or push the emergency button. The radio transmission will automatically contact the RFP security force, fire department, ambulance, occupational health department, RE department, and the contractor's yard supervisor. If a radio is not available, use an onsite or mobile telephone. Dial extension 2911 or (303) 966-2911, which is the RFP emergency telephone number. All of the services (fire, police, ambulance) are available at this number. See Section 10.3.1 for reporting requirements. For incidental releases, dial channel

1, extension 2911, (303) 966-2911, and then extension 2914 or (303) 966-2914 to report the release.

Emergency telephones are available at all guard posts.

If the emergency involves responding to an incidental release, dial 2914 for additional reporting.

DO NOT CALL EMERGENCY RESPONDERS WHO ARE NOT ONSITE. THEY WILL NOT BE ALLOWED TO ENTER THE PLANT.

10.2.2 Evacuations

In case of an emergency, such as fire, explosion, or significant release of a hazardous substance, an air horn or vehicle horn will sound three times with five-second intervals between blasts. All personnel in the Exclusion Zone and the Contamination Reduction Zone will evacuate and assemble within the Support Zone before exiting the site in an upwind direction. When the safety of all personnel has been established, calls for emergency response will be made.

10.2.3 First Aid

First aid will be provided by Jacobs personnel for minor injuries not requiring the services of a physician. The following general approaches to first aid will be taken.

TABLE 10-1
EMERGENCY TELEPHONE AND RADIO NUMBERS - FIELDWORK

Department/Individual	Telephone No.	Radio No.
Fire	(303) 966-2911	Channel 1 Emergency Button or 2911
Ambulance	(303) 966-2911	Channel 1 Emergency Button or 2911
Poison Center	(303) 629-1123	Channel 1 Emergency Button or 2911
Security (Protective Force Dispatcher)	(303) 966-2444	Channel 1 Emergency Button or 2911
Police	(303) 966-2444	Channel 1 Emergency Button or 2911
Incidental Release	(303) 966-2911 then (303) 966-2914	Channel 1
Occupational Health General Information	(303) 966-2594	N/A
YOU ARE LOCATED AT: T891R (Jacobs Engineering Trailer)		
NEAREST TELEPHONE IS AT: PACs1 Guard Post		
NEAREST EMERGENCY MEDICAL SERVICES ARE LOCATED AT: Building 122		
Program Health and Safety Manager - TBD	(303) 595-8855	N/A
Project Manager - John Freshwater	(303) 595-8855	N/A
Jacobs HSS/HSO - David Spruce	(303) 966-5874	EMAD 4 JAKE 13
EG&G CTR - Tim Loveseth	(303) 966-8706	N/A
EG&G Asst. CTR - Mark Wood	(303) 966-8784	N/A
EG&G ERHSO - Keith Anderson	(303) 966-6979	N/A
EG&G Industrial Hygiene Manager - J.M. Brooks	(303) 966-7910	N/A
EG&G Health and Safety Liason Officer - Lisa Nelowet	(303) 966-5471	N/A
Jacobs Engineering Site Manager - George Jansen	(303) 966-5874	EMAD 4 JAKE 1
EG&G 24-Hour Installation Emergency Response	(303) 966-2911	Emergency Button or 2911
EG&G Incidental Release Reporting	(303) 966-2911 and -2914	Emergency Button or 2911
EG&G Occupational Safety	(303) 966-2955	N/A
EG&G Construction Safety - Don Harlow	(303) 966-4165	N/A

10.2.3.1 Physical Injury

Minor injuries may be treated onsite, but all injuries will be examined by trained medical personnel. In the case of serious injuries, the victim will be transported to the RFP medical center as soon as possible. Victims of serious bites or stings will be taken to the RFP medical center.

10.2.3.2 Injury As a Result of Heat

Refer to Section 5.4.9.1, Heat and Cold Stress, for first aid instructions to treat heat-related injuries.

10.2.3.3 Injury As a Result of Cold

Refer to Section 5.4.9.2, Heat and Cold Stress, for first aid instructions to treat cold-related injuries.

10.2.4 Decontamination

In the event that an injured person is contaminated with chemicals or radioactive materials, the person will be taken to the RFP medical center as soon as possible. Decontamination will be performed to prevent further exposure only if it will not aggravate the injury.

10.2.5 Transport to Medical Facility

In most cases, an ambulance will transport a seriously injured worker to the medical facility. However, if it becomes necessary to transport the worker, follow proper first-aid guidelines for moving an injured person.

Figure 3-3 shows the layout of the streets and buildings at RFP. The medical center is located in Building 122. Directions to the center from three site entrance points are as follows:

- From the contractor's trailer compound, head north to Central Avenue. Turn left onto Central Avenue and proceed approximately 1.25 miles. Building 122 is on the left.

- From the eastern entrance of the plant, proceed approximately 3.5 miles on Central Avenue. Building 122 is on the left.

- From the western entrance of the plant, proceed along the entrance road through a second guard building onto Cactus Avenue. Proceed on Cactus Avenue one street beyond Second Street and turn left. (This unmarked street is Third Street.) Follow Third Street to Building 122, which is on the left following Building 125.

An Authorization for Medical Treatment form (in Jacobs SOP 9.1, Appendix B) must accompany the injured employee to the medical center; the top portion of the form must be completed.

10.2.6 Communication Methods

The following communication methods will be used:

- Two-way radios provided by EG&G allow communication among field teams, the Jacobs trailer, the contractor's yard supervisor, and the emergency response services at RFP.

- One cellular telephone will be located in each Jacobs field vehicle. The telephones can be used to call for emergency services onsite by dialing 966-2911. All guard posts have telephones. Telephone numbers for the RFP emergency services are provided in Table 10-1.

- To improve communication with the field crews and to provide communication with key persons both during the daytime and off-duty hours, digital pagers will be used.

- A compressed air horn or vehicle horn will sound in the event of an emergency.

Horn signals follow:

- One long blast (repeated three times with five-second intervals between blasts) indicates that personnel should evacuate area by nearest emergency exit.

- Two short blasts indicate a localized problem that is not dangerous to workers.

- Two long blasts indicate all is clear.

The following visual hand signals will be used:

- clutching throat: personal distress; and

- arm waving in a circle over the head: if given in the Exclusion Zone, need assistance; if given in the Support Zone, evacuate.

10.2.7 Emergency Equipment

The following emergency equipment will be available at each site:

- first-aid kit (10 unit);
- eye-wash station;
- air horn;
- Gatorade or equivalent;
- fire extinguisher (10-pound A:B:C);
- one full set of the appropriate PPE for each team member;
- short-handled shovel; and
- two-way radio (provided by EG&G).

10.3 NOTIFICATION

Reporting and notification of emergency situations will be carried out in accordance with requirements in DOE Order 5484.1.

10.3.1 Reporting

Field personnel will notify appropriate emergency assistance personnel (for example, fire, police, ambulance) at extension 2911 or security (protective force dispatcher at extension 2444) immediately and then notify the Site Manager. The Site Manager will notify the HSS/HSO, EG&G CTR, Project Manager, and Program Health and Safety Manager.

When calling for an emergency response, by telephone or radio, report the following information:

- name and association;
- location;
- type of emergency;
- time of incident; and
- type of first aid or response rendered.

Caller does not hang up until the emergency responder has received complete emergency response information.

A complete notification procedure is provided in Appendix B (Jacobs SOP 9.1, Accident Investigation and Notification).

An immediate verbal report must be given to the Corporate Health and Safety Manager within 24 hours of each incident involving medical treatment. The following information will be provided:

- the exact location of the incident;
- name and employer of victim(s);
- nature and extent of injuries; and
- whether victim(s) was transported offsite for medical treatment.

10.3.2 Primary Contacts

Reporting procedures include notifying the following primary contacts:

- Corporate Environmental Health and Safety Department
  Jacobs Engineering Group Inc.
  600 Seventeenth Street, Suite 1100N
  Denver, Colorado 80202
  Attention: Terry Briggs, Manager
  Office Telephone: (303) 595-8855
  FAX Machine: (303) 595-8857

- Program Health and Safety Manager
  Jacobs Engineering Group Inc.
  600 Seventeenth Street, Suite 1100N
  Denver, Colorado 80202
  Attention: TBD
  Office Telephone: (303) 595-8855
  FAX Machine: (303) 595-8857

- Pasadena Risk Management (Safety) Department
  Jacobs Engineering Group Inc.
  251 South Lake Avenue
  Pasadena, California 91101
  Attention: Pat Costamagna
  Office Telephone: (818) 578-6886
  FAX Machine: (818) 578-6837

- Western Region Safety Department
  Jacobs Engineering Group Inc.
  251 South Lake Avenue
  Pasadena, California 91101
  Attention: Ken Wilkenson
  Office Telephone: (818) 449-2171
  FAX Machine: (818) 578-6827

10.3.3 Procedure: Reporting at Medical Facility

An Authorization for Medical Treatment form (Appendix B) must accompany an injured worker to the medical facility. The top portion of the form is to be completed by job site personnel. A Worker's Compensation form may also be required.

10.3.4 Procedure: Postaccident

After the employee has received treatment, the Program Health and Safety Manager will arrange for a postaccident drug screen for all injured employees immediately following an accident. A

vaccine for hepatitis B may be offered to employees exposed to blood during response to an incident.

An initial accident investigation will begin at the discretion of the HSS/HSO or the Site Manager. At a minimum, the scene will be secured (no movement of material or equipment will be made until a review of the accident is completed), and signed statements from witnesses will be maintained.

10.4 RECORD KEEPING

The following record keeping documents will be completed following an emergency.

10.4.1 Site Manager's Investigation Report

A Site Manager's Investigation Report (provided in Appendix B) will be completed by the first line Site Manager as soon as possible following the incident. The completed form will be returned to Jacobs' Corporate Environmental Health and Safety Department. A copy must also be sent to the Corporate Health and Safety Manager and the Program Health and Safety Manager.

10.4.2 Witness Statement

A Witness Statement (provided in Appendix B) will be used to obtain a signed statement from witnesses of their complete (factual) observations. Names and permanent addresses will be secured for future reference. The form will be returned to Jacobs' Corporate Environmental Health and Safety Department. A copy must also be sent to the Corporate Health and Safety Manager and the Program Health and Safety Manager.

10.4.3 Employee's Report of Occupational Injury or Disease

An Employee's Report of Occupational Injury or Disease (provided in Appendix B) is state specific. This form must be completed for all injuries, illnesses, and exposures requiring a doctor's visit. The location code (project number) will be used as the form of identification. This form must be returned to Jacobs' Corporate Environmental Health and Safety Department within 24 hours of the initial doctor visit. A copy must also be sent to the Corporate Health and Safety Manager and the Program Health and Safety Manager.

See Appendix B for a copy of the Employee Exposure/Hazardous Chemical Release Report Form 9-1.

10.4.4 First-Aid Register

A First-Aid Register (provided in Appendix B) is the primary project injury log. All injuries or illnesses treated or reported (actual or alleged) will be entered into the log. This register will be used no matter how minor the event may be. There are no exceptions to this reporting requirement. The register is kept at the project site.

10.4.5 Vehicle Accident Reporting Procedure

For any vehicle accident or injuries involving a vehicle, please follow and complete the necessary forms dictated by the Vehicle Accident Reporting Procedures (provided in Appendix B).

10.5 ROCKY FLATS PLANT REPORTING PROCEDURE

The HSS/HSO will submit the completed DOE Form 5484.x to the EG&G CTR, the Jacobs Project Manager, the Jacobs Corporate Health and Safety Manager, and the Jacobs Program Health and Safety Manager for any of the following incidents:

- Recordable occupational injury or illness as defined below:

  - Occupational Injury. An occupational injury is any injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment and requires treatment in excess of first aid. Note: Conditions resulting from animal or insect bites, or one-time exposure to chemicals, are considered to be injuries.

  - Occupational Illness. The occupational illness of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. This category includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

- Property damage losses include losses of $1,000 or more. Accidents that cause damage to DOE property, regardless of fault, or accidents where DOE may be liable for damage to a second party, are reportable if damage is $1,000 or more. This category includes damage to facilities, inventories, equipment, and properly parked motor vehicles and excludes damage resulting from a DOE reportable vehicle accident.

- Government motor vehicle accidents are reported as accidents resulting in damages of $500 or more. Accidents resulting in damages of $500 or more, or that involve an injury, are reported unless the government vehicle is not at fault, damage of less than $500 is sustained by the government vehicle, or no injury is inflicted on the government vehicle occupants. Accidents are also reportable to DOE if the following applies:

  - Damage to DOE property is greater than or equal to $500, and the driver of a government vehicle is at fault.

  - Damage to any private property or vehicle is greater than or equal to $500, and the driver of a government vehicle is at fault.

  - Any person is injured, and the driver of a government vehicle is at fault.

11.0 LOGS, REPORTS, AND RECORD KEEPING

Records documenting the safety program will be maintained. Logs and records will include documentation of exams, training, medical information, safety meetings, injuries, illnesses, and emergency events. Record keeping in the field includes maintaining a health and safety logbook and calibration logs.

11.1 HEALTH AND SAFETY LOGBOOK

A separate health and safety logbook and sign in/sign out log will be maintained by the Site Manager throughout the project and given to the Corporate Health and Safety Manager after the project is completed. Copies of logbook contents will be maintained in the project files. Logged information will include the following: (1) names of all Jacobs and subcontract personnel entering and leaving the site each day; (2) daily listing of data collection in site numbers to be visited by field teams; (3) description of unforeseen hazards and steps taken to mitigate hazards; (4) summary of telephone conversations regarding health and safety; (5) safety infractions, if any; (6) accidents and injuries; and (7) all other significant health and safety items.

Records will be kept for each onsite individual. Records include a medical clearance statement from a qualified physician and respiratory fit test and training documentation. When site safety meetings are conducted, an attendance sheet must be kept.

11.2 CALIBRATION LOGS

Calibration records for instruments used to monitor employee nonradioactive contaminant exposures will be maintained in a calibration log. Refer to Section 6.2 for an explanation of

contents and procedures. Radiological instrumentation performance checks will be maintained in a daily source check log as described in Section 6.4.2.

12.0 PLAN APPROVAL

This site safety plan has been written for the exclusive use of Jacobs Engineering Group Inc., its employees, and subcontractors. The plan is written for the specified site conditions, dates, and personnel and must be amended if these conditions change.

Kent Malianna by J. Freshwater

PLAN PREPARED BY

ROCKY FLATS PLANT PROGRAM MANAGER

HEALTH AND SAFETY MANAGER

13.0 EMPLOYEE CERTIFICATION FORM

By my signature, I certify that I have read, understand, and will abide by, the Health and Safety Plan for the Rocky Flats Plant.

Printed Name	Signature	Company	Date

14.0 BIBLIOGRAPHY

EG&G Rocky Flats Inc. 1992 (June). *Historical Release Report*. Environmental Restoration Program.

EG&G Rocky Flats Inc. 1994a (March 14). *Rocky Flats Plant Environmental Management Division Operating Procedures Manual. Standard Operation Procedures for Field Operations (FO)*. Volume I.

EG&G Rocky Flats Inc. 1994b (March 14). *Rocky Flats Plant Environmental Management Division Operating Procedures Manual, Operating Procedures for Geotechnical Activities (GT)*. Volume III.

EG&G Rocky Flats Inc. 1994c (April). *Rocky Flats Health and Safety Practices Manual.* Revised April 6, 1994.

Jacobs Environmental Group Inc. 1991. *Corporate Health and Safety Manual for Environmental Field Programs*. Part 1: Environmental Health and Safety Procedures. Part 2: Standard Operating Procedures.

U.S. Department of Energy. 1988 (December). DOE Order 5480.11, *Radiation Protection For Occupational Workers.*

U.S. Department of Energy. 1994 (April). *Radiological Control Manual.*

APPENDIX A

JACOBS MEDICAL SURVEILLANCE PROCEDURES

APPENDIX A CONTENTS

Jacobs Corporate Health and Safety Manual

SOP 1.0 Training and Medical Monitoring Tracking System

Jacobs Medical Protocol

Baseline Examination
Interim Medical Review
Periodic Medical Examination

Jacobs Environmenatl Health and Safety Procedures

Medical Program, Section 4.0

JACOBS

JACOBS ENGINEERING GROUP INC.
CORPORATE HEALTH AND SAFETY MANUAL

TRAINING AND MEDICAL MONITORING TRACKING SYSTEM

SOP NO. 1.0

APPROVED: _____
HEALTH AND SAFETY MANAGER

OBJECTIVE
The following computerized tracking system has been implemented to track medical monitoring and field training needs. The objectives are to provide current certifications on all field clearance parameters and to enforce any restrictions on field clearance.

APPLICABILITY
This procedure applies to all personnel whose job requires them to work in areas where toxic and hazardous materials are present and where a potential for exposure to these materials exists. This includes persons working in areas where physical hazards, such as excessive noise, which may have adverse effects on health are present.

PROGRAM ADMINISTRATION
The Health and Safety Manager (HSM) is responsible for overall administration of the medical surveillance program. The HSM shall select a medical consultant to provide guidance in establishing and maintaining the medical surveillance program and shall be responsible for monitoring the consultant's performance.

The Corporate Health and Safety Coordinator (HSC), appointed by the HSM, is responsible for establishing medical clinics, setting up medical protocol and administrative procedure in coordination with the Corporate Medical Consultant, coordinating the scheduling of physical exams, maintaining a current database and confidential medical records system, notifying the employee's supervisor of any work restrictions as noted by the examining physician, and monitoring Hazardous Materials Exposure information.

The Corporate Medical Consultant (CMC), appointed by the HSM, is responsible for quality control review and auditing of the performance of the medical clinics and laboratories. The CMC may also be asked by the Corporate Health and Safety Office to advise on additional testing, emergency event consultation, new clinic setup and new program medical protocol, as well as miscellaneous concerns.

Program Participants Program participants will agree to take a Baseline (Initial) Examination, annual and post-exposure examinations as well as an exit exam upon leaving or termination of the program.

Medical Clinics All medical examinations will be performed by a pre-qualified occupational medicine clinic.

"ACTIVE" FIELD STATUS CLEARANCE REQUIREMENTS
An "active" field status is required of all employees in order to perform field work on hazardous waste sites. The requirements for an "active" field status are: current certifications in 40-hour hazardous waste basic training, 8-hour refresher training, and a fit for work duty certification from a medical monitoring program physical. (Refresher training is not required for employees who have completed a 40-hour basic training course within the last twelve months.)

Those employees who lack one or more of the requirements for an "active" field status, will be designated as "inactive".

Additional certifications may be required of an "active" status field employee. These certifications include: CPR and First Aid, 24-hours of supervised field experience in Level D, C, B, and A., and respirator fit testing.

TRAINING AND MEDICAL MONITORING SUMMARY REPORT
A Training and Medical Monitoring Summary Report (Figure 1-1) will be issued to employees monthly summarizing their field status. The training and medical monitoring certifications needed in the next 30 days will also be listed.

Supervisors (office or departmental operations managers) will also receive a monthly Training and Medical Monitoring Summary report. This is intended to assist in staff project planning, budget planning, and identification of field restriction problems.

UPDATING TRAINING AND MEDICAL MONITORING CERTIFICATIONS
It is the responsibility of each employee to maintain an "active" field status clearance. It is also the employee's responsibility to maintain any additional certifications required for the type of field work they anticipate being involved in.

Scheduling for needed trainings and certifications is to be coordinated with the employee's local health and safety coordinator. Medical monitoring is to be coordinated with the Corporate Health and Safety Coordinator in the JEG Denver office.

TRAINING AND MEDICAL MONITORING WALLET CARDS
It is the responsibility of the project manager or site safety officer to assure that employees assigned to a specific project have the required field status and necessary certifications for field work.

A wallet size training and medical monitoring summary card (Figure 1-2) will be issued to employees with an "active" field status. This card serves as ready proof to the project manager or site safety officer that the employee does possess the "active" field status required to perform field work on hazardous waste sites.

It also outlines additional certifications the employee may have. Field work may be restricted if the employee lacks any of the applicable certifications required, i.e. CPR, F/A, Fit testing, Levels of Protection, Supervisor training, etc.

The parameters presented on the card include:

- **Name and Employee Number**
- **Level of Protection Qualified For** - Based on at least 24 hours of supervised field experience in a given level of protection.
- **Medical** - Physical Examination Expiration Date - Must not be expired to perform field work.
- **CPR and First Aid Training Expiration Dates** - To work on site, must be current or be accompanied by another employee with current CPR and First Aid training.
- **Fit Test** - Must have a current fit test clearance to wear Level C protection or higher.
- **Basic Training Date** - 40-hour hazardous waste training was successfully completed. Supervisor training, if any, is also listed here.
- **Refresher Training** - Date annual 8-hour refresher training expires.
- **Known Medical Restriction** - Lists any medical conditions that would limit participation in field activities.

The reverse side of the card presents the address of the Jacobs Denver office where all the above health and safety documentation is maintained. It also refers to the site health and safety plan in case of site emergencies.

An expired medical or refresher training expiration dates indicates that the card has expired. A new one will be issued once updated documentation for the expired date(s) has been received in the corporate health and safety office.

HEALTH AND SAFETY DATABASE

The Health and Safety database (Figure 1-3) is a summary of all documented medical monitoring, health and safety certifications, and health and safety training. The database lists each employee individually by office. It includes the employee's social security number and performance unit.

The database lists the date and type of physical the employee was given. The type of physical is designated by BI, I, P, or BE. The key is as follows: BI = Baseline (Initial) Exam, I = Interim Medical Review, P = Periodic Medical Exam, and BE = Baseline (Initial) Exam. Entry into the database verifies that the employee was certified as "fit for work duty". Any medical restrictions, if any, are also listed.

Training completion dates are listed for basic training and refresher training. If the employee has completed a supervisor training course, a "Y" appears after "Supervisor:". Certification dates for CPR and First Aid are listed after the appropriate titles. Respirator fit testing is documented by date, respirator type, and size.

There is also a comment section for any comments or explanations.

INDIVIDUAL TRAINING AND MEDICAL MONITORING REPORTS
Individual training and medical monitoring reports (Figure 1-4) list the training and medical monitoring needs individually by office.

For instance, the "Personnel Due for CPR Training Report" lists all the employees due for CPR certification in a designated office. The testing date for the training can be entered by the computer operator. Therefore, a list can be created of all Denver employees needing CPR within the next 30 days.

There are individual reports for employees needing the following: basic training, refresher training, CPR certification, first aid certification, fit testing, to submit "Individual Field Training Records" for level qualification, and physicals from the medical monitoring program.

PROGRAM ADMINISTRATION
The Health and Safety Manager (HSM) is responsible for overall administration of the medical surveillance program. The HSM shall select a medical consultant to provide guidance in establishing and maintaining the medical surveillance program and shall be responsible for monitoring the consultant's performance.

The Corporate Health and Safety Coordinator (HSC), appointed by the HSM, is responsible for establishing medical clinics, setting up medical protocol and administrative procedure in coordination with the Corporate Medical Consultant, coordinating the scheduling of physical exams, maintaining a current database and confidential medical records system, notifying the employee's supervisor of any work restrictions as noted by the examining physician, and monitoring Hazardous Materials Exposure information.

The Corporate Medical Consultant (CMC), appointed by the HSM, is responsible for quality control review and auditing of the performance of the medical clinics and laboratories. The CMC may also be asked by the Corporate Health and Safety Office to advise on additional

testing, emergency event consultation, new clinic setup and new program medical protocol, as well as miscellaneous concerns.

Program Participants Program participants will agree to take a Baseline (Initial) Examination, annual and post-exposure examinations as well as an exit exam upon leaving or termination of the program.

Medical Clinics All medical examinations will be performed by a pre-qualified occupational medicine clinic.

REFERENCES

29 CFR 1910 Occupational Safety and Health Standards: respiratory protection (1910.134); occupational noise exposure (1910.95); toxic and hazardous substances (1910.1001 through 1910.1045); hazardous waste operations and emergency response (1910.120 interim final rule. Federal Register December 19, 1985).

NIOSH, OSHA, USCG, USEPA. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. U.S. Department of Health and Human Services, Public Health Services Centers, National Institute for Occupational Safety and Health, Washington, D.C.

ANSI. American National Standard for Respiratory Protection. ANSI Z88.6-1984. American National Standards Institute, New York, N.Y., 1984.

Figure 1-1
Summary Report for Training and Medical Monitoring

Name	Office	Status	Training and/or Medical Updates Needed
Tom Bond	Denver	A	NONE
Terry Briggs	Denver	A	NONE
Sarah Brown	Denver	A	L
Michael Carmein	Denver	A	NONE
Roy Evans	Denver	A	L
Bill Fieselman	Denver	A	NONE
Ed Gorove	Denver	A	NONE
Tim Grace	Denver	A	NONE
Gary Graham	Denver	A	L
Paul Hanneman	Denver	A	NONE
Daniel Harelson	Denver	A	NONE
Joyce Miyagishima	Denver	A	NONE
Dale Rowlison	Denver	A	NONE
Lynn Schuetter	Denver	A	NONE
Tom Staible	Denver	A	NONE
Donna Toeroek	Denver	A	P
Chris Williams	Denver	A	P
Ann Wortman	Denver	A	NONE
Don Beaver	Denver	I	P
Steve Hart	Denver	I	BT, C, F/A, FT, L, R
Bob Henry	Denver	I	C, FT, P, R
Arthur Glen Lane	Denver	I	BT, FT, L, R
Pam McDevitt	Denver	I	R
John Zimmerman	Denver	I	P

EXAMPLE

Training and Medical Monitoring Key

BT = Basic Training
C = CPR Certification
F/A = First Aid Certification
FT = Fit Testing Certification
L = Level of Field Experience (Needs to Submit Employee Field Training Record.)
P = Physical
R = Refresher Training

Status Key

A = Active Status - The employee has completed all training and medical monitoring certifications required to perform field work on hazardous waste sites.

I = Inactive Status - Employee is lacking one or more of the training or medical monitoring certifications required to perform field work on hazardous waste sites.

For further information or questions, contact: Robin "Ann" Kring, Health and Safety Coordinator, Jacobs Engineering Group Inc., 600 Seventeenth Street, Suite 1100N, Denver, Colorado 80202, (303) 595-8855, (303) 595-8857 FAX.

Figure 1-2
Training and Medical Monitoring Card

NAME: Example Employee EMPL #: 000000000

IS CURRENT AND QUALIFIED FOR LEVEL: D

MEDICAL EXPIRES	03/14/91	FIRST AID EXPIRES	11/13/93
FIT TEST EXPIRES	06/18/91	CPR EXPIRES	11/14/91
REFRESHER TRAINING EXPIRES	06/18/91	BASIC TRAINING DATE	02/06/85 SUPERVISOR

KNOWN MEDICAL RESTRICTIONS:

EXAMPLE

JACOBS ENGINEERING GROUP, INC.
5000 Seventeenth Street, #1100N
Denver, Colorado 80202
(303) 595-8855

Support Documentation: Kept at above address.

In Case of Emergency: Follow the procedure outlined in the site health and safety plan.

Emergency Consultation: JEG Medical Consultant, Dr. Mitchell Zavon, Agatha Corp. is available to answer any questions regarding proper treatment or diagnosis of an injury or exposure. For further instruction, consult S.O.P. 1.1.

HOTLINE TELEPHONE #(513) 421-3063

Figure 1-3
Health and Safety Database

Name: Beaver, Don
Employee Number: [redacted]
Office: Denver | Performance Unit: 005 | Start Date: 05/20/85
Basic Training: 02/06/85 | Refresher: 06/18/90 | CPR: 11/14/90
Annual Physical: 03/14/90 | First Aid: 11/14/90 | Level: D
Physical Type: | Status: I | Supervisor:
Known Medical Restrictions:
Respirator Fit Date: 06/18/90 Make: MSA Ultratwin Size: M
Comment:

Name: Bond, Tom
Employee Number: [redacted]
Office: Denver | Performance Unit: 005 | Start Date: 01/16/91
Basic Training: 03/24/90 | Refresher: 01/25/91 | CPR: 01/31/91
Annual Physical: 01/24/91 | First Aid: 01/31/91 | Level: D
Physical Type: BI | Status: [illegible] | Supervisor: Y
Known Medical Restrictions:
Respirator Fit Date: 02/04/91 Make: MSA Ultratwin Size: M
Comment:

EXAMPLE

Name: Briggs, Terry
Employee Number: [redacted]
Office: Denver | Performance Unit: 097 | Start Date: 02/20/89
Basic Training: 09/25/89 | Refresher: 11/01/90 | CPR: 06/04/90
Annual Physical: 02/27/91 | First Aid: 06/04/90 | Level: D,C,B
Physical Type: I | Status: A | Supervisor: Y
Known Medical Restrictions: NONE
Respirator Fit Date: 10/11/90 Make: MSA Ultratwin Size: M
Comment:

Name: Brown, Sarah
Employee Number: [redacted]
Office: Denver | Performance Unit: 005 | Start Date: 01/10[illegible]
Basic Training: 01/24/91 | Refresher: 01/24/91 | CPR: 01/31[illegible]
Annual Physical: 01/29/91 | First Aid: 01/31/91 | Level:
Physical Type: BI | Status: A | Supervisor:
Known Medical Restrictions:
Respirator Fit Date: 01/24/91 Make: MSA Ultratwin Size: S
Comment: Employee scheduled physical 1/29/91.

Figure 1-4
Personnel Overdue for CPR Training

EXAMPLE

Name	Employ #	Previous C.P.R.	Comments
** Office: Denver			
Hart,Steve	[redacted]	/ /	Employee having exit phys sent. Gave ftr. Sending ref/CPR/f/a copies
Henry,Bob		04/23/90	

JACOBS ENGINEERING GROUP INC.
MEDICAL PROTOCOL

BASELINE (Initial) EXAMINATION

HISTORY

- Occupational History Form
- The Cornell Medical Index Health Questionnaire
- Examining Physician's Medical History Form (May be used to elaborate the Cornell Questionnaire.)

ABILITY TO WEAR A RESPIRATOR TEST - (Initial exam only) Follow the Ability To Wear A Respirator Test instructions. Complete the Ability to Wear a Respirator Questionnaire & Exam.

PHYSICAL EXAMINATION Complete Baseline (Initial/Exit) and Periodic Medical Exam Form. Keep with employee's records according to the Records Retention Agreement.

- **Height** (without shoes)
- **Weight** (stripped, with shorts for males, gown for females)
- **Blood Pressure** (recumbent, arm specified, done after at least five minutes of relaxation during history taking)
- **Vision** This shall be done on a tabletop device, such as a Titumus and including near corrected and uncorrected, and far corrected and uncorrected. Color shall be checked. A crude peripheral vision check shall be made for gross defects.
- **Musculo-skeletal** (a rapid survey of major muscle groups and agility)
- **EKG** (screening examination)
- **Chest X-ray** (PA film only.) A chest x-ray shall be performed only if a film is not available that has been taken within the past three months and that can be included in the file.
- **Pulmonary Function** FVC and FEV 1. Also, note any obvious deformities that would interfere with wearing a respirator.
- **Audiometry** Through 8000 hz in a booth with acceptable background noise and with an audiometer calibrated within the year and checked each day.

LABORATORY ANALYSIS

- The laboratory analyses are to serve as a baseline to compare against future analyses.
- **SMAC 12, 16, 20, or 24** Whichever profile your office uses routinely.
- **CBC** with a differential
- **Sedimentation Rate and Hematocrit**
- **Urinalysis with Microscopic**
- **Blood Lead** Must be sent to ESA Laboratories in Bedford, MA for laboratory analysis. Please see separate instructions under ESA Laboratories.

Additional Testing must be authorized by Dr. Terry Briggs or Ms. Robin "Ann" Kring (303) 595-8855.

Notification Instructions

- Complete Physical Examination Summary. Mail to the Corporate Health and Safety Administrator within two weeks of the examination. Send to: Robin "Ann" Kring, Health and Safety Administrator, Jacobs Engineering Group Inc., 600 Seventeenth Street, Suite 1100N, Denver, CO 80202. Mark "Confidential".

- Send the patient a letter outlining the results of the examination within two weeks of the exam. Include a copy of the laboratory results. Mail to the patient at their home address.

Using an Exit Physical from Previous Employment

- Exit physicals from previous employment may be substituted for performing the physical examination and laboratory analysis procedures listed above. To qualify, the exit physical must have been performed within the last three months.

  The physician shall review the exit physical and perform any missing components required in the above examination and laboratory protocol. In addition, the physician shall perform the history, ability to wear a respirator test, and a blood lead analysis according to the protocol guidelines listed above. The employee will need to submit the original x-ray from the exit physical. If an original is not available, a copy can be submitted.

JACOBS ENGINEERING GROUP INC.
MEDICAL PROTOCOL

INTERIM MEDICAL REVIEW

The review will be performed as closely as possible to the anniversary of the previous baseline examination or periodic medical exam (whichever was performed last). And if possible, performed at the same clinic or facility. If the review is to be performed at a different facility, arrangements should be made, in advance, to have the previous records transferred to the new examining location.

Occupational History

A copy of the employee's Hazardous Materials Exposure reports for the previous year's activities will be submitted by the employee. These reports outline the hazardous materials and chemicals the employee has worked near and the job function performed.

Interim Questionnaire

The questionnaire shall be completed by the employee. The physician or an experienced designee appointed by the physician shall review the form. The questionnaire should be reviewed for significant negatives. Negatives, that on further investigation, might possibly indicate that the employee may not be fit for work duty.

If the physician is of the opinion that the questionnaire contains significant negatives, the physician should follow-up with further interrogation of the patient and, if necessary, a physical examination and/or testing.

"California Clinics Only" - Perform Ability to Wear a Respirator Test. See test instructions under Baseline (Initial) Exam.

Laboratory Analysis:

The laboratory analyses are to be compared to the previous baseline laboratory results. Any levels seriously out of the normal range warrant further examination. The clinic should call the patient back to perform a periodic medical examination. Please note this on the Physical Examination Summary form. The Periodic Exam protocol can be found in Jacobs Engineering Group Inc. Medical Monitoring Program Manual, S.O.P. 1.1.

SMAC 12, 16, 20, or 24 Whichever profile your office performs routinely.

CBC with a differential

Sedimentation Rate and Hematocrit

Urinalysis with Microscopic

Blood Lead - Complete only if employee has occupational lead exposure. Must be sent to ESA Laboratories in Bedford, MA, for laboratory analysis. Please see separate instruction under ESA Laboratories, Inc.

Personal Physician Referrals

Patients should be referred to their personal physician for non-occupational related derangements. If you have any questions, please contact Ms. Robin "Ann" Kring (303) 595-8855.

mmp/interim

Notification Instructions

- Complete Physical Examination Summary. Mail to the Corporate Health and Safety Coordinator within two weeks of the examination. Send to: Robin "Ann" Kring, Health and Safety Administrator, Jacobs Engineering Group Inc., 600 Seventeenth Street, Suite 1100N, Denver, CO 80202. Mark "Confidential".

- Send the patient a letter outlining the results of the examination within two weeks of the exam. Include a copy of the laboratory results. Mail to the patient at their home address.

JACOBS ENGINEERING GROUP INC.
MEDICAL PROTOCOL

PERIODIC MEDICAL EXAMINATION

The examination will be performed as closely as possible to the anniversary of the baseline or interim medical review. And, if possible, at the same clinic or facility. If the examination is to be performed at a different facility, arrangements should be made to have the previous records transferred to the new examining location.

UPDATED HISTORY

- Occupational History - copies of employee's exposure/injury reports provided with exam packet
- The Cornell Medical Index Health Questionnaire
- Examining Physician's Medical History For (May be used to elaborate the Cornell Questionnaire.)

ABILITY TO WEAR A RESPIRATOR TEST - Follow test instructions (attached). Complete exam form.

PHYSICAL EXAMINATION Complete the Baseline (Initial/Exit) and Periodic Medical Exam Form. Keep with the employee's records according to the Records Retention Agreement.

- **Height** (without shoes)
- **Weight** (stripped, with shorts for males, gown for females)
- **Blood Pressure** (recumbent, arm specified, done after at least five minutes of relaxation during history taking)
- **Vision** This shall be done on a tabletop device, such as a Titumus and including near corrected and uncorrected, and far corrected and uncorrected. Color shall be checked. A crude peripheral vision check shall be made for gross defects.
- **Musculo-skeletal** (a rapid survey of major muscle groups and agility)
- **Chest X-ray** PA film every 5 years only. Exception - if employee is asbestos exposed, perform yearly.
- **Pulmonary Function** FVC and FEV 1. Also, note any obvious deformities that would interfere with wearing a respirator.
- **Audiometry** Through 8000 hz in a booth with acceptable background noise and with an audiometer calibrated within the year and checked each day.

LABORATORY ANALYSIS

- The laboratory analyses are to be compared against the Baseline (Initial/Exam) results by the physician.
- **SMAC 12, 16, 20, or 24** (Whichever profile your office uses routinely.)
- **CBC** with a differential
- **Sedimentation Rate and Hematocrit**
- **Urinalysis with Microscopic**
- **Blood Lead - Complete only if employee has occupational lead exposure.** Must be sent to ESA Laboratories in Bedford, MA for laboratory analysis. Please see separate instructions under ESA Laboratories, Inc.

Additional Testing must be authorized by Dr. Terry Briggs or Ms. Robin "Ann" Kring (303) 595-8855.

NOTIFICATION INSTRUCTIONS

- Complete Physical Examination Summary. Send within two weeks of the examination to: Robin "Ann" Kring, Health and Safety Administrator, Jacobs Engineering Group Inc., 600 Seventeenth Street, Suite 1100N, Denver, CO 80202. Mark "Confidential".

- Send the patient a letter outlining the results of the examination within two weeks of the exam. Include a copy of the laboratory results. Mail to the patient at their home address.

4.1 MEDICAL SURVEILLANCE

The medical surveillance program is established in accordance with the Federal Occupational Safety and Health (OSHA) Hazardous Waste Operations and Emergency Response Standard 1910.120 to assure the continued health and well being of employees assigned to hazardous waste operations. The program is administered to monitor the health of those employees whose work regularly poses the possibility of exposure to toxic materials and or hazardous operations.

Participation Participation in the medical surveillance program is mandatory for all personnel involved in hazardous waste site investigations who are exposed or potentially exposed to hazardous substances or health hazards at or above the established exposure levels for these substances, or who wear respirators.

Other employees exposed to specific hazardous materials will be evaluated on a case by case study for inclusion in a medical monitoring program under the direction of the CHSM.

Baseline (Initial) Examination An initial or baseline exam is given to each participant prior to any work assignment involving potential exposure to hazardous materials. The exam is intended to determine that the employee will be able to perform their job without undue risk to themselves, fellow employees, or to the public and to provide a baseline against which future examinations can be measured.

The exam consists of a complete medical examination designed to screen for evidence of adverse effects of occupational exposure to toxic substances or health hazards. It includes a medical and occupational history review, examination, basic blood and urine laboratory tests, and a physician's evaluation to determine the individual's fitness to perform field work. In addition, the exam shall assess the individual's ability to wear and use personal protective equipment. The results of the exam shall be reviewed by a physician qualified in the practice of occupational and industrial medicine to determine the individual's fitness to perform field work. The protocol for the baseline exam is listed in SOP No. 1.1. The Corporate Health and Safety Department may request to include additional tests as necessary for specific anticipated exposures.

Annual Examinations Each individual shall receive an interim medical review or periodic exam annually. These examinations are to be used for comparison with the baseline exam in order to detect any early indication of change in health status, whether work related or of a non-occupational origin.

The interim medical review includes an interim questionnaire, updated Hazardous Materials Exposure Summary, and laboratory analysis to compare to the baseline exam. The physician may request approval from the Corporate Health and Safety Office for special examination procedures for additional testing if he/she finds it necessary. The interim medical review will be

given the first year after the baseline exam and every other year thereafter. Protocol for this exam is listed in SOP No. 1.1.

The periodic medical exam includes a thorough examination similar to the baseline exam but not including an EKG or chest x-ray except where noted. Protocol for the periodic medical exam is listed in SOP No. 1.1. The periodic medical exam will be given the second year after the baseline exam and every other year thereafter. For example:

YEAR ONE	YEAR TWO	YEAR THREE	YEAR FOUR	YEAR FIVE	YEAR SIX
Baseline Exam (Initial)	Interim Medical Review	Periodic Medical Exam	Interim Medical Review	Periodic Medical Exam	Interim Medical Review

Employees already in the medical monitoring program prior to August 1, 1990, who have previously completed a baseline physical and who may have completed one or more annual physicals will be considered a Year 2 participant and be given an interim medical review on or about the anniversary of their last physical examination. The following year the employee will be considered a Year 3 participant and so forth.

Baseline (Exit) Examination Upon terminating employment or leaving the program, the employee must complete an exit examination whether or not the employee has completed any field work since his/her last physical exam.

The exit exam is identical to the initial exam except that it does not include the ability to wear a respirator test. Protocol for the exit exam is listed in SOP No. 1.1. The exit exam requirement may be waived by the Corporate Health & Safety office if the employee has completed a baseline (initial) or periodic medical exam with the preceding six months.

If the employee refuses the baseline (exit) examination, he/she must put the refusal in writing.

Post Exposure Examinations Following an accidental exposure to hazardous materials, a post-exposure exam may be required. The exam may be requested by the exposed individual or project/site manager or the manager of health and safety. The tests included in the post-exposure exam will be determined by the nature of the exposure and may include all tests performed in the baseline (initial) exam and additional tests as necessary. In most cases, additional testing to monitor tissue damage after an exposure will be performed three to four months following the exposure. The post-exposure exam will be established on a case-by-case basis and reviewed by the corporate medical consultant.

Notification of Examination Results The physician shall notify the Corporate Health and Safety Office of the individual's fitness to complete field work by completing the Physical Examination Summary.

The employee will be notified of the results of the examination by the medical clinic who shall send a letter along with a copy of the laboratory test results to the employee at his/her home address. The CHSC will notify the employee's supervisor of any work restrictions issued by the examining physician.

Medical Records The original exams, x-rays, and laboratory results are kept in Jacobs' designated files in the examining physician's office. Physical examination summaries are kept in the Corporate Health and Safety Office in the individual's Confidential Medical Surveillance File.

All medical records will be kept in accordance with OSHA's rule on Access to Employee Exposure and Medical Records (29 CFR Section 1910.20) for at least the duration of the individual's employment plus thirty years. See SOP No. 1.1.

Medical Clinics Medical clinics are established by the Corporate Health and Safety Coordinator in coordination with the Corporate Medical Consultant. The CHSC directs the clinic in medical protocol and administrative procedure. All medical protocol and administrative procedure must be authorized by the Corporate Health and Safety Office.

Scheduling Medical Examinations Upon notification of new employee hires and terminations, and in response to a physical examination follow-up system, a medical examination packet is sent to the employee by the CHSC instructing the employee to call his/her local clinic to schedule the appointment. The correct medical protocol is set up with the medical clinic beforehand by the CHSC. The examination packet is described in the Medical Protocol Manual SOP 1.1.

Hazardous Materials Exposure Reports The CHSC distributes hazardous materials exposure reports to the employee on a monthly basis. These reports provide an exposure record to aid in the coordination of medical monitoring.

Any injuries or potential or actual exposure is also listed on this report. In addition, the employee must complete the Employee Injury and Exposure Form and submit this to the Health and Safety Manager. The report and form are shown in SOP 1.1.

4.2 EMERGENCY MEDICAL CARE AND TREATMENT

Emergency medical care must be addressed in the site safety plan for all hazardous waste site operations (see SOP No. 5.0). The plan must identify the provisions made for handlin g physical injuries as well as accidental exposure to hazardous materials. Emergency medical care facilities and other emergency resources (physicians, hospitals, ambulance) must be identified.

In case of an injury or exposure to toxic substances, Jacobs' medical consultant shall be notified and shall provide consultation to the emergency medical facility, as appropriate. The

medical consultant will also be responsible for determining follow-up care and medical evaluation.

4.3 EMERGENCY CONSULTATION

The Corporate Medical Consultant has been contracted to provide emergency consultation services.

A hotline telephone number (513) 421-3063 has been set up with Agatha Corporation. This hotline will answer questions or respond to any inquiries regarding proper treatment or diagnosis of any injury or exposure.

Instructions for using the hotline telephone are included in SOP 1.1.

4.4 MEDICAL MONITORING TRACKING SYSTEM

A computerized tracking system has been implemented to track medical monitoring and training needs. This system provides assistance in tracking the medical monitoring requirements of an "active" field status clearance described in Section 5.0, Health and Safety Training. The medical monitoring and training tracking system is detailed in SOP 1.0.

APPENDIX B

JACOBS ENGINEERING GROUP
STANDARD OPERATING PROCEDURES
AND RADIOLOGICAL OPERATIONS PROCEDURES

APPENDIX B CONTENTS

U.S. Department of Energy

Industrial Accident/Incident Report

Jacobs Environmental Health and Safety Procedures

Respiratory Protection Program, Section 7-0
Health and Safety Training, Section 5.0
Reporting and Recordkeeping, Section 13.0
Personnel Monitoring, Section 9.0

Jacobs Corporate Health and Safety Manual

SOP 3.0 Health and Safety Training - Hazardous Waste Operations
SOP 3.1 Hazard Communication Training
SOP 4.4 Respiratory Protection Program Inspection and Maintenance of Air Purifying Respirator
SOP 4.6 Respiratory Protection Program Respirator Fit Test
SOP 6.0 Operation, Calibration, and Maintenance of Field Monitoring Equipment Without Specific SOPs
SOP 6.2 Operation, Calibration, and Maintenance of Monitoring Equipment Portable Photoionizer - HNu PI101
SOP 6.6 Personal Air Monitoring
SOP 7.0 Physical Hazard Control
SOP 7.1 Heat Stress Monitoring
SOP 7.2 Cold Stress Monitoring
SOP 7.3 Hearing Protection Conservation Policy
SOP 7.7 Utility Clearance

SOP 9.1 Accident Investigation and Notification

SOP 9.4 Personnel Monitoring

Jacobs Corporate Safety Procedures

8.6 Confined Space Entry

8.10 Excavations

Jacobs Radiological Operations Procedures

ROP 10.01 High Volume Air Particulate Sampling

ROP 10.02 Personal Air Particulate Sampling

ROP 10.03 Performance Check and Operation of Alpha Smear/Filter Counting Instrumentation

ROP 10.04 Personal Air Sample Pump Calibration

ROP 10.05 Utilization of Airflow Calibration Log

Jacobs Engineering Group Inc. Safety Manual

Hearing Protection Conservation Policy, Section 7.3

DOE F 5484.X

U.S. Department of Energy
INDIVIDUAL ACCIDENT/INCIDENT REPORT
For All Type A, B, and C Investigations

For SSDC Use Only

P.D. Accident Type: _____ Energy Flow _____ _____ _____
Enter GICS _____ Narrative _____ FRASE Coding _____ Revision: 1st ___ 2nd ___ 3rd ___ 4th ___

General Information

1. Reporting Organization _____
   Organization Code _____
2. Case Number _____ Revision ☐ Yes
3. Multiple Case No. _____

4. Accident Type ☐ Injury/Illness ☐ Vehicle ☐ Property Damage ☐ Other

5. Investigation Type ☐ A ☐ B ☐ C ☐ Non-Recordable

6. Department, Division, or I.D. Code (optional) _____
7. Date of Occurrence: _____ Month Day Year
8. Time: _____ (Military Time)
9. Accident Occurred: ☐ Indoors ☐ Outdoors
10. On Employer's Premises? ☐ Yes ☐ No
11. Specific Location: _____

Employee Information

12. Check One: ☐ Injured or Ill Employee ☐ Operator of Equipment/Vehicle
13. Name: _____
14. S.S. or ID Number: _____
15. Age: _____
16. Sex: ☐ Female ☐ Male
17. Occupation: _____
18. Length of Present Employment: ☐ Under 3 mos. ☐ 3-12 months ☐ Over 12 mos.
19. Experience on the job/equipment: ☐ Under 3 mos. ☐ 3-12 months ☐ Over 12 mos.

If Property Damage or Vehicle Accident, go to line 26

Injury/Illness (OSHA Information)

20. ☐ Injury Code (10)
    ☐ Code 7a(21) Skin diseases or disorders
    ☐ Code 7b(22) Dust diseases of lungs
    ☐ Code 7c(23) Resp. due to toxic Agents
    ☐ Code 7d(24) Poisoning
    ☐ Code 7e(25) Disorders - Physical agents
    ☐ Code 7f (26) Disorders - Repeated trauma
    ☐ Code 7g(29) All other
21. Workdays Lost _____
22. Workdays Restricted _____
23. Death: ☐ Yes ☐ No _____ Month Day Year
24. Permanent transfer because of injury disability? ☐ Yes ☐ No
    Terminated because of injury disability? ☐ Yes ☐ No
25. Has Employee returned to work with no further anticipated workdays lost or restricted? ☐ Yes ☐ No

Property/Vehicle Damage

26. Property: ☐ Fire ☐ Non-Fire
    (if Property Damage Accident, go to line 30)
27. Vehicle: ☐ Government
    ☐ Private-Driven by Government Employee
    ☐ Car/Pickup/Van/Motorcycle
    ☐ Truck (1 ton or over)
    ☐ Bus
    ☐ Other (Air, Marine, Railroad, etc.)
28. Was vehicle equipped with seatbelts? ☐ Yes ☐ No
    If yes - Was seatbelt worn? ☐ Yes ☐ No
29. Did vehicle accident involve recordable injury? ☐ Yes ☐ No
30. $ _____ Total Accident Damage
    $ _____ DOE Property/Vehicle
    $ _____ Non-DOE Property/Vehicle
31. $ _____ Claim Against DOE
    $ _____ Paid by DOE
    $ _____ Reimburseable to DOE
    $ _____ Paid to DOE
32. Are dollar amounts final? ☐ Yes ☐ No

Equipment/Hardware/Vehicle Involved *(as applicable)*

33. Equipment: (Generic [or Brand] Name & Model) _____ ID Number _____
34. Did equipment design or defect contribute to the accident cause or severity? ☐ Yes ☐ No

Continued on the following page

DO NOT WRITE IN THE SHADED AREAS

Case Number

NARRATIVE GUIDE

35. Activity in progress at the time of accident.

36. Events - Begin with initiating and end with nature and extent of injury/damage.

37. Accident Causes

a. Conditions

b. Actions

c. Factors influencing a. or b.

38. Corrective Actions (if risk is acceptable, corrective action may not be necessary)

a. Action taken

b. Actions recommended

c. To be completed by

39. Accident Investigator: _____ Date: _____ FTS Telephone _____

Job Title: ☐ Supervisor ☐ Safety Professional ☐ Other _____

40. Supervisor responsible for Corrective Action:

_____ Date: _____ FTS Telephone _____

41. Accident Investigation Contact (*if different from 39.*) _____ FTS Telephone _____

SECTION 5.0 - HEALTH AND SAFETY TRAINING

5.1 HAZARDOUS WASTE SITE REQUIREMENTS

All personnel assigned to hazardous site work shall be trained to conduct on-site operations in a safe manner, as required by 29 CFR 1910.120. Employees will not be allowed to perform field work until such time as their safety training has been completed. Proficiency in field health and safety procedures shall be maintained through regular refresher training programs and continual field practice.

Basic Training - Employee All field personnel are required to complete a basic training course before assignment to any field activities. This training will include a minimum of 40 hours of classroom instruction and demonstration. Topics covered will include:

- recognition, evaluation, and control of chemical and physical hazards;
- radiation health principles if the employee has the potential for work with radiological hazards;
- personal protective clothing and equipment;
- respiratory protection and respirator fit testing;
- environmental monitoring equipment;
- standard operating procedures and safe work practices;
- site safety plan development;
- decontamination procedures; and
- practical exercise in use of personnel protective equipment and monitoring instruments (Levels B and C).

New employees who have had equivalent previous training and/or work experience may be considered as meeting the initial training requirement. The HSM will determine whether the employee is exempt from this training requirement.

Basic Training For Facility Hazardous Waste Workers Initial 24-hour training is required for facility hazardous waste treatment, storage or disposal operations (TSD) and for in-plant hazardous waste emergency response cleanup personnel. This training shall be job specific including the specific hazards associated with the job and procedures for their control. At least one-third of the training shall consist of field exercises.

Basic Training - On-Site Managers/Supervisors On-site managers and supervisors who are directly responsible for field activities or who directly supervise employees engaged in

hazardous waste operations shall receive, in addition to the required 40 hours basic training for employees, at least eight additional hours of specialized training on managing field activities. At a minimum, this training should include the management of hazardous waste site cleanup operations, and management of site work zones.

Refresher Training Field personnel will be required to maintain proficiency in the areas covered in the basic training course by completing a minimum of eight hours of refresher training annually. The annual refresher training will also include a regulatory update on relevant topics.

CPR And First Aid Training Selected field personnel shall maintain current Red Cross multimedia first aid and basic life support cardiopulmonary resuscitation (CPR) training to assure that at least one site team member has this training. All site safety officers must have current CPR and first aid training.

Field Supervision In addition to the basic training described above, it is Jacobs' policy that all personnel complete a minimum of 24 hours of supervised training in the field in each level of protection (EPA-defined Levels A through C) before that employee is considered competent to operate at that level of protection in the field without supervision.

Responsibilities The Health and Safety Manager is ultimately responsible for scheduling and directing health and safety training for all new employees who will be engaged in hazardous site work, and for scheduling and directing refresher courses for existing employees engaged in such work. It is the responsibility of each project manager to ensure that all training requirements are met before an individual is permitted to work on the site.

Contracted Training All contracted training for the health and safety training described above must be preauthorized by the CHSM.

Reporting And Recordkeeping Reports on training activities and training status of field personnel will be kept by the CHSC as described in Standard Operating Procedure No. 3.0. Copies of the reports may be kept by the regional health and safety coordinator.

Employee Certifications All employees will receive copies of certification upon completion of the Hazardous Materials Field Activities Training Course, Refresher Training, and the On-site Managers/Supervisors Training Course, if applicable, and are required to submit to the CHSC copies of their Red Cross first aid/CPR training certificates as described in SOP No. 3.0.

Site Training At the initiation of site work and whenever new employees or contractors arrive on site, training on the specific hazards and hazard control methods shall be provided. A review of the HSP shall be included in this training.

Also, daily safety meetings shall be conducted at the beginning of each shift or the beginning of each new job phase to discuss specific health and safety issues and procedures.

5.2 HAZARD COMMUNICATION REQUIREMENTS

All personnel involved in project activities that may result in exposure to hazardous materials must be included in a pre-job training program in compliance with 1910.1200. The scope of the pre-training program shall include:

- a discussion of the physical and health hazards of the chemicals in the work;
- a review of the site safety hazards;
- methods that may be used to detect hazardous chemicals;
- methods to be used to protect employees from exposure to hazardous chemicals;
- a review of the project hazard communication program including material safety data sheet (MSDS) information and chemical labeling system.

5.3 HEALTH AND SAFETY TRAINING TRACKING SYSTEM

A computerized tracking system has been implemented to track training and medical monitoring needs. The objectives are to provide current certification on all field clearance parameters and to enforce any restrictions or field clearance. The tracking system is described in detail in SOP 1.0.

5.4 ACTIVE FIELD STATUS CLEARANCE

An active field status is required of all employees in order to perform field work on hazardous waste sites. The requirements for an active field status are: current certification in 40-hour hazardous waste basic training, 8-hour refresher training, and a fit for work duty certification from a medical monitoring program physical. (Refresher training is not required for employees who have completed a 40-hour basic training course within the last twelve months.

Those employees who lack one or more of the requirements for an active field status, will be designated as inactive.

Additional certifications may be required of an active status field employee. These certifications include: CPR and First Aid, 24 hours of supervised field experience in Levels D, C, B, and A, and respirator fit testing.

SECTION 7.0 - RESPIRATORY PROTECTION PROGRAM

7.1 INTRODUCTION

It is the policy of Jacobs Engineering Group to provide maximum protection of its employees from occupational exposure to dusts, fumes, mists, radionuclides, toxic gases, and vapors. Where feasible, exposure to contaminants at concentrations presenting potential health hazards will be eliminated by engineering controls. When effective engineering controls are not feasible, use of personal respiratory protective equipment may be required to achieve this goal.

This respiratory protection program complies with the OSHA General Industry Standard for Respiratory Protection 29 CFR Section 1910.134. Jacobs standard operating procedures for respirator selection, use, and care follow the guidance provided in ANSI Standard Z88.2-1980, Practices for Respiratory Protection and other applicable federal regulations (see SOP No. 4.0).

Responsibilities of key personnel in the respiratory protection program are:

- Management - It is the responsibility of Jacobs safety management to determine what specific applications require use of respiratory equipment. Jacobs will provide employees with proper respiratory equipment to meet the needs of each specific application. Employees will also be provided with adequate training and instructions on all equipment.

- Supervisors - Supervisors, office managers, group managers, project managers, and site managers are responsible for insuring that all personnel under their control are completely knowledgeable of the respiratory protection requirements for the areas in which they work. They are also responsible for insuring that their subordinates comply with all facets of this respiratory protection program, including respirator inspection and maintenance.

- Employees - It is the responsibility of the employee to be knowledgeable of the respiratory protection requirements for their work areas. Employees are also responsible for wearing the appropriate respiratory equipment according to proper instructions and for maintaining the equipment in a clean and operable condition.

7.2 RESPIRATOR PROGRAM ELEMENTS

Physiological And Psychological Limitations For Respirator Wearers Employees shall not be assigned to tasks requiring use of respiratory equipment unless it has been determined by a qualified physician that they are physically able to perform the work while using the equipment (see SOP No. 1.0). The determination shall be made on the basis of a medical examination as required by 29 CFR 1910.120. The determination of medical acceptability for respirator use shall be reviewed annually during the annual examination.

Respirator Selection Only respirators certified by the National Institute of Occupational Safety and Health (NIOSH) and Mine Safety and Health Administration (MSHA) will be used. Selection of a proper respirator for any given situation shall require consideration of the following factors:

a. The nature of the hazard (including physical properties, physiological effects on the body, concentration of toxic material or airborne radioactive level, established permissible time-weighted average concentration for toxic material, established permissible airborne concentration for radioactive material, and established immediately dangerous to life or health concentration for toxic material).

b. The characteristics of the hazardous operations or process.

c. The location of the hazardous area with respect to a safe area having respirable air.

d. The period of time for which respiratory protection may be required.

e. The activity of workers in the hazardous area.

f. The physical characteristics, functional capabilities, and limitations of various types of respirators.

g. Respirator protection factors.

Jacobs Standard Operating Procedure for respirator selection is contained in SOP No. 4.0.

Training Each respirator wearer shall be provided training covering the following topics:

a. respiratory hazards and what happens if the respirator is not used properly;

b. engineering and administrative controls being used and the need for respirators to provide protection;

c. reason for selecting a particular type of respirator;

d. function, capabilities, and limitations of the selected respirator;

e. method of donning the respirator and checking the fit and operation;

f. proper wearing of the respirator;

g. respirator maintenance; and

h. recognizing and handling emergency situations.

Respirator Fit Each respirator user will be qualitatively fit-tested annually for an appropriate respirator in accordance with Standard Operating Procedures No. 4.6. The wearer is required to check the seal of the respirator by appropriate means (negative and positive sealing test) before each use.

Facial Hair, Contact Lenses, And Eye And Face Protective Devices A respirator equipped with a facepiece shall not be worn if facial hair comes between the sealing periphery of the facepiece and the face or if facial hair interferes with valve function. Contact lenses shall not be worn when a respirator is needed. If a spectacle, goggle, face shield, or welding helmet must be worn with a facepiece, it shall be worn so as not to adversely affect the seal of the facepiece to the face.

Issuance Of Respirators The proper types of respirators specified for each respiratory hazard are listed in the previous section describing levels of protection. Only persons trained to ensure that proper respirators are issued shall be permitted to issue respirators to persons needing them.

Respirator Inspection Respirators must be inspected by the wearer prior to its use to ensure that it is in proper working condition. The method of inspection will be demonstrated and discussed during training. Each office or location using respirators shall maintain written inspection procedures for each type of respirator used (see SOP No. 4.4 and 4.5). Each respirator stored for emergency or rescue use shall be inspected at least once a month.

Monitoring Respirator Use Members of the health and safety staff will monitor the use of respirators to ensure that the correct respirators are used, that respirators are working properly, and that respirators being used are in good working condition. In work areas where respirator use is routine, inspections will be done at least quarterly. For nonroutine respirator use, an inspection will be made each time respirators are worn.

This inspection can be part of a health and safety field audit (see SOP No. 11.0). Results of respirator use inspections will be recorded and sent to the Health and Safety Manager for review.

Monitoring Respiratory Hazards The concentration or the airborne radioactivity level of the respiratory hazard in the work area shall be monitored initially prior to respirator selection and periodically during respirator use to ensure that the proper type of respirator is being utilized. This can be done by using personal sampling equipment or area monitoring using real time monitoring equipment, as appropriate for the particular respiratory hazard.

Medical And Bioassay Surveillance When applicable, medical surveillance, including bioassay, shall be carried out periodically to determine if respirator wearers are receiving adequate respiratory protection. A physician shall determine the requirements of the surveillance program. Medical surveillance requirements for hazardous waste site workers are described in Section 4.0.

Respirator Maintenance Respirator maintenance shall be performed regularly to ensure that each respirator wearer is provided with a respirator that is clean and in good operating condition. A respirator maintenance schedule will be established in each office or location where respirators are used. This schedule will be based on the specific respirators used and whether they are used routinely or nonroutinely.

- Cleaning and Sanitizing - Respirators will be cleaned and sanitized after each use. Commercially available cleaner/sanitizer recommended by the respirator manufacturer will be used.

- Inspection - Respirators will be inspected by the user prior to use as described in SOP No. 4.0. Respirators will also be inspected by an equipment officer or another member of the safety staff assigned this responsibility.

- Part Replacement and Repair - This function will be performed only by persons trained in proper respirator assembly and repair. When replacing worn or deteriorated parts, only those made specifically for the device will be used, and all maintenance and repair work will be recorded.

- Storage - Respirators will be stored in a convenient, clean, and sanitary location. Respirator facepieces will be stored in protective plastic bags in a manner that will prevent distortion of rubber or elastic parts.

7.3 RESPIRATOR PROGRAM EVALUATION

An appraisal of the effectiveness of the respirator program shall be carried out annually by the health and safety manger. This evaluation will cover a) the adequacy of respirators in providing the necessary protection, b) inspection of program operation, and c) wearer acceptance. The evaluation will be documented. Corrective action plans and target dates will be listed.

SECTION 9.0 - AIR MONITORING

9.1 INTRODUCTION

This section presents an overview of the procedures used during initial and continuing site air and surface monitoring and site characterizations.

Prior to commencement of site activities, an evaluation of the potential hazards associated with the site is undertaken. The evaluation will consist of summarizing available data concerning the site by reviewing current information in project files.

If the information available is insufficient to adequately describe on-site conditions, an initial site characterization is conducted to determine any evidence of radiation hazards, explosion hazards, oxygen deficiency, toxic chemical vapors, or other conditions that may adversely affect the health and safety of site personnel.

All field air monitoring shall be conducted using approved monitoring devices and shall be standardized and calibrated in accordance with NIOSH, OSHA or NRC requirements.

9.2 INITIAL SITE CHARACTERIZATION

The objective of an initial site characterization is to determine, on a preliminary basis, the presence of potentially hazardous conditions. An approved HSP is required for an initial site characterization. Table 9.1 provides guidelines to be used for the evaluation of atmospheric hazards during the characterization.

Organic Vapors and Gases If the types of substances present at the site are known and the materials are volatile or can become airborne, measurements for organics are made with one or more appropriate, properly calibrated survey instruments.

When the presence of types of organic vapors/gases is unknown, instruments such as a photoionizer and/or a portable gas chromatograph operated in the total readout mode, are used to detect organic vapors. Until specific constituents are identified, the readout indicates total airborne substances to which the instrument is responding. Identification of the individual vapor/gas constituents permit the instruments to be calibrated and used for more specific analysis.

When individual chemical constitutnets present a particular hazard, chemical identification should be undertaken using techniques such as colorimetric tubes, direct reading electronic instrumentation or field sampling or with laboratory analysis.
Sufficient data is obtained during the initial entry to map or screen the site for various levels of organic vapors. These gross measurements are used on a preliminary basis to: 1) determine levels of personnel protection, 2) establish site work zones, and 3) select candidate areas for more thorough qualitative and quantitative studies.

Inorganic Vapors and Gases The ability to detect and quantify nonspecific inorganic vapors and gases is limited. Presently, photoionizers have limited or no detection capability, while the chromatographs have none. If specific inorganics are known or suspected, measurements are made with appropriate instruments, if available. Colormetric tubes or other techniques presented above can be used if substances present are known and appropriate tubes are available.

Radiation Radiation monitoring is incorporated in the initial survey where radioactive materials are suspected to be present.

Normal gamma radiation background is approximately 0.01 to 0.02 mR per hour (mR/hr) on a gamma survey instrument. However, limited investigation may continue with elevated radiation exposure rates. If the exposure rate increases to 3-5 times above gamma background, a qualified health physicist must be consulted before work is allowed to continue.

The absence of gamma readings above background is not interpreted as the complete absence of radioactivity. Radioactive materials emitting low-energy gamma, alpha, or beta radiation may be present, but for a number of reasons may not cause a response on a general gamma survey instrument. Unless airborne or ingested, these radioactive materials should present minimal hazard, but more thorough surveys are conducted as site operations continue, to completely characterize the presence of any radioactive material.

Airborne Particulates Where the potential exists for hazardous concentrations of airborne particulates, sampling is performed to evaluate the hazard level. Sampling protocols for specific contaminants shall follow OSHA or NIOSH standard methods if established. Common particulate contaminants requiring air monitoring include asbestos, metals, PCBs, PNAs, pesticides and radionuclides. Sampling and analytical methods require filter samples and laboratory analyses.

For routine monitoring, direct reading particulate analyzers are used if calibrated with parallel laboratory analytical results.

Oxygen Deficiency Ambient air must contain at least 19.5 percent oxygen by volume. At lower percentages, air-supplied respiratory protective equipment is needed. Oxygen measurements are of particu'ar importance for work in enclosed spaces, low-lying areas, or in the vicinity of accidents that have produced heavier-than air vapors, which could displace ambient air. These oxygen-deficient areas are also prime locations for taking further organic vapor and combustible gas measurements, since the air has been displaced by other substances. Oxygen-enriched atmospheres increase the potential for fires. Oxygen measurements are made through the use of an approved oxygen meter.

Combustible Gases The presence or absence of combustible vapors or gases is determined through the use of an approved explosimeter. If readings approach or exceed 10 percent of the lower explosive limit (LEL), extreme caution must be exercised in continuing the investigation. If readings approach or exceed 20 percent LEL, personnel are withdrawn from

the area immediately. Before resuming any on-site activities, project personnel, in consultation with experts in fire or explosion prevention, must develop procedures for continuing operations.

While on-site, visual observations are made to further evaluate site hazards. For example, dead fish or other animals, land features, wind direction, or the presence of corroded materials may indicate increased hazard potential.

Interpretive Direct-Reading Reading A variety of toxic air pollutants, including organic and inorganic vapors, gases, or particulates can be produced at, for example, abandoned waste sites; fires at chemical manufacturing, storage, reprocessing, or formulating facilities; or fires involving pesticides. Direct-reading field instruments will not detect or measure all of these substances. Thus, negative readings should not be interpreted as the complete absence of airborne toxic substances. Verification of negative results can only be done by collecting air samples and analyzing them in a laboratory.

9.3 CONTINUING SITE CHARACTERIZATION

To verify that site control procedures are preventing the spread of contamination, a monitoring and sampling program is established based on the initial site characterization. Each work zone is periodically monitored for air contaminants, especially when:

- work begins on a different portion of the site;
- different contaminants are being handled;
- a markedly different type of operation is initiated (e.g., barrel opening as opposed to exploratory well drilling); and
- significant change occurs in atmospheric conditions (e.g., temperature, wind speed, rainfall).

In addition, analysis of soil collected in the most heavily traveled areas would indicate contaminants being carried from the Exclusion Zone by personnel, equipment, or wind. Air monitoring techniques described in Section 9.2 are also applied for continued monitoring. The results of these and further tests are then used to modify the existing HSP as necessary.

9.4 PERSONNEL MONITORING

For site tasks with the potential for exposure greater than existing OSHA PELS, ACGIH-TLVs, or OSHA action levels, selective personal monitoring of high-risk workers is undertaken. Monitoring is undertaken to ensure compliance with OSHA and state OSHA (where applicable) standards and uses the applicable OSHA or NIOSH standard methods.

Monitoring results are compared with OSHA PELS and ACGIH-TLVs. All personnel monitoring results are maintained for 30 years in accordance with 29 CFR 1910.20.

During site work employees shall wear a LTD (thermo luminescent dosimetry) badge if gamma results are greater than background and/or if known radioactive source(s) are present at the site.

Breathing zone airborne radiation monitoring will be conducted if specific jobs involve more than 10 MPC-hours in any week.

If employee full shift noise exposure is potentially above 85dBA based on sound level measurements for specific tasks, full shift personnel noise dosimetry shall be performed on highest risk employees.

9.5 PERIMETER MONITORING

Where contaminant migration away from the active site presents a potential hazard to site personnel outside the Exclusion Zone or to the public, a location monitoring program is undertaken in consultation with the HSM. Since the fixed-location samples may reflect exposures either upwind or downwind from the site, wind speed and direction data are needed to determine monitoring locations and to interpret the sample results.

As a minimum, one upwind (or background), two downwind, and two crosswind sampling locations are monitored. OSHA or NIOSH standard methods for sample analysis are followed.

For ongoing site air monitoring, direct reading instruments may be employed when calibrated against laboratory analysis for specific contaminants.

9.6 MONITORING ACTION LEVELS

For all air borne monitoring required, Action Levels will be established dependent upon the nature and extent of hazards, site logistics and meteorological conditions. Action Levels shall trigger a discontinuation of site activity at affected locations until employees upgrade the level of protection or until air borne concentrations decrease below the Action Level.

TABLE 9.1
ATMOSPHERIC HAZARD GUIDELINES

Monitoring Equipment	Hazard	Ambient Level	Action
Combustible gas indicator	Explosive	Less than 10% LEL atmosphere	Continue investigation.
		10% - 20%	Continue on-site monitoring with extreme caution as higher levels are encountered.
		More than 20% LEL	Explosion hazard; withdraw from area immediately. Return to work only is level decreases below 10%.
Oxygen concentration meter	Oxygen	Less than 19.5%	Monitor wearing SCBA. Note: Combustible gas readings are not valid in atmosphere with less than 19.5% oxygen.
		19.5 % - 25%	Continue investigation with caution. SCBA not needed; based on oxygen content only.
		More than 25.0%	Discontinue inspection; fire hazard potential consult specialist.
Radiation survey	Radiation	Less than 0.1 mR/hr	Continue investigation.
		More than 0.1 mR/hr , and above background	If radiation is detected above this level, this signifies the presence of possible radiation sources. At this level, more thorough monitoring is necessary. Consult with a health physicist.
Colorimetric tubes and other direct reading specific gas monitors	Organic and inorganic	Depends on species	Consult standard reference manuals for air and concentrations/ toxicity data.
Photoionizer	Organic vapors/gases	1) Depends on species	Consult standard reference manual for air concentrations/ toxicity data. Normally use PEL or TVL limits.
		2) Total Response Mode	Consult standard reference manual with industrial hygiene evaluation.
Organic vapor analyzer	Organic	1) Depends on species	Consult standard reference manuals for concentration/ toxicity data. Normally use PEL or TLV limits.
		2) Total Response Mode	Consult standard reference manual with industrial hygiene evaluation.
Pump sampling, specific media and laboratory analysis	Most vapor and particulate contaminants	Depends on species	Follow OSHA or NIOSH sampling and analysis procedures. Use contaminant PEL as action level.

SECTION 13.0 - REPORTING AND RECORDKEEPING

13.1 INTRODUCTION

In the event of a fatal or serious accident, or an incident involving personal injury or exposure to potentially hazardous materials, certain reporting and recordkeeping requirements must be met. These reporting and recordkeeping requirements comply with Jacobs' in-house policies as well as federal, state and local regulations. In addition, Jacobs maintains a monthly record of each employee's field activities at sites where hazardous substances are known or suspected to be present.

13.2 ILLNESS AND INJURY REPORTING

Reporting Of Serious And Fatal Accidents In the event of a fatal or serious accident an immediate telephone report will be made by the Site Safety Officer to the Health and Safety Manager outlining all details of the accident and action taken.

The Health and Safety Manager shall immediately advise the program manager and the group vice president of QA and safety of the incident and actions taken. The Health and Safety Manager will then notify the appropriate local, state or federal safety and health agency(s), as necessary.

Reporting Incidents Involving Personal Injury Or Exposure To Hazardous Materials All incidents involving personal injury or exposure to potentially hazardous materials during any field activity must be documented and reported to the HSM and Corporate Safety Director. A standard Employee Exposure/Injury Report form is used for this purpose (see SOP No. 9.0).

It is important to report all exposures and injuries even though the incident is not considered serious or no adverse health effects or symptoms are apparent at the time. Often exposure to a toxic agent has delayed or latent effects which can only be detected by specific diagnostic tests. Documenting an exposure may aid in identifying the cause of symptoms or changes in health status indicators at a later date. Likewise, an injury, such as an eye injury caused by dust particles, may result in delayed damage to the eye. To clarify the types of injuries which require the filing of an incident report, the following definitions are provided:

- Exposure For the purpose of reporting, an "exposure" is defined as any contact with a chemical physical or radiological material by epidermal contact, ingestion, which causes or might cause, a potentially harmful health effect. For example, airborne exposure exceeding the PEL or TLV is considered an exposure. The contact need not be for an extended time or with a large amount of material in order for the contact to be considered an "exposure".

- Injury For the purpose of reporting, an "injury" is defined as any accidental event which results in, physical harm. The extent of damage or potential damage need not be a factor in deciding whether an injury is reported.

The procedure for reporting incidents involving personal injury or exposure to hazardous materials (Employee Exposure/Injury Report) is contained in SOP No. 9.0.

13.3 OSHA RECORDKEEPING REQUIREMENTS

Regulations established by the Occupational Safety and Health Act of 1970 (OSHA) require employers to prepare and maintain records of occupational injuries and illnesses. In addition, the act requires the reporting of fatal or serious injuries to the U.S. Department of Labor. Minor injuries requiring first aid treatment only are not reported. All reports must be on the forms approved by the Department of Labor or applicable state forms. They must be kept current and retained for five years following the end of the calendar year to which they relate.

Forms Records of occupational injury and illness are kept by the Health and Safety Manager on two separate report forms. These forms are OSHA Form 200, Log and Summary of Occupational Injuries and Illnesses, and OSHA Form 101, Supplementary Report of Occupational Injuries and Illnesses. These forms and the reporting procedure are contained in Jacobs SOP No. 9.0. When there are applicable state forms, these will be used in lieu of the federal forms.

Record Of Employee Exposure To Toxic Or Hazardous Materials Federal standards applicable to toxic and hazardous substances require employers to establish and maintain accurate records of employee exposure to certain toxic or hazardous materials. A monthly report of field activities will be maintained for each employee participating in operations where toxic or hazardous materials are known or suspected to be present. The reports provide a permanent record of sites on which the employee worked and the types of chemicals or other agents to which the employee may have been exposed. Actual or suspected exposures are also indicated. The employee is required to complete the Monthly Hazardous Materials Exposure Report at the end of each month. This form with instructions for completing, and the procedure for filing, are all contained in Jacobs SOP No. 9.0.

13.4 CONFIDENTIALITY OF RECORDS

All health and safety reports and records on Jacobs personnel will be maintained in confidence by the Health and Safety Manager. Files are kept in locked filing cabinets in the corporate health and safety office. Employees may receive a copy of their health and safety records upon request.

JACOBS

JACOBS ENGINEERING GROUP INC.
CORPORATE HEALTH AND SAFETY MANUAL

HEALTH AND SAFETY TRAINING - HAZARDOUS WASTE OPERATIONS

SOP NO. 3.0

APPROVED: HEALTH AND SAFETY MANAGER

OBJECTIVE
This standard operating procedure outlines basic requirements for the health and safety program. The objectives of Jacobs' health and safety training program are:

- to make employees aware of the potential hazards they may encounter;
- to provide the knowledge and skills necessary to perform the work with minimal risk to worker health and safety;
- to make employees aware of the purpose and limitations of safety equipment; and
- to ensure that employees can safely avoid or escape from emergencies.

This procedure is intended to ensure compliance with all applicable regulations, including those set forth in 29 CFR section 1910.120.

APPLICABILITY
This procedure applies to all Jacobs personnel, contractors and subcontractors involved in hazardous waste activities. Those contractors and subcontractors who administer their own health and safety training programs must provide documentation to Jacobs' Health and Safety Manager (HSM) which shows their program to be at least as stringent as Jacobs'. In addition, copies of employee certifications in all required basic, refresher and field training must be submitted to the Jacobs HSM for each employee who will be involved in field activities.

REFERENCES
29 CFR 1910.120. Hazardous waste operations and emergency response. Federal Register March 6, 1989.

EPA Order 1440.2. Health and Safety Requirements for Employees Engaged in Field Activities. July 12, 1981.

Superfund Amendments and Reauthorization Act of 1986.

PROGRAM ADMINISTRATION

The Health and Safety Manager (HSM) is responsible for the overall direction and supervision of the health and safety training program. He/she shall approve the training course content and requirements, assure that all OSHA and other federal regulations for employee training are met, and modify the program as necessary to assure that each employee receives relevant and comprehensive training in health and safety.

The Corporate Health and Safety Coordinator (HSC), will schedule all training programs in conjunction with projects and provide arrangements for Regional Health and Safety Coordinators. He/she will provide documentation of course completion and records management for all training activities.

The Program Health and Safety Manager (PHSM) will coordinate with the Corporate Health and Safety Coordinator to schedule and conduct basic, refresher, and Pre-Job training courses, as needed. He/she will audit site training programs and site procedures for conformance with the program Health and Safety Plan. He/she will also maintain the program health and safety training files. He/she will send copies of all health and safety training documentation to the Corporate Health and Safety Coordinator.

The Regional Safety Coordinator (RSC) shall coordinate with the Corporate Health and Safety Coordinator to schedule basic, refresher, and field training, including the American Red Cross CPR and First Aid courses, for all applicable employees. He/she shall maintain the health and safety regional files and provide copies of the regional files to the Corporate Health and Safety Coordinator. He/she will also maintain (and calibrate where necessary) all personal protective clothing and equipment for the region. (In some regions the equipment maintenance and calibration will be the responsibility of the region's Equipment Officer, under the direction of the Regional Safety Coordinator.)

The Project Manager (PM) will assure that every team member is trained prior to the initiation of field activities. He/she will also assure that all the necessary respiratory and personal protective clothing and equipment are available and on-site prior to field activity start-up.

PROCEDURE

Basic Training Jacobs' Hazardous Waste Operations Training Course (40-hour Basic Training Course) is conducted on an as-needed basis for new employees at various offices and locations around the country. When less than eight employees require training, external commercial training programs shall be used. The Corporate Health and Safety Coordinator will schedule courses in conjunction with the Program Health and Safety Managers and Regional Health and Safety Coordinators.

Classroom and field exercise training will include a minimum of 40 hours and will cover the following topics:

- recognition, evaluation, and control of chemical and physical hazards;
- personal protective clothing and equipment;
- respiratory protection and respirator fit testing;
- environmental monitoring equipment;
- standard operating procedures and safe work practices;
- site safety plan development;
- decontamination procedures; and
- practical field exercise in use of personal protective equipment and monitoring instruments (Levels B and C).

All topics (except first aid and CPR) are addressed in the 40-hour Training Manual, and each course attendee will receive a copy of the manual for future reference.

The respirator fit test will be conducted during basic training and the Respirator Fit Test Record (see SOP No. 4.0) is kept in the employee's corporate training file. The procedure for respirator fit testing is described in SOP No. 4.6.

Upon completion of the basic training course, each attendee will receive a Certification of Health and Safety Training for Hazardous Materials Field Activities. The HSC will complete the form for each attendee. The HSC will keep a copy of the certification in the employee's corporate health and safety file. No employee may participate in field activities without this basic training.

Cardiopulmonary Resuscitation (CPR) In addition to the basic training course, all field personnel will attend Standard First Aid and Basic Life Support Cardiopulmonary Resuscitation courses taught by certified American Red Cross instructors. Each attendee will receive copies of the first aid and CPR text used in the course. Employees who complete the courses will be issued American Red Cross certificates, copies of which must be submitted to the HSC for the corporate files.

24-Hour Basic Training The 24-hour basic training course is offered to hazardous waste treatment, storage and disposal (TSD) operators and in-plant hazardous waste emergency response and cleanup operations. Classroom and field exercise training will include a minimum of 24 hours and will cover the following topics.

- regulatory review;
- recognition, evaluation and control of chemical and physical hazards;
- personal protective clothing and equipment;
- respiratory protection and respirator fit testing;
- environmental monitoring equipment;
- standard operating procedures and safe work practice;
- site safety plan development;
- decontamination procedures; and
- practical field exercise in use of personal protective equipment and monitoring instruments (Levels B and C).

All topics are addressed in the 24-hour training manual, and each course attendee will receive a copy of the manual for future reference.

The respirator fit test will be conducted during the basic training. The respiratory fit test record (see SOP No. 4.0) is kept in the employee's corporate training file. The procedure for respiratory fit testing is described in SOP No. 4.6.

Upon completion of the basic training course, each attendee will receive a Certificate of Health and Safety Training for Hazardous Materials Field Activities. The HSC will complete the form for each attendee. The HSC will keep a copy of the certification in the employee's corporate health and safety file. No employee may participate in field activities without this basic training.

Additional Training for On-Site Managers and Supervisors Managers and supervisors of on-site field activities are required to complete an additional eight-hour training in the management of hazardous waste site cleanup operations and management of site work zones. This additional training must be completed by an employee prior to any assignment in which he/she will be managing field activities. These training sessions are held on an as-needed basis. Individuals completing this specialized training receive Certification of Health and Safety Training for On-site Managers and Supervisors. The HSC will complete the form for each attendee. The HSC will keep a copy of the certification in the employee's corporate health and safety file. No employee may act as a manager or supervisor for on-site field activities without successful completion of this additional health and safety training.

Field Supervision In addition to the basic training described above, all field personnel must complete a minimum of 24 hours of supervised field experience in each level of protection (EPA-defined Levels A through D) before that employee may operate in that level of protection in the field without supervision. Supervised field experience is documented on Form 3-3, Individual Field Training Record.

The Corporate Health and Safety Coordinator will provide each employee with a copy of his/her training record log for updating every six months. The HSC will verify all information before entering it in the employee's permanent file.

Project-Specific Training Prior to doing site work, all site employees will be given pre-job training. The scope of topics will comply with SOP 3.1.

Additionally, at the beginning of each site phase, or daily as necessary, employees shall receive training on the specific job hazards involved in that phase, protective equipment and other control procedures required and review of any site health and safety issues or problems.

All pre-job, site phase, or daily training shall be documented using Form 3-4 (Health and Safety Meeting Form) or its equivalent, and will be retained as a part of the site health and safety records.

Recordkeeping Training Certificates, Forms 3-1 and 3-2, discussed in this SOP, will be given to the employee and copies maintained in the corporate and regional health and safety files. Employees who receive additional training (e.g., Level A training, radiation protection training, and so forth) are required to submit copies of all relevant certifications and documentations to the HSC.

FORMS
The following forms are included in this SOP.

FORM 3-1	Certification of 40-Hour Health and Safety Training for Hazardous Materials Field Activities
FORM 3-2	Certification of Health and Safety Training for On-site Managers and Supervisors
FORM 3-3	Individual Field Training Record
FORM 3-4	Health and Safety Meeting Form
FORM 3-5	Certification of 8-Hour Refresher Training for Hazardous Materials Field Activities
FORM 3-6	Certification of 24-Hour Health and Safety Training for Hazardous Waste Site Operations

FORM 3-1

Certification of 40-hour Health and Safety Training
For
Hazardous Materials Field Activities

JE JACOBS ENGINEERING GROUP INC.

CERTIFICATE OF COMPLETION

EXAMPLE

_____

has successfully completed the 40-hour Health & Safety Training course for Hazardous Waste Site Operations and Emergency Response in compliance with OSHA regulations pursuant to 29 CFR Part 1910.120

this _____ day of _____, 19 ___

_____
Location

_____
Dr. Jerry M. Briggs, Ph.D., CIH
Manager, Environmental Health and Safety

consop-3

FORM 3-2

Certification of Health and Safety Training
For
On-site Managers and Supervisors

JE JACOBS ENGINEERING GROUP INC.

CERTIFICATE OF COMPLETION

EXAMPLE

_____

has successfully completed the 8-hour Management and Supervisor Training course relative to Hazardous Waste Site Operations and Emergency Response under regulations pursuant to 29 CFR Part 1910.120

this _____ day of _____, 19____

_____
Location

_____
Dr. Jerry M. Briggs, Ph.D., CIH
Manager, Environmental Health and Safety

CORSOP-3

FORM 3-3

INDIVIDUAL
FIELD TRAINING RECORD

Name _____ Social Security # _____

Date of Employment _____

Title/Job Function _____ Performance Unit _____

LEVEL D

Site	Activity	Supervisor	Date	Hours

LEVEL C

Site	Activity	Supervisor	Date	Hours

LEVEL B

Site	Activity	Supervisor	Date	Hours

FORM 3-3 (continued)

LEVEL A

Site	Activity	Supervisor	Date	Hours

OTHER TRAINING • (advanced training, special courses, etc.)

Course Title	Presentor	Dates	Hours

• Do not include initial basic training, refresher, or general CPR and First Aid courses.

FORM 3-4

HEALTH AND SAFETY MEETING FORM
HEALTH AND SAFETY PROGRAM

PROJECT:
SITE:

NAME SSN:

NAME SSN:

NAME SSN:

NAME SSN:

NAME SSN:

NAME SSN:

NAME SSN:

NAME SSN:

PRESENTED BY: SIGNATURE

DATE LOCATION

TOPICS:

FORM 3-5

Certification of 8-hour Refresher Training
For
Hazardous Materials Field Activities

JE JACOBS ENGINEERING GROUP INC.

CERTIFICATE OF COMPLETION

_____

has successfully completed the 8-hour Health & Safety Training refresher course for Hazardous Waste Site Operations and Emergency Response in compliance with OSHA regulations pursuant to 29 CFR Part 1910.120

this _____ day of _____, 19____

_____
Location

_____
Dr. Jerry M. Briggs, Ph.D., CIH
Manager, Environmental Health and Safety

consop-3

24-HOUR TRAINING CERTIFICATE

JACOBS ENGINEERING GROUP INC.

CERTIFICATE OF COMPLETION

_____

has successfully completed the 24-hour Health & Safety Training course for Hazardous Waste Site Operations and Emergency Response in compliance with OSHA regulations pursuant to 29 CFR Part 1910.120

this _____ ____ day of _____, 19__

_____ _____

Location *Dr. Terry M. Briggs, PhD, CIH*

Manager, Environmental Health and Safety

conscp-3

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JACOBS ENGINEERING GROUP INC.
CORPORATE HEALTH AND SAFETY MANUAL

HAZARD COMMUNICATION TRAINING
SOP NO. 3.1

REVISION NO.
DATE

APPROVED: _____
HEALTH AND SAFETY MANAGER

OBJECTIVE
This standard operating procedure outlines the basic provisions of the pre-job training requirements for employees involved in any project activity that may result in exposure to hazardous materials. This procedure is intended to ensure compliance with 29 CFR section 1910.1200, any applicable state employee right-to-know regulation and any other applicable training provisions presented in 1910 & 1926.

APPLICABILITY
This procedure applies to all Jacobs personnel, contractors, and subcontractors involved in project activities with the potential for exposure to hazardous materials.

REFERENCES
29 CFR 1910.1200. Hazard communication

PROGRAM ADMINISTRATION
The Health and Safety Manager (HSM) is responsible for overall supervision of health and safety training. He/she shall provide program auditing for compliance with this SOP.

The Program Health and Safety Manager (PHSM) or Regional Safety Coordinator (RSC) has direct responsibility for program compliance, course presentation as needed, and course auditing for program compliance.

The Project Manager/Site Safety Officer (PM/SSO) will assure that every team member is trained prior to the initiation of field activities. He/she will assure that all site health and safety plan components are implemented and that site training records are maintained.

HAZARD COMMUNICATION TRAINING
SOP NO. 3.1

PROCEDURE
All site employees shall be provided training on the following topics prior to beginning work:

- review of their rights to information on hazardous materials in the work area and the location of that information;
- review of site operations where hazardous chemicals are present;
- a review of the physical and health hazards of the chemicals in the work site;
- methods of detecting the hazards;
- control measures and emergency procedures used to protect employees; and
- a review of the site health and safety plan including hazard labeling and material safety data sheets (MSDSs) and how to interpret this information. The HSP must be readily available to site employees.

Training shall also include the following elements, where applicable, in compliance with specific OSHA standards:

- hearing conservation,
- respiratory protection,
- confined space entry,
- lock out/tag out procedures, and
- any 1910 Part Z chemical hazards e.g., asbestos, benzene, lead, arsenic.

Recordkeeping
Form 3-6, Individual Field Training Record, will be used to document training under this SOP. A full list of training topics must be included in this record. The form shall be retained with the site project file and is shown in Appendix E.

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RESPIRATORY PROTECTION PROGRAM INSPECTION AND MAINTENANCE OF AIR PURIFYING RESPIRATOR

SOP NO. 4.4

APPROVED: _____
HEALTH AND SAFETY MANAGER

OBJECTIVE
This procedure describes the requirements for the inspection, cleaning, repair and storage of Jacobs' air purifying respirators. The purpose of this inspection and maintenance program is to ensure that all respirators are maintained at their original effectiveness.

APPLICABILITY
This procedure applies to any Jacobs' personnel who has been assigned the duty of respirator maintenance.

REFERENCES
U.S. EPA. Course Manual for "Hazardous Materials Incident Response Operations," Cincinnati, Ohio, 1987.

PROCEDURE
The following sections detail the procedures for inspection, cleaning and disinfecting, repairing and storing air purifying respirators. In addition, air-purifying respirators used in the field must be decontaminated according to the procedures described in SOP No. 4.2.

INSPECTION
Inspect respirators after each use. Inspect a respirator that is kept ready for emergency use monthly to assure it will perform satisfactorily.

Thoroughly check all connections for gaskets and "O" rings and for proper tightness. Check the condition of the facepiece and all its parts, connecting air tube, and headbands. Inspect rubber or elastomer parts for pliability and signs of deterioration. Any respirator found defective must be repaired before being used in the field, as described below.

Maintain a record for each respirator inspection, including date, inspector, and any unusual conditions or findings.

CLEANING AND DISINFECTION
Respirators used during field work at hazardous waste sites must first be decontaminated according to SOP No. 4.2 before they are returned to the office storage area. To clean and disinfect respirators prior to storage:

- Remove all cartridges, canisters, and filters, plus gaskets or seals not affixed to their seats.
- Remove elastic headbands.
- Remove exhalation cover.
- Wash facepiece and breathing tube (if so equipped) in cleaner/sanitizer powder mixed with warm water, preferably at 120° to 140°F. Wash components separately from the facemask, as necessary.
- Remove all parts from the wash water and rinse twice in clean warm water.
- Air dry parts in a designated clean area.
- Wipe facepieces, valves, and seats with a damp lint-free cloth to remove any remaining soap or other foreign materials.

Note: Most respirator manufacturers market their own cleaners/sanitizers as dry mixtures of a bactericidal agent and a mild detergent. One-ounce packets for quantity use are usually available. Follow manufacturer's recommendations for cleaning/sanitizing if different from the above procedure.

REPAIRS

Only a trained person with proper tools and replacement parts should work on respirators. No one should ever attempt to replace components or to make adjustments or repairs beyond the manufacturer's recommendations.

Make repairs as follows (or follow manufacturer's instructions):

- Disassemble and hand clean all respirator parts, as described above.
- Replace all faulty or questionable parts or assemblies. Use parts only specifically designed for the particular respirator.
- Reassemble the entire respirator and visually inspect the completed assembly.
- Insert new filters, cartridges, or canisters, as required. Make sure that gaskets or seals are in place and tightly sealed.

STORAGE

Follow manufacturer's storage instructions, which are always furnished with new respirators or affixed to the lid of the carrying case. In addition, these general instructions may be helpful:

- After respirators have been inspected, cleaned, and repaired, they must be stored and protected against dust, excessive moisture, damaging chemicals, extreme temperatures and direct sunlight.

- Do not store respirators in clothes lockers, bench drawers, or tool boxes. Place them in wall compartments at work stations or in a work area designated for emergency equipment. Store them in the original carton or carrying case.

- Draw clean respirators from storage for each use. Each unit can be sealed in a plastic bag, placed in a separate box, and tagged for immediate use.

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RESPIRATORY PROTECTION PROGRAM
RESPIRATOR FIT TEST
SOP NO. 4.6

APPROVED: HEALTH AND SAFETY MANAGER

OBJECTIVE
This standard operating procedure provides four methods which can be used to fit test users of demand-type respiratory protection devices.

APPLICABILITY
This SOP applies to any Jacobs' personnel using demand-type respiratory protection devices for field activities. All respirator wearers must be fit tested prior to conducting any on-site activities requiring respirator use.

REFERENCES
American National Standards Institute, Inc. American National Standard Practices for Respiratory Protection, ANSI Z88.2-1980, New York, 1982.

American National Standards Institute, Inc., American National Standard for Respiratory Protection - Respirator Use - Physical Qualifications for Personnel, ANSI Z88.6-1984, New York, 1984.

PROCEDURE
All users or potential users of demand-type respiratory protection devices must be fit tested to ensure a proper facepiece-to-face seal. Both the isoamyl acetate (organic vapor) and irritant smoke (particulates) fit tests will be used for each employee using the methods described below. A selection of respirators should be tested, with users allowed to choose the most comfortable from those that fit satisfactorily.

Each respirator wearer must be cleared for respirator use during the initial and yearly annual medical examination as described in the medical protocol. Employees will be qualitatively fit tested during the initial health and safety training session and the results of each test will be documented on Form 4.6.1, Respirator Fit Test Record. Re-testing will occur semi-annually. In addition, any employee gaining or losing 10 or more pounds from the time of his/her last fit test must be re-tested prior to respirator use.

Respirator Negative and Positive Pressure Tests
The negative and positive pressure tests described below are the first, gross determinations of respirator fit prior to the administration of the isoamyl acetate and irritant smoke tests. The respirator wearer should place the respirator over the face and draw the straps securely, tightening the bottom straps first. The mask should not be so tight as to cause discomfort or a headache.

Negative Pressure Test

In this test, the inlet opening of the respirator's canister(s), cartridge(s) or filter(s) is closed off by covering with the palm of the hand(s), by replacing the inlet seal on a canister(s), or by squeezing a breathing tube or blocking its inlet so that it will not allow the passage of air. Then the wearer inhales gently and holds his breath for at least 10 seconds. If a facepiece collapses slightly and no inward leakage of air into the facepiece is detected, it can be reasonably assured that the fit of the respirator to the wearer is satisfactory. For a respirator equipped with a mouthpiece and nose clamp, if leakage of air into the nose or the mouth cannot be detected, then it can be reasonably assured that the fit of the respirator to the wearer is satisfactory, and further testing commences.

Positive Pressure Test

This test, similar to the negative pressure test, is conducted by closing off the exhalation valve and exhaling gently into the facepiece. The fit is considered satisfactory if slight positive pressure can be built up inside the facepiece without any evidence of outward leakage. For some respirators, this method requires that the wearer remove the exhalation valve cover; this often disturbs the respirator fit even more than does the negative pressure test. Therefore, this test should be used sparingly if it requires removing and replacing a valve cover. The test is easy for respirators whose valve cover has a single small port that can be closed by the palm or a finger.

After it is determined that a respirator is a satisfactory fit by either the positive or negative pressure test (or both), the wearer is further tested using the isoamyl acetate and irritant smoke tests described below.

Isoamyl Acetate (Organic Vapor) Test

- Prior to testing, expose employee to a very low concentration of the isoamyl acetate to assure that he/she can detect the odor.

- Use facepieces equipped with organic vapor cartridges or canister.

- After employee dons the respirator, tester visually inspects facepiece-to-face seal. If seal obviously leaks, test ends and mask is recorded as 'No Fit' on Form 4.6.1. In addition, if the employee is uncomfortable, test ends.

- Instruct employee to put his/her head into the fit test chamber (plastic bag or hood) and breathe normally during a short (30-60 seconds) sedentary period while tester holds an isoamyl acetate ampule near the facepiece seal. If no leakage is detected, instruct the employee to perform various exercises simulating, as nearly as possible, work conditions (i.e., talking, running in place, turning head from side to side, nodding head up and down, bending over).

- If the respirator wearer detects the odor of isoamyl acetate vapor during the test, the wearer should be permitted to readjust the seal of the respirator.

- If the wearer again detects the odor during testing, record that respirator as 'No Fit' on Form 4.6.1, and remove it from the employee. Visually inspect the sealing surface. If any doubt exists about the respirator or cartridges and canisters, test a duplicate to assure that leakage was due to the facepiece-to-face seal.

- If the employee is unable to detect the odor of isoamyl acetate vapor during the test, the wearer has achieved a satisfactory fit with the respirator. This should be recorded by making a check under Isoamyl Acetate - 'FIT' - on Form 4.6.1.

The use of isoamyl acetate vapor as a test agent has the following two major drawbacks: the odor threshold varies widely among persons, although most people can detect by odor a concentration of isoamyl acetate vapor in air as low as 0.1 parts per million by volume; and olfactory fatigue may cause a person to fail to detect the odor of a low concentration of isoamyl acetate vapor in air. Since the odorous vapor test is subjective, the validity of the test result depends on honest indication by the respirator wearer as to whether or not an odor was detected during the test. Therefore, a second test is performed on each employee to ensure an adequate respirator fit test. The second test, the irritant smoke (particulates) test, is described below.

Irritant Smoke (Particulates) Test

- Use respirators equipped with high-efficiency filters.

- Break both ends of an MSA ventilation smoke tube. Insert one end into the tube connected to the positive-pressure end of a two-way aspirator bulb and cover the end with a 1 to 2 inch length of Tygon, surgical, or rubber tubing. Squeeze the aspirator bulb to generate the test aerosol.

- Ventilation should be provided when carrying out a test to prevent contaminating the room where the test is carried out with smoke. The respirator wearer should keep his/her eyes closed during the test, even if the respirator offers eye protection.

- After subject dons the respirator, tester visually inspects facepiece-to-face seal. If seal obviously leaks, test ends and mask is recorded as 'No Fit' on Form 4.6.1. Also, if employee is uncomfortable, the test ends.

- Generate smoke into the input of the harvard hood or a hole punched in the top of the closed plastic bag until smoke can be visually detected throughout the bag or hood.

- Instruct employee to put his/her head into the bag or hood and breathe shallowly during a short (30-60 seconds) sedentary period. If no leakage is detected during sedentary period, instruct employee to perform various exercises simulating, as nearly as possible, work conditions (i.e., talking, running in place, turning head from side to side, nodding head up and down, bending over) while breathing normally.

- If respirator wearer detects the penetration of the smoke into the respirator during the test, the wearer should be permitted to readjust the seal of the respirator and be retested.

- If the respirator wearer again detects the penetration of smoke into the respirator during testing, end the test, record that respirator as 'No Fit' on Form 4.6.1, and remove the respirator from the employee. Visually inspect the sealing surface. If any doubt exists about the respirator or cartridges, test a duplicate to assure that leakage was due to the facepiece-to-face seal.

- If the employee is unable to detect the penetration of smoke during the test, the wearer has achieved a satisfactory fit with the respirator. This should be recorded by making a check under Irritant Smoke - 'FIT' - on Form 4.6.1.

Physical Conditions for Respirator Wearers
In addition to passing the baseline medical examination, obtaining the physician's approval for respirator use, and passing fit tests described above, potential respirator users should be aware of the following conditions for respirator use.

- Excessive facial hair or other conditions that interfere with the proper sealing of the respirator shall disqualify the employee from using a respirator.

- Employees with prescription eyeglasses or contact lenses who are required to wear a full-face respirator shall use special frames for their glasses that do not interfere with the facepiece seal. Contact lenses are not permitted for any field work or respirator use; when using a half-face respirator, the employee must use prescription safety glasses.

FORMS
The following form is included with this SOP:

Form 4.6.1, Respirator Fit Test Record

Instructions for Form 4.6.1, Respirator Fit Test Record

Name:	Name of person being fit tested
Date:	Date of fit test
Organization:	Company or affiliation of person being fit-tested
Location:	Place where test is conducted
Respirator: (make and model)	Self explanatory
Size:	Respirator size (usually small, medium, or large)
Cartridge Type:	Self explanatory
Facial Hair:	Check yes ('Y') or no ('N') to indicate the presence or absence of facial hair (mustache, beard, etc.) which may interfere with facepiece-to-face seal
Corrective Lenses:	Check yes ('Y') or no ('N') to indicate whether or not the test subject wears prescription glasses or contact lenses
Fit/No Fit:	Check the appropriate line for respirator fit or no fit for the isoamyl acetate and irritant smoke test. If an odorous vapor other than isoamyl acetate is used, record what odorous material is used in the 'other' column and check the appropriate 'fit' or 'no fit' row.
Comments:	Self explanatory
Fit Tester/Title/ Organization:	Self explanatory

Respirator FIT Test Record

NAME _____ DATE ____

ORGANIZATION _____

LOCATION _____

RESPIRATOR (MAKE AND MODEL) _____ SIZE ____

CARTRIDGE TYPE _____

FACIAL HAIR* Y __ N __

CORRECTIVE LENSES** (glasses or contacts) Y __ N __

Results

	IsoAmyl Acetate	Irritant Smoke	Other
FIT	__	__	__
NOFIT	__	__	__

COMMENTS:

FIT TESTER _____ TITLE _____ ORGANIZATION _____

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* Excessive facial hair or other conditions that interfere with proper sealing of the respirator shall disqualify the applicant.

** Individuals with prescription eyeglasses who are required to wear a full-face respirator shall use special frames for their glasses that do not interfere with the facepiece seal. Contact lenses are not permitted for respirator work.

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OPERATION, CALIBRATION AND MAINTENANCE OF FIELD MONITORING EQUIPMENT WITHOUT SPECIFIC SOPs

SOP NO. 6.0

REVISION NO. 0
DATE 2/91

APPROVED:

HEALTH AND SAFETY MANAGER

OBJECTIVE
This standard operating procedure describes the protocol for development of operation, calibrations and maintenance procedures for all monitoring equipment without specific SOPs. The objective of the SOP is to ensure that valid and consistent readings are produced from all field hazard exposure monitoring instruments operated by Jacobs Engineering Group Inc. personnel.

APPLICABILITY
This SOP will be followed by all personnel operating, calibrating and maintaining field exposure monitoring equipment for Jacobs Engineering Group Inc. except the Tip II and HNu PI 101 presented in SOPs 6.1 and 6.2 respectively and any other implemented field monitoring equipment SOPs.

PROGRAM ADMINISTRATION
The Health and Safety Manager is responsible for auditing monitoring equipment procedures for compliance with this procedure.

The Program Health and Safety Manager or Regional Safety Coordinator is responsible for development and approval of all monitoring equipment procedures developed under this SOP.

The Equipment Officer is responsible for calibrating and maintaining all monitoring equipment under his/her jurisdiction.

PROCEDURE
A set of equipment specific procedures shall be developed detailing the operation, calibration and maintenance of each field monitoring equipment type. The procedure shall be consistent with the manufacturers specifications.

OPERATION, CALIBRATION AND MAINTENANCE OF FIELD MONITORING EQUIPMENT WITHOUT SPECIFIC SOPs

SOP NO. 6.0

Operative procedures shall include the applications and use limitations of the equipment and any battery recharging instructions.

Calibration procedures shall include all equipment and supply needs, any calibration gas required and calibration frequency. Maintenance procedures shall differentiate field maintenance, Equipment Officers manufacturer maintenance issues and expected frequency for routine maintenance.

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OPERATION, CALIBRATION AND MAINTENANCE OF MONITORING EQUIPMENT PORTABLE PHOTOIONIZER - HNu PI101

SOP NO. 6.2

APPROVED: HEALTH AND SAFETY MANAGER

OBJECTIVE
This standard operating procedure describes the procedures for operation, calibration and maintenance of the HNu PI101 Portable Photoionizer. The objective of the SOP is to ensure that valid and consistent readings are produced from all HNu PI101 instruments operated by Jacobs Engineering Group Inc. personnel.

APPLICABILITY
This SOP will be followed by all personnel operating, calibrating and maintaining the PI101 for Jacobs Engineering Group Inc.

REFERENCES
"Instruction Manual for Model PI101 Portable Photoionizer", HNu Systems, Inc., 1986

PROGRAM ADMINISTRATION
The Health and Safety Manager is responsible for auditing monitoring equipment procedures for compliance with this procedure.

The Equipment Officer is responsible for calibrating and maintaining regional field monitoring equipment, as well as scheduling maintenance service for equipment which requires specialized and/or manufacturer-provided periodic maintenance.

EQUIPMENT
HNu PI101 portable photoionizer with probe
HNu Benzene (reference) span gas
Regulator for span gas cylinder
Tubing to connect regulator, HNu photoionizer, and flowmeter
3-way connector
Flow meter
Charger

PRINCIPLE OF OPERATION
The analyzer measures the concentration of trace gases present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule in electron volts (eV) is less than the energy of the

photon. The source of photons is an ultraviolet lamp with an energy of either 9.5, 10.2 or 11.7 eV.

Sample gases enter the instrument probe through an inlet into the ion chamber and are exposed to photons emanating from the ultraviolet lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp.

A positive-biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter.

This is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

In service, the analyzer is first calibrated with a gas of known composition equal, close to or representative of that to be measured.

Refer to the instruction manual for additional information about ionization potentials and ionization sensitivities of specific compounds.

Care must be taken to select the probe with enough energy to ionize the compound of interest. If the compound has an ionization potential greater than 11.7 eV it may not be detected by either probe.

OPERATING PROCEDURES

The following procedures are to be used in operating the analyzer:

1. Unclamp the cover from the main readout assembly.

2. Remove the inner lid from the cover by pulling out the two fasteners. The probe extension is stored inside the lid.

3. Connect the probe cable plug to the 12 pin keyed socket on the readout assembly panel. Carefully match the alignment slot in the plug to the key in the connector. Screw down the probe connector until a distinct snap and lock is felt.

4. Screw the probe extension into the probe end cap. The probe may be used without the extension if desired.

5. Set the SPAN control for the probe being used (10.2, 9.5, or 11.7 eV) as specified by the initial factory calibration or by subsequent calibrations. If the instrument has already been calibrated using the SPAN control, do not change this setting.

6. Turn the function switch to the BATT (battery check) position. The needle on the meter will go to the green zone if the battery is fully charged. If the needle is below the green arc or if the Low Battery Indicator comes on, the battery must be recharged before the analyzer is used.

7. Turn the function switch to the STANDBY position. Turn the zero adjustment until the meter needle is at zero.

8. Calibrate the instrument daily as described below. Calibration on the selected operating range is desirable.

9. Turn the function switch to the appropriate operating position. Start with the 0-2000 position and then switch to the more sensitive ranges. The UV light source should be on, confirmed by briefly looking into the probe to observe a purple glow from the lamp.

   Warning: Do not look at the light source closer than 6 inches with unprotected eyes. Observe only if necessary, then only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

10. The analyzer is now operational.

11. Hold the probe so that the extension is at the point where the measurement is to be made. The instrument measures the concentration by drawing the gas in at the end of the extension, through the ionization chamber, and out the handle end of the probe.

    Warning: The instrument measures gases in the vicinity of the operator and a high reading when measuring toxic or explosive gases should be cause for action for operator safety.

12. Take the reading or readings as desired taking into account that air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings. Change the ranges as required.

13. Check battery condition as required. If the Low Battery Indicator comes on, turn analyzer off and recharge.

    Caution: Use only in an emergency with a low battery when on battery charge.

14. After completion of use, check battery condition as described in paragraph 6.

15. Turn function switch to OFF position.

16. When not operating, leave analyzer in assembled condition, and connected to battery charger.

17. When transporting, disassemble probe and extension from readout assembly and return equipment to its stored condition.

18. In case of emergency, turn function switch to OFF position.

Battery Charge
Check the battery charge as described above under Operating Procedures during each period of operation, at least once daily. If the battery is low as indicated by the meter reading or the warning indicator, it is necessary to recharge the battery.

To charge the battery, first insert the mini phone plug of the charger into the jack, on the side of the bezel adjacent to the meter. Then insert the charger plug into a 120 or 230 V AC single phase, 50-60 cycle outlet. To ensure that the charger is functioning, turn the function switch to the battery check (BATT) position. The meter should deflect full scale if the charger is working and connections properly made. For normal battery charging, leave the function switch in the OFF position.

The analyzer can be operated, however, while recharging by turning the function switch to the desired position. Such usage will extend the time required to completely recharge the battery. The battery charger is not Div. II approved.

NOTE: It is necessary to connect the probe assembly before turning on the instrument and re-charging. Without following this procedure the instrument will not show battery check.

CALIBRATION
Calibration should be performed before and after every use of the HNu and daily when the HNu is used more than one day.

Span Gas
1. The method of sampling the calibration gas is illustrated in Figure 6.1. Connect the cylinder to one leg of the tee, a flow meter to the opposite leg, and the probe to the third leg. The flow meter does not require a valve. If there is a valve, it must be left wide open. The flowmeter is only to indicate excess flow. Adjust the flow from the regulator such that only a little excess flow is registered at the flowmeter.

This insures that the PI 101 sees the calibration gas at atmospheric pressures and ambient temperature.

2. Usage - Generally, a gas cylinder should not be used below 200-300 psi as pressure effects could cause concentration variations. The cylinder should not be used past the recommended age of the contents as indicated by the manufacturer. In case of difficulty, verify the contents and concentration of the gas cylinder.

3. Alternate means of calibration are possible. For more information contact the HNU Service Department.

Probe

1. Identify the probe by the lamp label. If a question exists, disassemble the probe and inspect the lamp. The energy of the lamp is etched into the glass envelope.

2. Connect the probe to the readout assembly, making sure the red interlock switch is depressed by the ring on the connector.

3. Set the SPAN pot to the proper value for the probe being calibrated. Refer to the calibration memo accompanying the probe.

4. Check the Ionization Potential (IP) of the calibration gas to be used. The IP of the calibration gas must be at or below the IP of the lamp.

5. Proceed with the calibration as described below. Check the calibration memo for specific data. If any questions develop, call the HNU representative.

6. NOTE: The 11.7 eV lamp has a special cleaning compound. Do not use water or any other cleaning compound with the 11.7 eV lamp. Do not interchange ion chambers, amplifier boards or lamps between probes. UV Lamp and Ion Chamber Cleaning Procedures are presented below.

Procedure

1. Battery Check - Turn the function switch to BATT. The needle should be in the green region. If not, recharge the battery.

2. Zero set - Turn the function switch to STANDBY. In this position the lamp is OFF and no signal is generated. Set the zero point with the ZERO set control. The zero can also be set with the function switch on the XI position and using a "Hydrocarbon-free" air. In this case "negative" readings are possible if the analyzer measures a cleaner sample when in service.

3. Set the function switch to the 0-20 range and note the meter reading. Adjust the SPAN control setting as required to read the ppm concentration of the standard. Recheck the zero setting (step 2). If readjustment is needed, repeat step 3. This gives a two-point calibration: zero and the gas standard point. Additional calibration points can be generated by dilution of the standard with zero air if desired.

4. Lamp cleaning - If the span setting resulting from calibration is 0.0 or if calibration cannot be achieved, then the lamp must be cleaned.

5. Lamp replacement - If the lamp output is too low or if the lamp has failed, it must be replaced.

MAINTENANCE

Maintenance of the analyzer consists of cleaning the lamp and ion chamber, replacement of the lamp or other component parts or subassemblies. Lamp and ion chamber cleaning is described below. Refer to the Instruction Manual for replacement procedures.

Warning: Turn the function switch on the control panel to the OFF position before any disassembly. Otherwise, high voltage of 1200 V DC will be present.

Warning: Use great care when operating the analyzer with the readout assembly outside its case due to the presence of 1200 V DC.

Warning: Do not look at the light source from any closer than 6 inches with unprotected eyes. Observe only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

Caution: Do not interchange lamps of different eV ratings in a probe. Amplifier and components are selected for a specific eV lamp. A probe with the wrong lamp will not operate properly.

UV Lamp and Ion Chamber Cleaning

During periods of operation of the analyzer, dust or other foreign matter could be drawn into the probe forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, or drifting, or show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings. Check for this condition monthly or as required. Cleaning can be accomplished as follows:

A. Disassemble the probe and remove the lamp and ion chamber (refer to Instruction Manual). Exercise great care in doing so to prevent inadvertent damage to these components.

B. First check the lamp window for fouling by looking at the surface at an incident angle. Any deposits, films or discoloration may interfere with the ionization process. Clean the window as follows:

1. 9.5 and 10.2 eV lamps.

   a) First clean by rubbing gently with lens tissue dipped in a detergent solution.

   b) If this does not remove deposit, apply a small amount of HNU cleaning compound (PA101534) directly onto the lends of the lamp and spread evenly over surface with a non-abrasive tissue (e.g. Kim-Wipe) or a lens tissue.

   c) Wipe off compound with a new tissue.

   d) Rinse with warm water (about 80 degrees F) or damp tissue to remove all traces of grit or oils and any static charge that may have built up on the lens. Dry with new tissue.

   e) Reinstall lamp in detector and check analyzer operation.

   f) If performance is still not satisfactory replace the lamp.

2. 11.7 eV lamp

   a) Clean by putting a freon or chlorinated organic solvent on a tissue and rubbing gently.

   b) DO NOT CLEAN THIS LAMP WITH WATER OR ANY WATER MISCIBLE SOLVENTS (methanol or acetone). It will damage the lamp.

   c) DO NOT USE THE CLEANING COMPOUND used for the 9.5 and 10.2 eV lamps under any circumstances on the 11.7 eV lamp.

C. Then inspect the ion chamber for dust or particulate deposits. If such matter is present, the chamber can be cleaned by removing the outer Teflon ring, and the four screws holding the retaining ring. Carefully move the retaining ring aside (NOTE: this is soldered) and remove the screen. A tissue or cotton swab, dry or wetted with methanol, can be used to clean off any stubborn deposits. The assembly can also be gently swirled in methanol and dried gently at 50-60 degrees C for approximately a half hour. No liquid must be present at reassembly as this would affect the performance. Do not clean the ion chamber with the HNU cleaning compound cited above in paragraph B.1.b).

D. Reassemble the probe and check analyzer operation.

E. If performance is still not satisfactory replace the lamp.

PERSONAL AIR MONITORING

1.0 OBJECTIVE

1.1 This Standard Operating Procedure provides the minimum procedures to be followed when conducting personal monitoring at hazardous waste operations sites.

2.0 APPLICABILITY

2.1 This procedure applies to all employees and on-site hazardous waste operations covered by the Jacobs Health and Safety Program.

3.0 REFERENCES

3.1 OSHA, Technical Manual, Volume V1
OSHA 3058, Chapter 1 - Personal Sampling for Air Contaminants, 1990.

4.0 RESPONSIBILITIES

4.1 The *Health and Safety Manager* (HSM) is responsible for auditing for adherence to procedures during field operations, unless such authority is delegated.

4.2 The *Program Health and Safety Manger* (PHSM) is responsible for ensuring that all on-site personnel are aware of such monitoring requirements and that all personnel have the knowledge to perform operations necessary to conduct such monitoring.

4.3 The *Site Manager* (SM) shall implement this SOP onsight.

4.4 The *Site Health and Safety Officer (SHSO)* is responsible for the performance of on-site personal monitoring and the reporting that accompanies it.

5.0 PROCEDURE

5.1 Air monitoring of personnel shall be performed to identify and quantify airborne levels of hazardous substances in order to evaluate the appropriate level of employee protection needed on-site. It is performed also to determine if additional medical monitoring is needed, and to determine if a change in work practices or engineering controls is needed.

5.2 Personal monitoring shall be conducted on job functions with the potential for exposure to hazardous atmospheres or if monitoring data is available, when personnel may be exposed to airborne contaminants at greater than 25% of the individual PEL.

5.3 Personal monitoring shall focus on the potentially highest exposed employees in each job classification. Sampling shall be representative for that job classification.

5.4 Sampling shall be sufficient to determine a time weighted value in accordance with the appropriate OSHA or NIOSH standard.

5.5 The OSHA Technical Manual procedures shall be followed for personal air sampling (enclosed in Appendix A). OSHA or NIOSH analytical methods shall be used.

5.6 Employees shall be notified in writing of the results of tneir personal monitoring and copies shall be maintained with employee's monthly exposure records. For any results above PELs, specific corrective action measures must be included and implemented on site.

APPENDIX A

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION TECHNICAL MANUAL CHAPTER 1 — PERSONAL SAMPLING FOR AIR CONTAMINANTS

(Issued by OSHA Instruction CPL 2-2.20B, February 5, 1990; Amended by CPL 2-2.20B CH-1, November 13, 1990)

A. General

1. Unnecessary air sampling can tie up laboratory resources and produce delays in reporting results of necessary sampling. Evaluate the potential for employee overexposure through observation and screening samples before any partial or full-shift air sampling is conducted. Do not overexpose the employee to gather a sample.

2. Screening with portable monitors, gravimetric sampling, or detector tubes can be used to evaluate the following:

a. Processes, such as electronic soldering.

b. Exposures to substances with exceptionally high PELs (Permissible Exposure Limits) in relatively dust-free atmospheres, e.g., ferric oxide and aluminum oxide.

c. Intermittent processes with substances without STELs (Short Term Exposure Limits)

d. Engineering controls, work practices, or isolation of process.

e. The need for CSHO protection

3. Take a sufficient number of samples to obtain a representative estimate of exposure. Contaminant concentrations vary seasonally, with weather, with production levels, and in a single location or job class.

4. The number of samples taken depends on the error of measurement and differences in results. Consult the NIOSH Occupational Exposure Sampling Strategy Manual for further information.

5. If the employer has conducted air sampling and monitoring in the past, review the records.

6. Bulk Samples are often required to assist the Salt Lake City Lab in the proper analysis of field samples. (See the Sample Shipping and Handling Chapter.) Some contaminants which fall into these categories include:

— silica,
— portland cement,
— asbestos
— mineral oil and oil mist
— chlorodiphenyl,
— hydrogenated terphenyls, and
— chlorinated camphene
— fugitive grain dust
— explosibility testing.

B. General Sampling Procedures

1. Screen the sampling area using detector tubes, if appropriate. Determine the appropriate sampling technique (see Section C and the Chemical Information Manual). Prepare and calibrate the equipment and prepare the filter media (Section F).

2. Select the employee to be sampled and discuss the purpose of the sampling. Inform the employee when and where the equipment will be removed. Stress the importance of not removing or tampering with the sampling equipment. Turn off or remove sampling pumps before an employee leaves a potentially contaminated area (such as when he/she goes to lunch or on a break).

3. Instruct the employee to notify the supervisor or the CSHO if the sampler requires temporary removal.

4. Place the sampling equipment on the employee so that it does not interfere with work performance.

5. Attach the collection device (filter cassette, charcoal tube, etc.) to the shirt collar or as close as practical to the nose and mouth of the employee, i.e., in a hemisphere forward of the shoulders with a radius of approximately 6 to 9 inches.

The inlet should always be in a downward vertical position to avoid gross contamination. Position the excess tubing so as not to interfere with the work of the employee.

6. Turn on the pump and record the starting time.

7. Observe the pump operation for a short time after starting to make sure it is operating correctly.

8. Record the information required by the Air Sampling Data Form (OSHA—91A).

9. **Check pump status every two hours.** More frequent checks may be necessary with heavy filter loading. Ensure that the sampler is still assembled properly and that the hose has not become pinched or detached from the cassette or the pump. For filters, observe for symmetrical deposition, finger prints, or large particles, etc. Record the flow rate.

10. Periodically monitor the employee throughout the work day to ensure that sample integrity is maintained and cyclical activities and work practices are identified.

11. Take photographs, as appropriate, and detailed notes concerning visible airborne contaminants, work practices, potential interferences, movements, and other conditions to assist in determining appropriate engineering controls.

12. Prepare a blank(s) during the sample period for each type of sample collected. See the Sample Shipping and Handling Chapter. For any given analysis, one blank will suffice for up to 20 samples collected, except for asbestos which requires a minimum of two field blanks. These blanks may include opened but unused charcoal tubes, and so forth.

13. Before removing the pump at the end of the sample period, check the flow rate to ensure that the rotameter ball is still at the calibrated mark (if there is a pump rotameter). If the ball is no longer at the mark, record the pump rotameter reading.

14. Turn off the pump and record the ending time.

15. Remove the collection device from the pump and seal it with an OSHA—21 as soon as possible. The seal should be attached across sample inlet and outlet so that tampering is not possible. (See Figures 1-1a and 1-1b.)

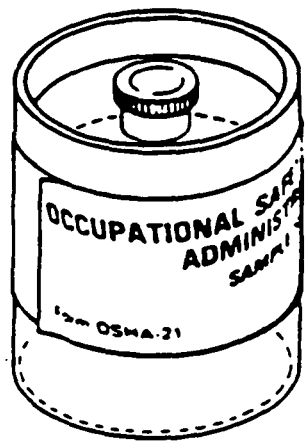

Figure 1-1a. Improperly sealed cassette allows access to inlet and outlet ports after sample has been taken.

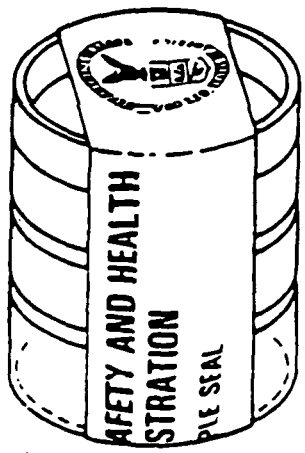

Figure 1-1b. Properly sealed cassette covering inlet and outlet ports provides for sample security.

16. Prepare the samples for mailing to the Salt Lake City Analytical Laboratory (SLCAL) for analysis. (See Chapter 9.)

17. Recalibrate pumps after each day of sampling (before charging).

18. For unusual sampling conditions, such as wide temperature and pressure differences from the calibration conditions, call the regional technical support section.

C. Sampling Techniques

1. Detector Tubes

a. Each pump should be leak-tested before use.

b. Calibrate the detector tube pump for proper volume at least quarterly or after 100 tubes. (See Appendix 1-A.)

2. Total Dust and Metal Fume

a. Collect total dust on a pre-weighed, low-ash polyvinyl chloride filter at a flow rate of about 2 liters per minute (lpm), depending on the rate required to prevent overloading.

b. Collect metal fumes on a 0.8 micron mixed cellulose ester filter at a flow rate of approximately 1.5 lpm, not to exceed 2.0 lpm. When the gravimetric weight needs to be determined for welding fumes, collect these fumes on a low-ash polyvinyl chloride filter.

c. Take care to avoid any overloading of the filter, as evidenced by any loose particulate.

d. Calibrate personal sampling pumps before and after each day of sampling, using a bubble meter method (electronic or mechanical) or the precision rotameter method (that has been calibrated against a bubble meter), as described in Section E.

e. Weigh PVC filters before and after taking the sample. See Section F.

3. Respirable Dust

a. Collect respirable dust using a clean cyclone equipped with a pre-weighed low-ash polyvinyl chloride filter at a flow rate of 1.7 ± 0.2 lpm.

b. Collect silica only as a respirable dust. A bulk sample should be submitted to the Salt Lake City Analytical Laboratory.

c. All filters used shall be pre-weighed and post-weighed.

d. *Calibration Procedures*

(1) Do the calibration at the pressure and temperature where the sampling is to be conducted.

(2) For respirable dust sampling using a cyclone or for total dust sampling using an open face filter cassette, set up the calibration apparatus as shown in Figure 1-10.

(3) Place the open face filter cassette or cyclone assembly in a 1-liter jar. The jar is provided with a special cover.

(4) Connect the tubing from the electronic bubble meter to the inlet of the jar.

(5) Connect the tubing from the outlet of the cyclone holder assembly or from the filter cassette to the outlet of the jar and then to the sampling pump.

(6) Calibrate the pump. The calibration readings must be within 5% of each other.

e. *Cyclone cleaning*

(1) Unscrew the grit pot from the cyclone. Empty the grit pot by turning it upside down and tapping it gently on a solid surface.

(2) Clean the cyclone thoroughly and gently after each use in warm soapy water or, preferably, wash in an ultrasonic bath. Rinse thoroughly in clean water, shake off excess water, and set aside to dry before reassembly. Never insert anything into the cyclone during cleaning. See Figure 1-2.

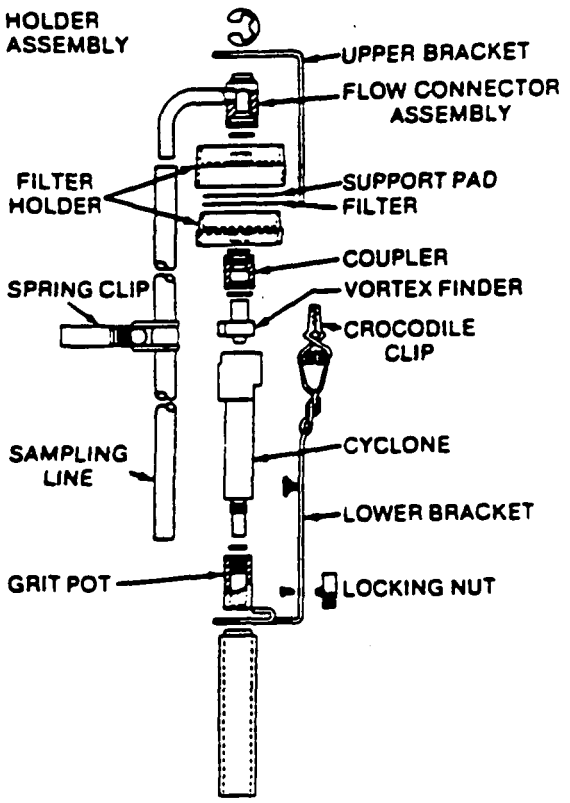

Figure 1-2. The cyclone (chamber) of the cyclone assembly is sensitive to scratches.

(3) Inspect the cyclone parts for signs of wear or damage, such as scoring, rifling, or a loose coupler. Replace the units or parts if they appear damaged.

(4) Leak test the cyclone at least once a month with regular usage.

(5) Detailed instructions on leak testing are available from the Directorate of Technical Support.

4. Organic Vapors and Gases

a. Organic vapors and gases may be collected on activated charcoal, silica gel, or other adsorption tubes using low flow pumps.

b. Immediately before sampling, break off the ends of the charcoal tube so as to provide an opening approximately one-half the internal diameter of the tube. Wear eye protection when breaking ends. Use tube holders, if available, to minimize the hazards of broken glass. Do not use the charging inlet or the exhaust outlet of the pump to break the ends of the charcoal tubes. See Figure 1-3, charcoal tube.

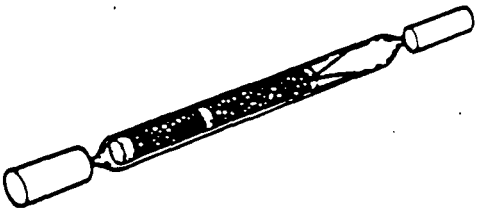

Figure 1-3. A charcoal or "C"-tube with glass-sealed ends and NIOSH-approved caps is shown before taking a sample.

c. Use the smaller section of the charcoal tube as a back-up and position it near the sampling pump. The charcoal tube shall be held or attached in an approximately vertical position with the inlet either up or down during sampling.

d. Draw the air to be sampled directly into the inlet of the charcoal tube. This air is not to be passed through any hose or tubing before entering the charcoal tube.

e. Cap the charcoal tube with the supplied plastic caps immediately after sampling and seal with an OSHA—21 as soon as possible. (See Figures 1-4a and 1-4b, C-tube seal.) Do not ship with bulk material.

Figure 1-4a. *Correctly*, sealed "C"-Tube. Sample is completely enclosed in the seal and no tampering is possible.

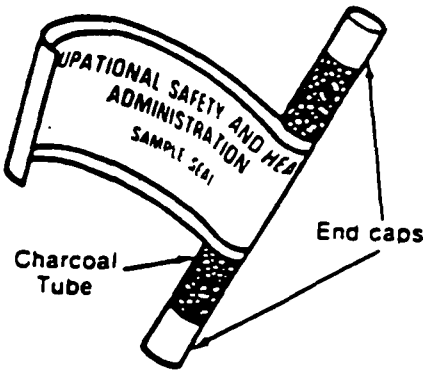

Figure 1-4b. *Incorrectly*, sealed "C"-Tube. End caps can be removed and sample integrity jeopardized without disturbing the seal.

f. For other adsorption tubes, follow the same procedures as those for the charcoal tube, with the following exceptions:

(1) Tubes may be furnished by SLCAL with either caps or flame-sealed glass ends. If using the capped version, simply uncap during the sampling period and recap at the end of the sampling period.

(2) The ends of the flame-sealed glass tubes are broken at the beginning of the sampling period and capped at the end of the sampling period.

g. For organic vapors and gases, low flow pumps are required. Refer to the Chemical Information Manual to determine the appropriate flow rates recommended for specific chemicals.

h. With sorbent tubes, flow rates may have to be lowered or smaller air volumes (½ the maximum) used when there is high humidity (above 90%) in the sampling area or relatively high concentrations of other organic vapors.

i. *Calibration Procedures*

(1) Set up the calibration apparatus as shown in Figure 1-9 replacing the cassette with the solid sorbent tube to be used in the sampling (e.g., charcoal, silica gel, etc.). If a sampling protocol requires the use of two charcoal tubes, then the calibration train must include two charcoal tubes. The air flow must be in the direction of the arrow on the tube.

(2) Calibrate the pump.

5. Midget Impingers/Bubblers

a. *Method*

(1) Take care in preparing bubblers and impingers to see that frits or tips are not damaged and that joints can be securely tightened.

(2) Rinse the impinger/bubbler, Figure 1-5, with the appropriate reagent (see the Chemical Information Manual and Appendix 1-D). Then, add the specified amount of this reagent to the impinger flask either in the office or at the sampling location. If flasks containing the reagent are transported, caps must be placed on the impinger stem and side arm. To prevent overflowing, do not add over 10 milliliters of liquid to the midget impingers.

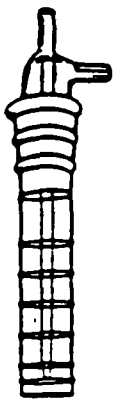

Figure 1-5. A typical glass bubbler is illustrated.

(3) Collect contaminants in an impinger at a maximum flow rate of 1.0 lpm. Contact the SLCAL prior to collecting samples for dust counting.

(4) The impinger may either be hand-held by the industrial hygienist or attached to the employee's clothing using an impinger holster. In either case, it is very important that the impinger does not tilt, causing the reagent to flow down the side arm to the hose and into the pump.

NOTE: Attach a trap in line to the pump, if possible.

(5) In some instances, it will be necessary to add additional reagent during the sampling period to prevent the amount of reagent from dropping below one-half of the original amount.

(6) After sampling, remove the glass stopper and stem from the impinger flask.

(7) Rinse the absorbing solution adhering to the outside and inside of the stem directly into the impinger

flask with a small amount (1 or 2 ml.) of the sampling reagent. Stopper the flask tightly with the plastic cap provided or pour the contents of the flask into a 20 cc. glass bottle. Rinse the flask with a small amount (1 or 2 ml.) of the reagent and pour the rinse solution into the bottle. Tape the cap shut to prevent it from coming loose due to vibration. If electrical tape is used, do not "stretch" tape since it will contract and loosen cap.

b. *Calibration Procedure*

(1) Set up the calibration apparatus as shown in Figure 1-9, replacing the cassette with the impinger/bubbler filled with the amount of liquid reagent specified in the sampling method. (Refer to Chemical Information Manual.)

(2) Connect the tubing from the electronic bubble meter to the inlet of the impinger/bubbler.

(3) Connect the outlet of the impinger/bubbler to the tubing to the pump.

(4) Calibrate the pump at a maximum flow rate of 1.0 lpm.

6. Mailing

Mail bulks and air samples separately to avoid cross-contamination. Pack the samples securely to avoid any rattle or shock damage (do not use expanded polystyrene-"packing"). Use bubble sheeting as packing. Put identifying paperwork in every package. Do not send samples in plastic bags or in envelopes. Use OSHA Form 91A. PRINT LEGIBLY ON ALL FORMS. See Chapter 9.

7. Vapor Badges

a. Passive diffusion sorbent badges, Figure 1-6, are useful for screening and monitoring certain chemical exposures, especially vapors and gases. Few badges have been validated for use in compliance.

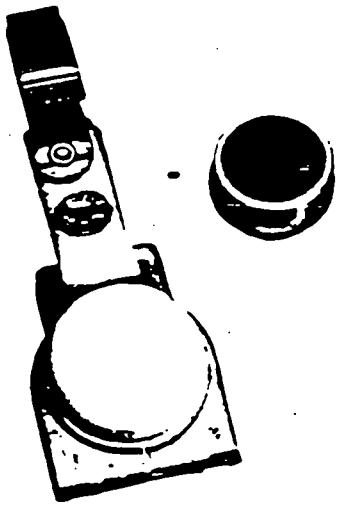

Figure 1-6. Vapor badge shown has a clothing clip.

b. Badges are available from the SLCAL to detect mercury, nitrous oxides, ethylene oxide, formaldehyde, etc.

c. Interfering substances should be noted.

D. Special Sampling Procedures

1. Asbestos

a. Collect asbestos on a special 0.8 micrometer pore size, 25 mm diameter mixed cellulose ester filter, using a back-up pad.

b. Use fully conductive cassette with conductive extension cowl, Figure 1-7.

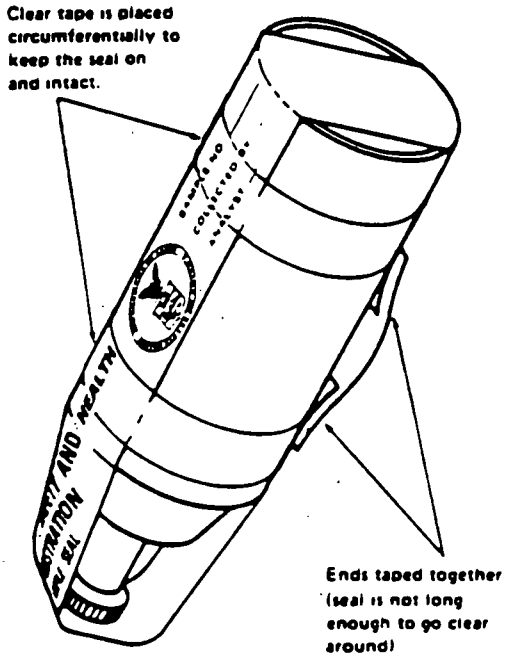

Figure 1-7. A standard asbestos cassette (25mm) sealed properly with an OSHA 21 form.

c. Sample open face in worker's breathing zone.

d. Assure that the bottom joint (between the extension and the conical black piece) of the cassette is sealed tightly with a shrink band or electrical tape. Point the open end of the cassette down to minimize contamination.

e. Use a flow rate in the range of 0.5 to 2.5 liters per minute. One liter per minute is suggested for general sampling. Office environments allow flow rates of up to 2.5 lpm. Calibrate pump before and after sampling. Calibration may be done either as in figure 1-9 or 1-10. Do not use nylon or stainless steel adaptors if in-line (Figure 1-9) calibration is done.

f. Sample for as long a time as possible without overloading (obscuring) the filter.

g. Submit 10% blanks, with a minimum in all cases of 2 blanks.

h. Where possible, collect and submit to the SLCAL a bulk sample of the material suspected to be in the air.

i. Mail bulks and air samples separately to avoid cross-contamination. Pack the samples securely to avoid any rattle or shock damage (do not use expanded polystyrene-"packing"). Use bubble sheeting as packing. Put identifying paperwork in every package. Do not send samples in plastic bags or in envelopes. Use OSHA Form 91A. PRINT LEGIBLY ON ALL FORMS.

j. Instruct the employee to avoid knocking the cassette and to avoid using a compressed air source that might dislodge the sample.

k. This procedure has been revised as of May, 1989. For exceptional sampling conditions or high flow rates, contact the SLCAL. More detailed instructions can be obtained from SLCAL.

2. Sampling for welding fumes

a. When sampling for welding fumes, the filter cassette must be placed inside the welding helmet to achieve an accurate characterization of the employee's exposure.

b. Welding fume samples are normally taken using 37-mm filters and cassettes; however, if these cassettes will not fit inside the helmet, 25-mm filters and cassettes can be used. Care must be taken not to overload the 25-mm. cassette when sampling.

c. The Assistant Regional Administrator for Technical Support should be consulted in the case of any technical difficulties.

E. Equipment Preparation and Calibration

1. Replace alkaline batteries frequently (once a month). Also carry fresh replacement batteries with the equipment.

2. Check the rechargeable Ni-Cad batteries in older pumps under load (e.g., turn pump on and check voltage at charging jack) before use.

3. Calibrate personal sampling pumps before and after each day of sampling, using either the electronic bubble meter method or the precision rotameter method (that has been calibrated against a bubble meter).

4. Electronic Flow Calibrators

a. These units are high accuracy electronic bubble flowmeters that provide instantaneous air flow readings and a cumulative averaging of multiple samples. These calibrators measure the flow rate of gases and present the results as volume per unit of time.

b. These calibrators should be used to calibrate all air sampling pumps.

c. See Appendix 1-A for more details on this piece of equipment.

5. When a sampling train requires an unusual combination of sampling media (e.g., glass fiber filter preceding impinger), the same media/devices should be in line during calibration.

a. *Electronic Bubble Meter Method*

(1) Allow the pump to run 5 minutes prior to voltage check and calibration.

(2) Assemble the polystyrene cassette filter holder, using the appropriate filter for the sampling method. Compress cassette by using a mechanical press or other means of applying pressure. Use shrink tape around cassette to cover joints and prevent leakage. If a cassette adaptor is used, care should be taken to ensure that it does not come in contact with the back up pad.

NOTE: When calibrating with a bubble meter, the use of cassette adaptors can cause moderate to severe pressure drop at high flow rates in the sampling train, which will affect the calibration result. If adaptors are used for sampling, then they should be used when calibrating.

CAUTION: Nylon adapters can restrict air flow due to plugging over time. Stainless steel adapters are preferred.

(3) Connect the collection device, tubing, pump and calibration apparatus as shown in Figures 1-9 and 1-10, cassette and cyclone samplers, respectively.

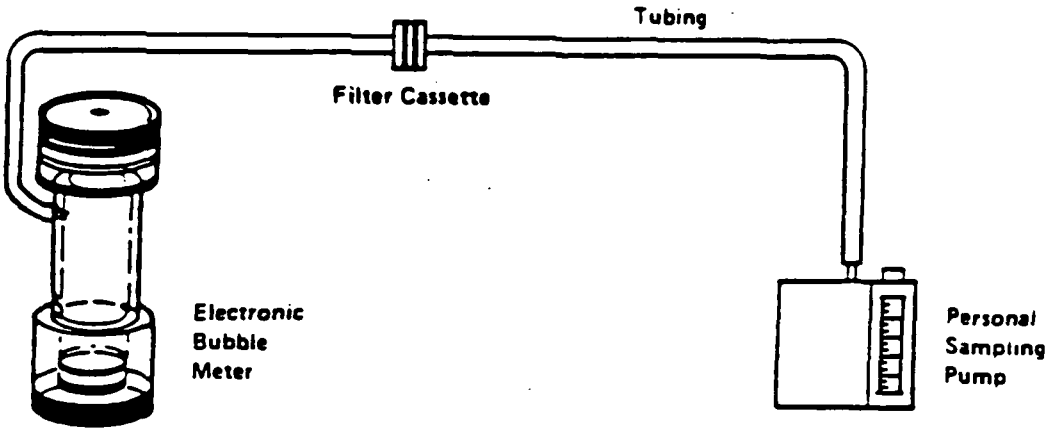

Figure 1-9. For calibration, the cassette is attached to an electronic bubble meter as shown in the illustration.

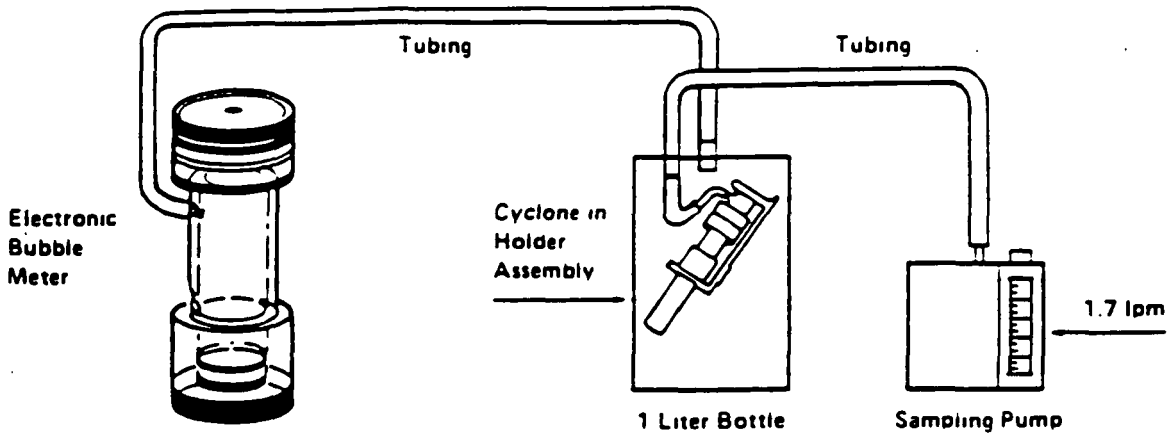

Figure 1-10. The cyclone is calibrated by placing the cyclone in a 1 liter vessel attached to an electronic bubble meter as illustrated above.

(4) A visual inspection should be made of all Tygon tubing connections.

(5) Wet the inside of the electronic flow cell with the supplied soap solution by pushing on the button several times.

(6) Turn on the pump and adjust the pump rotameter, if available, to the appropriate flow rate setting.

(7) Press the button on the electronic bubble meter. Visually capture a single bubble and electronically time the bubble. The accompanying printer will automatically record the calibration reading in liters per minute.

(8) Repeat step 7 until two readings are within 5%.

(9) While the pump is still running, adjust the pump, if necessary.

(10) Repeat the procedures described above for all pumps to be used for sampling. The same cassette and filter may be used for all calibrations involving the same sampling method.

b. *Precision Rotameter Method* The precision rotameter, Figure 1-11 is a secondary calibration device. If it is to be used in place of a primary device such as a bubble meter, care must be taken to ensure that any introduced error will be minimal and noted.

(1) Replacing the Bubble Meter. The precision rotameter may be used for calibrating the personal sampling pump in lieu of a bubble meter provided it is:

(a) Calibrated with an electronic bubble meter or a bubble meter, as described in Appendix I—C, on a regular basis (at least monthly).

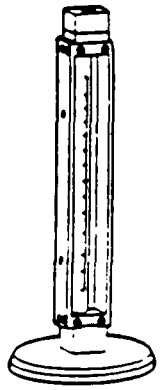

Figure 1-11. A single column precision rotameter can be used a secondary calibration device.

(b) Disassembled, cleaned as necessary, and recalibrated. It should be used with care to avoid dirt and dust contamination which may affect the flow.

(c) Not used at substantially different temperature and/or pressure from those conditions present when the rotameter was calibrated against the primary source.

(d) Used such that pressure drop across it is minimal.

(2) Unusual conditions. If altitude or temperature at the sampling site are substantially different from the calibration site, it is necessary to calibrate the precision rotameter at the sampling site where the same conditions are present.

c. Manual Buret Bubble meter method. See Appendix 1-C.

F. Filter Weighing Procedure

The step-by-step procedure for weighing filters depends on the make and model of the balance. Consult the manufacturer's instruction book for directions. In addition, follow these guidelines:

1. There shall be no smoking or eating in the weighing area. All filters will be handled with tongs or tweezers. Do not handle the filters with bare hands.

2. Dessicate all filters at least 24 hours before weighing and sampling. Change dessicant before it completely changes color (e.g., before blue dessicant turns all pink). Evacuate dessicator with a sampling or vacuum pump.

3. Zero the balance prior to use.

4. Calibrate the balance prior to use and after every 10 samples.

5. Immediately prior to placement on the balance, pass all filters over an ionization unit to remove static charges. (Return the unit after 12 months of use to the distributor for disposal).

6. Weigh all filters at least twice.

a. If there is more than 0.005 milligram difference in the two weighings, repeat the zero and calibration and reweigh the filter.

b. If there is less than 0.005 milligram difference in the two weighings, average the weights for the final weight.

7. Record all the appropriate weighing information (in ink) in the Weighing Log (OSHA-96).

8. In reassembling the cassette assembly, remember to add the unweighed backup pad (Figure 1-12).

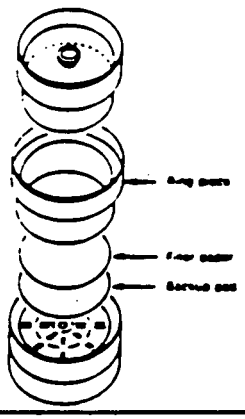

Figure 1-12. Exploded view of three piece cassette shows placement of backup pad.

9. When weighing the filter after sampling, dessicate first and include any loose material from an overloaded filter and cassette.

NOTE: At all times take care not to exert downward pressure on the weighing pan(s). Such action may damage the weighing mechanism.

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APPENDIX 1-A

DETECTOR TUBES/PUMPS

Principle/Description

1. Detector tube pumps are portable equipment which, when used with a variety of commercially available detector tubes, are capable of measuring the concentrations of a wide variety of compounds in industrial atmospheres.

2. Operation consists of using the pump to draw a known volume of air through a detector tube designed to measure the concentration of the substance of interest. The concentration is determined by a colorimetric change of an indicator which is present in the tube contents.

3. Some of the more frequently used detector tubes are available from the OSHA Cincinnati Lab (OCL). Most tubes can be obtained locally.

Applications/Limitations

1. Detector tubes/pumps are screening instruments which may be used to measure over 200 organic and inorganic gases and vapors or for leak detection. Some aerosols can also be determined.

2. Detector tubes of a given brand are to be used only with a pump of the same brand. The tubes are calibrated specifically for the same brand of pump and may give erroneous results if used with a pump of another brand.

3. A limitation of many detector tubes is the lack of specificity. Many indicators are not highly selective and can cross-react with other compounds. Manufacturers' manuals describe the effects of interfering contaminants.

4. Another important consideration is sampling time. Detector tubes give only an instantaneous interpretation of environmental hazards. This may be beneficial in potentially dangerous situations or when ceiling exposure determinations are sufficient. When long-term assessment of occupational environments is necessary, short-term detector tube measurements may not reflect time-weighted average levels of the hazardous substances present.

5. Detector tubes normally have a shelf-life at 25°C of 1 to 2 years. Refrigeration during storage lengthens the shelf-life. Outdated detector tubes (i.e., beyond the printed expiration date) should never be used. The OSHA Training Institute can sometimes use these outdated tubes for training purposes.

Performance Data

1. Specific manufacturers' models of detector tubes are listed in the Chemical Information Manual. The specific tubes listed are designed to cover a concentration range that is near the PEL. Concentration ranges are tube-dependent and can be anywhere from one-hundredth to several thousand ppm. The limits of detection depend on the particular detector tube.

2. Accuracy ranges vary with each detector tube.

3. The pump may be handheld during operation (weighing from 8 to 11 ounces), or it may be an automatic type (weighing about 4 pounds) which collects a sample using a preset number of pump strokes. A full pump stroke for either type of short-term pump has a volume of about 100 cc.

4. In most cases where only one pump stroke is required, sampling time is about one minute. Determinations for which more pump strokes are required take proportionately longer.

Maintenance

Contact the OSHA Calibration Laboratory in Cincinnati, Ohio for long-term maintenance.

Leakage Test

1. Each day prior to use, perform a pump leakage test by inserting an unopened detector tube into the pump and attempt to draw in 100 ml of air. After a few minutes, check for pump leakage by examining pump compression for bellows-type pumps or return to resting position for piston-type pumps. Automatic pumps should be tested according to the manufacturer's instructions.

2. In the event of leakage which cannot be repaired in the field, send the pump to the OSHA Cincinnati Laboratory for repair.

3. Record that the leakage test was made on the Direct-Reading Data Form (OSHA—93).

Calibration Test

1. Calibrate the detector tube pump for proper volume measurement at least quarterly.

2. Simply connect the pump directly to the bubble meter with a detector tube in-line. Use a detector tube and pump from the same manufacturer.

3. Wet the inside of the 100 cc bubble meter with soap solution.

4. For volume calibration, experiment to get the soap bubble even with the zero ml mark of the buret.

a. For piston-type pumps, pull the pump handle all the way out (full pump stroke) and note where the soap bubble stops; for bellows-type pumps, compress the bellows fully; for automatic pumps, program the pump to take a full pump stroke. For either type pump, the bubble should stop between the 95 cc and 105 cc marks. Allow 4 minutes for the pump to draw the full amount of air (This time interval varies with the type of detector tube being used in-line with the calibration setup).

b. Also check the volume for 50 cc (½ pump stroke) and 25 cc (¼ pump stroke) if pertinent. As in Section 1 above, a ± 5 percent error is permissible. If error is greater than ± 5 percent, send the pump to OCL for repair and recalibration.

5. Record the calibration information required on the Calibration Log (OSHA—93).

6. It may be necessary to clean or replace the rubber bung or tube holder if a large number of tubes have been taken with the pump.

Additional Information.

1. Draeger, Model 31 (bellows)

When checking the pump for leaks with an unopened tube, the bellows should not be completely expanded after 10 minutes.

2. Draeger, Quantimeter 1000, Model 1 (automatic)

A battery pack is an integral part of this pump. The pack must be charged prior to initial use. One charge is good for 1000 pump strokes. During heavy use, it should be recharged daily. If a "U" (undervoltage) message is continuously displayed in the readout window of this pump, the battery pack should be immediately recharged.

3. Matheson-Kitagawa, Model 8014-400A (piston)

When checking the pump for leaks with an unopened tube, the pump handle should be pulled back to the 100-ml mark and locked. After 2 minutes, the handle should be released carefully. It should return to a point <6 mm from zero or resting position. After taking 100 to 200 samples, the pump should be cleaned and relubricated. This involves removing the piston from the cylinder, removing the inlet and pressure-relief valve from the front end of the pump, cleaning, and relubricating.

4. Mine Safety Appliances, Samplair Pump, Model A, Part No. 463998 (piston)

The pump contains a flow-rate control orifice protected by a plastic filter which periodically needs to be cleaned or replaced. To check the flow rate, the pump is connected to a buret and the piston is withdrawn to the 100-ml position with no tube in the tube holder. After 24-26 seconds 80 ml of air should be admitted to the pump. Every 6 months the piston should be relubricated with the oil provided.

5. Sensidyne—Gastec, Model 800, Part No. 7010657—1 (piston)

This pump can be checked for leaks as mentioned for the Kitagawa pump; however, the handle should be released after 1 minute. Periodic relubrication of the pump head, the piston gasket, and the piston check valve is needed and is use-dependent.

Special considerations

1. Detector tubes should be refrigerated when not in use to prolong shelf life.

2. Detector tubes should not be used when cold. They should be kept at room temperature or in a shirt pocket for one hour prior to use.

3. Lubrication of the piston pump may be required if volume error is greater than 5 percent.

APPENDIX 1-B

ELECTRONIC FLOW CALIBRATORS

Description

1. These units are high accuracy electronic bubble flowmeters that provide instantaneous air flow readings and a cumulative averaging of multiple samples. These calibrators measure the flow rate of gases and report volume per unit of time.

2. The timer is capable of detecting a soap film at 80 microsecond intervals. This speed allows under steady

flow conditions an accuracy of + or -0.5% of any display reading. Repeatability is + or -0.5% of any display.

3. The range with different cells is from 1 cc/min to 30 Lpm.

4. Battery power will last 8 hours with continuous use. Charge for 16 hours. Can be operated from A/C charger.

Maintenance of Calibrator

1. Cleaning before use:

Remove the flow cell and gently flush with tap water. The acrylic flow cell can be easily scratched. Wipe with cloth "only." Do not allow center tube where sensors detect soap film to be scratched or get dirty. NEVER clean with ACETONE. Use only soap and warm water. When cleaning prior to storage, allow flow cell to air dry. If stubborn residue persists, it is possible to remove the bottom plate. Squirt a few drops of soap into the slot between base and flow cell to ease removal.

2. Leak Testing:

The system should be leak checked at 6" H2O by connecting a manometer to the outlet boss and evacuate the inlet to 6" H2O. No leakage should be observed.

3. Verification of Calibration:

The calibrator is factory calibrated using a standard traceable to National Institute of Standards and Technology, formerly called the National Bureau of Standards, (NBS). Attempts to verify calibrator against a glass one liter burette should be conducted at 1000 cc/min. for maximum accuracy. The calibrator is linear throughout the entire range.

Shipping/Handling

1. When transporting, especially by air, it is important that one side of the seal tube which connects the inlet and outlet boss, be removed for equalizing internal pressure within the calibrator.

2. Do not transport unit with soap solution or storage tubing in place.

Precautions/Warnings

1. Avoid the use of chemical solvents on flow cell, calibrator case and faceplate. Generally, soap and water will remove any dirt.

2. Never pressurize the flow cell at any time with more than 25 inches of water pressure.

3. Do not charge batteries for longer than 16 hours.

4. Do not leave A/C adapter plugged into calibrator when not in use as this could damage the battery supply.

5. Black close fitting covers help to reduce evaporation of soap in the flow cell when not in use.

6. Do not store flow cell for a period of one week or longer with soap. Clean and store dry.

7. The Calibrator Soap is a precisely concentrated and sterilized solution formulated to provide a clean, frictionless soap film bubble over the wide, dynamic range of the calibrator. The sterile nature of the soap is important in the prevention of residue build-up in the flow cell center tube, which could cause inaccurate readings. The use of any other soap is not recommended.

APPENDIX 1-C

MANUAL BURET BUBBLE METER TECHNIQUE

When a sampling train requires an unusual combination of sampling media (e.g., glass fiber filter preceeding impinger), the same media/devices should be in line during calibration. Calibrate personal sampling pumps before and after each day of sampling.

Bubble Meter Method

1. Allow the pump to run 5 minutes prior to voltage check and calibration.

2. Assemble the polystyrene cassette filter holder using the appropriate filter for the sampling method. If a cassette adaptor is used, care should be taken to ensure that it does not come in contact with the back-up pad.

NOTE: When calibrating with a bubble meter, the use of cassette adaptors can cause moderate to severe pressure drop in the sampling train, which will affect the calibration result. If adaptors are used for sampling, then they should be used when calibrating.

3. Connect the collection device, tubing, pump and calibration apparatus as shown in Figures 1-13 and 1-14.

4. A visual inspection should be made of all Tygon tubing connections.

5. Wet the inside of a 1-liter buret with a soap solution.

6. Turn on the pump and adjust the pump rotameter to the appropriate flow rate setting.

7. Momentarily submerge the opening of the buret in order to capture a film of soap.

8. Draw two or three bubbles up the buret in order to ensure that the bubbles will complete their run.

9. Visually capture a single bubble and time the bubble from 0 to 1000 ml for high flow pumps or 0 to 100 ml for low flow pumps.

10. The timing accuracy must be within +1 second of the time corresponding to the desired flow rate.

11. If the time is not within the range of accuracy, adjust the flow rate and repeat steps 9 and 10 until the correct flow rate is achieved. Perform steps 9 and 10 at least twice, in any event.

12. While the pump is still running, mark the pump or record on the OSHA—91 the position of the center of the float in the pump rotameter as a reference.

13. Repeat the procedures described above for all pumps to be used for sampling. The same cassette and filter may be used for all calibrations involving the same sampling method.

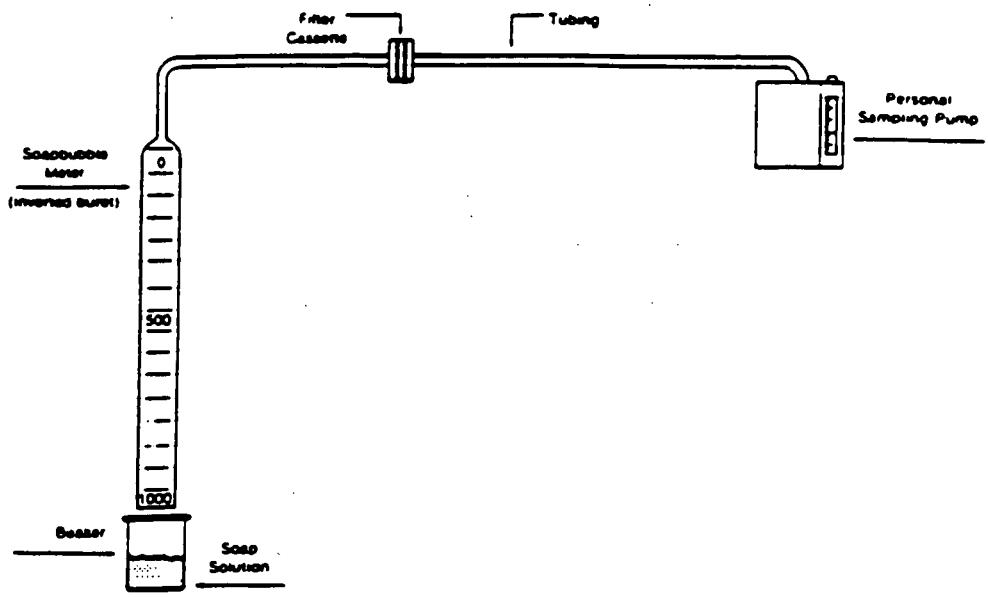


Figure 1-13. Calibration setup for personal sampling with filter cassette.

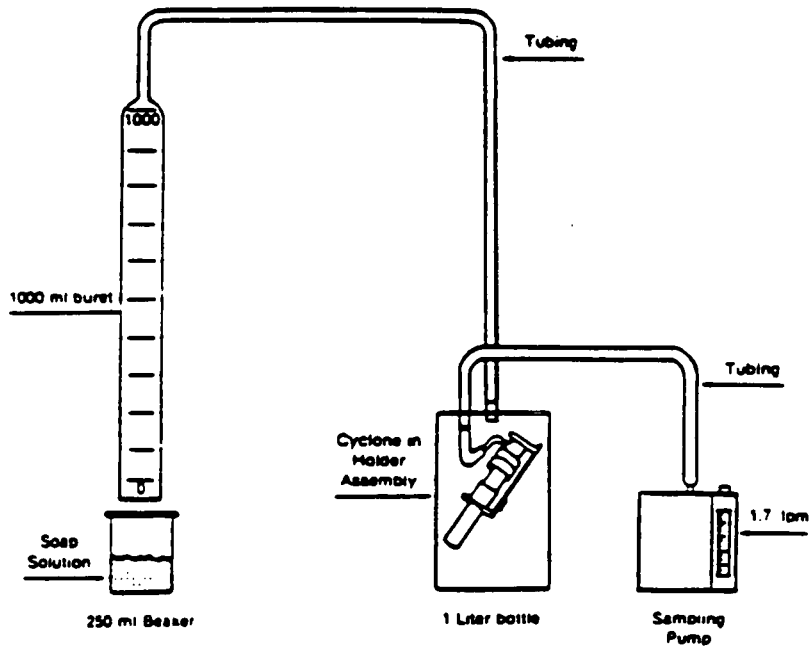


Figure 1-14. Calibration of cyclone respirable dust sampler using a bubble meter.

JACOBS

JACOBS ENGINEERING GROUP INC.
CORPORATE HEALTH AND SAFETY MANUAL

PHYSICAL HAZARD CONTROL
SOP NO. 7.0

APPROVED:

HEALTH AND SAFETY MANAGER

OBJECTIVE
This standard operating procedure describes common physical and biological hazards present at hazardous waste sites and at industrial facilities. Effective control procedures are presented to mitigate safety risks.

APPLICABILITY
This procedure applies to all Jacobs employees who perform field work.

PROCEDURE
Control measures for physical and biological hazards are:

- noise,
- excavation and trenching, and
- drilling equipment.

Whenever any of these issues present a potential hazard at a site, they shall be included in the site HSP.

NOISE
Whenever workplace noise levels exceed 85 dBA (85 decibels on the A-weighted scale) a hearing protection program shall be instituted. This shall include instituting noise control procedures in the HSP, assuring that all affected employees have hearing tests as a component of their regular medical examination and conducting site noise monitoring if the full shift noise level at the workplace can exceed 85 dBA.

The recommended site noise control procedure is to specify that hearing protection must be worn when working in the high noise areas and hearing protection must be worn while within 30 feet of operating heavy equipment. Hearing protection may include ear plugs and ear muffs.

DRILLING EQUIPMENT

Core or well drilling for the purposes of soil and water sampling involve a number of injury hazards including, but not limited to the following: injuries from flying debris, being caught up in machinery, hydraulic failures, unguarded points of operation, air-borne particulates, equipment rollover and other hazards associated with the transportation and use of drill rigs.

- The supplier of the drill rig shall ensure equipment is well maintained, meets existing safety requirements and is inspected regularly and before releasing to new projects.
- The rig shall be operated by a fully qualified person to operate equipment, identify pending failures, and supervise the other people on the project.
- Transporting the rig to the work site shall be done by a person with the proper commercial license.
- To the extent possible, the terrain should be level and the condition of the ground such that unexpected movement of the rig will be unlikely. Tugger and anchor lines shall be used to secure the rig if the slope is hazardous.
- All power transmission equipment, prime movers, and machine parts of rotary drilling equipment must be guarded. Chains and sprockets shall be enclosed to prevent accidental contact.
- Employees involved in the operation shall not wear any loose and/or sloppy fitting clothing which could get caught in any exposed moving machinery. Foot wear should be steel-toe.
- If any air or hydraulic lines are visible and uncovered in such a way that a failure could allow them to whip around, they shall be tied back or somehow secured.
- Dust suppression shall be used to control emissions.
- Emergency stop devices are required for the prime movers on drilling rigs to allow the operator or others to quickly respond to an emergency and prevent an accident or at least limit the injury. Emergency stops must be manually reset before restarting prime movers.
- The area should be roped off, marked or personnel posted to keep the area clear of pedestrian traffic or spectators.
- A 20 lb. A:B:C fire extinguisher shall be readily available for use.

EXCAVATION AND TRENCHING SAFETY

Excavation is merely a man-made depression or cavity in the earth. A trench is man-made excavation which is deeper than it is wide, but is generally no wider than 15 feet. Excavations which are deeper than five feet are required to be shored, sloped, sheeted, braced, or otherwise supported. Prior to excavating, a permit must be obtained from the regional OSHA office.

Given a maximum expected survival time without breathing of three minutes, there is not much time to locate, dig out, and resuscitate a buried worker. Cave-ins develop very suddenly and without warning. Never get into an unprotected trench for even what you believe will be only a few minutes. Just the action of your jumping in may be enough to disturb the earth.

A number of basis guidelines must be followed while working near or in an excavation.

- Determine the location of underground utilities and notify the owners.
- Inspect the area for hazards form moving ground.
- Silts, loams or nonhomogeneous soils require shoring or bracing and cannot be sloped.
- Inspect the excavation after every rainstorm, earthquake or other hazard-increasing occurrence.
- Locate spoil at least two feet from the edge of the excavation.
- Inspect the face, banks, and top daily when workers are exposed to falling or rolling material.
- Shoring plans must be designed and approved by a civil engineer registered in California.
- In trenches four feet deep or more, provide quick exit facilities every 25 feet.
- Install crossings with standard guard rails and toeboards when the excavation is 7.5 feet deep or greater.
- Use additional bracing when vibration from vehicular traffic or heavy equipment or external loads are a hazard.

- Erect barriers around excavations in remote work locations. Cover all wells, pits, shafts and caissons. Backfill temporary wells, pits, and shafts when work is completed.
- Do not excavate beneath the level of adjacent foundations, retaining walls, or other structures until a qualified person has determined that the work will not be hazardous. Support undermined sidewalks.
- Shore, brace, or underpin structures when their stability is threatened. Inspect the structures daily.
- Shafts aver four-feet square must be guarded by a lagging system made from proportionally larger materials as determined by a registered safety engineer.

JACOBS

JACOBS ENGINEERING GROUP INC.
CORPORATE HEALTH AND SAFETY MANUAL

HEAT STRESS MONITORING
SOP NO. 7.1

APPROVED: HEALTH AND SAFETY MANAGER

OBJECTIVE
This standard operating procedure describes the procedures for heat stress monitoring of personnel engaged in field work activities.

APPLICABILITY
This procedure applies to all Jacobs employees who perform field work in hot weather and who are at risk of developing heat stress.

REFERENCES
NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985.

American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1990-91, Cincinnati, Ohio, 1990.

PROCEDURE
Heat-induced physiological stress (heat stress) occurs when the body fails to maintain a normal body temperature. A number of physical reactions can occur ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal. Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow the ACGIH Threshold Limit Value recommendations for suggested work/rest schedules listed in Table 7-1-1. This work/rest schedule is determined by the Wet Bulb Globe Temperature Index (WBGT), a measure of environmental factors which most nearly correlate with deep body temperature and other physiological responses to heat. WBGT values are calculated by the following equations:

1. Outdoors with solar load

$$WBGT = 0.7\ NWB + 0.2\ GT + 0.1\ DB$$

2. Indoors or Outdoors with no solar load

$$WBGT = 0.7\ NWB + 0.3\ GT$$

where:

WBGT = Wet Bulb Globe Temperature
NWB = Natural Wet Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer. Commercially available instruments can be used for convenient measurement of WBGT.

For workers wearing semipermeable or impermeable encapsulating ensembles and/or levels of protection A, B, or C, the recommendations listed in Table 7-1-1 cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C).

To monitor these workers, measure:

1. Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

   a. 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.

   b. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

2. 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).

TABLE 7-1-1

WORK - REST REGIMEN [1]

	WBGT TEMPERATURE IN WHICH VARIOUS WORK LOADS ARE PERFORMED [F°(C°)]		
WORK-REST REGIMEN	LIGHT [2]	MODERATE [3]	HEAVY [4]
Continuous work permitted	86.0 (30.0)	80.1 (26.7)	77.0 (25.0)
75% work 25% rest, each hour	87.1 (30.6)	82.4 (28.0)	78.6 (25.9)
50% work 50 % rest, each hour	88.5 (31.4)	84.9 (29.4)	82.2 (27.9)
25% work 75% rest, each hour	90.0 (32.2)	88.0 (31.1)	86.0 (30.0)

1 Adapted from "Permissible Heat Exposure Threshold Limit Values" in Threshold Limit Values and Biological Exposure Indices for 1990-1991, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1990, p. 69.

2 Light work (up to 200 Kcal/hr or 800 Btu/hr): e.g., sitting or standing to control machines, performing light hand or arm work, etc.

3 Moderate work (200-300 Kcal/hr or 800-1400 Btu/hr): e.g., walking about with moderate lifting and pushing, etc.

4 Heavy work (350-500 Kcal/hr or 1400-2000 Btu/hr): e.g., sampling work, pick and shovel work, etc.

TABLE 7-1-2

SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT AND ACCLIMATIZED WORKERS[5]

ADJUSTED TEMPERATURE[6]	NORMAL WORK ENSEMBLE[7]	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: NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985, p. 8-22.

5 For work levels of 250 kilocalories/hour.

6 Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 x % 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.)

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

a. If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.

b. 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.

c. Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).

3. Body water loss. 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.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 7-1-2). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

PREVENTION

Proper training and preventative 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. One or more of the following recommendations will help reduce heat stress:

1. Adjust work schedules:

   a. Modify work/rest schedules according to monitoring requirements.

   b. Mandate work slowdowns as needed.

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

   d. Add additional personnel to work teams.

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

2. Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.

3. 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 18 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. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:

   a. Maintain water temperature at 50° to 60°F (10° to 15.6^{o}C).

   b. Provide small disposable cups that hold about 4 ounces (0.1 liter).

   c. Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.

   d. 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.

   e. Weigh workers before and after work to determine if fluid replacement is adequate.

4. Encourage workers to maintain an optimal level of physical fitness:

   a. Acclimatize workers to site work conditions: temperature, protective clothing, and workload.

   b. Urge workers to maintain normal weight levels.

5. Wear long cotton underwear under chemical protective clothing. Cotton will aid in absorbing perspiration and will hold it close to the skin, which will provide the maximum amount of cooling from the limited evaporation that takes place underneath the chemical resistant clothing.

6. Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:

   a. Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.

   b. Cooling jackets, vests, or suits.

HEAT STRESS MONITORING
SOP NO. 7.1

7. Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress. These are:

   a. Heat Rash: caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Symptoms include a decreased ability to tolerate heat as well as being a nuisance.

   b. Heat Cramps: caused by profuse perspiration with inadequate fluid intake and chemical replacement (especially salts). Signs: muscle spasm and pain in the extremities and abdomen.

   c. Heat Exhaustion: caused by increased stress on various organs to meet increased demands to cool the body. Signs: shallow breathing; pale, cool moist skin; profuse sweating; dizziness and lassitude; nausea; fainting.

   d. Heat Stroke: the most severe form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Body must be cooled immediately to prevent severe injury and/or death. Competent medical help must be obtained immediately. Signs and symptoms are: red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma.

JACOBS

JACOBS ENGINEERING GROUP INC.
CORPORATE HEALTH AND SAFETY MANUAL

COLD STRESS MONITORING
SOP NO. 7.2

APPROVED: HEALTH AND SAFETY MANAGER

OBJECTIVE
This standard operating procedure describes the procedures for cold stress monitoring of personnel engaged in field work activities.

APPLICABILITY
This procedure applies to all Jacobs employees who perform field work in cold weather and who are at risk of developing cold stress.

REFERENCES
American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1990-91, Cincinnati, Ohio, 1990.

PROCEDURE
Frostbite and hypothermia are two types of cold injury which personnel must be protected against during the performance of field activities. Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F (see Table 7-2-1). As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident.

Since prolonged exposure to cold air, or to immersion in cold water, at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

Adequate insulating clothing to maintain core temperatures above 36°C (96.8°F) will be provided to workers. The equivalent chill temperature (see Table 7-2-1) should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

TABLE 7-2-1

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	[illegible]
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	[illegible]
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-1[illegible]
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

Source: American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1987-1988, Cincinnati, Ohio, 1987

Core body temperatures lower than 96.8°F will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences. Unless there are unusual or extenuating circumstances cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia.

Evaluation and Control

For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of -32°C (-25°F). Superficial or deep local tissue freezing will occur only at temperatures below -1° (30°F) regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 7-2-2.

If available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (20°F) heated warming shelters (tents, trailers, etc.) shall be made available nearby and the workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria, are indications for immediate return to the shelter. When entering the heated shelter the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of a diuretic and circulatory effect.

cispl 12

TABLE 7-2-2

Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift

Air Temperature - Sunny Sky		No Noticeable Wind				5 mph Wind		10 mph Wind		15 mph Wind	20 mph Wind
°C (approx.)	°F	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
1. -26° to -28°	-15° to -19°	(Norm. Breaks) 1		(Norm. Breaks) 1		75 min	2	55 min	3	40 min	4
2. -29° to -31°	-20° to -24°	(Norm. Breaks) 1		75 min	2	55 min	3	40 min	4	30 min	5
3. -32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
4. -35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
5. -38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-emergency work should cease					
6. -40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease							
7. -43° & below	-45° & below	Non-emergency work should cease									

Notes:

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For light-to-moderate work (limited physical movement): apply the schedule one step lower. For example, at -30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).

2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:
   5mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.

Source: American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1990-1991, Cincinnati, Ohio, 1990.

For work practices at or below -12°C (10°F) ECT the following shall apply:

1. The worker shall be under constant protective observation (buddy system or supervision).

2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, test periods must be taken in heated shelters and opportunity for changing into dry clothing shall be provided.

3. New employees shall not be required to work full-time in cold in the first days until they become accustomed to the working conditions and required protective clothing.

4. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used.

5. The workers shall be instructed in safety and health procedures. The training program shall include as a minimum instruction in:

   a. Proper re-warming procedures and appropriate first aid treatment.

   b. Proper clothing practices.

   c. Proper eating and drinking habits.

   d. Recognition of impending frostbite.

   e. Recognition signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.

   f. Safe work practices.

UTILITY CLEARANCE

1.0 PURPOSE

1.1 This standard operating procedure describes procedures to reduce the risk of contact with buried or above ground utility service lines.

2.0 SCOPE

2.1 This SOP applies to all field activities where there is possible contact with above ground utilities or sub-surface utilities.

3.0 REFERENCES

3.1 OSHA 1926.650 - 1926.652 Excavations

3.2 Underground Services - State Standards (e.g. California, Title 1 CCR 4216)

3.3 OSHA 1926.955 Provisions for Preventing Accidents Due to Proximity to Overhead Lines

3.4 OSHA 1910.333 Selection and Use of Work Practices in Sub-part S - Electrical

4.0 RESPONSIBILITIES

4.1 It is the responsibility of the *Project Manager* (PM) to assure full compliance with this SOP.

4.2 The *Site Manager* (SM) shall implement this SOP on site.

4.3 The *Site Health and Safety Officer* (SHSO) shall assure full compliance with the SOP and report any deficiencies to the Health and Safety Manager and the Project Manager.

5.0 PROCEDURES

5.1. Buried Utilities

A review will be made of any available property maps, blue lines, or as-builts prior to site activities.

5.1.1. During the project site walk, any discrepancies or new information regarding utility locations will be added to project maps.

5.1.2 If the project is located on Federal land, if possible, facility personnel (Base or facility engineering) should provide utility clearance and sign off. If work is for a government facility, the Site Manager shall obtain and submit the property facility utility service clearance request forms. If work is within a local government jurisdiction, the Site Manager shall notify the local utility locator service using standard geophysical methods such as electromagnetic (EM), ground penetrating radar (GPR), magnetic gradient survey and/or a pipe locator. Two methods will be relied on. Utility locations will be marked using the following color code, unless the facility locator uses a different color code:

white	work location
red	electrical
yellow	gas or oil
orange	telephone
blue	water
green	sewer

5.1.3 If the project occurs in a state which has an agency doing utility clearances, they will be notified. State Underground Service Alert (USA) or other designation in a given state will be notified prior to commencing field work per their requirements. USA will assign a "ticket" number to your site which will need to be recorded. This ticket number is valid for a limited time but, may be extended by contacting USA again. USA will notify utility representatives who will mark according to the utilities' color scheme.[1]

5.1.4 After utilities have been marked by the federal, state or local locator service, the Site Manager will clear utilities.

5.1.5 In addition to geophysics, borings will be hand augured to a minimum of seven feet for all locations within developed areas where there is a potential to impact buried utilities. The hole must be reamed by hand to at least the diameter of the drill rig auger or bit prior to drilling. For soil gas surveys, the survey probe shall be placed as close as possible to the hand auger.

5.1.6 Methods for utility clearance for horizontal and slant boring will be determined by the Project Manager and Health & Safety Manager.

5.1.7 All uncovered utilities must be supported. Any repairs or modifications to existing utility lines require the line to be locked-out/tagged-out prior to work.

5.1.8 At each location where trenching or excavating will occur using a backhoe or other heavy equipment, prior to ground-breaking, the soil must be probed with a magnetometer and/or a pole made of non-conductive material. Additional requirements for trenching/excavating activities can be found in Jacobs Safety Manual, Section 10.9.4.

[1] In California USA will not locate utilities on federal property, but will have information on any easements.

5.2. Above Ground Power Lines

The following table gives the required minimum clearances for working in proximity to overhead power lines.

Nominal Voltage	Minimum Clearance
0 -50 KV	10 ft., or one mast length; whichever is greater
50 KV+	10 ft. + 4 in. for every 10 KV over 50 KV or 1.5 mast lengths; whichever is greater

If it is necessary to work without the minimum clearance, the overhead line must be de-energized or re-routed by the utility company or a competent electrician.

5.3 Approval

Utility Clearance Form 7-1 must be completed and signed-off by the Site Manager prior to commencement of relevant site work.

Any deviations from this SOP must be approved by the Project Manager after collaboration with Health and Safety Manager. Approval via telephone is acceptable in the event the Project Manager is not on site.

5.4 Existing Utility Repair

When repairing existing utilities, refer to the Jacob's Lock-Out and Tag-Out Procedure (Section 8.9 in the Safety Manual).

UTILITY CLEARANCE FORM 7-1

Project: _____ Completed by: _____

Site Location: _____ Date: _____

		Circle One
1.	Review of Existing Maps	yes no n/a
2.	Above Ground Utilities	
	a) marked on site maps	yes no n/a
	b) necessary to lockout	yes no n/a
	c) document procedures used to lockout or re-route	yes no n/a
3.	Underground Utilities	
	a) State Agency called by: _____ Date: _____ Ticket Number _____	yes no n/a
	b) Geophysical clearance method(s) used By: _____ Date: _____	yes no n/a
	c) Utilities marked on site map (attached) by: _____ Date: _____	yes no n/a
4.	Hand auguring completed to _____ feet By whom: _____ Date: _____	yes no n/a
5.	Trench/excavation probed	yes no n/a

6. Approval:

_____ _____
Site Manager Date

_____ _____
Client Rep Date

7. Deviations from SOP Approval:

_____ _____
Project Manager Date

_____ _____
Health and Safety Manager Date

cc: Project File

ACCIDENT INVESTIGATION AND NOTIFICATION

1.0 OBJECTIVE

1.1 This Standard Operating Procedure provides the following:

1.1.1 Effective investigation and analysis of accidents/post-accident procedures

1.1.2 Reporting and recording procedures for accidents, injuries, and hazardous chemical releases and exposures

1.1.3 Applicable site postings

1.1.4 Accident response procedures

2.0 APPLICABILITY

2.1 This procedure applies to all employees covered by the Jacobs Environmental Health and Safety Program. The information herein will be included in the Emergency Preparedness Section of site health and safety plans.

3.0 SCOPE

3.1 The scope of this SOP is intended to cover accident investigation and notification of all accidents and/or incidents including "near misses." This SOP further covers procedure, reporting, and record keeping requirements for personal injury, illness, and exposure. Also covered are any accidental releases of hazardous chemicals and/or property damage occurring as a consequence of site activity.

4.0 PROGRAM ADMINISTRATION DEFINITIONS

4.1 The *Corporate Health and Safety Manager* (CHSM) is responsible for reviewing all occupationally-related injuries, illnesses, and exposures, including First Aid only and OSHA reportable incidents, and hazardous chemical releases. The CHSM is also responsible for taking necessary corrective action based on submitted reports and notifications.

4.2 The *Corporate Health and Safety Administrator* (CHSA) is responsible for maintenance for all corporate health and safety files and collecting all occupationally-related injury, illness, exposure, and hazardous chemical release information.

4.3 The *Site Manager* (SM) is responsible for conducting investigations of accidents/incidents and "near misses." After identification of problems, corrective actions will be instituted. All findings and corrective actions will be documented on the Site Manager's Investigation Report.

4.3.1 The SM is also responsible for coordinating with the Corporate Health & Safety Office, local Jacobs Human Resources Department, and Regional Safety Department to insure completion, filing, and posting of all OSHA forms 200 and 101 for reportable site injuries, illnesses, and exposures.

4.3.2 The SM shall notify the CHSM and Regional or Regional Safety Department Representative of all occupationally-related injuries, illnesses, and exposures, including First Aid only and OSHA reportable incidents, and hazardous chemical releases.

4.4 The *Site Health and Safety Officer* (SHSO) is responsible for assisting the SM in the above listed responsibilities.

4.4.1 If a SHSO is not appointed, a designated personnel may be delegated to assist the Site Manager in the reporting and record keeping responsibilities.

4.5 The *Local Human Resources Representative* (LHRR) is responsible for: processing workmans' compensation claims and coordinating approved company doctor, hospital, or clinic for office injuries/exposures. The LHRR is also responsible for following Jacobs Safety Department *and* Corporate Health and Safety Department procedures for office injuries and exposures. In addition, the LHRR shall complete, file, and post OSHA Forms 200 and 101 for reportable office injuries and exposures. This includes injuries while traveling for business.

4.6 The *Regional Safety Department Representative* (RSDR) is responsible for administering the Jacobs Safety Program. Therefore, reporting procedures include notifying the primary contacts designated in attachment A.

5.0 PROCEDURE - GENERAL

5.1 The following information will be obtained as appropriate:

5.1.1 Approved Company Doctor, Clinic, or Hospital
Prior to initiation of any onsite activities requiring health and safety plans, the SHSO will contact the Coordinator in the Corporate Risk Management Department in Pasadena at (818) 578-6886 to obtain a list of approved medical facilities for the site location.

6.0 PROCEDURE - ACCIDENT RESPONSE

6.1 Injured/ill employees shall be taken to approved facilities. To obtain a list of approved doctors, clinics, or hospital, see 5.1.1.

6.1.1 An Authorization for Medical Treatment Form (attachment B) is to accompany each injured/ill employee. The top portion of the form is to be completed by job site personnel and the attending physician is

to complete the bottom portion. The completed form must be forwarded to the appropriate regional contact (See attachment A) within 48 hours of each visit. A Workers' Compensation Form (completed by LHRR) may also be required.

7.0 PROCEDURE - POST-ACCIDENT

7.1 After the employee has received treatment, the Site Health and Safety Officer will arrange for a post-accident drug screen for all injured employees immediately following an accident. Hepatitis B vaccine may need to be offered to employees who were exposed to blood during responding to an incident. Review SOP 7.6 Bloodborne Pathogens.

7.2 Initial accident investigation shall begin at the discretion of the Site Health and Safety Officer and/or the Site Manager. At a minimum, the scene shall be secured (no movement of material or equipment shall be made until a review of the accident is completed) and signed statements from witnesses shall be obtained.

8.0 REPORTING

All occupationally-related injuries, illnesses, accidents, exposures, hazardous chemical releases, and property damage will be appropriately reported. Completion of this activity is imperative to detecting trends and establishing actions to prevent recurrence.

8.1 A verbal report must be made to the CHSM *and* RSDR as soon as possible for all occupationally-related injuries (including First Aid only incidents,) illnesses, exposures, and hazardous chemical releases.

8.2 Serious or fatal injuries are to be reported *immediately* to the CHSM, the RSDR, the appropriate Operations Manager, and the appropriate Group Vice President.

8.3 The following must be reported to the CHSM, RSDR, and the appropriate Operations Manager with the appropriate form(s) (See Section 9.0 Record Keeping): All job related injuries and illnesses requiring a doctors visit, all exposures, and hazardous material releases in potentially reportable quantities (by EPA-RCRA definitions.)

8.4 The following information must be made available:

8.4.1 Name, social security number, office location, job title

8.4.2 Date and location of accident or incident

8.4.3 Description of the event/and injury - (extent)

8.4.4 Potential for lost time

8.4.5 What medical facility was used and when

8.4.6 Who rendered First Aid/CPR

8.5 The Corporate Risk Management Department in Pasadena will be contacted to report all property damage. (See attachment A)

8.6 The Project Manager will contact the client

9.0 RECORD KEEPING

All occupationally-related injuries, illnesses, accidents, and hazardous chemical release (exposure) incidents will be appropriately recorded. The following reports will be made and submitted:

9.1 Site Managers Investigation Report (See attachment F)
To be completed by the first line Site Manager as soon as possible following the incident. Return completed form to the RSDR. A copy *must* also be sent to the CHSM.

9.2 Witness Statement (See attachment G)
To be used to obtain a signed statement from witnesses of their complete (factual) observations. Names and permanent addresses shall be secured for future reference. Return to the RSDR. A copy *must* also be sent to the CHSM.

9.3 Employee's Report of Occupational Injury or Disease (See attachment H)
This form is state specific. This form must be completed for all injuries, illnesses, and exposures requiring a doctor's visit. The location code (project number) will be used as the form of identification. Return this form to the RSDR within 24 hours of initial doctor's visit. A copy *must* also be sent to the CHSM.

9.4 Employee Exposure/Hazardous Chemical Release Report Form 9-1 (See attachment C)

9.4.1 All incidents involving exposure to potentially hazardous materials while working, including incidents onsite, in the office, during company travel, and hazardous material releases in potentially reportable quantities (by EPA-RCRA definitions) must be reported to CHSM. Document the incident on Employee Exposure/Hazardous Chemical Release Report, Form 9-1.

9.4.1.1 Further notification procedures i.e., agency notifications, shall be followed as outlined in the site specific health and safety plan.

9.4.2 The SM shall complete and return Form 9-1 to the CHSM as soon as possible. A copy of this form *must* also be sent to the RSDR. This form is to be completed for all hazardous chemical exposure and release incidents *only*.

9.4.3 It is important to report all exposures even though the incident is not considered serious or no adverse health effects or symptoms are apparent at the time.

9.4.4 The employee must be given a copy of the report. Additional copies must be placed in the employee's corporate health and safety medical file and exposure file.

9.5 First Aid Register (See attachment E)
This is the primary project injury log. All injuries/illness, treated or reported (actual or alleged), shall be entered into the log. This register is to be used no matter how minor the event may be. *There are no exceptions to this reporting requirement*. The register is kept at the project site.

9.6 Vehicle Accident Reporting Procedure (See attachment I)
For any vehicle accident or injuries involving a vehicle, please follow and complete necessary forms dictated by the Vehicle Accident Reporting Procedures.

10.0 OSHA REPORTING/RECORD KEEPING PROCEDURES

10.1 Preparation and Maintenance of records relating to occupational injuries, illnesses, and exposures required by OSHA will be maintained by:

Office-related This includes injuries or accidents while on company-related travel.	LHRR
Project Site-related	SHSO or designated personnel

10.2 Log and Summary of Occupational Injuries and Illnesses Form - OSHA Form 200 (See attachment D)

10.2.1 All occupational injuries and illnesses that require treatment other than First Aid are reported on OSHA Form 200 - Log and Summary of Occupational Injuries and Illnesses. Information for each "recordable case" of occupational injury or illness shall be entered on the form within six (6) work days after learning of its occurrence.

10.2.1.1 A "recordable case" is defined on the front of OSHA Form 200 as "...every occupational death, every nonfatal occupational illness, and

those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid)..." Further definitions and instructions are provided on the back of the form.

10.2.1.2 OSHA's record keeping and reporting requirements differ from those under the various State Workers' Compensation laws. Because they differ, employers must not substitute Workers' Compensation criteria for determining whether or not a case should be recorded for OSHA.

10.2.2 All entries on OSHA Form 200 must be identified by a case or file number. Entry numbers must be non-duplicating to facilitate comparison with OSHA Form 101, Supplementary Record of Occupational Injuries and Illnesses (described in section 10.3).

10.2.3 One OSHA Form 200 is used at the project site or office location per year. Each incident is added to the same form on a separate line.

10.2.4 A copy of OSHA Form 200 with injury/illness information recorded shall be sent to the CHSM and RSDR within 45 calendar days of its recording.

10.2.5 At the beginning of each calendar year, a summary of all injuries and illnesses recorded on OSHA Form 200 for the preceding year must be made. Instructions on the back of Form 200 describe how the summary is compiled. Even if there were no injuries or illnesses during the year, zeros must be entered on the totals line, and the form posted.

10.2.5.1 The OSHA 200 Form must be posted with summary information for the preceding year where notices to employees are commonly posted ***no later than February 1 and must remain in place until March 1.***

10.2.5.2 A copy of the summary OSHA Form 200 *must* be sent to the CHSA and RSDR at year end no later than January 15.

10.3 Supplementary Record of Occupational Injuries and Illness - OSHA Form 101. (See attachment K)

10.3.1 To supplement the Log and Summary of Occupational Injuries and Illnesses - OSHA Form 200, each establishment must maintain a record of each recordable occupational injury or illness. If no suitable report is made for other purposes, the Supplementary Record OSHA No. 101 may be used.

10.3.1 Or, the record may consist of the one or more of the documents listed below.

10.3.1.1 Workers' Compensation, insurance, or other reports are also acceptable as records if they contain all facts listed below or are supplemented to do so.

10.3.1.2 The record may also be listed on a plain sheet of paper containing the following facts. For further information, please see Definitions on the back of OSHA Form 200:

1) *About the employer*-name, mail address, and location if different from mail address.

2) *About the injured or ill employee*-name, social security number, home address, age, sex, occupation, and department.

3) *About the accident or exposure to occupational illness*-place of accident or exposure, whether it was on employer's premises, what the employee was doing when injured, and how the accident occurred.

4) *About the occupational injury or illness*-description of the injury or illness, including part of body affected, name of the object or substance which directly injured the employee, and date of injury or diagnosis of illness.

5) *Other*-name and address of physician; if hospitalized, name and address of

hospital, date of report, and name and position of person preparing the report.

10.3.2 These records must also be available without delay and at reasonable times for examination by representatives of the Department of Labor and the Department of Health, Education and Welfare, and States accorded jurisdiction under the Act.

10.3.3 The records must be maintained for a period of not less than five years following the end of the calendar year to which they relate.

11.0 SITE POSTINGS

11.1 The following forms will be posted for all on-going field projects. Contact your Regional Safety Department or local OSHA office to obtain these forms and postings.

11.1.1	Jacobs Forms:	First Aid Register Emergency Phone Numbers Specific to the Site
11.1.2	OSHA Forms:	OSHA 200 Log OSHA Health and Safety Poster (or State Equivalent) Access to Medical and Exposure Records OSHA Permits Forklift Operating Instructions

11.1.3 Human resource forms and postings appropriate to each job site will be obtained from regional contacts and kept onsite as required. (See attachment J)

12.0 ATTACHMENTS

The following attachments are included with this SOP:

Attachment A	Primary Contacts
Attachment B	Authorization For Medical Treatment
Attachment C	Employee Exposure/Hazardous Chemical Release Report
Attachment D	OSHA Form 200 - Log and Summary of Occupational Injuries and Illnesses
Attachment E	First Aid Register
Attachment F	Site Manager's Investigation Report
Attachment G	Witness Statement
Attachment H	Employee's Report of Occupational Injury or Disease
Attachment I	Vehicle Accident Reporting Procedure
Attachment J	Human Resources Contacts
Attachment K	OSHA Form 101 - Supplementary Record of Occupational Injuries and Illness

Attachment A

PRIMARY CONTACTS

Corporate Environmental Health and Safety Department
Jacobs Engineering Group, Inc.
600 Seventeenth Street, Suite 1100N
Denver, Colorado 80202
Attention: Terry Briggs
Office Phone: (303) 595-8855
FAX Machine: (303) 595-8857

Pasadena Risk Management (Safety) Department
Jacobs Engineering Group, Inc.
251 S. Lake Avenue
Pasadena, California 91101
Attention: Pat Costamagna
Office Phone: (818) 578-6886
FAX Machine: (818) 578-6837

Central Region Safety Department
Jacobs Engineering Group, Inc.
4848 Loop Central Drive
Houston, Texas 77081-2211
Attention: Steve Pianalto
Office Phone: (713) 669-2200
FAX Machine: (713) 669-0045

Eastern Region (Including Louisiana) Safety Department
Jacobs Engineering Group, Inc.
4949 Essen Lane
Baton Rouge, Louisiana 70809
Attention: C.J. Beysellance
Office Phone: (504) 769-7700
FAX Machine: (504) 768-5228

Midwest Region Safety Department
Jacobs Engineering Group, Inc.
1880 Waycross Road
Cincinnati, Ohio 45240
Attention: Bill Minear
Office Phone: (513) 595-7500
FAX Machine: (513) 595-7717

Western Region Safety Department
Jacobs Engineering Group, Inc.
251 S. Lake Avenue
Pasadena, California 91101
Attention: Ken Wilkenson
Office Phone: (818) 449-2171
FAX Machine: (818) 578-6827
Home Phone: (805) 255-6973

Attachment B

JACOBS ENGINEERING GROUP INC.

_____
(Division)

AUTHORIZATION FOR MEDICAL TREATMENT

TO: Dr._____ Address:_____ Date_____

This form signed by our representative is your authority to render treatment to:

_____
(Employee)

in accordance with the provisions of and under the conditions prescribed by the Workmens' Compensation Act. Unless the case is an emergency, kindly obtain authorization for surgery, radical procedures, or hospitalization from the insurance carrier. Send your bill and report to us at the address listed below.

_____
Authorized Representative

Date of Injury_____Location_____Job No._____
How Injury Occurred_____

Please complete and return by mail to the following address to insure prompt payment of charges.

Pat Costamagna, Jacobs Enginnering Group, 251 S. Lake Ave
Pasadena, CA 91101 (818) 578-6886

==========

FOR DOCTOR'S USE ONLY

Diagnosis of Injury:_____

Disposition of Patient:

____Occupational ____Non-Occupational ____Unable to Determine

____Able to resume regular duties
____Able to resume regular duties next workday
____Able to resume restricted duties with the following limitations:_____
____Unable to return to work, estimated length of disability:_____

Return for follow-up visit on _____(Date)

_____
(Doctor's Signature)

JACOBS ENGINEERING GROUP INC.

FORM 9-1
EMPLOYEE EXPOSURE/HAZARDOUS CHEMICAL RELEASE REPORT

Client: _____ Site: _____

Name: _____ Site Location: _____

SSN: _____ _____

Occupation: _____ Incident: _____

Description (Date/Time): _____

List Amount Of Time Lost From Work (if any): _____

Person To Whom Incident Was Reported: _____ Date/Time: _____

Weather Condition During Incident: Temperature _____ Wind Speed & Direction _____

Humidity _____ Cloud Cover _____ Clear _____ Precipitation _____

Materials Potentially Encountered:
Chemical (Give chemical name or description-liquid, solid, gas, vapor fume, mist):

_____

_____

Radiological: _____

_____

Volume Or Quantity Released: _____

Other: _____

_____

Nature Of The Exposure/Release:
State the nature of the exposure/release in detail and list the parts of the body affected and potential on-site and off-site receptors: (Attach extra sheets if needed)

_____

_____

_____

Was Medical Care Received? Yes( ) No( )
If So, When? _____

JACOBS ENGINEERING GROUP INC.
FORM 9-1
EMPLOYEE EXPOSURE/HAZARDOUS CHEMICAL RELEASE REPORT

Where? On-Site _____ Off-Site _____

By Whom? Name Of Paramedic: _____

Name Of Treating Physician: _____

Other: _____

If "Off-Site", Name Facility (hospital, clinic, etc.): _____

Length Of Stay At The Facility? _____

Was The Health And Safety Manger Contacted? Yes( ) No( ) Date/Time: _____

Was The Medical Consultant Contacted? Yes( ) No( )
If So, Who Was The Contact? _____ Date/Time: _____

Did The Exposure Result In Disability? Yes( ) No( )
If So, Estimated Length Of Disability: _____

Who Authorized Disability?: _____

Has The Employee Returned To Work? Yes( ) No( )
If So, Give Date: _____

List The Names Of Other Persons Affected During This Incident: _____

_____

List The Names Of Persons Who Witnessed The Exposure/Release Incident: _____

_____

Possible Cause Of The Exposure/Release: _____

_____

Was The Operation Being Conducted Under An Established Health And Safety Plan? Yes() No()
If No, Explain: _____

Were Agency/Client Contacts Made? _____ Date/Time: _____

List Agencies/Persons Contacted: _____

_____

JACOBS ENGINEERING GROUP INC.
FORM 9-1
EMPLOYEE EXPOSURE/HAZARDOUS CHEMICAL RELEASE REPORT

Describe Protective Equipment And Clothing Used By The Employee (List Equipment, Make, Model) _____

_____

_____

Other Information, Comments (Attach relative data if necessary): _____

_____

What Was The Employee Doing When The Exposure/Release Occurred? (Describe briefly as "Site Reconnaissance", "Site Categorization", "Sampling", etc.) How Did The Exposure/Release Occur? (Describe fully what factors led up to and/or contributed to the incident):

_____

_____

_____

What Follow-Up Actions Occurred? _____

_____

What Corrective Action(s) Or Change To The Site Health & Safety Plan, If Any, Have Been Or Will Be Taken To Avoid Recurrence Of The Exposure And/Or Release? This question is to be completed by the Site Manager or Site Health & Safety Officer.

_____

_____

Additional Comments: _____

_____

_____

_____

Project Manager (Print or Type)	Project Manager (Signature)	Date
Site Health & Safety Officer (Print or Type)	Site Health & Safety Officer (Signature)	Date

Bureau of Labor Statistics
Log and Summary of Occupational
Injuries and Illnesses

U.S. Department of Labor

For Calendar Year 19 _____ Page ___ of ___

NOTE: This form is required by Public Law 91-596 and must be kept in the establishment for 5 years. Failure to maintain and post can result in the issuance of citations and assessment of penalties. (See posting requirements on the other side of form.)

RECORDABLE CASES: You are required to record information about every occupational death, every nonfatal occupational illness, and those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid). (See definitions on the other side of form.)

Company Name
Establishment Name
Establishment Address

Form Approved
O.M.B. No. 1220-0029
See OMB Disclosure Statement on reverse

Case or File Number	Date of Injury or Onset of Illness	Employee's Name	Occupation	Department	Description of Injury or Illness	Extent of and Outcome of INJURY: Fatalities	Nonfatal Injuries					Type, Extent of, and Outcome of ILLNESS: Type of Illness							Fatalities	Nonfatal Illnesses				
						Injury Related	Injuries With Lost Workdays				Injuries Without Lost Workdays	CHECK Only One Column for Each Illness (See other side of form for terminations or permanent transfers.)							Illness Related	Illnesses With Lost Workdays				Illnesses Without Lost Workdays
Enter a nonduplicating number which will facilitate comparisons with supplementary records.	Enter Mo./day.	Enter first name or initial, middle initial, last name	Enter regular job title, not activity employee was performing when injured or at onset of illness. In the absence of a formal title, enter a brief description of the employee's duties	Enter department in which the employee is regularly employed or a description of normal workplace to which employee is assigned even though temporarily working in another department at the time of injury or illness	Enter a brief description of the injury or illness and indicate the part or parts of body affected. Typical entries for this column might be: Amputation of 1st joint right forefinger. Strain of lower back. Contact dermatitis on both hands. Electrocution, body.	Enter DATE of death. Mo./day/yr.	Enter a CHECK if injury involves days away from work or days of restricted work activity or both	Enter a CHECK if injury involves days away from work.	Enter number of DAYS away from work	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in columns 1 or 2 but the injury is recordable as defined above	Occupational illness of a disease or disorder	Dust diseases of the lungs	Respiratory conditions due to toxic agents	Poisoning (systemic effects of toxic materials)	Disorders due to physical agents	Disorders associated with repeated trauma	All other occupational illness	Enter DATE of death. Mo./day/yr.	Enter a CHECK if illness involves days away from work, or days of restricted work activity, or both	Enter a CHECK if illness involves days away from work	Enter number of DAYS away from work	Enter number of DAYS of restricted work activity	Enter a CHECK if no entry was made in columns 8 or 9
(A)	(B)	(C)	(D)	(E)	(F)	(1)	(2)	(3)	(4)	(5)	(6)	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(8)	(9)	(10)	(11)	(12)	(13)
					PREVIOUS PAGE TOTALS →																			
					TOTALS (instructions on other side of form.) →																			

INJURIES

ILLNESSES

OSHA No. 200

U.S. GPO 1990-282-258/15419

FOLD

Certification of Annual Summary Totals By _____ Title _____ Date _____

OSHA No. 200

POST ONLY THIS PORTION OF THE LAST PAGE NO LATER THAN FEBRUARY 1.

ATTACHMEN
Page 1 of

FIRST AID REGISTRY

FROM: _____ TO: _____ DATE: _____ PAGE ____ OF ____

JOB NUMBER: _____ LOCATION: _____

DATE TIME	NAME	FOREMAN	TYPE OF INJURY/ BODY PART	TYPE OF ACCIDENT	LEGEND* FAV	RTW	DV	LTA

*FAV-First Aid Visit *RTW-Return to Work *DV-Doctor Visit *LTA-Lost Time Accident

Attachment E

OMB DISCLOSURE STATEMENT

We estimate that it will take from 4 minutes to 30 minutes to complete a line entry on this form, including time for reviewing instructions, searching, gathering and maintaining the data needed, and completing and reviewing the entry. If you have any comments regarding this estimate or any other aspect of this recordkeeping system, send them to the Bureau of Labor Statistics, Division of Management Systems (1220 0029), Washington, D.C. 20212 and to the Office of Management and Budget, Paperwork Reduction Project (1220-0029), Washington, D.C. 20503

Instructions for OSHA No. 200

I. Log and Summary of Occupational Injuries and Illnesses

Each employer who is subject to the recordkeeping requirements of the Occupational Safety and Health Act of 1970 must maintain for each establishment a log of all recordable occupational injuries and illnesses. This form (OSHA No. 200) may be used for that purpose. A substitute for the OSHA No. 200 is acceptable if it is as detailed, easily readable and understandable as the OSHA No. 200.

Enter each recordable case on the log within six (6) workdays after learning of its occurrence. Although other records must be maintained at the establishment to which they refer, it is possible to prepare and maintain the log at another location using data processing equipment if desired. If the log is prepared elsewhere, a copy updated to within 45 calendar days must be present at all times in the establishment.

Logs must be maintained and retained for five (5) years following the end of the calendar year to which they relate. Logs must be available (normally at the establishment) for inspection and copying by representatives of the Department of Labor, or the Department of Health and Human Services, or States accorded jurisdiction under the Act. Access to the log is also provided to employees, former employees and their representatives.

II. Changes in Extent of or Outcome of Injury or Illness

If, during the 5 year period the log must be retained, there is a change in an extent and outcome of an injury or illness which affects entries in columns 1, 2, 6, 8, 9, or 13, the first entry should be lined out and a new entry made. For example, if an injured employee at first required only medical treatment but later lost workdays away from work, the check in column 6 should be lined out, and checks entered in columns 2 and 3 and the number of lost workdays entered in column 4.

In another example, if an employee with an occupational illness lost workdays, returned to work, and then died of the illness, any entries in columns 9 through 12 should be lined out and the date of death entered in column 8.

The entire entry for an injury or illness should be lined out if later found to be nonrecordable. For example, an injury which is later determined not to be work related, or which was initially thought to involve medical treatment but later was determined to have involved only first aid.

III. Posting Requirements

A copy of the totals and information following the fold line of the last page for the year must be posted at each establishment in the place or places where notices to employees are customarily posted. This copy must be posted no later than *February 1 and must remain in place until March 1.*

Even though there were no injuries or illnesses during the year, zeros must be entered on the totals line, and the form posted.

The person responsible for the *annual summary totals* shall certify that the totals are true and complete by signing at the bottom of the form.

IV. Instructions for Completing Log and Summary of Occupational Injuries and Illnesses

Column A – CASE OR FILE NUMBER. Self explanatory.

Column B – DATE OF INJURY OR ONSET OF ILLNESS
For occupational injuries enter the date of the work accident which resulted in injury. For occupational illnesses enter the date of initial diagnosis of illness, or, if absence from work occurred before diagnosis, enter the first day of the absence attributable to the illness which was later diagnosed or recognized.

Columns C through F – Self explanatory.

Columns 1 and 8 – INJURY OR ILLNESS RELATED DEATHS
Self explanatory.

Columns 2 and 9 – INJURIES OR ILLNESSES WITH LOST WORKDAYS
Self explanatory.

Any injury which involves days away from work, or days of restricted work activity, or both must be recorded since it always involves one or more of the criteria for recordability.

Columns 3 and 10 – INJURIES OR ILLNESSES INVOLVING DAYS AWAY FROM WORK. Self explanatory.

Columns 4 and 11 – LOST WORKDAYS--DAYS AWAY FROM WORK.
Enter the number of workdays (consecutive or not) on which the employee would have worked but could not because of occupational injury or illness. The number of lost workdays should not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.

NOTE: For employees not having a regularly scheduled shift, such as certain truck drivers, construction workers, farm labor, casual labor, part time employees, etc., it may be necessary to estimate the number of lost workdays. Estimates of lost workdays shall be based on prior work history of the employee AND days worked by employees, not ill or injured, working in the department and/or occupation of the ill or injured employee.

Columns 5 and 12 – LOST WORKDAYS--DAYS OF RESTRICTED WORK ACTIVITY
Enter the number of workdays (consecutive or not) on which because of injury or illness:

(1) the employee was assigned to another job on a temporary basis, or
(2) the employee worked at a permanent job less than full time, or
(3) the employee worked at a permanently assigned job but could not perform all duties normally connected with it.

The number of lost workdays should not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.

Columns 6 and 13 – INJURIES OR ILLNESSES WITHOUT LOST WORKDAYS. Self explanatory.

Columns 7a through 7g – TYPE OF ILLNESS
Enter a check in only one column for each illness.

TERMINATION OR PERMANENT TRANSFER–Place an asterisk to the right of the entry in columns 7a through 7g (type of illness) which represented a termination of employment or permanent transfer.

V. Totals

Add number of entries in columns 1 and 8.
Add number of checks in columns 2, 3, 6, 7, 9, 10, and 13.
Add number of days in columns 4, 5, 11, and 12.
Yearly totals for each column (1-13) are required for posting. Running or page totals may be generated at the discretion of the employer.

If an employee's loss of workdays is continuing at the time the totals are summarized, estimate the number of future workdays the employee will lose and add that estimate to the workdays already lost and include this figure in the annual totals. No further entries are to be made with respect to such cases in the next year's log.

VI. Definitions

OCCUPATIONAL INJURY is any injury such as a cut, fracture, sprain, amputation, etc., which results from a work accident or from an exposure involving a single incident in the work environment.
NOTE: Conditions resulting from animal bites, such as insect or snake bites or from one time exposure to chemicals, are considered to be injuries.

OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact.

The following listing gives the categories of occupational illnesses and disorders that will be utilized for the purpose of classifying recordable illnesses. For purposes of information, examples of each category are given. These are typical examples, however, and are not to be considered the complete listing of the types of illnesses and disorders that are to be counted under each category.

7a. Occupational Skin Diseases or Disorders
Examples: Contact dermatitis, eczema, or rash caused by primary irritants and sensitizers or poisonous plants, oil acne, chrome ulcers, chemical burns or inflammations, etc.

7b. Dust Diseases of the Lungs (Pneumoconioses)
Examples: Silicosis, asbestosis and other asbestos related diseases, coal worker's pneumoconiosis, byssinosis, siderosis, and other pneumoconioses.

7c. Respiratory Conditions Due to Toxic Agents
Examples: Pneumonitis, pharyngitis, rhinitis or acute congestion due to chemicals, dusts, gases, or fumes, farmer's lung, etc.

7d. Poisoning (Systemic Effect of Toxic Materials)
Examples: Poisoning by lead, mercury, cadmium, arsenic, or other metals, poisoning by carbon monoxide, hydrogen sulfide, or other gases, poisoning by benzol, carbon tetrachloride, or other organic solvents, poisoning by insecticide sprays such as parathion, lead arsenate, poisoning by other chemicals such as formaldehyde, plastics, and resins, etc.

7e. Disorders Due to Physical Agents (Other than Toxic Materials)
Examples: Heatstroke, sunstroke, heat exhaustion, and other effects of environmental heat, freezing, frostbite, and effects of exposure to low temperatures, caisson disease, effects of ionizing radiation (isotopes, X-rays, radium), effects of nonionizing radiation (welding flash, ultraviolet rays, microwaves, sunburn), etc.

7f. Disorders Associated With Repeated Trauma
Examples: Noise induced hearing loss, synovitis, tenosynovitis, and bursitis, Raynaud's phenomena, and other conditions due to repeated motion, vibration or pressure.

7g. All Other Occupational Illnesses
Examples: Anthrax, brucellosis, infectious hepatitis, malignant and benign tumors, food poisoning, histoplasmosis, coccidioidomycosis, etc.

MEDICAL TREATMENT includes treatment (other than first aid) administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does NOT include first aid treatment (one time treatment and subsequent observation of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care) even though provided by a physician or registered professional personnel.

ESTABLISHMENT: A single physical location where business is conducted or where services or industrial operations are performed (for example: a factory, mill, store, hotel, restaurant, movie theater, farm, ranch, bank, sales office, warehouse, or central administrative office). Where distinctly separate activities are performed at a single physical location, such as construction activities operated from the same physical location as a lumber yard, each activity shall be treated as a separate establishment.

For firms engaged in activities which may be physically dispersed, such as agriculture, construction, transportation, communications, and electric, gas, and sanitary services, records may be maintained at a place to which employees report each day.

Records for personnel who do not primarily report or work at a single establishment, such as traveling salesmen, technicians, engineers, etc., shall be maintained at the location from which they are paid or the base from which personnel operate to carry out their activities.

WORK ENVIRONMENT is comprised of the physical location, equipment, materials processed or used, and the kinds of operations performed in the course of an employee's work, whether on or off the employer's premises.

Attachment F

SITE MANAGER'S INVESTIGATION REPORT

WHY: PREVENTION is the primary reason. PREVENTION is the goal of accident investigation. Your investigation should be an attempt to reveal the causes so that they may be eliminated. Eliminating causes will PREVENT a recurrence.

WHAT HAPPENED: Before the causes can be determined, you, the supervisor, must get the accurate facts of what happened. These should give a clear description of what actually took place. The injured or involved person or persons are usually best able to describe what happened. Witnesses are also important. You should interview everyone involved before writing down the description.

WHY DID THIS HAPPEN: Once you know exactly what happened, you must analyze the facts and determine the causes.

First, you must determine the immediate cause or causes, such as someone's improper actions, faulty equipment, or other conditions which directly caused the accident or incident. More than one cause often exists, and you must give careful consideration to all possible causes. List them on your report.

The second part of the analysis involves some "backtracking." Think through the immediate causes you listed and try to give the reasons they existed. For example, the box that fell from a pallet of stock might be the immediate cause of injury to an employee. By "backtracking", the underlying, more fundamental causes can be determined. The pallet wasn't stacked properly. It was stacked improperly because the boxes were wet and soggy. They were wet because a section of the roof leaked and needed repairs, or because they were unloaded on an open loading dock in the rain, etc. List as many as possible. "Backtrack" as far as possible.

WHAT CORRECTIVE ACTION: After you have analyzed the causes, eliminate them. As the first-line supervisor you can probably do a great deal on your own to eliminate causes. Give additional training in safe, proper working procedures to your workers. Correct any housekeeping problems in your area of responsibility. Check machinery more often. Indicate on the report what you can do and what you have done to prevent a recurrence. For those causes beyond your direct control (such as the leaky roof in the example above), indicate what things should be done by management to eliminate the causes. This is your chance to advise them of what should be done to improve work efficiency and eliminate possible accident producing situations.

Remember--PREVENTION of recurrences is the purpose of your investigation and report. Be concise in your report. Avoid finding fault with individuals. Avoid vague, general descriptions or causes such as "carelessness". As the first-line supervisor, you are in the best position to understand the real causes of an accident or incident. Eliminating them will benefit you by providing safe working conditions for you and your workers while improving the efficiency of your crew.

SITE MANAGER'S INVESTIGATION REPORT

Required For:

Every injury requiring medical treatment

Non-injury incidents of serious potential

Disposition:

Medical treatment injuries

Employee medical file (site) - 1 copy

Manager of Safety - 1 copy

Corporate Insurance & Safety - 1 copy (attached to Employer's First Report of Injury)

Non-injury incidents of serious potential

Site incident file - 1 copy

Manager of Safety - 1 copy

Instructions: (See Appendix 2-5.1)

Client:	Client's name
Project number:	Assigned project number
Name:	Name of injured party/not required if a non-injury incident report
Skill:	Employee's occupation
Department:	Department within which incident occurred
Age:	Age of injured
Location:	Location of project where incident occurred
Date:	Date of occurrence
Supervisor:	Supervisor directing employee or task
Time:	Time of occurrence
Property damage:	Was it involved?
What happened:	Facts revealed as to how incident occurred
Nature of injury:	What was the injury, if any
Injury potential:	Was the potential there for serious or major injury?
Why?	Facts revealed through investigation as to the injury cause
Recurrence?:	Is the potential there?
Corrective action?:	Retraining, equipment change, procedure change?

SITE MANAGER'S INVESTIGATION REPORT

Client:_____ Project Number:_____

Name:_____ Department:_____ Skill:_____

Age:_____ Location:_____ Date:_____

Site Manager: _____ Time:_____

Property Damage: Yes _____ No _____

What Happened: _____

_____

_____

_____

Nature of Incident: _____

_____

_____

Injury Potential: Major_____ Serious_____ Minor_____

Why Did This Happen?: _____

_____

Possibility of Recurrence: Often _____ Seldom _____ Rarely _____

What Corrective Action Has Been/Will Be Taken? _____

_____

_____

Site Health & Safety Officer: _____ Project Manager:_____

Report Written By: _____

Date of Report:_____ Time of Report:_____

Attachment G

WITNESS STATEMENT

DATE: _____

NAME: _____ TITLE: _____

SOCIAL SECURITY NUMBER: _____

TEMPORARY ADDRESS: _____ PHONE NO. _____

_____

PERMANENT ADDRESS: _____ PHONE NO. _____

_____

LOCATION AT TIME OF ACCIDENT: _____

DESCRIBE, TO THE BEST OF YOUR KNOWLEDGE, HOW THE ACCIDENT HAPPENED:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____
Signature

THE USE OF THIS FORM IS REQUIRED UNDER THE PROVISIONS OF THE ALABAMA WORKERS' COMPENSATION LAW

WCC Form 2
Rev. 1985

STATE OF ALABAMA
EMPLOYER'S FIRST REPORT OF INJURY OR OCCUPATIONAL DISEASE

Send to: Your workers' compensation insurance carrier, in duplicate

OSHA CASE OR FILE NUMBER

PRINT OR TYPE

Carrier's File No. _____

EMPLOYER

1. EMPLOYER'S NAME AND MAILING ADDRESS (No. & Street, City, County, State, ZIP)

TELEPHONE NUMBER

LOCATION, IF DIFFERENT FROM MAILING ADDRESS

2. EMPLOYER IDENTIFICATION (U.C. ACCOUNT) NUMBER

3. CARRIER OR SELF-INSURANCE REGISTRATION NUMBER

4. NATURE OF BUSINESS (Manufacturing, Trade, Transportation, etc.)

SPECIFIC PRODUCTS

5. WORKERS' COMPENSATION PROVIDED BY: INSURANCE CARRIER ( ) SELF-INSURANCE ( ) GROUP FUND ( )
IF INSURANCE CARRIER, GIVE NAME AND ADDRESS:

EMPLOYEE

6. EMPLOYEE'S NAME (Last) (First) (Middle)

7. SEX MALE ( ) FEMALE ( )

8. AGE

9. SOCIAL SECURITY NO.

10. EMPLOYEE'S HOME ADDRESS (No. & Street or RFD, City, County, State, ZIP)

11. MARITAL STATUS: SINGLE ( ) MARRIED ( ) DIVORCED ( ) SEPARATED ( ) WIDOWED ( )

12. HOME TELEPHONE

13. REGULAR OCCUPATION

14. WORKING IN WHAT DEPARTMENT WHEN HURT

INJURY OR ILLNESS

15. PLACE OF ACCIDENT OR EXPOSURE (Address or location, include County)

16. ON EMPLOYER'S PREMISES? YES ( ) NO ( )

17. Date of Occurrence

18. TIME OF DAY a.m. ( ) p.m. ( )

19. Date Disability Began

20. Date Employer Notified

21. DESCRIBE THE INJURY OR ILLNESS IN DETAIL AND INDICATE THE PART OF THE BODY AFFECTED
(e.g., amputation of right index finger at second joint, fracture of 2 ribs, lead poisoning, dermatitis of left hand, etc.)

22. IF FATAL, GIVE DATE OF DEATH

23. WHAT THING DIRECTLY PRODUCED THIS INJURY OR ILLNESS?
(Name object struck against or struck by; vapor, poison, chemical or radiation; if strain or hernia, the thing being lifted, pulled pushed, etc.; if injury resulted solely from bodily motion, the stretching, twisting, etc. which resulted in injury.)

24. HOW DID THE ACCIDENT OR EXPOSURE OCCUR?
(Begin by telling what the employee was doing just before the accident or exposure. Be specific. If employee was using tools or equipment, or handling material, name them and tell what employee was doing with them.)

(Now describe fully the events which resulted in injury or illness. Tell what happened and how it happened. Specify how objects or substances were involved. Give full details of all factors which led or contributed to the accident or exposure.)

25. NAME AND ADDRESS OF TREATING PRACTITIONER

NAME AND ADDRESS OF HOSPITAL
HOSPITALIZED ( )
OUT-PATIENT ( )
EMERGENCY TREATMENT ( )

WAGE INFORMATION

26. Has Injured Returned to Work? Yes ( ) No ( )

27. If so, Date

28. At What Wage?

29. At What Occupation?

30. LENGTH OF TIME IN YOUR EMPLOY?

31. LENGTH OF TIME IN PRESENT JOB

32. NUMBER OF DEPENDENTS

33. Average Weekly Wage

34. Weekly Value of Remuneration Other Than Wages-(Food, Lodging, etc.) $

35. DID EMPLOYEE RECEIVE FULL PAY FOR DAY OF INJURY? YES ( ) NO ( )

36. Date of This Report

37. Signed by

38. Signature

39. Official Position or Title

Do Not Write In The Space Be
Employer U.
Carrier Numb
SIC
Carrier-Fun
Soc. Sec. N
Sex
Marital Stat
Dependent
Age
Occupatior
Event Count
On Premise
Event Date
Employer Kn
Injury Sourc
Accident Ty
Nature of Inj
Part of Bod
Date of Dea
Stopped Wo
Time Employ
Time in Job
Weekly Wag
Report Dat
Report Rece
Back to Wo
Case Clas

JF-4182b Prtd. in U.S.A.

Attachment I

VEHICLE ACCIDENT REPORTING PROCEDURE

1.0 Purpose

To set for the minimum requirements for the timely and accurate reporting of vehicular accidents.

2.0 Scope

This procedure applies to all Region operations and projects.

3.0 Responsibilities

3.1 Operations Managers are responsible for assuring that their respective department, project and other managers, and supervisors fully understand and comply with this procedure and any supplementary procedure(s).

3.2 All managers and supervisors are responsible for assuring that all employees reporting to them fully understand and comply with this procedure and any supplementary procedure(s).

3.3 Any employee involved in an accident while using a Jacobs pool car, rental car on company business, or other company owned, rented, or operated vehicle or heavy equipment, shall comply with this procedure and any supplementary procedure(s).

4.0 Requirements

4.1 Each office and project site shall develop a supplementary vehicle accident reporting procedure to address any applicable local and state requirements and/or client requirements.

4.2 At a minimum, the police will be notified and a police accident report filed for any accident involving another vehicle or property when damages are estimated to be greater than $500.00 or when there is allegedly bodily injury (more stringent requirements by local, state or client shall be addressed by a supplementary office or project procedure).

4.3 All vehicle and/or equipment accidents shall be verbally reported to the Pasadena Risk Management Department and Western Region Safety Department (see Exhibit A) within 24 hours of the accident.

4.4 The employee assigned to the vehicle or equipment, or who holds the vehicle rental agreement, shall be responsible for completing and returning the following to the Pasadena Risk Management Department:

- Cigna "Notice of Automobile Accident" (Exhibit B);
- Copies of any completed local, state or client required forms.

4.5 If the vehicle involved in the accident is a Jacobs pool car, the employee assigned to the vehicle is responsible for obtaining two written estimates for repair of the Jacobs vehicle and obtaining a copy of the police investigation report (when applicable). All information is to be sent to the Pasadena Risk Management Department.

4.6 If the vehicle involved in the accident is a rental vehicle, the rental company will normally take care of the repair estimates. However, the employee shall be responsible for obtaining a copy of the police investigation report (when applicable) and forwarding a copy of the Pasadena Risk Management Department.

4.7 All Jacobs vehicles that are non-driveable, due to an accident, are to be towed to the nearest garage that will hold them until further instructions are received.

4.8 All questions regarding vehicle insurance shall be directed to the Pasadena Risk Management Department.

4.9 In the event that the employee responsible for the vehicle is, due to the accident, unable to complete the foregoing requirements, it shall be the responsibility of the respective Operations Manager or his/her designate to do so.

5.0 Attachments

5.2 Exhibit B - Cigna "Notice of Automobile Accident"

ATTACHMENT K

OSHA No. 101
Case or File No. _____

Form approved
OMB No. 44R 1453

Supplementary Record of Occupational Injuries and Illnesses

EMPLOYER

1. Name _____
2. Mail address _____
   (No. and street) (City or town) (State)
3. Location, if different from mail address _____

INJURED OR ILL EMPLOYEE

4. Name _____ Social Security No. _____
   (First name) (Middle name) (Last name)
5. Home address _____
   (No. and street) (City or town) (State)
6. Age _____ 7. Sex: Male_____ Female_____ (Check one)
8. Occupation _____
   (Enter regular job title, *not* the specific activity he was performing at time of injury.)
9. Department _____
   (Enter name of department or division in which the injured person is regularly employed, even though he may have been temporarily working in another department at the time of injury.)

THE ACCIDENT OR EXPOSURE TO OCCUPATIONAL ILLNESS

10. Place of accident or exposure _____
    (No. and street) (City or town) (State)
    If accident or exposure occurred on employer's premises, give address of plant or establishment in which it occurred. Do not indicate department or division within the plant or establishment. If accident occurred outside employer's premises at an identifiable address, give that address. If it occurred on a public highway or at any other place which cannot be identified by number and street, please provide place references locating the place of injury as accurately as possible.
11. Was place of accident or exposure on employer's premises? _____ (Yes or No)
12. What was the employee doing when injured? _____
    (Be specific. If he was using tools or equipment or handling material, name them and tell what he was doing with them.)
13. How did the accident occur? _____
    (Describe fully the events which resulted in the injury or occupational illness. Tell what happened and how it happened. Name any objects or substances involved and tell how they were involved. Give full details on all factors which led or contributed to the accident. Use separate sheet for additional space.)

OCCUPATIONAL INJURY OR OCCUPATIONAL ILLNESS

14. Describe the injury or illness in detail and indicate the part of body affected. _____
    (e.g.: amputation of right index finger at second joint; fracture of ribs; lead poisoning; dermatitis of left hand, etc.)
15. Name the object or substance which directly injured the employee. (For example, the machine or thing he struck against or which struck him; the vapor or poison he inhaled or swallowed; the chemical or radiation which irritated his skin; or in cases of strains, hernias, etc., the thing he was lifting, pulling, etc.)
16. Date of injury or initial diagnosis of occupational illness _____
    (Date)
17. Did employee die? _____ (Yes or No)

OTHER

18. Name and address of physician _____
19. If hospitalized, name and address of hospital _____

Date of report _____ Prepared by _____
Official position _____

SUPPLEMENTARY RECORD OF OCCUPATIONAL INJURIES AND ILLNESSES

To supplement the Log and Summary of Occupational Injuries and Illnesses (OSHA No. 200), each establishment must maintain a record of each recordable occupational injury or illness. Worker's compensation, insurance, or other reports are acceptable as records if they contain all facts listed below or are supplemented to do so. If no suitable report is made for other purposes, this form (OSHA No. 101) may be used or the necessary facts can be listed on a separate plain sheet of paper. These records must also be available in the establishment without delay and at reasonable times for examination by representatives of the Department of Labor and the Department of Health, Education and Welfare, and States accorded jurisdiction under the Act. The records must be maintained for a period of not less than five years following the end of the calendar year to which they relate.

Such records must contain at least the following facts:

1) *About the employer*—name, mail address, and location if different from mail address.

2) *About the injured or ill employee*—name, social security number, home address, age, sex, occupation, and department.

3) *About the accident or exposure to occupational illness*—place of accident or exposure, whether it was on employer's premises, what the employee was doing when injured, and how the accident occurred.

4) *About the occupational injury or illness*—description of the injury or illness, including part of body affected; name of the object or substance which directly injured the employee; and date of injury or diagnosis of illness.

5) *Other*—name and address of physician; if hospitalized, name and address of hospital; date of report; and name and position of person preparing the report.

SEE *DEFINITIONS* ON THE BACK OF OSHA FORM 200.

JACOBS ENGINEERING GROUP INC.
AUTO ACCIDENT REPORT

Date of Accident _____ Time of Accident _____
Location of Accident _____

Driver of Company Vehicle
Name _____ Date of Birth _____
Address _____
Home Phone No. _____ Driver's License No. _____
License Number _____
Serial Number of Vehicle _____
Name of Other Passengers in Vehicle _____
Equipment Number _____

Driver of Other Vehicle
Name of Driver _____
Home Address of Driver _____
Phone Number Home _____ Work _____
Driver's License Number (Including State) _____
Employer _____
Owner of Vehicle _____
Serial Number of Vehicle _____
Make and Model of Car _____
Relation of Driver to Owner of Vehicle _____
Insurance Company of Owner _____
Insurance Company of Driver & Policy Number _____

Description of Accident - _____

Description of Damage to Vehicles
Company Vehicle _____

Other Vehicle _____

Place Where Damaged Vehicles Can Be Seen _____

Injuries (Explain) _____

Name of Law Enforcement Body Investigating Accident _____
Name, Address & Phone No. of Witnesses _____

Signature _____ Date _____

Job Name: _____ Job Number: _____

AUTOMOBILE ACCIDENT OR LOSS NOTICE

ESIS, Inc.
a CIGNA company

CIGNA

CONTRACT #	NAME OR COMPANY	FILE NO. (ESIS/INA USE ONLY)

LOCATION CODES			
1	2	3	4

(1) COMPANY

NAME | PHONE

ADDRESS

(2) TIME & PLACE

DATE & TIME OF LOSS OR ACCIDENT ☐ A.M. ☐ P.M. | LOCATION

(3) AUTO USED OR OCCUPIED BY CLIENT

MUST GIVE DRIVER'S AGE

YEAR	MAKE	MODEL	SERIAL NUMBER	MOTOR NUMBER	LICENSE NO., YEAR & STATE

NAME OF OWNER | ADDRESS | ☐ HOME ☐ BUS. PHONE

NAME OF DRIVER | ADDRESS | ☐ HOME ☐ BUS. PHONE

RELATION TO OWNER (EMPLOYEE, ETC.) | WAS CAR USED WITH OWNER'S PERMISSION? | OTHER INSURANCE ☐ YES ☐ NO

FOR WHAT PURPOSE WAS AUTO BEING USED AT TIME OF ACCIDENT

WHERE MAY AUTO BE SEEN (ADDRESS)? | ESTIMATED COST OF REPAIRS

IF THEFT, SPECIFY PROPERTY STOLEN. IF COLLISION OR COMPREHENSIVE, SPECIFY DAMAMGE

DATE, LOCATION & BADGE NO. OR NAME OF POLICE AUTHORITY TO WHOM ACCIDENT WAS REPORTED

(4) DAMAGE TO PROPERTY OF OTHERS

Use Additional Sheet If Necessary

OWNER | ADDRESS | ☐ HOME ☐ BUS. PHONE

OTHER DRIVER — SAME AS ABOVE ☐ | ADDRESS | OPERATOR LICENSE # | ☐ HOME ☐ BUS. PHONE

LIST DAMAGE. IF AUTO, MAKE YEAR, LICENSE NUMBER, YEAR & STATE | ESTIMATED COST OF REPAIRS

WAS OTHER CAR INSURED? ☐ YES ☐ NO | NAME OF COMPANY & POLICY NUMBER

(5) PERSONS INJURED

NAME	ADDRESS	PHONE	AGE	PASSENGER IN: CLIENT CAR	PASSENGER IN: OTHER CAR		EXTENT OF INJURIES

"It is unlawful to

For your protection California law requires the following to appear on this form. Section 556 of the Insurance Code reads as follows

(a) Present or cause to be presented any false or fraudulent claim for the payment of a loss under a contract of insurance

(b) Prepare, make, or subscribe any writing, with intent to present or use the same or to allow it to be presented or used in support of any such claim

Every person who violates any provision of this section is punishable by imprisonment in the State prison not exceeding three years, or by fine not exceeding one thousand dollars or by both.

SEE REVERSE SIDE FOR ACCIDENT DESCRIPTION AND OTHER INFORMATION

DATE

SIGNATURE OF CLIENT OR DRIVER

2.4 VEHICLE ACCIDENTS

2.4.1 Reporting

- An Auto Accident Form (Appendix 2-7) shall be kept in all Company vehicles utilized for offsite service.

- The form shall be completed by the driver of the vehicle in conjunction with his Supervisor and the Project Superintendent and forwarded within 24 hours after an accident to the Corporate Safety Department.

2.4.2 Requirements

- The report shall be filed when a Company vehicle is involved in <u>any</u> type of accident.

- The form shall also be used in filing reports of accidents involving equipment vehicles (onsite or offsite) such as cherry pickers, backhoes, trucks, cars, etc.

2.4.3 Distribution

- The report shall be distributed as follows:

  - Equipment Yard - 1 Copy
  - Site File - 1 Copy
  - Corporate Insurance - Original
  - Corporate Safety Department - 1 Copy

8.6 CONFINED SPACE ENTRY

8.6.1 Purpose

The purpose of this section is to ensure the safety and health of employees who enter or work in any type of enclosed space such as tanks, pipes, pits, vaults, or similar confined spaces where an oxygen deficient or gaseous atmosphere may exist or such a space where emergency egress would be restricted.

8.6.2 Scope

This procedure applies to all personnel who may be required to enter tanks and other enclosed spaces as defined.

8.6.3 Description

Personnel are at times required to enter enclosed spaces, hereafter called vessels, to clean, inspect, repair, and perform other duties associated with the equipment or the process of various testing activities. Enclosed spaces which are potentially hazardous include but are not limited to:

- Enclosures with limited access openings for personnel such as closed storage tanks and process vessels
- Tanks, pits, tubs, vaults, vessels, or other confined spaces
- Confined spaces such as ventilation or exhaust ducts, sewers, underground utility tunnels, pipelines, or piping of any type.

8.6.4 Hazards

- Toxic vapors in unhealthy or fatal concentrations may result from residue of last material in tank by gradual release from sludge or scale, be introduced by leakage from interconnected systems, or be introduced by use of cleaning solvents, welding, cutting, etc.
- Flammable gases or dust have the potential of fire or explosion.
- Lack of oxygen, causing asphyxiation, may result from chemicals absorbing or replacing oxygen in the tank or from inert gas used to exclude oxygen from a specific area of work. Air in clean tanks closed for an extended period may become deficient in oxygen because of oxidation of the metal of the tank. Improper or inadequate ventilation during tank work may also result in a lack of oxygen.
- Electric shock may result from portable lights, tools, or associated electrical equipment.

- Injury may result from mechanical equipment which may be defective or incorrectly locked out.
- Difficulty may be encountered in removing workers who are seriously injured or lose consciousness.
- Injury may result from direct contact with corrosives or dermatitis producing chemicals.
- Physical hazards such as slipping, falling, or falling objects may exist.

8.6.5 General-Personal Protective & Respiratory Equipment

Supervision and all personnel who may be required to enter vessels and other enclosed spaces shall review this instruction to ensure compliance with all applicable paragraphs.

- Prior to entry into a confined space, all personnel must complete the Respiratory Protection Program.
- Personnel with respiratory problems as determined by a physician shall not be permitted in tanks.
- All personal protective apparel and respiratory equipment shall be worn when entering any hazardous enclosure as required.
- All personal protective apparel and respiratory equipment will be maintained in good condition preferably stored in ventilated cabinets and cleaned or sanitized according to good house-keeping and hygiene standards.
- Supervision over the area in which vessels to be entered are located and Supervision responsible for other work conducted in such areas shall coordinate and regulate operations of their organizations in a manner which reduce hazards to personnel entering such vessels.
- The Corporate Safety Department shall be consulted by Supervisors contemplating entry of personnel into vessels. No deviations from the safety requirements specified in these instructions will be permitted without prior approval from the Corporate Safety Department.

8.6.6 Procedures for Tank Entry

- Prior to personnel entering any confined space which falls within the description in the above scope, a Confined Space/Vessel Entry Permit (Appendix 8-6) must be properly executed by the Supervisor of the personnel entering the confined space and the Site Safety Superintendent, if applicable.

- When there is doubt as to whether or not a particular location is covered by the above scope, the Corporate Safety Department is to be consulted.

- The executed Confined Space/Vessel Entry Permit is valid only for one shift, and for the specified work, location, and time period indicated on the permit.

- A Rescue Plan must be developed and reviewed with all personnel entering the confined space and all standby personnel. The Rescue Plan should include:

  - An immediate call for assistance of back-up person(s).

  - Assist person(s) in the confined space by providing breathing air masks or assistance out of the confined space.

  - If unconscious, help out of confined space by using safety belt or harness.

  - As a last resort, don 30-minute air pack or air supplied respirator and remove person(s). Do not enter until back-up person is at the entrance of the confined space.

- All persons entering the confined space, standby personnel, and back-up personnel must review and sign the Confined Space/Vessel Entry Permit.

- The Confined Space/Vessel Entry Permit must be posted near the entry point of the confined space.

- A secondary method of exit should be considered during the planning stage, in order to execute a quick, safe exit, should an emergency situation arise during occupancy of the confined space.

- All persons entering a confined space should wear a safety belt or harness attached to a lifeline. The lifeline shall be securely fastened outside the confined space. A safety harness shall be used where the entrance is sufficiently restricted to prevent removal of a person equipped with a safety belt. Wristlets must also be considered with restricted access. In the event it is determined that use of such equipment attached to a person may pose an unnecessary hazard, another means of executing a rescue must be planned.

- If the confined space is equipped with a grounding cable, it must be meggered for a firm mechanical joint.

- If lighting and power requirements cannot be met by the use of battery lights and pneumatic equipment, reduced voltage at a maximum of 12 volts must be used. If plant air is used for pneumatic equipment, it must be verified that inert gases such as nitrogen cannot enter the plant air system. Higher voltages may be used only with a ground fault circuit interrupter (GFCI). The ground fault circuit interrupter, transformer and disconnects must be located outside of the confined space.

- All persons entering the confined space, standby personnel, and back-up personnel shall be instructed as to the hazards involved, the precautions to be taken, the use of protective and emergency equipment and the use of rescue equipment.

- At least one standby person must be at each point being used to enter the confined space. He must have a 30-minute air pack or air supplied respirator, a flashlight, and a Freon horn or some other reliable method for summoning additional assistance. The standby person's primary responsibility is to be attentive to the personnel inside the confined space. Each standby person must be trained in accordance with Section 8.6.12.

8.6.7 Safety Considerations

- In rare instances, because of the configuration of the confined space or large number of people involved, keeping safety lines attached may not be practical. In such cases, the safety belt or harness shall be worn and the lines shall be kept ready at the confined space exit point in the event of an emergency.

- Consideration shall be given to the need for five-minute escape air masks for personnel entering the confined space. A 30-minute air pack or air supplied respirator must be available at the entrance of the confined space in case rescue assistance is needed.

- An individual shall be designated as a back-up and shall have prime responsibility to be available for immediate assistance to the standby man. The back-up person and the standby man must have verbal communication at least once per hour.

- Sufficient manpower shall be available outside the confined space to effect rescue if it becomes necessary.

- Considerations shall be given for continuous monitoring for oxygen with an audio alarm monitoring system.

8.6.8 Isolation Requirements

- All energy sources such as pipelines, electrical services, agitators and any other services leading to the confined space must be physically disconnected, blanked off, valved off and locked, tagged and tried prior to personnel entering.

- Radioactive sources must be shielded or removed.

8.6.9 Environmental Requirements

- A review of the confined space and its previous contents must be made by the Client Representative, Safety Superintendents, and the Supervisor responsible for the work to ascertain that the necessary ventilation, protective clothing, respiratory equipment, emergency standby equipment, and fire prevention precautions have been specified and provided.

- If the confined space has previously been in use, cleaning and decontamination must be performed and tests performed to determine atmospheric and residual analysis prior to personnel entering.

- The confined space must be adequately ventilated by removal of manholes, vents, lines or installing an exhaust blower. Compressed air must not be blown into a confined space. Air supplied respiratory equipment is required when entering a confined space where there is any oxygen deficiency (less than 19.5%). All air movers used for ventilation must be properly grounded.

- Appropriate tests of the atmosphere shall be made before entering the confined space. In all cases an oxygen and explosive atmosphere test will be performed. The test results will be recorded on the Confined Space/Vessel Entry Permit by the person performing the test, who will initial the permit. The atmosphere inside the confined space must meet the following conditions:

  - Oxygen - 19.5% minimum

  - Flammable gases - 0% maximum or no kick on the explosimeter.

  - Toxic gases - 0% maximum or non-detectable.

  - Radioactivity - not to exceed state or Federal regulations.

- If work being performed inside the confined space could generate any toxic or flammable vapors or produce any oxygen deficient atmosphere, testing should be done continuously while work is being performed.

- If hazardous substances are found to exist in the confined space; prior to entry by personnel, a Pre-entry Meeting shall be held to apprise employees of the hazards and the safety and health plan that will be followed.

- A decontamination procedure shall be developed, communicated to employees and implemented before any employee or equipment may enter into confined spaces containing a hazardous substance or where exposure to hazardous substances exist.

8.6.10 Burning and Welding

- Burning and welding in confined spaces entails unusual hazards and a detailed analysis shall be made of each specific case to insure safe performance of the work.

- When burning, welding or heating operations are required in a confined space, either a mechanical method of ventilation, such as a blower, or local exhaust ventilation method, such as exhaust hood must be provided to ensure adequate ventilation. When sufficient ventilation cannot be obtained without blocking the means of access to the confined space, employees in the confined space shall be protected by air supplied respiratory equipment.

- When burning or welding is required in any confined space, the gas cylinders and welding machines shall be located outside. Hose connections shall be checked for leakage prior to entry into confined space. Remove all hoses from the confined space at the end of work, during lunch periods, breaks, or whenever all personnel leave the confined space.

- All surfaces coated with toxic preservatives or any residual materials from previous use must be removed for a distance of two feet from the point of burning or welding to prevent evolution of fumes.

- Vessels and/or tanks of laminated shell construction should be given special consideration for the possibility of trapped residuals from the previous contents.

8.6.11 Emergency Alarms

The Confined Space/Vessel Entry Permit will be automatically cancelled in the event that a major emergency alarm, fume release, area fire alarm, or plant emergency is sounded, with the exception of a test alarm. Personnel inside the confined space should exit and follow emergency procedures. When the all clear signal is sounded, the Confined Space/Vessel Entry Permit can be reinstated or reissued after atmospheric tests are retaken and noted on the permit.

8.6.12 Confined Space Standby Attendant Training

Prior to a person being designated as a Standby Attendant for confined space work, they must be trained on the following information. Documentation of training shall be maintained at the site on the "Confined Space Standby Attendant Training Form" (Appendix 8-12).

- A Standby Attendant shall not be used for any other duties while the confined space is occupied.

- A Standby Attendant should be required to wear a vest or some other identification to signify he/she is a Standby Attendant.

- Each Standby Attendant must be equipped with an air horn or some other means of communication to summon help in the event of an emergency. The communication device shall be used only in an emergency.

- All personnel inside the confined space must exit upon command of the Standby Attendant.

- The Standby Attendant is responsible for maintaining a sign-in/sign-out roster on all persons entering and exiting the confined space. The roster must be turned in to the Site Supervision at the end of each shift.

- The Standby Attendant will be provided with the same equipment as those entering into the confined space.

- A self-contained breathing apparatus may be required at the entrance of the confined space in order to execute a rescue.

- If an emergency occurs inside the confined space, the Standby Attendant will summon additional help, but will not enter until help has arrived and it is necessary to enter.

- A Standby Attendant will not leave his/her station for any reason while personnel are inside the confined space, or unless relieved by another Standby Attendant.

Each Standby Attendant must realize the importance of his duties.

APPENDIX 8-6

CONFINED SPACE/VESSEL ENTRY

PERMIT

NAME AND LOCATION OF CONFINED SPACE:
DESCRIPTION OF WORK TO BE PERFORMED:
CRAFT/GROUP TO ENTER:
DATE OF ENTRY: FROM:_____A.M P.M. TO:_____A.M. P.M.
PREVIOUS CONTENTS OF CONFINED SPACE:
ANY HAZARDOUS MATERIALS OR FUMES TO BE GENERATED BY WORK:

VESSEL OR SPACE PREPARATION REQUIREMENTS

	YES	NO	N/A	INITIAL SUPERVISION	SAFETY REPRESENTATIVE
DRAIN, FLUSH, CLEAN:					
LOCK, TAG AND TRY:					
DISCONNECT LINES:					
BLANK LINES:					
OPEN MANHOLES:					
FORCED VENTILATION:					
AGITATOR OUT OF SERVICE:					
RADIOACTIVE SOURCES REMOVED OR SHIELDED:					
GROUNDING CABLE MEGGERED:					
GFCI ON VOLTAGE > 12V:					
LIFE LINE AND HARNESS AVAILABLE FOR ENTRANCE:					
30-MIN. AIR PAK OR AIR SUPPLIED RESPIRATOR AVAILABLE AT ENTRANCE:					

ATMOSPHERIC ANALYSIS

	RESULTS	INITIAL PERSON TESTING
OXYGEN (O_2) 19.5% MIN.:		
CARBON MONOXIDE (C_O):		
CARBON DIOXIDE (CO_2):		
EXPLOSIBILITY:		
OTHER SPECIFY:		

PERSONS ENTERING:_____

STANDBY PERSON(S)_____

APPROVALS

_____

(SAFETY SUPERINTENDENT) (ELECTRICAL SUPERINTENDENT)

_____

APPENDIX 8-12

CONFINED SPACE ENTRY STANDBY ATTENDANT TRAINING FORM

I have received standby attendant training in accordance with the Confined Space Entry Procedure, Section 8.6.

Name (print)	Signature	SS Number	Date Trained

8.10 Excavations

8.10.1 Purpose

The purpose of this section is to ensure the safety and health of employees who are required to enter/work in excavations.

8.10.2 Scope

This procedure will apply to all Personnel and Subcontractors whose job function requires them to enter any excavation.

Excavation shall be defined as follows: Any man made cut, cavity, trench or depression in an earth surface formed by earth removal.

8.10.3 Competent Person Responsibilities

Competent person is defined as anyone capable of identifying existing and predictable hazards in the work environment and who has authority to correct such hazards.

The competent person must have a thorough knowledge of all requirements and aspects of excavation work.

It is the responsibility of each competent person who supervises employees performing such work as described above to:

- Train employees on the contents of this procedure and ensure it is clearly understood.
- Evaluate whether the excavation may also be considered a confined space.
- Perform documented daily inspections of excavations, the adjacent areas, and protective systems before the start of work each day and as necessary throughout the shift.
- Inspections shall be made after every rainstorm or other hazard increasing occurrence.
- Where evidence indicates a possible cave in, failure of protective system, hazard atmosphere or other hazardous conditions, employees shall be removed until the proper precautions have been taken.

8.10.4 General Requirements

- All employees shall be protected with personal protective equipment for the protection of head, eyes, respiratory organs, hands, feet, and other parts of the body as required.
- In many instances excavations are considered confined spaces (See Section 8.6). If this is the case, all parts of both the excavation and the confined space entry procedures must be followed.
- Physical barricades must be placed around all excavations.
- Employees outside of excavations and exposed to vehicular traffic shall be provided with and wear reflectorized or highly visible warning vests.
- No person shall be permitted under loads handled by lifting or digging equipment.
- No employees shall remain near a vehicle being loaded. Operators may remain in the enclosed cab of the vehicle.
- All excavating work must have the prior approval of the area supervisor.
- The proper permit must be issued before excavation work may be done.
- The possibility of flammable or toxic gases settling in low places of excavations must be assessed before entering excavations or doing hot work.

8.10.5 Specific Requirements

- Employees entering excavations five (5) feet or more in depth must be protected by an adequate protective system (as described in Section 8.10.13).
- Employees entering excavations less than five (5) feet in depth must be protected by an adequate protective system when a competent person determines the possibility of hazardous ground movement.
- Prior to opening an excavation, the estimated location of utility installations that may be encountered shall be determined.

Utility companies or owners shall be contacted to establish the location of the underground utility installations. The location and depth shall be marked indicating the type of service.

- While the excavation is open, underground installations shall be protected, supported or removed to safeguard employees.

- All surface objects that may present a hazard to employees by rolling or falling into an excavation shall be removed or supported.

- All excavations four (4) feet or more in depth require a safe means of egress.

8.10.6 Access and Egress

- A stairway, ladder, ramp or other safe means of egress shall be located in excavations that are four (4) feet or more in depth so as to require no more than 25 feet of lateral travel for employees.

- Ladders must extend 36 inches above the point of support at the top of the excavation.

- Structural ramps used solely by employees shall be designed by a competent person.

- Structural ramps used by equipment shall be designed by a competent person qualified in structural design and shall be constructed accordingly.

8.10.7 Hazardous Atmosphere

- Where oxygen deficiency (less than 19.5%) or a hazardous atmosphere exists or could exist, the atmosphere in the excavation shall be tested before employees enter excavations greater than four (4) feet in depth.

- Adequate precautions shall be taken to prevent employee exposure to oxygen deficiency or hazardous atmospheres. These precautions may include providing proper respiratory protection or ventilation.

- Periodic testing shall be conducted to ensure all potentially hazardous atmospheres remain safe.

- Emergency rescue equipment such as breathing apparatus and safety harness and lifeline shall be readily available where hazardous atmospheres exist or may be expected to develop. This equipment shall be attended by a qualified attendant.

- Employees entering bell-bottom pier holes or other similar deep and confined footing excavations shall wear a harness with a lifeline securely attached. The lifeline shall be individually attended at all times.

8.10.8 Water Accumulation

- Employees shall not work in excavations in which there is accumulated water, or which water is accumulating unless the proper precautions have been taken.

Precautions include support or shield systems, water removal to control the level, and use of a safety harness and lifeline. When used, water removal equipment must be monitored by a competent person.

8.10.9 Stability of Adjacent Structures

- Except in stable rock, excavation below the level or base of footing of any foundation or retaining wall shall not be permitted unless the wall is underpinned and all other precautions taken to ensure the stability of the adjacent walls and the safety of employees involved in the work.

- Shoring, bracing, or underpinning shall be inspected daily, or more often as conditions warrant by a competent person and the protection effectively maintained.

8.10.10 Protection of employees from loose rock or soil and equipment.

- Excavated or other material and equipment shall be kept at least two (2) feet from the edge of excavations or behind retaining devices sufficient to prevent material or equipment from falling or rolling into the excavation.

- If the operator of mobile equipment adjacent to or near the edge of an excavation does not have a clear view of the edge of the excavation, a warning system such as barricades, stop logs, or hand signals shall be used. If possible, the grade should be away from the excavation.

8.10.11 Fall Protection

- Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guard rails shall be provided.

- Adequate barricades providing physical protection shall be provided at all excavations. All wells, pits, shafts, etc., shall be barricaded or covered.

- Upon completion of operations, temporary wells, pits, shafts, etc. shall be promptly and adequately back filled.

8.10.12 Soil Classification

- Each soil and rock deposit shall be classified by a competent person as stable rock, type A, type B, or type C in accordance with the definitions set forth in 29 CFR 1926.652 (Appendix A).

- The classification shall be based on at least one visual and at least one manual analysis. Such analysis shall be conducted by a competent person using tests described in 29 CFR 1926.652 (Appendix A).

8.10.13 Protective Systems

- Sloping and Benching

Sloping and benching systems for excavations greater than 20 feet deep shall be designed by a Registered Professional Engineer.

For excavations 20 feet or less, one of the following options may be used:

Option 1 Excavations shall be sloped one and one half horizontal to one vertical (34 degrees measured from the horizontal) unless you use Option 2, 3, or 4. Slopes shall be excavated to form configurations in accordance with slopes shown for Type C Soil in Appedix B, Maximum Allowable Slopes.

Option 2 Slopes and configurations for sloping and benching systems shall be determined in accordance with Section 8.10.14, Soil Classification and Appendix B, Maximum Allowable Slopes.

Option 3 Designs of sloping and benching systems shall be in accordance with tabulated data and charts identifying parameters, limits of use, and explanatory information as necessary. This data must be in written form on the jobsite and bearing the seal of the approving Registered Professional Engineer.

When excessive loads from stored material or equipment, operating equipment or traffic are present, the competent person shall determine to what degree the slope must be reduced below the maximum allowable slope.

- *Support* and Shield Systems (Shoring)

For excavations greater than 20 feet deep, refer to Section 8.10.15, Timber Shoring in Trenches.

For support and shield systems in excavations 20 feet or less in depth, one of the following options may be used.

Option 1 Designs for timber shoring in trenches shall be determined using Tables C 1.3 or C 2.3 (Appendix C) for soil type C. Designs for aluminum hydraulic shoring shall be in accordance with manufacturers tabulated data, or 29 CFR 1910.652 (Appendix D).

Option 2 Designs for timber shoring in trenches shall be determined according to Section 8.10.13, Soil Classification and Section 8.10.14, Timber Shoring in Trenches.

Option 3 Use of pre-fabbed support systems, such as aluminum hydraulic shoring, or other protective systems drawn from manufacturers data must be used in accordance with all specifications and limitations issued by the manufacturer.

Option 4 Designs of support, shield, or other protective systems must be in accordance with tabulated data and bear the seal of the approving Registered Professional Engineer.

- Materials and Equipment

  Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function. Manufactured materials and equipment shall be used in a manner that is consistent with the recommendations of the manufacturer. Damaged material or equipment shall be removed from use.

- General Requirements

  Members of support systems shall be securely connected together to prevent sliding, falling, kick outs or other failure.

Support systems shall be installed and removed in a manner that protects employees from cave ins, collapses, or being struck by support members. Removal shall begin at and progress from the bottom of the excavation. Members shall be released slowly so as to note any changes in the stability of the structure or excavation.

Components of pre-fabbed systems must be supplied with the manufacturers seal or identification markings, these markings must remain legible.

Excavations of material no greater than two (2) feet below the bottom of the support or shield systems is permitted if the system is designed to resist the forces of the full depth.

Employees shall not be allowed in shields when shields are being installed, removed, or moved.

8.10.14 Timber Shoring for Trenches (Tables C)

- Timber shoring may be provided as a means of protection from cave ins in excavations that do not exceed 20 feet.

- Timber shoring for excavations greater than 20 feet deep must be designed by a Registered Professional Engineer.

- In order to use this section, the soil type or types in which the excavation is made must first be determined using Section 8.10.14, Soil Classification.

- There are six tables, two for each soil type (Appendix C). Minimum sizes of shoring members are specified for each soil type. Using the appropriate table, the selection of the size and spacing of members is made. The selection is based on the depth and width of the trench and spacing of the cross braces.

Note: The members specified in the table are not considered adequate when:

1. Stored material adjacent to the excavation exceeds the load imposed by a two foot soil surcharge.

2. When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

3. When vertical loads imposed on cross braces exceeds a 240 pound gravity load distributed on a one foot section of the center of the cross brace.

When any of the above conditions exist, an alternate timber shoring or protective system shall be used.

APPENDIX A - SOIL CLASSIFICATION

Appendix A to Subpart P

Soil Classification

(a) *Scope and application*—(1) *Scope.* This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

(2) *Application.* This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in § 1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic shoring is designed in accordance with appendix D. This Appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in § 1926.652(c), and the use of the data is predicated on the use of the soil classification system set forth in this appendix.

(b) *Definitions.* The definitions and examples given below are based on, in whole or in part, the following: American Society for Testing Materials (ASTM) Standards D653–85 and D2488: The Unified Soils Classification System. The U.S. Department of Agriculture (USDA) Textural Classification Scheme; and The National Bureau of Standards Report BSS–121.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Dry soil means soil that does not exhibit visible signs of moisture content.

Fissured means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

Soil classification system means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure.

Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Submerged soil means soil which is underwater or is free seeping.

Type A means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

(i) The soil is fissured; or

(ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or

(iii) The soil has been previously disturbed; or

(iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

(v) The material is subject to other factors that would require it to be classified as a less stable material.

Type B means:

(i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or

(ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.

(iii) Previously disturbed soils except those which would otherwise be classed as Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

(v) Dry rock that is not stable; or

(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C means:

(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or

(ii) Granular soils including gravel, sand, and loamy sand; or

(iii) Submerged soil or soil from which water is freely seeping; or

(iv) Submerged rock that is not stable, or

(v) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) *Requirements*—(1) *Classification of soil and rock deposits.* Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in paragraph (b) of this appendix.

(2) *Basis of classification.* The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses

shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

(3) *Visual and manual analyses.* The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.

(4) *Layered systems.* In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

(5) *Reclassification.* If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

(d) *Acceptable visual and manual tests.*—(1) *Visual tests.* Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

(i) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

(ii) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

(iii) Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

(iv) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

(v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

(vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

(vii) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

(2) *Manual tests.* Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

(i) *Plasticity.* Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as ⅛-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of ⅛-inch thread can be held on one end without tearing, the soil is cohesive.

(ii) *Dry strength.* If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

(iii) *Thumb penetration.* The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. (This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2488—"Standard Recommended Practice for Description of Soils (Visual—Manual Procedure).") Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) *Other strength tests.* Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane.

(v) *Drying test.* The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are indicated.

(B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as a unfissured cohesive material and the unconfined compressive strength should be determined.

(C) If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

Appendix B to Subpart P

Sloping and Benching

(a) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and benching protective systems is to be performed in accordance with the requirements set forth in § 1926.652(b)(2).

(b) *Definitions.*

Actual slope means the slope to which an excavation face is excavated.

Distress means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and raveling, i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V).

Short term exposure means a period of time less than or equal to 24 hours that an excavation is open.

(c) *Requirements*—(1) *Soil classification.* Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(2) *Maximum allowable slope.* The maximum allowable slope for a soil or rock deposit shall be determined from Table B-1 of this appendix.

(3) *Actual slope.* (i) The actual slope shall not be steeper than the maximum allowable slope.

(ii) The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least ½ horizontal to one vertical (½H:1V) less steep than the maximum allowable slope.

(iii) When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with § 1926.651(i).

(4) *Configurations.* Configurations of sloping and benching systems shall be in accordance with Figure B-1.

TABLE B-1
MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V) [1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [3]
STABLE ROCK	VERTICAL (90°)
TYPE A [2]	3/4:1 (53°)
TYPE B	1:1 (45°)
TYPE C	1 1/2:1 (34)

NOTES:

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

2. A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°)

3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a Registered Professional Engineer.

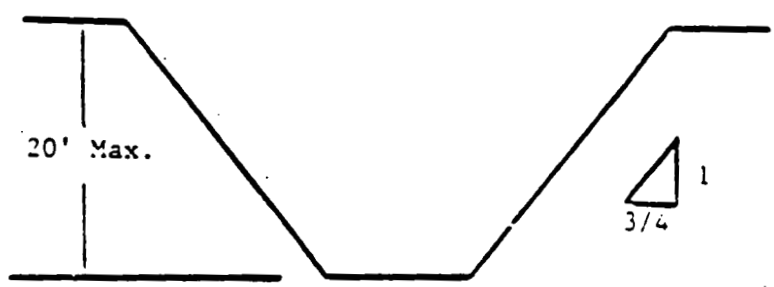
Figure B

Slope Configurations

(All slopes stated below are in the horizontal to vertical ratio)

B-1.1 Excavations made in Type A soil.

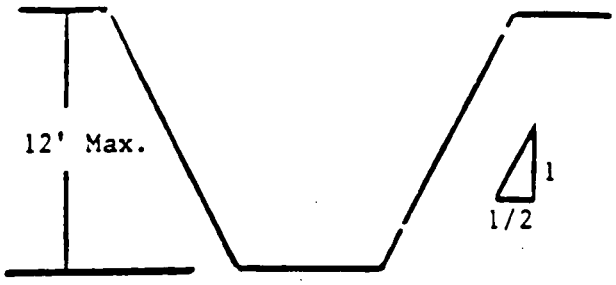
1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of 3/4:1.



Simple Slope—General

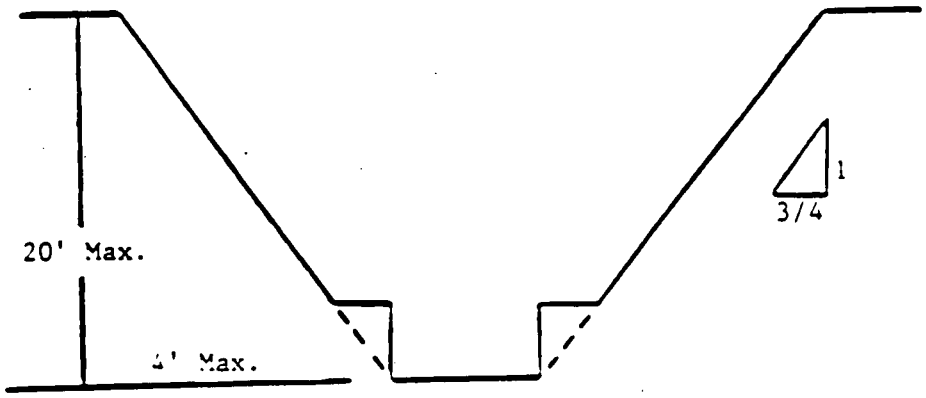
Simple Slope - General

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of 1/2:1.

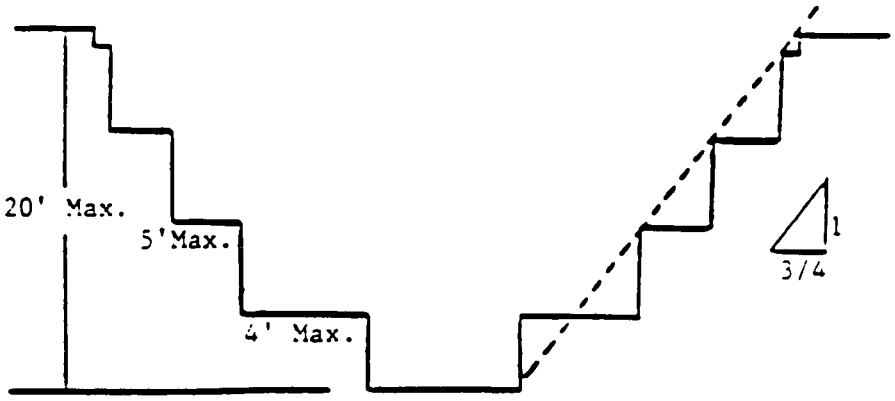


Simple Slope

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

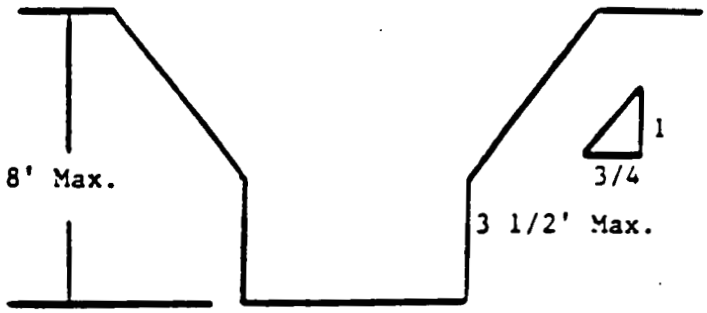


Single Bench



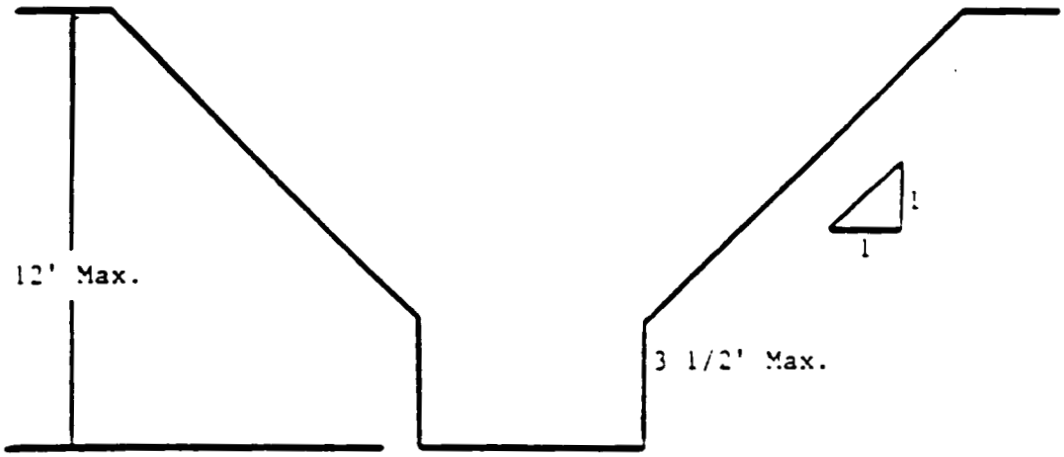
Multiple Bench

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3 1/2 feet.



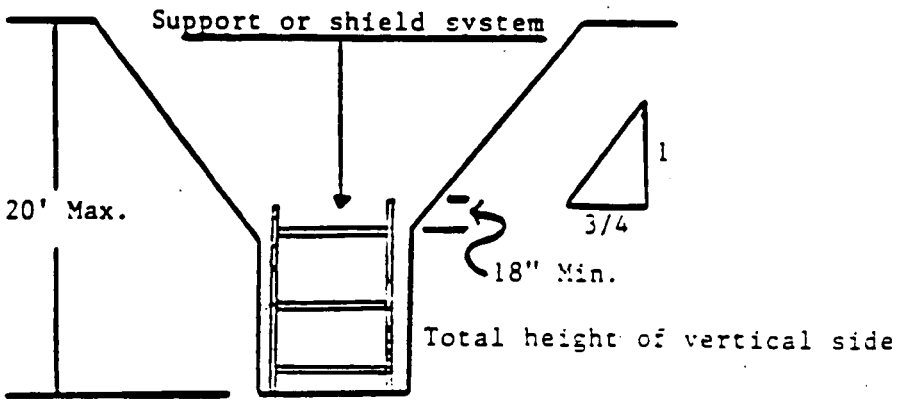
Unsupported Vertically Sided Lower Portion
Maximum 8-Feet in Depth

All excavations more than 8 feet but not more than 12 feet in depth which unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3 1/2 feet.



Unsupported Vertically Lower Portion
Maximum 12 Feet in Depth

All excavations 20-feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of 3/4:1. The support or shield system must extend at least 18-inches above the top of the vertical side.

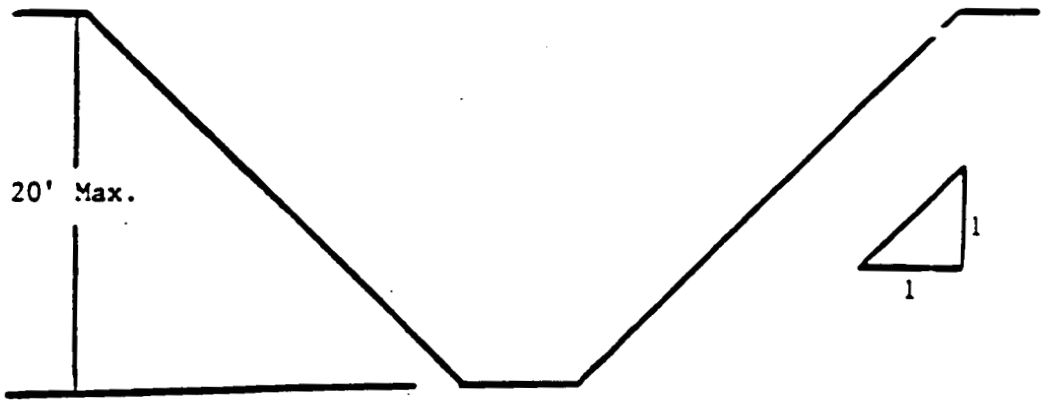


Supported or Shielded Vertically Sided Lower Portion

4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under §1926.652(b).

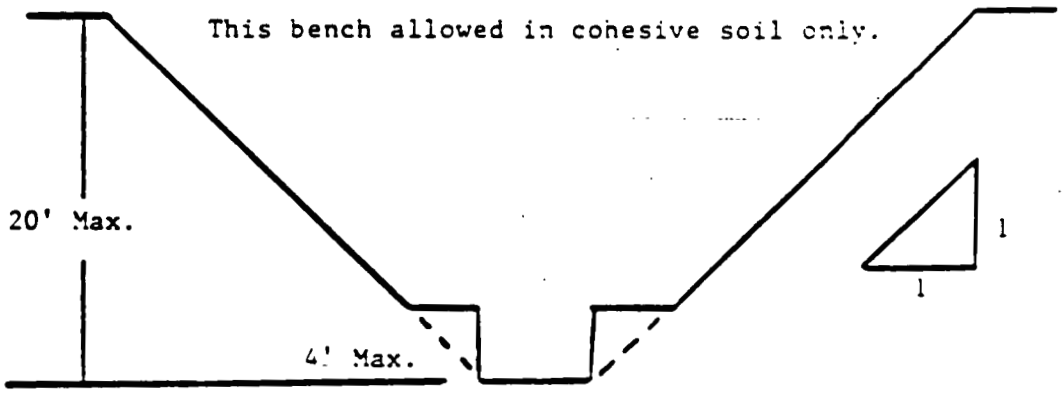
B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20-feet or less in depth shall have a maximum allowable slope of 1:1.

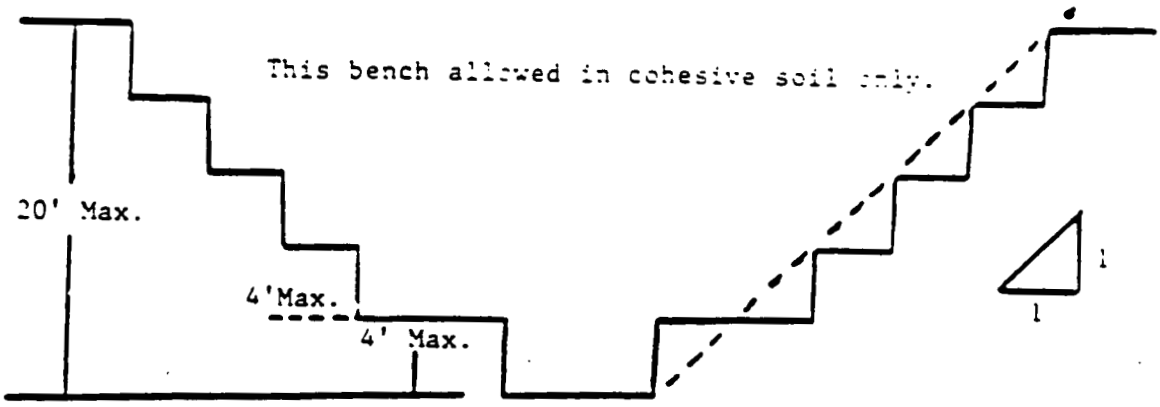


Simple Slope

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

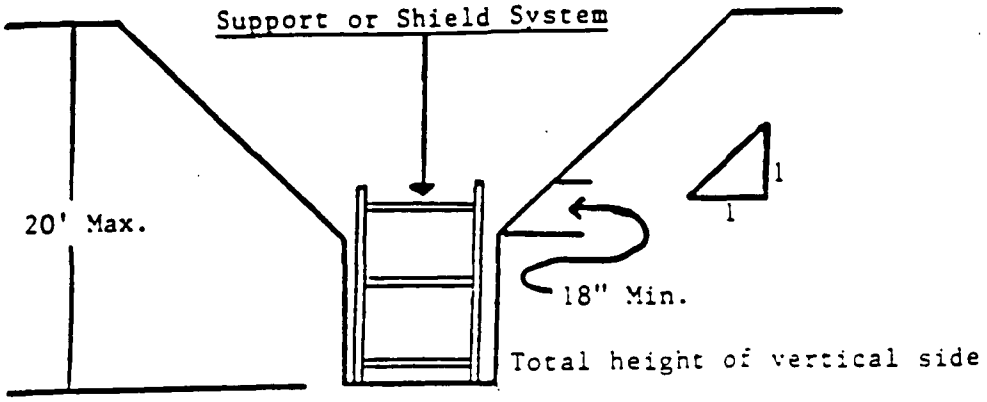


Single Bench



Multiple Bench

3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.

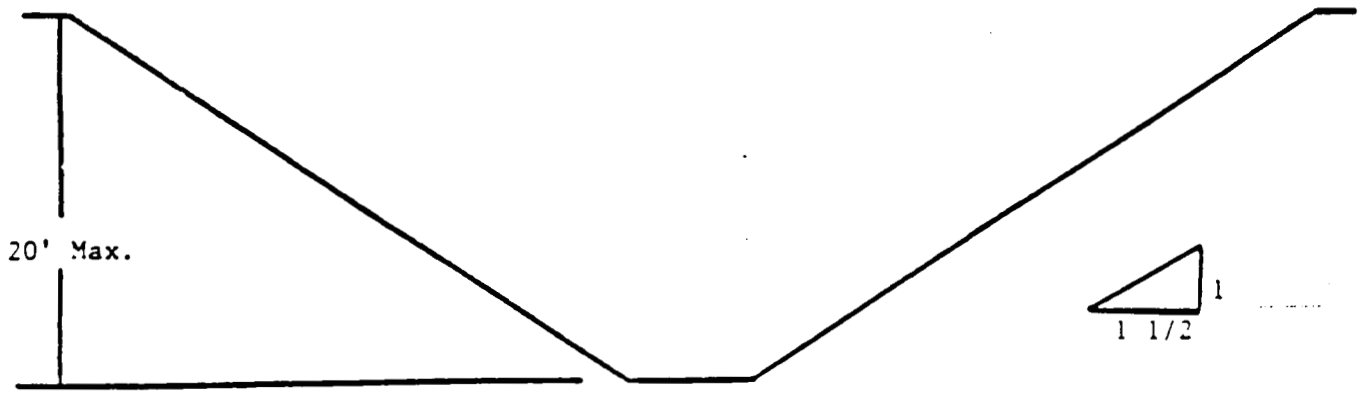


Vertically Sided Lower Portion

4. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

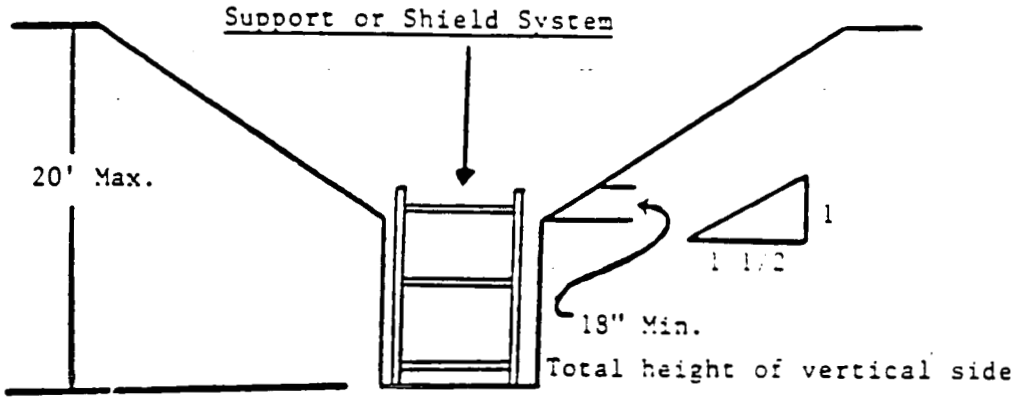
B-1.3 Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1 1/2:1.



Simple Slope

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1 1/2:1.

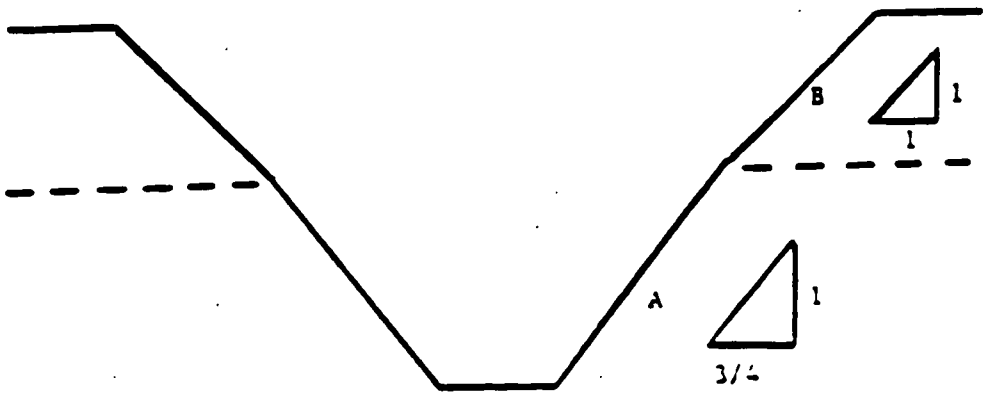


Vertical Sided Lower Portion

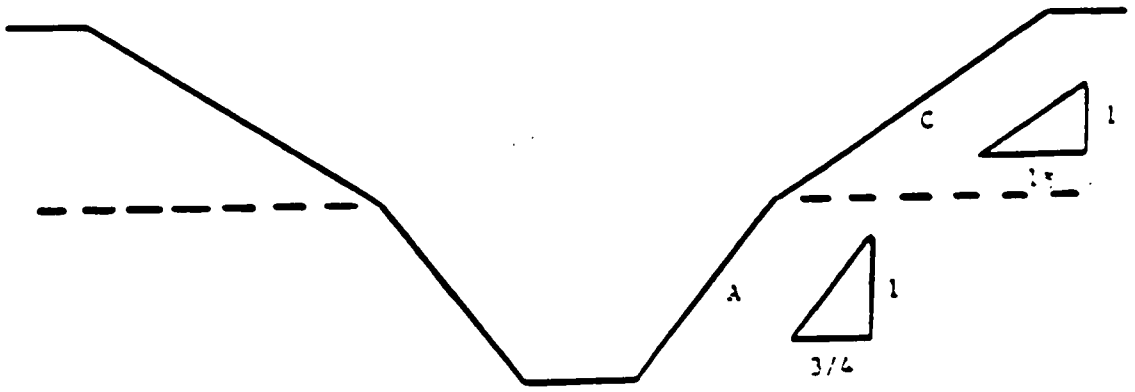
3. All other sloped excavations shall be in accordance with the other options permitted in §1926.652(b).

B-1.4 Excavations Made in Layered Soils

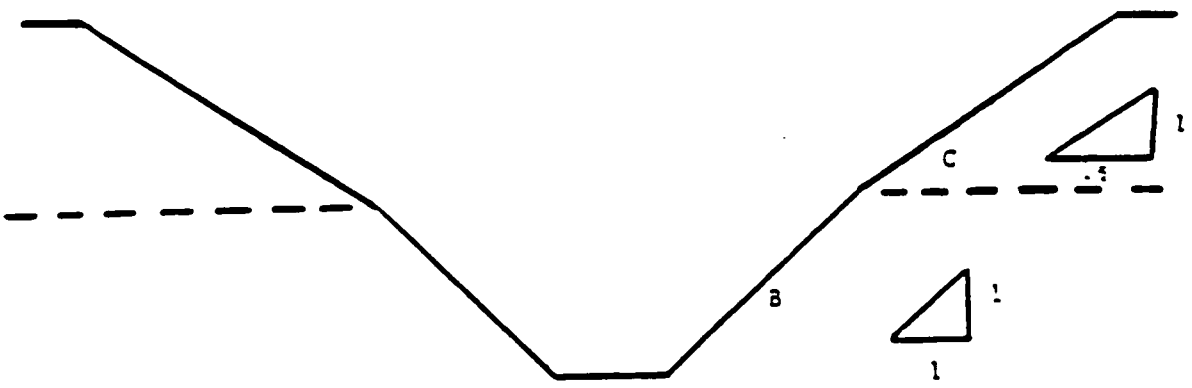
1. All excavations 20 feet or less in depth made in layered soils shall have a minimum allowable slope for each layer as set forth below.



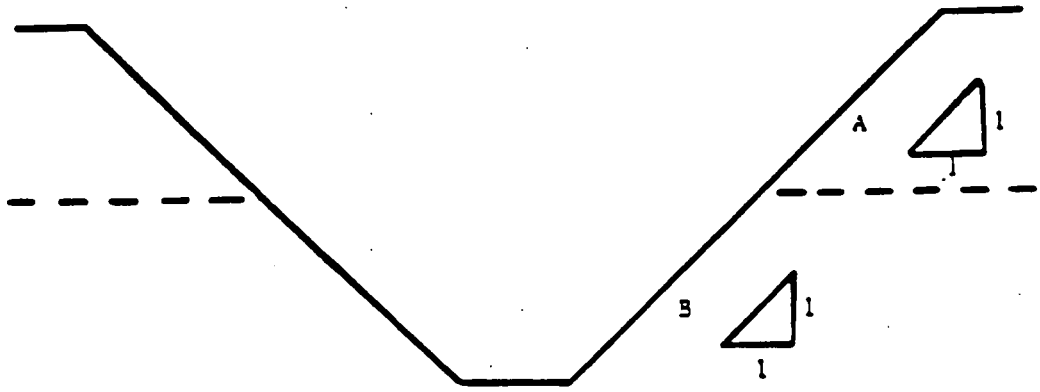
B OVER A



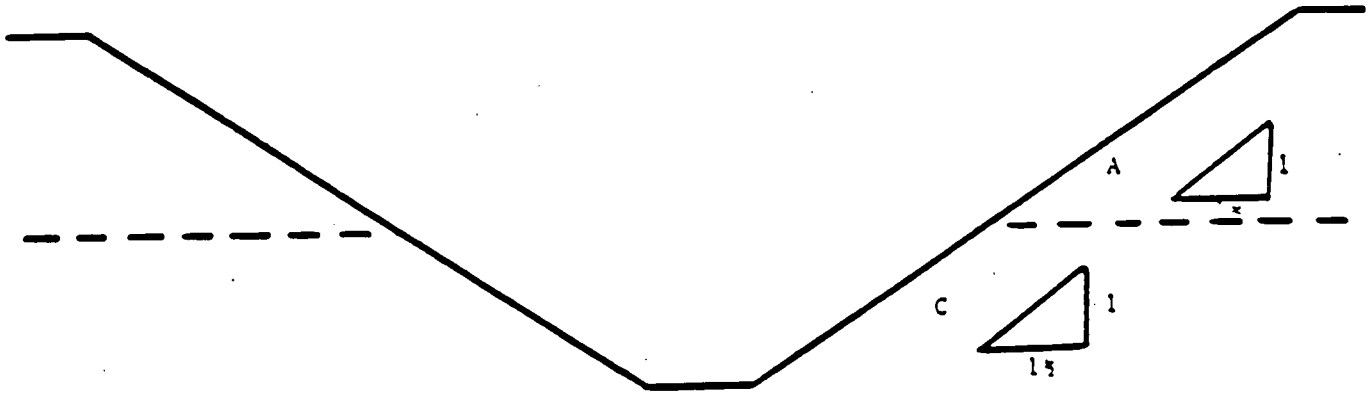
C OVER A



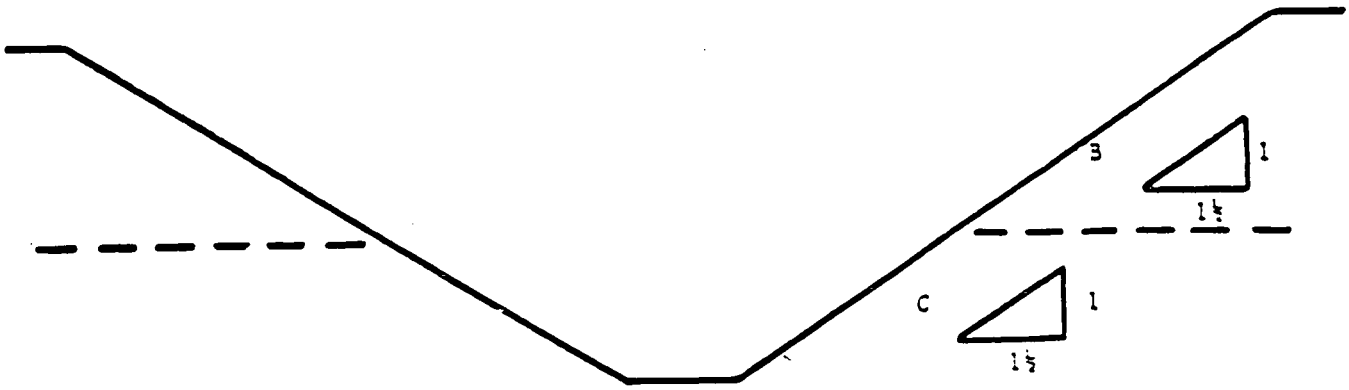
C OVER B



A OVER B



A OVER C



B OVER C

Appendix C to Subpart P

Timber Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with § 1926.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in § 1926.652(b) and § 1926.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil

classification method set forth in appendix A of subpart P of this part.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Table C-1.1, C-1.2 and C-1.3 and Tables C-2.1, C-2.2 and C-2.3 following paragraph (g) of the appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix, and on the tables themselves.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations regarding Tables C-1.1 through C-1.3 and Tables C-2.1 through C-2.3 are presented in paragraph (g) of this Appendix.

(d) *Basis and limitations of the data.*—(1) *Dimensions of timber members.* (i) The sizes of the timber members listed in Tables C-1.1 through C-1.3 are taken from the National Bureau of Standards (NBS) report, "Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations." In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables C-1.1 through C-1.3 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables C-2.1 through C-2.3, or have this choice under § 1926.652(c)(3), and are referred to The Corps of Engineers, The Bureau of Reclamation or data from other acceptable sources.

(2) *Limitation of application.* (i) It is not intended that the timber shoring specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with § 1926.652.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a two-foot soil surcharge. The term "adjacent" as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables.* The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are six tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the crossbraces, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(f) *Examples to Illustrate the Use of Tables C-1.1 through C-1.3.*

(1) *Example 1.*

A trench dug in Type A soil is 13 feet deep and five feet wide.

From *Table C-1.1*, for acceptable arrangements of timber can be used.

Arrangement #1

Space 4 × 4 crossbraces at six feet horizontally and four feet vertically.

Wales are not required.

Space 3 × 8 uprights at six feet horizontally. This arrangement is commonly called "skip shoring."

Arrangement #2

Space 4 × 6 crossbraces at eight feet horizontally and four feet vertically.

Space 6 × 8 wales at four feet vertically.

Space 2 × 6 uprights at four feet horizontally.

Arrangement #3

Space 6 × 6 crossbraces at 10 feet horizontally and four feet vertically.

Space 8 × 10 wales at four feet vertically.

Space 2 × 6 uprights at five feet horizontally.

Arrangement #4

Space 6 × 6 crossbraces at 12 feet horizontally and four feet vertically.

Space 10 × 10 wales at four feet vertically.

Spaces 3 × 8 uprights at six feet horizontally.

(2) *Example 2.*

A trench dug in Type B soil in 13 feet deep and five feet wide. From Table C-1.2 three acceptable arrangements of members are listed.

Arrangement #1

Space 6 × 6 crossbraces at six feet horizontally and five feet vertically.

Space 8 × 8 wales at five feet vertically.

Space 2 × 6 uprights at two feet horizontally.

Arrangement #2

Space 6 × 8 crossbraces at eight feet horizontally and five feet vertically.

Space 10 × 10 wales at five feet vertically.

Space 2 × 6 uprights at two feet horizontally.

Arrangement #3

Space 6 × 8 crossbraces at 10 feet horizontally and five feet vertically.

Space 10 × 12 wales at five feet vertically.

Space 2 × 6 uprights at two feet vertically.

(3) *Example 3.*

A trench dug in Type C soil is 13 feet deep and five feet wide.

From Table C-1.3 two acceptable arrangements of members can be used.

Arrangement #1

Space 8 × 8 crossbraces at six feet horizontally and five feet vertically.

Space 10 × 12 wales at five feet vertically.

Position 2 × 6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

Arrangement #2

Space 8 × 10 crossbraces at eight feet horizontally and five feet vertically.

Space 12 × 12 wales at five feet vertically.

Position 2 × 6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(4) *Example 4.*

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15 feet in depth is determined using Table C-1.3. Only one arrangement of members is provided.

Space 8 × 10 crossbraces at six feet horizontally and five feet vertically.

Space 12 × 12 wales at five feet vertically.

Use 3 × 6 tight sheeting.

Use of Tables C-2.1 through C-2.3 would follow the same procedures.

(g) *Notes for all Tables.*

1. Member sizes at spacings other than indicated are to be determined as specified in § 1926.652(c). "Design of Protective Systems."

2. When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least three inches thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

3. All spacing indicated is measured center to center.

4. Wales to be installed with greater dimension horizontal.

5. If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds two and one-half feet, uprights shall be firmly embedded or a mudsill shall be used. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench shall not exceed 30 inches. When mudsills are used, the vertical distance shall not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

6. Trench jacks may be used in lieu of or in combination with timber crossbraces.

7. Placement of crossbraces. When the vertical spacing of crossbraces is four feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is five feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

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TABLE C-1.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE A $P_a = 25 \times H + 72$ psf (2 ft Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS **													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				2X6	
	UP TO 8	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---					2X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			2X6		
	UP TO 12	4X6	4X6	6X6	6X6	6X6	4	8X8	4				2X6	
10 TO 15	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				3X8	
	UP TO 8	4X6	4X6	6X6	6X6	6X6	4	8X8	4		2X6			
	UP TO 10	6X6	6X6	6X6	6X8	6X8	4	8X10	4			2X6		
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	10X10	4				3X8	
15 TO 20	UP TO 6	6X6	6X6	6X6	6X8	6X8	4	6X8	4	3X6				
	UP TO 8	6X6	6X6	6X6	6X8	6X8	4	8X8	4	3X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X10	4	8X10	4	3X6				
	UP TO 12	8X8	8X8	8X8	8X8	8X10	4	10X10	4	3X6				
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B $P_a = 45 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3			
5 TO 10	UP TO 6	4X6	4X6	6X6	6X6	6X6	5	6X8	5			2X6			
	UP TO 8	6X6	6X6	6X6	6X8	6X8	5	8X10	5			2X6			
	UP TO 10	6X6	6X6	6X6	6X8	6X8	5	10X10	5			2X6			
	See Note 1														
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5		2X6				
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5		2X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X10	5	10X12	5		2X6				
	See Note 1														
15 TO 20	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	3X6					
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	3X6					
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6					
	See Note 1														
OVER 20	SEE NOTE 1														

* Mixed oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength [illegible] substituted for wood.

TABLE C-1.3

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C $P_a = 80 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**														
	CROSS BRACES									UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET) (See Note 2)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE					
5 TO 10	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	2X6					
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6					
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6					
	See Note 1														
10 TO 15	UP TO 6	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6					
	UP TO 8	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6					
	See Note 1														
	See Note 1														
15 TO 20	UP TO 6	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6					
	See Note 1														
	See Note 1														
	See Note 1														
OVER 20	SEE NOTE 1														

* Mixed Oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE A $P_a = 25 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X4	4X4	4X6	4	Not Req'd	Not Req'd				4X6	
	UP TO 8	4X4	4X4	4X4	4X6	4X6	4	Not Req'd	Not Req'd					4X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			4X6		
	UP TO 12	4X6	4X6	4X6	6X6	6X6	4	8X8	4				4X6	
10 TO 15	UP TO 6	4X4	4X4	4X4	6X6	6X6	4	Not Req'd	Not Req'd				4X10	
	UP TO 8	4X6	4X6	4X6	6X6	6X6	4	6X8	4		4X6			
	UP TO 10	6X6	6X6	6X6	6X6	6X6	4	8X8	4			4X8		
	UP TO 12	6X6	6X6	6X6	6X6	6X6	4	8X10	4		4X6		4X10	
15 TO 20	UP TO 6	6X6	6X6	6X6	6X6	6X6	4	6X8	4	3X6				
	UP TO 8	6X6	6X6	6X6	6X6	6X6	4	8X8	4	3X6	4X12			
	UP TO 10	6X6	6X6	6X6	6X6	6X8	4	8X10	4	3X6				
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	8X12	4	3X6	4X12			
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B P_a = 45 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3	4	6
5 TO 10	UP TO 6	4X6	4X6	4X6	6X6	6X6	5	6X8	5			3X12 4X8		4X12
	UP TO 8	4X6	4X6	6X6	6X6	6X6	5	8X8	5		3X8		4X8	
	UP TO 10	4X6	4X6	6X6	6X6	6X8	5	8X10	5			4X8		
	See Note 1													
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5	3X6	4X10			
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5	3X6	4X10			
	UP TO 10	6X8	6X8	8X8	8X8	8X8	5	10X12	5	3X6	4X10			
	See Note 1													
15 TO 20	UP TO 6	6X9	6X8	6X8	6X8	8X8	5	8X10	5	4X6				
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X12	5	4X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C $P_a = 80 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE					
5 TO 10	UP TO 6	6X6	6X6	6X6	6X6	8X8	5	8X8	5	3X6					
	UP TO 8	6X6	6X6	6X6	8X8	8X8	5	10X10	5	3X6					
	UP TO 10	6X6	6X6	8X8	8X8	8X8	5	10X12	5	3X6					
	See Note 1														
10 TO 15	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	10X10	5	4X6					
	UP TO 8	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6					
	See Note 1														
	See Note 1														
15 TO 20	UP TO 6	8X8	8X8	8X8	8X10	8X10	5	10X12	5	4X6					
	See Note 1														
	See Note 1														
	See Note 1														
OVER 20	SEE NOTE 1														

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

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Appendix D to Subpart P

Aluminum Hydraulic Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used when aluminum hydraulic shoring is provided as a method of protection against cave-ins in trenches that do not exceed 20 feet (6.1m) in depth. This appendix must be used when design of the aluminum hydraulic protective system cannot be performed in accordance with § 1926.652(c)(2).

(b) *Soil Classification.* In order to use data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of part 1926.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables D–1.1, D–1.2, D–1.3 and D–1.4. Each table presents the maximum vertical and horizontal spacings that may be used with various aluminum member sizes and various hydraulic cylinder sizes. Each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. Tables D–1.1 and D–1.2 are for vertical shores in Types A and B soil. Tables D–1.3 and D1.4 are for horizontal waler systems in Types B and C soil.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations (footnotes) regarding Table D–1.1 through D–1.4 are presented in paragraph (g) of this appendix.

(6) Figures, illustrating typical installations of hydraulic shoring, are included just prior to the Tables. The illustrations page is entitled "Aluminum Hydraulic Shoring; Typical Installations."

(d) *Basis and limitations of the data.*

(1) Vertical shore rails and horizontal wales are those that meet the Section Modulus requirements in the D–1 Tables. Aluminum material is 6061–T6 or material of equivalent strength and properties.

(2) Hydraulic cylinders specifications. (i) 2-inch cylinders shall be a minimum 2-inch inside diameter with a minimum safe working capacity of no less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe working capacity of not less than 30,000 pounds axial compressive load at extensions as recommended by product manufacturer.

(3) Limitation of application.

(i) It is not intended that the aluminum hydraulic specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be otherwise designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the Tables are not considered adequate. In this case, an alternative aluminum hydraulic shoring system or other type of protective system must be designed in accordance with § 1926.652.

(A) When vertical loads imposed on cross braces exceed a 100 Pound gravity load distributed on a one foot section of the center of the hydraulic cylinder.

(B) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(C) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables D–1.1, D–1.2, D–1.3 and D–1.4.* The members of the shoring system that are to be selected using this information are the hydraulic cylinders, and either the vertical shores or the horizontal wales. When a waler system is used the vertical timber sheeting to be used is also selected from these tables. The Tables D–1.1 and D–1.2 for vertical shores are used in Type A and B soils that do not require sheeting. Type B soils that may require sheeting, and Type C soils that always require sheeting are found in the horizontal wale Tables D–1.3 and D–1.4. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is made. The selection is based on the depth and width of the trench where the members are to be installed. In these tables the vertical spacing is held constant at four feet on center. The tables show the maximum horizontal spacing of cylinders allowed for each size of wale in the waler system tables, and in the vertical shore tables, the hydraulic cylinder horizontal spacing is the same as the vertical shore spacing.

(f) *Example to Illustrate the Use of the Tables:*

(1) Example 1:

A trench dug in Type A soil is 8 feet deep and 3 feet wide. From Table D–1.1: Find vertical shores and 2 inch diameter cylinders spaced 8 feet on center (o.c.) horizontally and 4 feet on center (o.c.) vertically. (See Figures 1 & 3 for typical installations.)

(2) Example 2:

A trench is dug in Type B soil that does not require sheeting, 13 feet deep and 5 feet wide. From Table D–1.2: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(3) A trench is dug in Type B soil that does not require sheeting, but does experience some minor raveling of the trench face. The trench is 18 feet deep and 9 feet wide. From Table D–1.2: Find vertical shores and 2 inch diameter cylinder (with special oversleeves as designated by footnote #2) spaced 5.5 feet o.c. horizontally and 4 feet o.c. vertically. [illegible] footnote (g)(7) to the D–1 Table) should be used behind the shores. (See Figures 2 & 3 for typical installations.)

(4) Example 4: A trench is dug in previously disturbed Type B soil, with characteristics of a Type C soil, and will require sheeting. The trench is 18 feet deep and 12 feet wide. 8 foot horizontal spacing between cylinders is desired for working space. From Table D–1.3: Find horizontal wale with a section modulus of 14.0 spaced at 4 feet o.c. vertically and 3 inch diameter cylinder spaced at 9 feet maximum o.c. horizontally. 3 × 12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(5) Example 5: A trench is dug in Type C soil, 9 feet deep and 4 feet wide. Horizontal cylinder spacing in excess of 6 feet is desired for working space. From Table D–1.4: Find horizontal wale with a section modulus of 7.0 and 2 inch diameter cylinders spaced at 6.5 feet o.c. horizontally. Or, find horizontal wale with a 14.0 section modulus and 3 inch diameter cylinder spaced at 10 feet o.c. horizontally. Both wales are spaced 4 feet o.c. vertically. 3 × 12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(g) *Footnotes, and general notes, for Tables D–1.1, D–1.2, D–1.3, and D–1.4.*

(1) For applications other than those listed in the tables, refer to § 1926.652(c)(2) for use of manufacturer's tabulated data. For trench depths in excess of 20 feet, refer to § 1926.652(c)(2) and § 1926.652(c)(3).

(2) 2 inch diameter cylinders, at this width, shall have structural steel tube (3.5 × 3.5 × 0.1875) oversleeves, or structural oversleeves of manufacturer's specification, extending the full, collapsed length.

(3) Hydraulic cylinders capacities. (i) 2 inch cylinders shall be a minimum 2-inch inside diameter with a safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe work capacity of not less than 30,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(4) All spacing indicated is measured center to center.

(5) Vertical shoring rails shall have a minimum section modulus of 0.40 inch.

(6) When vertical shores are used, there must be a minimum of three shores spaced equally, horizontally, in a group.

(7) Plywood shall be 1.125 in. thick softwood or 0.75 inch. thick, 14 ply, arctic white birch (Finland form). Please note that plywood is not intended as a structural member, but only for prevention of local raveling (sloughing of the trench face) between shores.

(8) See appendix C for timber specifications.

(9) Wales are calculated for simple span conditions.

(10) See appendix D, item (d), for basis and limitations of the data.

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ALUMINUM HYDRAULIC SHORING
TYPICAL INSTALLATIONS

FIGURE NO. 1
VERTICAL ALUMINUM HYDRAULIC SHORING (SPOT BRACING)

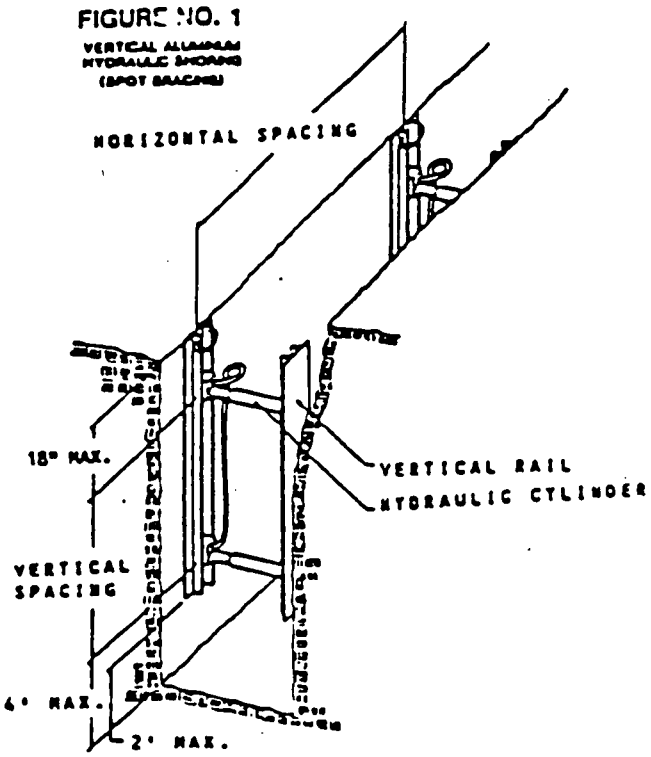


FIGURE NO. 2
VERTICAL ALUMINUM HYDRAULIC SHORING (WITH PLYWOOD)

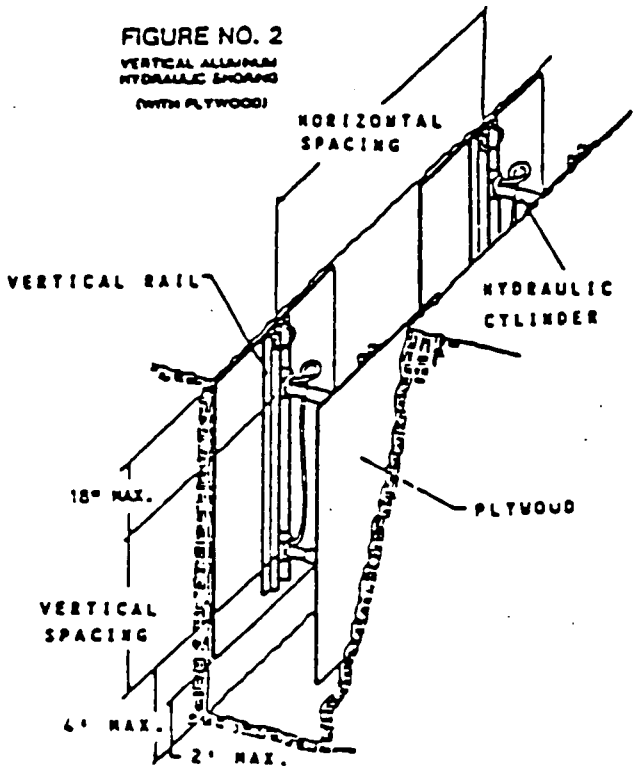


FIGURE NO. 3
VERTICAL ALUMINUM HYDRAULIC SHORING (STACKED)

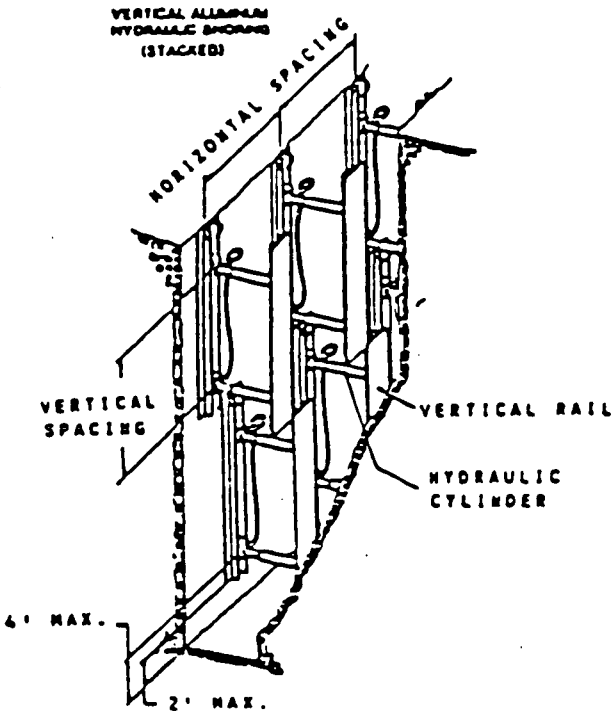


FIGURE NO. 4
ALUMINUM HYDRAULIC SHORING WALER SYSTEM (TYPICAL)

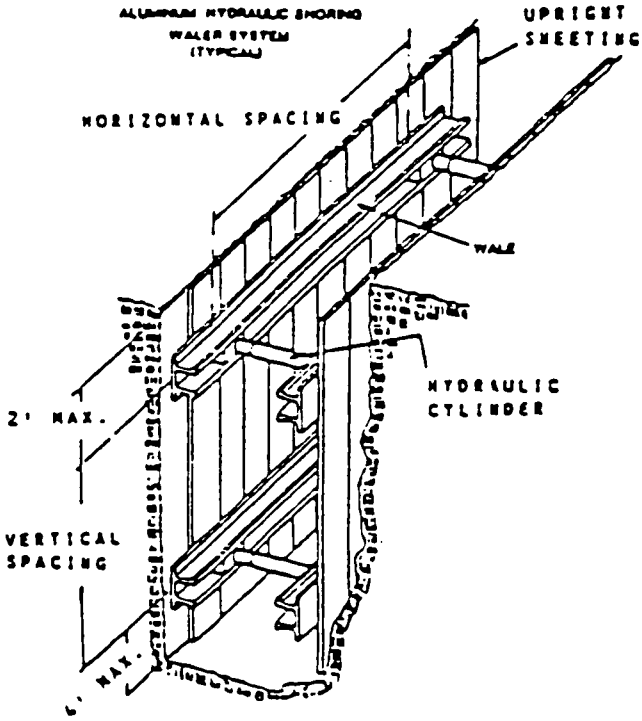


TABLE D - 1.1
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE A

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	8				
OVER 15 UP TO 20	7				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.2
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	6.5				
OVER 15 UP TO 20	5.5				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.3
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX. HORIZ. SPACING (ON CENTER)		
	VERTICAL SPACING (FEET)	• SECTION MODULUS (IN^3)	UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 5 UP TO 10	4	3.5	8.0	2 IN	8.0	2 IN NOTE(2)	8.0	3 IN	—	—	3x12
		7.0	9.0	2 IN	9.0	2 IN NOTE(2)	9.0	3 IN			
		14.0	12.0	3 IN	12.0	3 IN	12.0	3 IN			
OVER 10 UP TO 15	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	—	3x12	—
		7.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 15 UP TO 20	4	3.5	5.5	2 IN	5.5	2 IN NOTE(2)	5.5	3 IN	3x12	—	—
		7.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
		14.0	9.0	3 IN	9.0	3 IN	9.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Notes (1): See Appendix D, item (g) (1)

Notes (2): See Appendix D, Item (g) (2)

• Consult product manufacturer and/or qualified engineer for Modulus of available wales.

TABLE D - 1.4
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE C

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX. HORIZ SPACING (ON CENTER)		
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN³) •	UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 5 UP TO 10		3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN			
		7.0	6.5	2 IN	6.5	2 IN NOTE(2)	6.5	3 IN	3x12	—	—
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 10 UP TO 15	4	3.5	4.0	2 IN	4.0	2 IN NOTE(2)	4.0	3 IN			
		7.0	5.5	3 IN	5.5	3 IN	5.5	3 IN	3x12	—	—
		14.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
OVER 15 UP TO 20	4	3.5	3.5	2 IN	3.5	2 IN NOTE(2)	3.5	3 IN			
		7.0	5.0	3 IN	5.0	3 IN	5.0	3 IN	3x12	—	—
		14.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Notes (1): See Appendix D, item (g) (1)

Notes (2): See Appendix D, Item (g) (2)

• Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

Appendix E to Subpart P—Alternatives to Timber Shoring

Figure 1. Aluminum Hydraulic Shoring

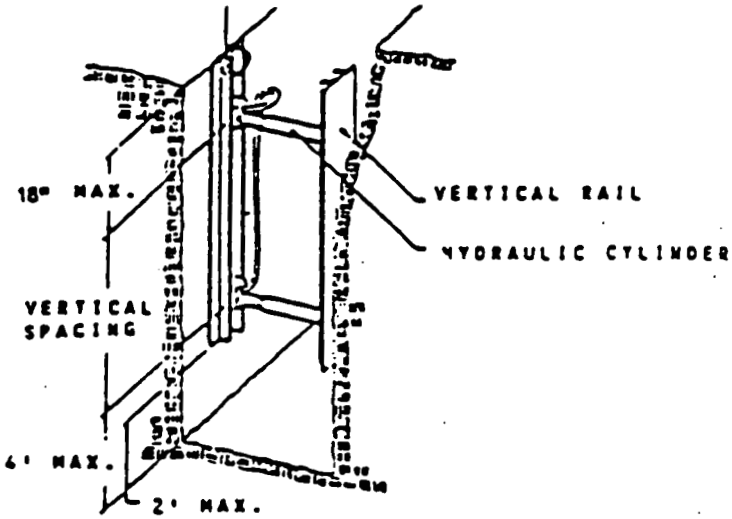
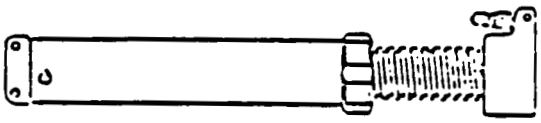
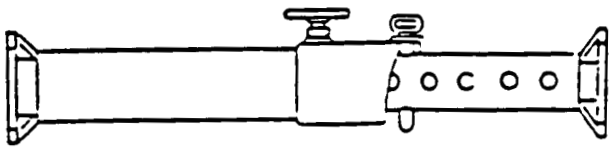


Figure 2. Pneumatic/hydraulic Shoring





BILLING CODE 4510-26-J

Figure 3. Trench Jacks (Screw Jacks)

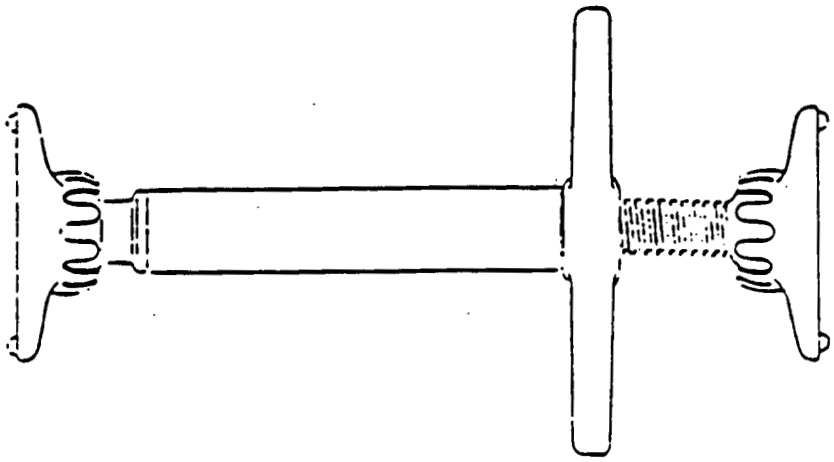
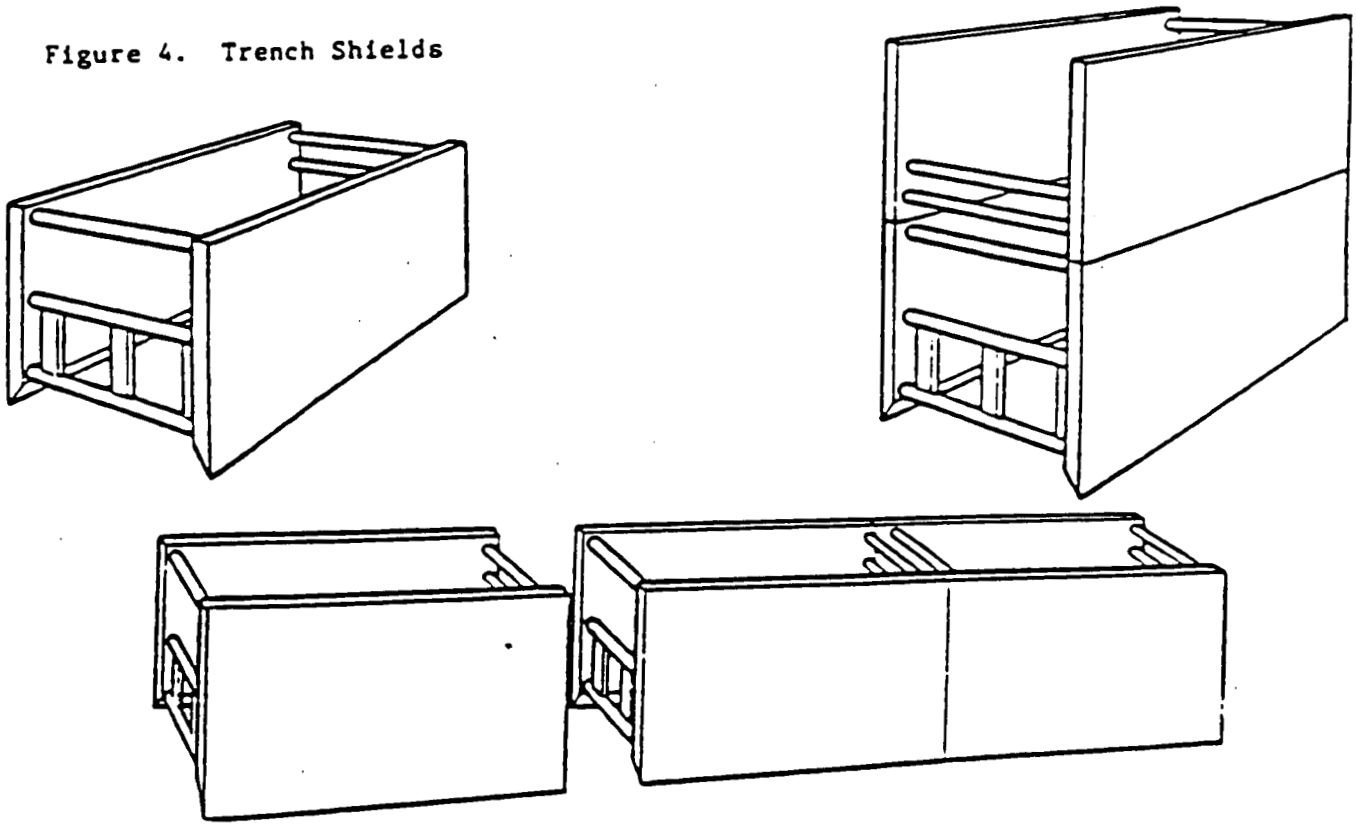


Figure 4. Trench Shields



BILLING CODE 4510-29-C

1.0 OBJECTIVE

This Radiological Operations Procedure (ROP) provides direction for the sampling and quantification of airborne particulate radioactivity in work areas by high volume air sampling.

2.0 SCOPE

This instruction provides for the following:

- material requirements;
- procedural definitions;
- sampling train assembly;
- operation;
- sample counting; and
- exposure analysis.

3.0 DEFINITIONS

3.1 Airborne Radioactivity Area - A designated area posted when airborne radioactive material concentrations greater than 1/10 of a derived air concentration (DAC) are likely to be present in accordance with U.S. Department of Energy (DOE) 5480.11.

3.2 Annual Limit on Intake (ALI) - The quantity of a single radionuclide that, if inhaled or ingested in one year, would irradiate a person to the limiting value for control of occupational exposure.

3.3 DAC - The concentration in air of a single radionuclide that, if inhaled in an average volume of air breathed by an individual in one year, would result in reaching an ALI for that radioactivity level for an occupational worker. DOE 5480.11 contains a list of DACs by radionuclide.

3.4 High Volume Sample - An air sample obtained through the use of an air sampling pump assembly capable of drawing air through an open-face 47-millimeter (mm)-diameter glass fiber filter at a flow rate of 20 to 150 liters per minute (lpm).

3.5 Minimum Detectable Activity (MDA) - The smallest quantity of radioactivity that a specific instrument is able to discern at a given confidence level. MDAs are instrument-specific.

3.6 Minimum Detectable Concentration (MDC) - The smallest concentration of radioactivity that can be detected at a given confidence level under specific sampling and counting. MDCs are method-specific.

3.7 Open-Faced Filter Holder - A device designed to hold and position a filter in the sampling location.

4.0 MATERIALS AND EQUIPMENT

4.1 Equipment

- high volume sampling pump;
- survey instrument(s);
- calibrated rotameter;
- 47-mm-diameter type A-E glass fiber filters;
- open-faced 47-mm filter holder;

- filter cutter;
- latex surgical gloves;
- Radioactive Particulate Sampling Log;
- airflow calibration labels;
- caution - radioactive material (CRM) labels;
- radioactive onsite shipping label; and
- material transfer - conditional release only.

4.2 Packaging and Miscellaneous Materials

- 1-gallon paint can;
- glassine envelopes;
- black indelible ink marking pen; and
- duct tape.

5.0 PREREQUISITES

- All measuring and test equipment will have a current calibration label.
- The Health and Safety Specialist In-Training (HSST) or Health and Safety Specialist (HSS) performing this procedure shall be trained in the use of the instructions provided by this procedure.

6.0 INSTRUCTIONS

6.1 Preliminary Activities

6.1.1 Visually check the airflow calibration label on the air sampler.

6.1.2 Perform a battery check if applicable.

6.1.3 Check the general condition of the equipment as follows:

- Check that flowmeter ball is free (tilt to check for movement).

- Verify that all parts required for sampling are present.
- Before each use, visually inspect sampler for damage. Areas to be checked include air sampler and sample filter assembly. If a sampler is damaged, or a defective sampler is found, attach an out-of-service tag and return the equipment for repair.

6.1.4 Evaluate Sampling Duration

The steps necessary to determine the required sampling duration based on work duration, MDC, and sampler flow rate, and the steps that must be completed to operate an assembled high volume sampling train are provided below:

Step 1:

Obtain the required MDC for the radionuclide of concern. This will be 10 percent of the DAC value listed in DOE 5480.11 or an MDC authorized by the Health and Safety Officer (HSO).

Step 2:

Determine the required sample volume to detect the MDC in accordance with the following equation:

$$V=\frac{2.71+3.39\,[Rb(26.67)]^{1/2}}{(MDC)\,(E)\,(4.44\times10^{10})\,(K)}$$

where:

Rb	=	background (blank) count rate
E	=	filter efficiency
V	=	total air volume (l)
K	=	calibration factor (counts per minute/disintegrations per minute [cpm/dpm])

NOTES: (1) The above equation assumes a 60-minute field blank count time and a 20-minute sample count time. (2) The background (blank) count rate (Rb) will be determined for each lot of glass fiber filters before use.

Step 3:

Determine the required minimum sampling duration based on the necessary volume (V from Step 2) and the projected flow rate according to the following equation:

$$D=\frac{V}{F}$$

where:

F = flow rate in liters per minute (lpm)
D = projected sampling duration in minutes
V = required volume (from Step 2) in liters

6.2 Assembly of the Air Sampling System

6.2.1 Load a 47-mm-diameter filter into the open-faced filter holder with the rough, irregular pattern of the filter facing outward.

6.2.2 Cover the outer face of the open-faced filter holder with duct tape to protect the filter from contamination. (Caution: do not allow tape to contact filter.)

6.2.3 Attach open-faced filter holder to air sampler. Do not operate air sampler until duct tape has been removed.

6.3 OPERATION

Step 1:

Remove duct tape from the filter holder.

Step 2:

Connect high volume sampler and sampling train to the rotameter. (This is only required if the sampler is not equipped with a calibrated flow measurement device.)

Step 3:

Turn sampler on and adjust to required flow rate.

Step 4:

Record flowmeter reading (Q_1) on the Dust, Fume, or Mist Sample Field Sheet.

Step 5:

When the required sampling duration has been obtained, record flowmeter reading (Q_2) on the Dust, Fume, or Mist Sample Field Sheet.

Step 6:

Turn the sampler off, and replace duct tape on filter cassette.

6.4 Air Sampling

6.4.1 Select location that is likely to provide a representative employee exposure based on time/location in the work area, degree of contamination, and type of work being performed.

6.4.2 Place the air sampler in a position approximately 1 meter above the ground/floor surface.

6.4.3 Record the following information on the Dust, Fume, or Mist Sample Field Sheet:

- sample identification (yy/mm/dd/start time);
- filter number;
- site/location;
- work activity description;
- personal protective equipment used;
- start time (date/time 24-hour notation);
- sample type;
- sampling instrument;
- sampler serial number;
- calibration due date; and
- workplace and weather conditions.

6.4.4 At the end of the sample period, take the following steps to determine sample volume and duration:

6.4.4.1 Record the stop time on the Dust, Fume, or Mist Sample Field Sheet.

6.4.4.2 Calculate the total sample time (T_t) in minutes.

6.4.4.3 Record the total sample time on the Radioactive Particulate Sampling Log.

6.4.4.4 Using a black indelible ink marking pen, record the sample identification information on a label and attach to the outside of the filter holder.

6.4.4.5 Take the filter to the counting location.

6.4.4.6 Calculate the average flow rate in lpm using the following formula:

$$Q_A = \frac{Q_1 + Q_2}{2}$$

where:

Q_A = average flow rate
Q_1 = presample flow rate x calibration factor
Q_2 = postsample flow rate x calibration factor

6.4.4.7 Record the average flow rate (lpm) on the Radioactive Particulate Sampling Log.

6.4.4.8 Calculate the total sample volume (V_T) by multiplying the average flow rate in lpm from Step 6.4.4.6 by the total sample time (T_T) from Step 6.4.4.2 as follows:

$$V_T = Q_A \times T_T$$

where:

V_T = total sample volume (l)
Q_A = average flow rate (lpm)
T_T = total sample time (min)

6.4.4.9 Record the total volume (V_T) on the Radioactive Particulate Sampling Log.

6.5 <u>Survey of Sample Media</u>

- Remove the duct tape covering the open-faced filter holder.

- Leaving the filter media in place in the holder, survey the filter with a Ludlum Model 12-1A using air proportional probe.
- Air sample filters surveyed at less than 5,000 cpm (10,000 dpm) may be counted immediately.
- Air sample filters surveyed at greater than 5,000 cpm (10,000 dpm) as measured with a Ludlum Model 12-1A and air proportional probe will be set aside. After 30 minutes, the filter will be resurveyed to determine short-lived activity contribution. If there is no significant reduction in activity level, report this to the HSS/HSO promptly.

6.6 Air Sample Counting

6.6.1 Using tweezers, remove the filter and cut to size (37-mm) for counting.

6.6.2 Using a calibrated and performance-tested smear counter, count the filter for 20 minutes in accordance with the requirements of ROP 10.03, Performance Check and Operation of Alpha Smear/Filter Counting Instrumentation. Allow a minimum of 30 minutes to elapse after sampling before making the first count (C_1).

6.6.3 Record the counting information on the Radioactive Particulate Sampling Log.

NOTE: If an immediate air concentration determination is desired, the result on Section 6.6.2 is considered long-lived (cpm_{LL}), and activity calculation starts with Step 2 of Section 6.6.7.

6.6.4 Perform and record a second count by repeating Sections 6.6.2 and 6.6.3.

6.6.5 Save the sample filter by placing it in a glassine envelope, and attach a properly completed sample label with sample identification.

6.6.6 If the second count was equal to or greater than the first count, or the sample filter has decayed for more than three hours, then the activity from the first count is considered long-lived (cpm_{LL}), and activity calculation starts with Step 2 of Section 6.6.7.

6.6.7 If the second count was less than the first count, then calculate the contribution from long-lived isotopes as follows:

Step 1:

Subtract the second count (C_2) from the first count (C_1). Then, divide the results above by 1-f (1-f is obtained from Appendix A). Finally, subtract the results from the first count.

The calculation is:

$$cpm_{LL} = C1 - \frac{(C_1 - C_2)}{(1-f)}$$

Step 2:

Divide the cpm_{LL} (obtained in Step 1) by the sample volume (V_T) obtained in Section 6.4.4.8 multiplied by 1,000.

The calculation is:

$$cpm/cm^3 = \frac{cpm_{LL}}{V_T(1) \times 1,000}$$

Note: cm^3 = cubic centimeters

Step 3:

Divide the result of Step 2 by 0.231 (the product of the counter efficiency of 0.33 and the self-absorption correction of 0.70 [0.33 x 0.70 = 0.231]) multiplied by 2.22 x 10^6 dpm/microcuries (μCi) and the ratio of the cut filter area to the uncut filter area.

The calculation is:

$$\mu Ci/cm^3 = \frac{cpm/cm^3}{(5.13 \times 10^5)\,(FR)}$$

Step 4:

Calculate the percent of the DAC by dividing the result of Step 3 by the DAC equivalent value for the isotope of concern and multiplying by 100.

The calculation is:

$$percent\ DAC = \frac{\mu Ci/cm^3}{(DAC\ equivalent)} \times 100$$

6.6.8 Record the sample results and all appropriate information on the Radioactive Particulate Sampling Log.

6.6.9 If the percent of the DAC calculated in Step 4 is equal to or greater than 10 percent, notify the HSS/HSO immediately and recount the filter after a four-hour period from the end of air sampling. Repeat this procedure after a 72-hour period if the DAC percentage remains equal to or greater than 10 percent.

7.0 PACKAGING AND TRANSPORTATION

7.1 Packaging of Filter Media for Transport

7.1.1 Place glassine envelopes containing the filter media in one or more plastic bags, as appropriate.

7.1.2 Cover the bag openings with plastic tape.

7.1.3 Attach a CRM label to each tape.

7.1.4 Place the plastic bag(s) in a 1-gallon paint can.

7.1.5 Securely cap can.

7.1.6 Complete and attach a radioactive onsite shipping label.

7.1.7 Complete and attach a material transfer - conditional release only tag in accordance with the requirements of Health and Safety Plan (HSP) 18.10.

7.2 Transportation of Filters

7.2.1 Packaged filter media will be transported in accordance with the Rocky Flats Plant (RFP) onsite transportation manual.

7.2.2 Filter media sent to an offsite laboratory for analysis will be packaged and shipped in accordance with the Department of Transportation (DOT) hazardous materials regulations.

8.0 REFERENCES

8.1 DOE 5480.11, Radiation Protection for Occupational Workers

8.2 NUREG-1400, Air Sampling in the Workplace

8.3 RFP Onsite Transportation Manual

8.4 HSP 18.10, Release of Property for Conditional and Unrestricted Use

8.5 ROP 10.03, Performance Check and Operation of Alpha Smear/Filter Counting Instrumentation

Prepared By: J B Baird

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Quality Assurance

Approved By: [signature]
Health and Safety Coordinator

APPENDIX A
Page 1 of 1

DECAY FACTOR TABLE

MINUTES BETWEEN COUNTS	DECAY FACTOR (f)	(1-f)
0	1.0	N/A
15	0.68	0.32
30	0.46	0.54
45	0.32	0.68
60	0.22	0.78
75	0.154	0.846
90	0.108	0.892
105	0.077	0.93
120	0.054	0.946
135	0.029	0.971
150	0.028	0.979
165	0.021	0.979
180	0.015	0.985

RADIOACTIVE PARTICULATE SAMPLING LOG

Sample ID: _____ Filter No.:_____ Sample Date: _____

Counting Instrument: Type/Model _____ Serial No. _____

Efficiency _____ Cal. Date _____ Counted By _____

Sample Duration = [Time Off - Time On]
= [_____(decimal hrs)- _____(decimal hrs)] x 60(min/hr) =_____(min)

Sample Volume = Average Flow Rate x Sample Duration x 1,000

= _____ (lpm) x _____ (min) x 1,000 = _____ (cm^3)

First Count:

	Date	Time	Count	Duration (min)	Count Rate (cpm)	Concentration ($\mu Ci/cm^3$)
Bkg						N/A
Sample						

Percent DAC:_____

Second Count:

	Date	Time	Count	Duration (min)	Count Rate (cpm)	Concentration ($\mu Ci/cm^3$)
Bkg						N/A
Sample						

Percent DAC:_____

Reviewed By:_____ Date:_____

Form: 10.2.2a

DUST, FUME, or MIST SAMPLE FIELD SHEET

Sample ID: ____________________ Date: ______________

Material of Interest in Dust: ________________________
Site: ____
Person Sampled: ____________________ SSN: ____________________
Job: ____________________ Work Location: ____________________
Sample Type: Personal__ Area__ Resp. Dust__ Total Dust __
Pump Type: ____________ Pump No.: ________ Flow Rate On/Off: ____/____(lpm)____

Calibration Due: ________ Filter No.: ________ Time On: ______ Time Off: __________

= =

Workplace Conditions:

Operations: Normal __ Not-Normal __ Explain ____________________
Respirator Use: Type ____________________ % of Time Worn ______________
Ventilation: Type ____
Normal ________ Not-Normal __ Explain ____________________

Weather Conditions:

Approximate Temperature: ________°F
Precipitation: __ Cloudy: __ Partly Cloudy: __ Clear: __
Wind: Calm __ Light __ Medium __ High __

= =

Work Description: ____

____

____

______________________________ Scheduled Hours Per Shift: ______________

Other Conditions, Remarks: ______________________________

____

____

____

= =

Sampled By: ____________________ Form: 10.2.2b

1.0 OBJECTIVE

This Radiological Operations Procedure (ROP) provides direction for the sampling and quantification of particulate radioactivity contamination in the worker breathing zone through the use of personal air sampling pumps (lapel air samplers).

2.0 SCOPE

2.1 This instruction provides the requirements for use of personal lapel air samplers.

2.2 Routine counting, filter sample packaging, and transportation are also specified in this procedure.

3.0 DEFINITIONS

3.1 Airborne Radioactivity Area - A designated area posted when airborne radioactive material concentrations greater than 1/10 of a derived air concentration (DAC) are likely to be present (in accordance with U.S. Department of Energy [DOE] 5480.11).

3.2 Annual Limit on Intake (ALI) - The quantity of a single radionuclide that, if inhaled or ingested in one year, would irradiate a person to the limiting dose value for control of occupational exposure.

3.3 Breathing Zone - That region within 1 foot of a worker's mouth and nostrils from which air is drawn into the lungs while he performs his assigned work. Air taken from this region will represent the air the worker is breathing while he works whether standing, sitting, or moving.

3.4 Breathing Zone Sample - A sample collected within an individual's breathing zone.

3.5 Cassette Holder - A device designed to hold and position a filter cassette in the breathing zone of an individual.

3.6 DAC - The concentration in air of a single radionuclide that, if inhaled in an average volume of air breathed by an individual in one year, would result in the ALI for that radionuclide being reached for an occupational worker. DOE 5480.11 contains a list of DACs.

3.7 Filter Cassette - A three-segment plastic filter holder used to house a sample filter and optional backing support.

3.8 Lapel Sampler - A device for collecting a representative fraction of radionuclides in the air consisting of a personal sampling pump and sampling train.

3.9 Minimum Detectable Activity (MDA) - The smallest concentration of radioactivity that can be detected at a given confidence level under specific sampling and counting conditions.

3.10 Minimum Detectable Concentration (MDC) - The smallest concentration of radioactivity that can be detected at a given confidence level under specific sampling and counting. MDCs are method-specific.

4.0 MATERIALS AND EQUIPMENT

4.1 Equipment

4.1.1 appropriate survey instrument(s);

4.1.2 lapel air sampler;

4.1.3 filter cassettes, three-segment, clear polystyrene-type, including end plugs;

4.1.4 filter cassette holders, plastic, spring-loaded with lapel clip;

4.1.5 filter supporting pads;

4.1.6 filters, glass fiber, Type A-E; and

4.1.7 Tygon-type vinyl tubing.

4.2 Forms

4.2.1 Radioactive Particulate Sampling Log;

4.2.2 Dust, Fume, or Mist Sample Field Sheet;

4.2.3 airflow calibration labels;

4.2.4 caution - radioactive material (CRM) labels;

4.2.5 radioactive onsite shipping label; and

4.2.6 material transfer - conditional release only tag.

4.3 Packaging and Miscellaneous Materials

4.3.1 1-gallon paint can;

4.3.2 glassine envelopes; and

4.3.3 black indelible ink marking pen.

5.0 LIMITATIONS AND PRECAUTIONS

5.1 Limitations

5.1.1 Lapel samplers will be calibrated no earlier than 24 hours before use.

5.1.2 Survey instruments will have current calibration as indicated on their calibration labels.

5.1.3 Survey instruments will have satisfactorily passed operational checks as specified in applicable procedures.

5.1.4 Lapel samplers will be recalibrated whenever the sampler configuration is changed.

5.1.5 Lapel samplers will be recharged after each use.

5.2 Precautions

5.2.1 If in doubt of the presence of potentially hazardous, explosive, or reactive aerosols, gases, or vapors, do not operate lapel sampler. If in doubt of sampling conditions, request that Health and Safety Specialist/Health and Safety Officer (HSS/HSO) assess situations that may exist for various sampling activities.

5.2.2 A clean pair of surgical gloves will be worn to change the cassette.

5.2.3 To prevent cross contamination of the sample filter and invalidation of the results, do not remove the sample filter from the filter cassette unit until it is ready to be counted.

5.2.4 Do not allow lapel samplers to become wet.

6.0 PREREQUISITES

6.1 All measuring and test equipment will have a current calibration label.

6.2 The Health and Safety Specialist In-Training (HSST) or HSS performing this procedure will be trained in the use of the lapel sampler and attachments and will demonstrate sampling proficiency before performing lapel sampling in actual workplace situations.

6.3 A sufficient stock of equipment and associated supplies should be available for lapel air sampling.

6.4 Before each use, visually inspect sampler external surfaces for damage.

6.4.1 Areas to be checked include air sampler and sample cassette assembly.

6.4.2 If a lapel sampler is damaged, or a defective sampler is found, attach an out-of-service tag and return the equipment for repair.

7.0 INSTRUCTIONS

7.1 Preliminary Activities

7.1.1 Calibration Check

7.1.1.1 Visually check the airflow calibration label on the lapel sampler.

7.1.1.2 If 24 hours have elapsed since calibration, perform the following tasks:

- Calibrate the sampler in accordance with the requirements of ROP 10.04; or
- Obtain a different lapel sampler and begin with Section 7.1.1.

7.1.2 Battery Check

7.1.2.1 Perform a battery check of the lapel air sampler.

7.1.2.2 If the lapel sampler LED display does not indicate "Battery OK," charge lapel sampler before using.

7.1.3 General Condition Check

Check the general condition of the equipment as follows:

- all caps secure;
- flowmeter ball free (tilt to check for movement); and
- all parts and tubing required for sampling present.

7.1.4 Communication with the Wearer

7.1.4.1 Discuss the purpose of the sampling with the wearer.

7.1.4.2 Inform the wearer when and where the equipment will be removed.

7.1.4.3 Stress the importance of not removing or tampering with the sampling equipment.

7.2 Assembly of the Lapel Sampling System

7.2.1 Filter Support Pads - If required, insert filter support pad in outlet segment of filter cassette before inserting filter.

7.2.2 Cassette Holder

7.2.2.1 Obtain a clean filter cassette.

7.2.2.2 Obtain a new 37-millimeter (mm) filter and insert it into the outlet segment of the filter cassette so that the patterned side of the filter faces away from the outlet nipple.

7.2.2.3 Place the filter-retaining segment of the cassette into the outlet segment.

7.2.2.4 Place the cassette with the filter-retaining segment centered over the large hole on the holder. The filter should be in the up position toward the collar clip.

7.2.2.5 Position the hold-down plate opening over the outlet nipple.

7.2.2.6 Insert the Lurer fitting on the rubber tubing through the hole in the hold-down plate and into the outlet nipple or the filter cassette.

7.2.2.7 Connect a 3-foot length of vinyl tubing between the cassette holder.

7.3 Sample Duration

7.3.1 Sample duration will be determined based on sample flow rate, required MDC, and duration of work activity. The MDC (microcuries per cubic centimeter [μCi/cm^3]) is calculated as follows:

$$MDC = \frac{2.71 + 3.29\ [RbTs(+Ts/Tb]^{1/2}}{EKTV\ (2.22 \times 10^6)}$$

where:

Rb = background (blank) count rate
Ts = sample counting time
Tb = background (blank) counting time
E = filter efficiency
K = calibration factor (counts per minute/disintegrations per minute [cpm/dpm])
V = total air volume sampled (cm^3)

7.3.2 The sensitivity of air sampling will be determined by taking the ratio of the MDC to the appropriate DAC.

7.3.3 Sampling periods of one shift (eight hours) at varying flow rates achieve the following sensitivities:

ISOTOPE	FLOW RATE (lpm)	SENSITIVITY (DAC)
		SAC-4*
U	2	0.177
U	4	0.088
U	6	0.059
U	8	0.044
Pu	2	1.77
Pu	4	0.88
Pu	6	0.59
Pu	8	0.44

* or alpha counter having background of <1 cpm

lpm = liters per minute
Pu = plutonium
U = uranium

7.3.4 When an eight-hour sample is not possible, maximize the flow rate and sampling time as much as the situation permits.

7.4 Operation

7.4.1 Activate the sampler by moving the power switch to the on position.

7.4.2 Replace the antitamper cover and tighten the cover screw.

7.4.3 When the desired sample time has elapsed, remove the antitamper cover.

7.4.4 Move the power switch to the off position.

7.5 Shutdown

7.5.1 Normal Shutdown - Remove the antitamper cover, and move the power switch to the off position. The sampler pump will stop. If operating by program, "sample over" will be displayed.

7.5.2 Fault Shutdown - Sampler will stop automatically if battery voltage is low or if airflow becomes restricted, and will indicate the cause of the shutdown on the display. In the case of a flow fault, the sampling may be resumed after the flow blockage is corrected, by removing the anti-tamper cover and pressing the START/HOLD key.

7.5.3 Pause/Early Shutdown - Sampling may be interrupted at any time, without loss of data, by removing the antitamper cover and pressing the START/HOLD key. To restart the sampler, press the START/HOLD key again.

7.6 Personnel Lapel Sampling

7.6.1 Select personnel who are likely to receive a representative exposure based on time/location in the work area, degree of contamination, and type of work being performed. (Personnel performing "hands-on" tasks will generally have a greater potential for exposure.)

7.6.2 Attach the lapel sampler to the individual (belt, hip pocket, or waist) in a position most comfortable for the person.

7.6.3 Place the vinyl tubing over the shoulder in a manner that does not significantly hamper movement or job performance.

7.6.4 Firmly attach the cassette holder in the wearer's breathing zone with the open end unobstructed and facing downward.

7.6.5 Instruct the wearer in proper use of the unit (for example, filter cassette orientation, on/off times for lunch/breaks when applicable, actions in the event of malfunction, and the reasons for sampling).

7.6.6 Ensure that the cassette holder is still in correct position.

7.6.7 Record the following information on the Dust, Fume, or Mist Sample Field Sheet:

- sample identification (yy/mm/dd/Employee No.);
- site/location;
- work activity description;
- personal protective equipment used;
- start time (date/time [military])
- sample/sampler type;
- sampler serial number;
- calibration due date;
- wearer's name and employee number;
- cassette/filter number; and
- workplace and weather conditions.

7.6.8 After specified sample period has elapsed, perform the following tasks:

7.6.8.1 Remove lapel sampler and attachments as a unit from the wearer.

7.6.8.2 Perform a postsampling calibration of the pump using the method specified in ROP 10.04.

7.6.8.3 Remove the antitamper cover.

7.6.8.4 Move the power switch to the off position.

7.6.8.5 Remove the filter cassette from the cassette holder.

7.6.8.6 If a cassette holder was used, then attach an inlet segment to the cassette.

7.6.8.7 Insert plugs in both ends of the cassette.

7.6.8.8 Record the date and time (military) that sampling stopped on the Dust, Fume, or Mist Sample Field Sheet.

7.6.8.9 Calculate the total sample time (T_T) in minutes.

7.6.8.10 Record the total sample time on the Radioactive Particulate Sampling Log.

7.6.8.11 Using a black indelible ink marking pen, record the sample identification information on a label and attach it to the outside of the cassette.

7.6.8.12 Take the filter cassette to the counting location.

7.6.8.13 Calculate the average flow rate in lpm using the following formula:

$$Q_A = \frac{Q_1 + Q_2}{2}$$

where:

Q_A = average flow rate
Q_1 = presample flow rate x calibration factor
Q_2 = postsample flow rate x calibration factor

7.6.8.14 Record the average flow rate (lpm) on the Radioactive Particulate Sampling Log.

7.6.8.15 Calculate the total sample volume (V_T) by multiplying the average flow rate in lpm from Section 7.6.8.13 by the total sample time (T_T) from Section 7.6.8.9 as follows:

$$V_T = Q_A \times T_T$$

where:

V_T = total sample volume (1)
Q_A = average flow rate (lpm)
T_T = total sample time (minutes)

7.6.8.16 Record the total volume (V_T) on the Radioactive Particulate Sampling Log.

7.6.8.17 Proceed to Section 7.7.

7.7 Survey of Sample Media

7.7.1 Remove the filter retaining segment of the cassette.

7.7.2 Leaving the filter media in place in the cassette, survey the filter with a Ludlum Model 12-1A.

7.7.2.1 Lapel sample filters surveyed at less than 5,000 cpm (10,000 dpm) may be counted immediately.

7.7.2.2 Lapel sample filters surveyed at greater than 5,000 cpm (10,000) dpm), as measured with a Ludlum Model 12-A, will be set aside and resurveyed to determine short-lived activity contribution. If there is no significant reduction in the activity level, report this to the HSS/HSO promptly.

7.8 Air Sample Counting

7.8.1 Using tweezers and extreme caution to avoid cross contamination and invalidation of results, place the filter on a 37-mm counting planchet.

7.8.2 Using a calibrated and performance-tested smear counter, count the filter for 10 minutes in accordance with the requirements of ROP 10.03, Performance Check and Operation of Alpha Smear/Filter Counting Instrumentation. Allow at least 30 minutes to elapse after sampling before making the first count (C^1).

7.8.3 Record the counting information on the Radioactive Particulate Sampling Log.

7.8.4 If an immediate air concentration determination is desired, the result of Section 7.8.2 is considered long-lived (cmp_{LL}) and activity calculation starts with Step 2 of Section 7.8.9.

7.8.5 Allow at least 30 minutes to elapse before the second count (C_2). When time permits, a longer waiting time will increase the accuracy of the final sample analysis.

7.8.6 Perform and record a second count by repeating Sections 7.8.2 and 7.8.3.

7.8.7 Save the sample filter by placing it in a glassine envelope, and attach a properly completed sample label with sample identification.

7.8.8 If the second count was equal to or greater than the first count, or the sample filter has decayed for more than three hours, then the activity calculation starts with Step 2 of Section 7.8.9.

7.8.9 If the second count was less than the first count, then calculate the contribution from long-lived isotopes as follows:

Step 1.

First, subtract the second count (C_2) from the first count (C_1). Next, divide the results by 1-f, (1-f is from Appendix A). Then, subtract those results from the first count.

The calculation is:

$$cpm_{LL} = C_1 - \frac{(C_1 - C_2)}{(1-f)}$$

Step 2.

Divide the cpm_{LL} (obtained in Step 1) by the sample volume (V_T) obtained in Section 7.6.8.15 multiplied by 1,000.

The calculation is:

$$cpm/cm^3 = \frac{cpm_{LL}}{V_T\ (I)\ x\ 1,000}$$

Step 3.

Divide the result of Step 2 by 0.231 (the product of the counter efficiency of 0.33 and the self-absorption correction of 0.70 [0.33 x 0.70 = 0.231]), multiplied by 2.22 x 10^6 dpm/μCi.

The calculation is:

$$\mu Ci/cm_3 = \frac{cpm/cm^3}{(5.13 \ x \ 10^5)}$$

Step 4.

Calculate the percent of the DAC by dividing the result of Step 3 by the DAC equivalent value for the isotope of concern and multiplying by 100.

The calculation is:

$$\% \ DAC = \frac{\mu Ci/cm^3}{DAC \ equivalent} \ x \ 100$$

7.8.10 Record the sample results and all appropriate information on the Radioactive Particulate Sampling Log.

7.8.11 If the percent of the DAC calculated in Step 4 is equal to or greater than 10 percent, notify the HSS/HSO immediately and recount the filter after a four-hour period from the end of air sampling. Repeat this procedure after a 72-hour period if the DAC percentage remains equal to or greater than 10 percent.

8.0 DISPOSITION

8.1 Packaging of Filter Media for Transport

8.1.1 Place glassine envelopes containing the filter media in one or more plastic bags, as appropriate.

8.1.2 Cover the bag openings with plastic tape.

8.1.3 Attach a CRM label to each bag.

8.1.4 Place the plastic bag(s) in a 1-gallon paint can.

8.1.5 Securely cap can.

8.1.6 Complete and attach a radioactive onsite shipping label.

8.1.7 Complete and attach a material transfer - conditional release only tag in accordance with the requirements of Health and Safety Plan (HSP) 18.10.

8.2 Transportation of Filters

8.2.1 Packaged filter media will be transported in accordance with the Rocky Flats Plant (RFP) Onsite Transportation Manual.

8.2.2 Filter media sent to an offsite laboratory for analysis will be packaged and shipped in accordance with the Department of Transportation (DOT) hazardous material regulations.

9.0 REFERENCES

9.1 DOE 5480.11, Radiation Protection for Occupational Workers

9.2 NUREG-1400, Air Sampling in the Workplace

9.3 RFP Onsite Transportation Manual

9.4 HSP 18.10, Release of Property

9.5 ROP 10.03, Performance Check and Operation of Alpha Smear/Filter Counting Instrumentation

9.6 ROP 10.04, Personal Air Sample Pump Calibration

Prepared By: _____

Reviewed By: _____

Approved By: _____
Radiological Services

Approved By: _____
Quality Assurance

Approved By: _____
Health and Safety Coordinator

APPENDIX A

Page 1 of 1

MINUTES BETWEEN COUNTS	DECAY FACTOR (f)	(1-f)
0	1.0	N/A
15	0.68	0.32
30	0.46	0.54
45	0.32	0.68
60	0.22	0.78
75	0.154	0.846
90	0.108	0.892
105	0.077	0.923
120	0.054	0.946
135	0.029	0.971
150	0.028	0.972
165	0.021	0.979
180	0.015	0.985

DUST, FUME, or MIST SAMPLE FIELD SHEET

Sample ID: ____________________ Date: ____________

Material of Interest in Dust: ____________________
Site: ______________________________
Person Sampled: ____________________ SSN: ____________________
Job: ____________________ Work Location: ____________________
Sample Type: Personal___ Area___ Resp. Dust___ Total Dust ___
Pump Type: ____________ Pump No.: ______ Flow Rate On/Off: ________ (lpm)____
Calibration Due: ________ Filter No.: ________ Time On: _____ Time Off: __________

==

Workplace Conditions:

Operations: Normal __ Not-Normal __ Explain ____________________
Respirator Use: Type ____________________ % of Time Worn ____________
Ventilation: Type ______________________________
Normal ________ Not-Normal __ Explain ____________________

Weather Conditions:

Approximate Temperature: _______ °F
Precipitation: __ Cloudy: __ Partly Cloudy: __ Clear: __
Wind: Calm __ Light __ Medium __ High __

==

Work Description: ______________________________

____

____

____________________ Scheduled Hours Per Shift: ____________

Other Conditions, Remarks: ____________________

____

____

____

==

Sampled By: ____________________ Form: 10.2.2b

RADIOACTIVE PARTICULATE SAMPLING LOG

Sample ID: _____ Filter No.:_____ Sample Date: _____

Counting Instrument: Type/Model _____ Serial No. _____

Efficiency _____ Cal. Date _____ Counted By _____

Sample Duration = [Time Off - Time On]
= [_____(decimal hrs)- _____(decimal hrs)] x 60(min/hr) =_____(min)

Sample Volume = Average Flow Rate x Sample Duration x 1,000

= _____ (lpm) x _____ (min) x 1,000 = _____ (cm^3)

First Count:

	Date	Time	Count	Duration (min)	Count Rate (cpm)	Concentration ($\mu Ci/cm^3$)
Bkg						N/A
Sample						

Percent DAC:_____

Second Count:

	Date	Time	Count	Duration (min)	Count Rate (cpm)	Concentration ($\mu Ci/cm^3$)
Bkg						N/A
Sample						

Percent DAC:_____

Reviewed By:_____ Date:_____

1.0 OBJECTIVE

To specify how alpha smear/filter counting instruments are to be performance checked and operated.

2.0 SCOPE

This Radiological Operations Procedure (ROP) contains performance checks and requirements for alpha smear/filter counting instruments.

3.0 GENERAL

3.1 Calibration Frequency - Calibrations shall be done in accordance with American National Standards Institute (ANSI) N323 semiannually.

3.2 Equipment Addressed - The equipment addressed in this procedure includes the following:

- Eberline SAC-4 scintillation alpha counter;
- Ludlum model 43-10 alpha smear/filter counting probe used with Ludlum model 2929 ratemeter/scaler or Ludlum model 1000 scaler; and
- equivalent counting instruments.

4.0 INSTRUCTIONS

4.1 Background Count Rate - Before using alpha-scintillation counting instruments on each shift, the average background count rate will be determined and a performance test conducted.

4.1.1 Check the calibration label to ensure the due date of calibration has not expired.

4.1.2 Determine the instrument background count rate by completing the following steps:

- Open the sample drawer and carefully wipe the top of the drawer and planchet area using cotton swabs or kimwipes moistened with alcohol. Dispose of these materials as radioactive waste.
- Place a clean smear on the sample tray with tweezers. The smear must remain flat in the sample tray while closing the drawer.
- Set the control switches of the SAC-4 counter, as example, as follows:

-	Power	ON
-	Minutes	10
-	Multiplier	x1
-	Count Mode	TIMED

Note: Ensure the instrument power is turned on at least 10 minutes before operation.

- Press the START/RESET button. The counting lamp will be illuminated.
- At the completion of the count time, divide the total counts by 10 to determine the average background count rate.
- If the average background count rate is less than 1 count per minute (cpm), record the value on the Performance Test Log Sheet (attached).

- Record the time of the background determination and the employee number or social security number in the space provided on the log sheet.
- If the backgound determination is equal to or greater than 1 cpm, repeat the previously mentioned steps in Section 4.1.2. If the second determination remains equal to or greater than 1 cpm, do not use the instrument and notify the Health and Safety Specialist/Health and Safety Officer (HSS/HSO).

4.1.3 Determine the percent error using a calibrated plutonium-239 (Pu-239) alpha source, or equivalent, approved by the HSS/HSO, and follow the steps below:

- Ensure the source has a current calibration label and that the source value is not less than 15,000 disintegrations per minute (dpm).
- Record the serial number of the source on the Performance Test Log Sheet in the space labeled SRC S/N.
- Record the certified activity of the source on the log sheet in the space labeled VALUE. The certifying facility (CFL) will be recorded on the Performance Test Log Sheet.
- Open the sample drawer and carefully place the alpha source, activity side up, in the middle of the sample holder.
- Close the sample drawer.

- With the count mode set to one minute, and all other controls set according to Section 4.1.2, press the START/RESET button. The counting lamp will be illuminated.
- When the counting lamp is no longer lit, record the cpm on the log sheet in the space labeled SOURCE CPM.
- Determine the percent error of the observed counts compared with the CFL source standard value in accordance with the following:

$$\% \; Error = \frac{(cpm \times 3) - CFL\ Value \times 100}{CFL\ Value}$$

NOTE: This percent error has been calculated for the SAC-4; if an equivalent instrument is being used, refer to the manufacturer's specifications.

- Record the percent error on the log sheet.
- The HSS/HSO will review and approve each shift record of performance testing. These records will be available in the project files.
- If the percent error does not lie within the ± 20 percent range on the log sheet, do not use the instrument, and notify the HSS/HSO.
- Remove the source from the sample holder and return it to the designated storage location.

4.2 <u>Operation of the Alpha-Scintillation Counting Instrument</u> - Normal operation of the alpha-scintillation counting instrument will be as specified below:

- Verify that the electrical power to the instrument has been on for 10 minutes.
- Set the instrument controls in accordance with Section 4.1.2; however, one-minute counts will be obtained for routine smear counts unless a longer count time is directed by the HSS/HSO.
- Pull the sample drawer open until fully extended and place the smear/filter to be evaluated in the center of the sample holder, activity side up.
- Ensure the sample is as flat as possible to prevent contamination of the detector window. Carefully close the sample drawer.
- Press the START/RESET button.
- The instrument will count for the preset time. At the end of the count time, the instrument readout will display gross counts.
- The instrument will count for the preset time. At the end of the count time, the instrument readout will display gross counts.
- Record the cpm and other information on the appropriate Sample Data Sheet.
- Open the sample drawer and dispose of the smear/filter as radioactive waste (unless the sample is to be retained for subsequent recounts).

5.0 REFERENCES

5.1 ANSI N323, Radiation Protection Instrumentation Tests and Calibration

5.2 U.S. Department of Energy N5480-6, Radiological Control Manual

Prepared By: _____

Reviewed By: _____

Approved By: _____
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Health and Safety Coordinator

PERFORMANCE TEST LOG SHEET

SAC - 4

Start Date _____

Stop Date _____

$$\% \text{ ERROR} = \frac{(\text{CPM} \times 3) - \text{CFL value} \times 100}{\text{CFL VALUE}}$$

LOCATION COUNTER S/N % ERROR

DATE	SRC. S/N	SRC. CPM	BKG. CPM	VALUE DPM	% ERROR	TIME	EMP. INT.

PERFORMANCE TEST LOG SHEET
LUDLUM 1000

Start Date _____
Stop Date _____

$$\% \text{ ERROR} = \frac{(\text{CPM} \times 3) - \text{CFL value} \times 100}{\text{CFL VALUE}}$$

LOCATION COUNTER S/N % ERROR

DATE	SRC. S/N	SRC. CPM	BKG. CPM	VALUE DPM	% ERROR	TIME	EMP. INT.

PERFORMANCE TEST LOG SHEET

LUDLUM 2929 - α

Start Date _____

Stop Date _____

$$\% \text{ ERROR} = \frac{(\text{CPM} \times 3) - \text{CFL value} \times 100}{\text{CFL VALUE}}$$

LOCATION COUNTER S/N % ERROR

DATE	SRC. S/N	SRC. CPM	BKG. CPM	VALUE DPM	% ERROR	TIME	EMP. INT.

1.0 OBJECTIVE

To set the flow rates of personal air sample pumps to specified flow rates and/or to produce calibration curves for personal air sample pumps with rotameters or other flow indicators, when necessary.

2.0 SCOPE

2.1 This Radiological Operations Procedure (ROP) shall be used for setting and/or determining airflow rates of personal sampling pumps used for collecting air samples to determine exposures of Jacobs' personnel to airborne contaminants.

2.2 A bubble tube is used to determine the volumetric flow rate of personal air sampling pumps. The time required for a soap bubble to pass through a known volume is measured. Division of the known volume by the measured time yields the flow rate.

3.0 PROCEDURE

3.1 General

3.1.1 Calibration frequency will be as follows:

- Pumps used for personal air samples should be calibrated before and after each use.
- Repaired pumps should be calibrated before use.

3.1.2 Pumps addressed in this procedure include the following:

- personal sampling pumps with rotameters;
- personal sampling pumps with flow controllers; and
- low-volume sampling pumps.

3.1.3 Special instructions/information include the following:

- The bubble tube is used for calibration because it is a primary standard.
- If pumps are calibrated near their use location, it should not be necessary to correct sample volumes for temperature and pressure (or altitude).
- Pumps calibrated using this procedure should have the appropriate air samplers (e.g., filter holders/filters, cyclones, etc.) in place in the sampling train.

3.1.4 For calibration information/date to be documented, see ROP 10.05, Utilization of Airflow Calibration Log.

3.1.5 Calibration equipment includes the following:

- timer - capable of timing to at least 1/10 second accurately;
- bubble tube, including the following:
  - 0 to 500 milliliter (ml) or larger for personal sampling pumps; and
  - 0 to 50 ml for low flow sampling pumps.

- sampler, including the following:
  - filter holder/filter;
  - cyclone/cassette/filter;
  - sorbent sample tubes; and
  - colormetric detector tubes, long duration.
- in-line chamber for use with samplers that cannot be operated in-line;
- flexible tubing; and
- pump-adjusting tools.

3.2 Calibration Procedural Steps

3.2.1 Charge pump battery(s), if low charge is indicated.

3.2.2 Turn pump on and allow to run at least one minute, preferably five minutes, before calibrating.

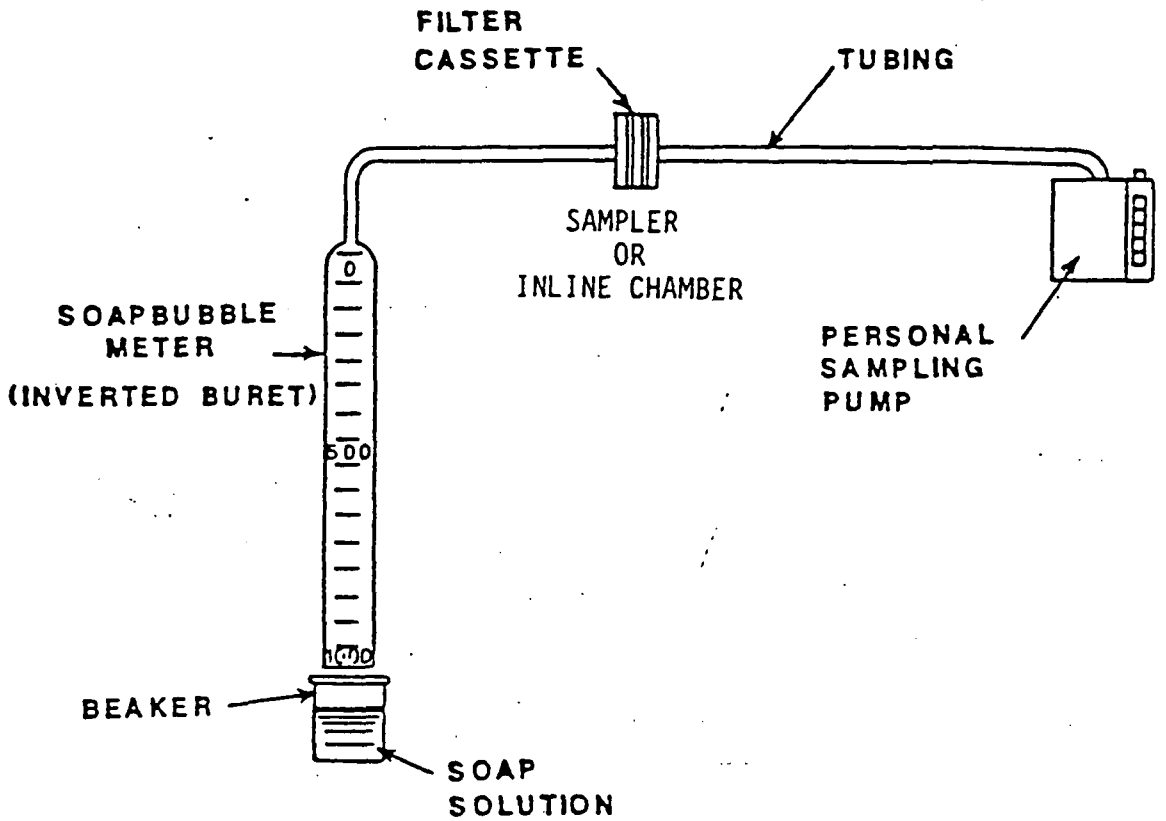
3.2.3 Fill in Items 1 through 10 on the Airflow Calibration Log form if not already done (ROP 10.05).

3.2.4 Record the date, time, and initials or signature on the log form according to instructions.

3.2.5 Specify the target flow rate and its units on the log form.

3.2.6 Wet the inside of the bubble tube with bubble solution or water.

3.2.7 Assemble calibration apparatus by connecting the bubble tube outlet to the sampler inlet (or inlet of the in-line chamber) and the outlet of the sampler (or outlet of the in-line chamber) to the pump inlet with flexible tubing. (See the figure below.)



3.2.8 Be sure connections are tight. The sampler and/or in-line chamber can be tested for leaks by sealing the inlet, drawing a slight vacuum by sucking on the outlet, sealing with the tongue, and noting if vacuum holds for several seconds. If the vacuum does not hold, check and seal all connections and retest.

3.2.9 Choose a calibration volume that will take the bubble at least 10 seconds to travel, if possible. For example, with a 500 ml bubble tube, a bubble will cover 400 ml in 14.1 seconds if the pump is pulling 1.7 liters per minute (lpm). Record the calibration volume on the log form.

3.2.10 Set acceptable flow rate limits (e.g., Q± 5 percent or Q± 2 percent).

3.2.11 Determine the time (for the bubble to traverse the calibration volume) limits equivalent to the flow rate limits set in Section 3.2.10 and record on log form.

Seconds = (Calibration Volume [liters]/Flow Rate [lpm]) x 60

3.2.12 Initiate bubbles by momentarily touching bubble solution in its container to the inlet of the bubble tube.

3.2.13 Run bubbles up the bubble tube until several pass the end of the calibration volume before breaking.

3.2.14 Initiate a bubble.

3.2.15 Time the bubble between the marks delineating the sample volume and record in the "Measured" column of the log form.

3.2.16 If the pump has a rotameter, note the reading (center of ball) on the log form.

3.2.17 If the "measured time" is within the limits determined in Section 3.2.11, repeat the steps in Sections 3.2.14 through 3.2.16 at least twice. If not, adjust the flow of the pump, note this on the log form, and go back to Section 3.2.14.

3.2.18 If three successive measurements are within the limits, the pump can be considered calibrated. If not, adjust the flow of the pump, note this on the log form, and go back to Section 3.2.14.

3.2.19 Be sure to record ambient temperature and pressure (or altitude) conditions on the log form as specified in the instructions.

NOTE: If a rotameter calibration curve is desired, the procedure can be repeated using different target flow rates until the data for the calibration curve are generated.

3.3 Quality Assurance

3.3.1 At least semiannually, check the timer against another timer (± 1/10 second agreement is acceptable).

3.3.2 At least annually, a minimum of 10 percent of the calibration calculations should be audited.

4.0 REFERENCES

ROP 10.05, Utilization of Airflow Calibration Log

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Reviewed By: _____

Approved By: _____
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Quality Assurance

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Health and Safety Coordinator

1.0 OBJECTIVE

To explain how the Airflow Calibration Log is to be used to document calibrations of airflow devices.

2.0 GENERAL INFORMATION

2.1 Calibration of all airflow devices used for health physics sampling shall be documented using the Airflow Calibration Log (Form 10.4.8A).

2.2 The Airflow Calibration Log, Form 10.4.8A, was designed specifically for documentation of calibrations performed on personal sampling pumps. The form should also be flexible enough to be used for any type of airflow calibration. Three blank columns are included to allow this flexibility. For example, when calibrating a high volume sampler, the pressure drop across the orifice can be entered in one of the blank columns, the rotameter reading in the rotameter reading column, and the resistance plate number in another blank column. Blank column(s) can be used for comments when appropriate.

2.3 The form was designed to document multiple calibrations of one specific airflow device (e.g., personal sampling pump, Staplex sampler, etc.) using one specific calibration device (e.g., bubble tube, orifice meter, etc.). If the same airflow device is to be calibrated with a different calibration device, a separate sheet should be used.

2.4 When calibrating personal sampling pumps for specific flow rates, a series of range-finding trials may be necessary. If the flow rate is measured and found

not to be the desired flow rate, the pump flow is adjusted in an attempt to obtain the desired flow rate. Some personnel may choose to document all calibration trials; others will want to document only the measurements made after the pump is properly adjusted. Either way is acceptable. At a minimum, at least three consecutive measurements of the flow rate of the properly adjusted pump should be documented. Also, if the pump is being calibrated after use, at least three consecutive measurements of the flow rate should be made and documented before any adjustment of the pump flow is made.

3.0 PROCEDURE

3.1 The procedure for completing the Airflow Calibration Log is described below. Numbers listed in brackets correspond to required entries as indicated in Figure 1 (attached).

3.2 List the location of the device being calibrated as assigned to or being used at.[1]

3.3 Enter the page number of this form sheet in relation to all other airflow calibration log form sheets on file for this particular device.[2]

3.4 Indicate the type of device calibrated (e.g., personal sampling pump, area sampling pump, wet test meter, etc.).[3]

3.5 Identify and document the brand name (e.g., DuPont, Gillian, Staplex, etc.).[4]

3.6 Document the model number (e.g., P25000, P4000, etc.).[5]

3.7 Record the serial and/or identification (ID) number(s).[6]

3.8 Note the type of calibration device used (e.g., bubble tube, orifice meter, etc.).[7]

3.9 Record the brand name, if any.[8]

3.10 Record the model number, if any (if not, a brief description such as 0-55/0-500 milliliter [ml] for a bubble tube could be used).[9]

3.11 Record the serial and/or ID number(s), if any.[10]

3.12 Record the date the calibration is performed.[11]

3.13 Recording the time of calibration is critical when there is the possibility that the device may be calibrated more than once on the same date, such as sampling before and after a shift. A simple notation of A.M. or P.M. may be adequate.[12]

3.14 The initials or signature of the person performing the calibration should be entered here.[13]

3.15 If there is a "target" flow rate the device is to be calibrated for (e.g., lpm), the flow rate should be written between the parentheses in the column heading.[14]

3.16 The units (e.g., lpm) of the flow rate should be written between the parentheses in the column heading.[15]

3.17 When the calibration involves the use of a measured "calibration" volume, as when using a bubble tube or spirometer, that volume should be recorded here.[16]

3.18 Record appropriate units between the parentheses in the column heading.[17]

3.19 When calibrating airflow devices, such as personal sampling pumps, it is not feasible to set the flow rates exactly. Therefore, a range of acceptable values, such as (Q ± 5 percent) or (Q ± 2 percent), must be determined. The "limits" of that range of flow rates or some other related parameter (e.g., the time for a bubble tube) can then be used to decide when the calibration of the device

is acceptable. The parameters, such as time, volume, or flow rate, that the limits are for should be written on this line.[18]

3.20 The units of that parameter go in this space.[19]

3.21 Record the lower limit from 19.[20]

3.22 Record the upper limit here.[21]

3.23 Record the measured quantity in this space.[22]

3.24 The unit of measured quantity is recorded here.[23]

3.25 The value of the measured parameter for each calibration trial should be recorded in this column.[24]

3.26 Use "N" for no or "Y" for yes to indicate whether the flow control of the device being calibrated was adjusted after this calibration trial.[25]

3.27 If the device has a rotameter (e.g., MSA Model G, Hi Vol, etc.), the reading (center of ball) should be noted here.[26]

3.28 XX - The blank columns can be used for recording other pertinent parameters or comments as mentioned in the introduction.

The information entered in the first five columns (Items 11 through 21) generally does not change during a calibration session and should be entered only in the row corresponding to the first calibration trial. This procedure will result in blank spaces in these columns in the following rows. The blank spaces in the third and fourth columns (Items 14 and 16) should be used to record the ambient temperature and atmospheric pressure (absolute) or altitude of the calibration site.

4.0 REFERENCES

None

Prepared By: J B Baird

Reviewed By: Warner K. Rosen

Approved By: J B Baird
Radiological Services

Approved By: [illegible]
Quality Assurance

Approved By: [illegible]
Health and Safety Coordinator

AIRFLOW CALIBRATION LOG

Page____

Location– _____

Device Calibrated:

Type– _____

Brand– _____

Model– _____

Serial/ID #– _____

Calibration Device:

Type– _____

Brand– _____

Model– _____

Serial/ID # _____

Date / Time	By	Target Flow * ( )	Calibration Volume * ( )	_____ Limits ( )	Measured _____ ( )	Adj. ?	Rotameter Reading			

* Document calibration site Temperature, Absolute Atmospheric Pressure or Altitude in blank spaces in these columns.

Form: 10.4.8a

AIRFLOW CALIBRATION LOG

Page (2)

Location– (1)

Device Calibrated:

Type– (3)

Brand– (4)

Model– (5)

Serial/ID #– (6)

Calibration Device:

Type– (7)

Brand– (8)

Model– (9)

Serial/ID # (10)

Date / Time	By	Target Flow * ((15))	Calibration Volume * ((17))	(18) Limits ((19))	Measured (22) ((23))	Adj. ?	Rotameter Reading			
(11) (12)	(13)	(14)	(16)	(20) (21)	(24)	(25)	(26)	(xx)	(xx)	(xx)
		(**)	(**)							

* Document calibration site Temperature, Absolute Atmospheric Pressure or Altitude in blank spaces in these columns.

Form: 10.4.8a

Figure 1

7.3 HEARING PROTECTION/CONSERVATION POLICY

7.3.1 Approved Hearing Protection

- Approved hearing protection must be worn by employees working in designated high noise areas, operating tools or equipment, or working near tools or equipment where time weighted average (TWA) is above permissible noise limit standards.

- Approved hearing protection shall consist of ear plugs or ear muffs which shall reduce the noise exposure to within a permissible limit.

7.3.2 Noise Exposure Monitoring

- The work areas shall be periodically monitored to establish designated high noise areas.

- Noise monitoring shall be conducted using a "delta" scale of the sound level meter.

- Documentation of the area sound level monitorings shall be maintained.

7.3.3 Audiometric Testing

- Audiometric testing is required to establish baseline audiometric evaluations when employee exposure will equal or exceed an 8-hour TWA of 85 decibels. Such audiometric testing should be conducted on an annual basis for employee hearing loss evaluation.

- The decision on audiometric testing shall be made on an individual project basis.

7.3.4 General

- Evaluation of construction equipment under general use has determined that hearing protection may be required when employees are involved in the following tasks or working with the following equipment.

Pile driving	Arc gouging
Chain saws	Concrete pumper
Skill saws operator	Ground tamper
Table saws	Cherry picker (full throttle)
Hydro-blasting	Concrete cut-off saw
Air grinding	Front end loader (without cab)
Electric grinding	Impact wrench operator
Air compressor (full throttle)	Bull dozer (without cab)
Welding machine (full throttle)	Pavement breakers
Sump pump (without muffler)	Powder actuated tools
Pneumatic chipping hammers/guns	

7.3.5 Training

- Employees shall be educated upon hire, and annually thereafter, in the proper use of the provided hearing protection equipment.

- Additional training shall be provided on the designated and evaluated high noise areas to include the tasks exposing employees to high noise levels.

- Training should also include the effects of high noise.

- Records shall be maintained on all training performed including those receiving such training.

7.3.6 Documentation

- In addition to documentation being maintained on noise surveys, hearing examinations, and training documentation shall be maintained on the types of hearing protection provided and its' application.

- Documentation shall be maintained by the Site Safety Representative.

APPENDIX C

CONTAMINANTS, PERSONAL PROTECTIVE EQUIPMENT, AND MONITORING REQUIREMENTS

Site Location and Description

Location: Well 5771

Description: Well to be abandoned. Potential exists for radionuclide contamination in well.

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Hydrocarbons	—	PID	0 - 2000 ppm	0 - 5 ppm	5 - 25 ppm	>25 ppm	PPE for RAD levels >.1 DAC and >2.5 mg/m^3 particulates will be determined in conjunction with EG&G Radiological Engineering and Industrial Hygiene.
Radionuclides	varies	HiVol	—	<.1 DAC	—	—	
Particulates	10 mg/m^3	MIE Miniram	.1 - 100 mg/m^3	0 - 2.5 mg/m^3	2.51 - 10 mg/m^3	—	

Personal Monitoring:

Contaminant	Analytical Method
PCBs (Aroclor 1260)	—

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves	Silvershield Gloves	Latex Inner Gloves	Face Shield	Rubber Apron	Full-face Respirator
Well Abandonment		X	X		X	X	X			GMC-H type
Well Installation		X	X		X	X	X			GMC-H type
Geophysical Logging		X	X		X	X	X			GMC-H type
Radiation Survey	X									
Other:										

Shading indicates upgrades in PPE if action levels are reached

Site Location and Description

Location: Wells 5670, 6271, and 0587

Description: Wells will be abandoned. Area is potentially contaminated with solvents, including carbon tetracholride, radionuclides, and particulates.

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Hydrocarbons	N/A	PID *	0 - 2000 ppm	0 - 5 ppm	5.1 - 25 ppm	>25 ppm	If positive readings are noted, colorimetric tubes will be used to check for carbon tetrachloride. (1) Level C work will be based on input from EG&G Radiological Engineering and Industrial Hygiene.
Carbon tetrachloride	2 ppm	Sensidyne Colorimetric tube		0 - 2 ppm	—	>2 ppm	
Radionuclides	varies	HiVol	—	<.1 DAC	(1)	—	
Particulates	10 mg/m^3	MIE Miniram	.1 - 100 mg/m^3	0 - 2.5 mg/m^3	(1)	—	

Personal Monitoring:

Contaminant	Analytical Method
Chlorinated Hydrocarbons	NIOSH 1003
Radionuclides	Jacobs ROP 10.01 and 10.02

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves	Silvershield Gloves	Latex Inner Gloves	Face Shield	Rubber Apron	Full-face Respirator
Well Abandonment		X	X		X	X	X			GMC-H type
Well Installation		X	X		X	X	X			GMC-H type
Geophysical Logging		X	X		X	X	X			GMC-H type
Radiation Survey	X									
Other:										

Shading indicates upgrades in PPE if action levels are reached

Site Location and Description

Location: Well 0888

Description: Well will be abandoned. Potential contaminants include solvents, radionuclides, particulates, and beryllium.

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Hydrocarbons	—	PID	0 - 2000 ppm	0 - 5 ppm	5 - 25 ppm	>25 ppm	(1) GMC-H type cartridge not certified for carbon tetrachloride. (2) PPE for radionuclides and particulate levels in excess of Level D Modified will be determined in conjunction with EG&G Industrial Hygiene and Radiological Engineering.
Carbon tetrachloride	2 ppm	Sensidyne Colorimetric tube		0 - 2 ppm	— (1)	>2 ppm	
Particulates	10 mg/m^3	MIE Miniram	.1 - 100 mg/m^3	0 - 2.5 mg/m^3	— (2)	— (2)	
Beryllium	.002 mg/m^3	MIE Miniram	.1 - 100 mg/m^3	0	>Background	— (2)	
Radionuclides	—	HiVol	—	<.1 DAC	— (2)	— (2)	

Personal Monitoring:

Contaminant	Analytical Method
Beryllium, Chromium	NIOSH 7300, Elements
Chlorinated Hydrocarbons	NIOSH 1003
Radionuclides	Jacobs ROP 10.01 and 10.02

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves	Silvershield Gloves	Latex Inner Gloves	Face Shield	Rubber Apron	Full-face Respirator
Well Abandonment		X	X		X	X	X			GMC-H type
Well Installation		X	X		X	X	X			GMC-H type
Geophysical Logging		X	X		X	X	X			GMC-H type
Radiation Survey	X									
Other:										

Shading indicates upgrades in PPE if action levels are reached

Site Location and Description

Locations:	Wells 0154, 0254, 0354, 5170, 5270, 5470, 5570, 5071, 5171, 5671, 5871, 5971, 6071, 6171, 6874, 4087, 0188, 0288, 0388, 0488, 0588, 0688, 0788, 0988, 1088, 45091, 45191, 45291, and 42893
Description:	Wells to be abandoned

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Hydrocarbons	—	PID	0 - 2000 ppm	0 - 5 ppm	5.1 - 25 ppm	>25 ppm	(1) Actions for elevated levels of radionuclides and particulates will be determined in conjunction with EG&G Radiological Engineering and Industrial Hygiene.
Particulates	10 mg/m^3	MIE Miniram	.1 - 100 mg/m^3	0 - 2.5 mg/m^3	(1)	(1)	
Radionuclides	—	HiVol	—	<.1 DAC	(1)	(1)	

Personal Monitoring:

Contaminant	Analytical Method
Radionuclides	Jacobs ROP 10.01 and 10.02

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves	Silvershield Gloves	Latex Inner Gloves	Face Shield	Rubber Apron	Full-face Respirator
Well Abandonment		X	X		X	X	X			GMC-H type
Well Installation		X	X		X	X	X			GMC-H type
Geophysical Logging		X	X		X	X	X			GMC-H type
Radiation Survey	X									
Other:										

Shading indicates upgrades in PPE if action levels are reached

Site Location and Description

Locations:	Wells 10094, 10194, 10294, 10394, 10494, 10594, 10694, 10794, 10894, 10994, 11094, 11194, 11294, 11394, 11494, 11594, 11894, and 11994
Description:	Wells to be installed

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Hydrocarbons	—	PID	0 - 2000 ppm	0 - 5 ppm	5.1 - 25 ppm	>25 ppm	(1) Actions for elevated levels of radionuclides and particulates will be determined in conjunction with EG&G Radiological Engineering and Industrial Hygiene.
Particulates	10 mg/m^3	MIE Miniram	.1 - 100 mg/m^3	0 - 2.5 mg/m^3	(1)	(1)	
Radionuclides	—	HiVol	—	<.1 DAC	(1)	(1)	

Personal Monitoring:

Contaminant	Analytical Method
Radionuclides	Jacobs ROP 10.01 and 10.02

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves	Silvershield Gloves	Latex Inner Gloves	Face Shield	Rubber Apron	Full-face Respirator
Well Abandonment		X	X		X	X	X			GMC-H type
Well Installation		X	X		X	X	X			GMC-H type
Geophysical Logging		X	X		X	X	X			GMC-H type
Radiation Survey	X									
Other:										

Shading indicates upgrades in PPE if action levels are reached

Site Location and Description

Locations: Wells 5474, 5674, 5574, 5271, 5070, 5471, 5371, 5571, 5370, and 0388

Descriptions: Locations noted as having high radionuclide levels per *Historical Release Report (EG&G 1992).*

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Hydrocarbons	—	PID	0 - 2000 ppm	0 - 5 ppm	5.1 - 25 ppm	>25 ppm	(1) PPE for radionuclide and particulate levels in excess of Level D modified will be made in conjunction with EG&G Industrial Hygiene and Radiological Engineering
Particulates	10 mg/m^3	MIE Miniram	.1 - 100 mg/m^3	0 - 2.5 mg/m^3	(1)	(1)	
Radionuclides							

Personal Monitoring:

Contaminant	Analytical Method
Radionuclides	Jacobs ROP 10.01 and 10.02

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves	Silvershield Gloves	Latex Inner Gloves	Face Shield	Rubber Apron	Full-face Respirator
Well Abandonment		X	X		X	X	X			GMC-H type
Well Installation		X	X		X	X	X			GMC-H type
Geophysical Logging		X	X		X	X	X			GMC-H type
Radiation Survey	X									
Other:										

Notes:
PEL = Permissible Exposure Limit
PID = photoionization detector
ppm = parts per million
DAC = derived-air concentration
HiVol = high volume

mg/m^3 = milligrams per cubic meter
PPE = personal protective equipment
RAD = radiation
N/A = not applicable

NIOSH = National Institute for Occupation Safety and Health

94-DMR-ERM-C097

Site Location and Description

Location: 24193, 24393

Description: Well will be abandoned. Potential Contaminants include solvents including carbon tetrachloride, chloroform and perchloroethylene, radionuclides

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Volatile organic compounds		PID	0-2000 ppm		5-25 ppm	>25ppm	*tube samples req'd if PID reads above background
Carbon tetrachloride	2 ppm	* Sensidyne colorimetric tube				>1 ppm	
Perchloroethylene	25 ppm	* Sensidyne colorimetric tube				>12 ppm	
Chloroform	2	* Sensidyne colorimetric tube				>1 ppm	
Nuisance dust	10 mg/m³	MIE Miniram	0.1 -100 mg/m³	0 -2.5	> 2.5 mg/m³		

Personal Monitoring:

Contaminant	Analytical Method	NOTES
Chlorinated Hydrocarbons	NIOSH 1003	if level B/C action levels reached

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves 11 mil outer	Silvershield Gloves	Other	Full-face Respirator	NOTES
Well Abandonment		X		X	X			GMC-H type	Saranex if body contact w/ free liquids likely; 11 mil Nitrile gloves if hand contact w/free liquids likely
Geophysical Logging		X		X	X				see above
Radiation Survey									
Other: discrete water sampling		X		X	X				see above

Shading indicates upgrades in PPE if action levels are reached

7 of 9 Lmc 8/22/94

94 - DME - SRM - CC97

Site Location and Description

Location: 24093, 25093

Description: Well will be abandoned. Potential Contaminants include solvents including carbon tetrachloride, chloroform and perchloroethylene, radionuclides

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Volatile organic compounds		PID	0-2000 ppm		5-25 ppm	>25ppm	*tube samples req'd if PID reads above background
Carbon tetrachloride	2 ppm	* Sensidyne colorimetric tube				>1 ppm	
Perchloroethylene	25 ppm	* Sensidyne colorimetric tube				>12 ppm	
Chloroform	2 ppm	* Sensidyne colorimetric tube				>1 ppm	

Personal Monitoring:

Contaminant	Analytical Method	NOTES
Chlorinated Hydrocarbons	NIOSH 1003	if level B/C action levels reached

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves 11 mil outer	Silvershield Gloves	Othfger	Full-face Respirator	NOTES
Well Abandonment		X		X	X			GMC-H type	Saranex if body contact w/free liquids likely; 11 mil Nitrile gloves if hand contact w/free liquids likely

Shading indicates upgrades in PPE if action levels are reached

8 of 9 lmc 8/22/94

94-DMR-ERM-087

Site Location and Description

Location: 11694, 11794

Description: Two wells to be installed

Suspect Contaminants:

MONITORING REQUIREMENTS				ACTION LEVELS			
Contaminant	PEL	Instrument	Range	Level D Modified	Level C	Level B	Notes
Volatile organic compounds		PID	0 - 2000 ppm	0 - 5 ppm	5 - 25 ppm	>25 ppm	
Nuisance dust	10 mg/m^3	MIE Miniram	0.1 - 100 mg/m^3	0 - 2.5 mg/m^3	>2.5 mg/m^3		

Personal Monitoring:

Contaminant	Analytical Method	Notes

Personal Protective Equipment:

Type of Work	Level D	Level D Modified	Tyvek Coveralls	Saranex Coveralls	Nitrile Gloves 11 mil outer	Silvershield Gloves	Other	Full-face Respirator	Notes
Well Installation	X		X	X				GMC-H	Tyvek coveralls may be worn if dust action levels are exceeded; Saranex if VOC action levels are exceeded
Radiation Survey									

Shading indicates upgrades in PPE if action levels are reached

9 of 9 lmc 8/22/94

APPENDIX D

SELECTED ANALYTICAL DATA

TMA

Thermo Analytical Inc.
TMA/Eberline Albuquerque Laboratory
7021 Pan American Hwy. NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 761-5416

FACSIMILE COVER SHEET

DATE: 2/24/94

TO: **COMPANY NAME:** EG&G

INDIVIDUAL: Matt Gardner

FAX NUMBER: 1 (303) 566-8575

TELEPHONE #: 1 (303) 966-8660

FROM: Dana / Dennis Hicks

Number of pages being sent (including this page): 12

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If you have received this facsimile in error, plea
and return the original facsimile to us at the above
Service. Thank you.

1993 UTL	pCi/L	$\bar{X}$
Am 241	0.03	0.01
α	390.58	43.5
β	221.31	24.9
Pu 239-240	0.06	0.00

IF YOU DO NOT RECEIVE ALL OF THIS TRA
FACSIMILE OPERATOR (Receptionist) AT (505) 34

OPERATOR NAME: (Receptionist)

COMMENTS:

			VIA
5670A	= 00237		✓
5170	= 00240	Pu, x, β Am	✓
0254	= 00241	x, β ?	✓
5570	= 00238	Pu, x, β, Am	✓
5770	= 00239 ? = 5270	Pu, x, β	✓

REV. 1 7/28/93

9402163-04

TMA/EBERLINE
ROCKY FLATS, SDG RF366

DATA SHEET

GW00241GA

0254

SDG	RF366	Client	EG&G Rocky Flats
Contact	Jeanette DeBar	Contract	

Lab sample id	9402163-04	Client sample id	GW00241GA		Filtered
Dept sample id		Location/Matrix/Level		WATER	
Received	02/18/94	Collected/Volume/Basis	02/15/94	1010 ML	
% moisture		Chain of Custody/SAS no	RFP941454		

ANALYTE	CAS NO	RESULT pCi/L	2σ ERR (TOTAL)	MDA pCi/L	RDL pCi/L	QUALIFIERS	TEST
Gross Alpha	14127-62-9	4.8	1.4	0.77	2.0	B	GA
Gross Beta	12587-47-2	4.7	1.9	2.4	4.0		GB

Lab id	TMAE
Protocol	GRRASP
Version	Ver 2.1
Form	DVD-DS
Version	2.28
Report date	02/28/94

9402163-03

TMA/EBERLINE
ROCKY FLATS, SDG RF366

DATA SHEET

GW002408A

SDG RF366 | Client EG&G Rocky Flats
Contact Jeanette DeBar | Contract 5170

Lab sample id 9402163-03 | Client sample id GW002408A | Filtered
Dept sample id | Location/Matrix/Level | WATER
Received 02/18/94 | Collected/Volume/Basis 02/15/94 | 990 ML
% moisture | Chain of Custody/SAS no RFP941456

ANALYTE	CAS NO	RESULT pCi/L	2σ ERR (TOTAL)	MDA pCi/L	RDL pCi/L	QUALIFIERS	TEST
Gross Alpha	14127-62-9	4.5	1.4	0.91	2.0	B	GA
Gross Beta	12587-47-2	7.8	2.4	2.6	4.0		GB

Lab id TMAE
Protocol GRRASP
Version Ver 2.1
Form DVD-DS
Version 2.2B
Report date 02/25/94

9402162-03

TMA/EBERLINE
ROCKY FLATS, SDG RF365

DATA SHEET

GW00240GA

5170

SDG	RF365	Client	EG&G Rocky Flats
Contact	Jeanette DeBar	Contract	

Lab sample id	9402162-03	Client sample id	GW00240GA		
Dept sample id		Location/Matrix/Level		WATER	
Received	02/18/94	Collected/Volume/Basis	02/15/94	7507 ML	
% moisture		Chain of Custody/SAS no	RFP941456		

ANALYTE	CAS NO	RESULT pCi/L	2σ ERR (TOTAL)	MDA pCi/L	RDL pCi/L	QUALI-FIERS	TEST
Americium 241	14596-10-2	0.005	0.006	0.008	0.010	U	AM
Plutonium 239/240	10-12-8	0.002	0.006	0.012	0.010	U	PU

Lab id	TMAE
Protocol	GRRASP
Version	Ver 2.1
Form	DVD-DS
Version	2.28
Report date	03/01/94

9402163-05

TMA/EBERLINE
ROCKY FLATS, SDG RF366

DATA SHEET

GW00239GA

5276

SDG	RF366	Client	EG&G Rocky Flats
Contact	Jeanette DeBar	Contract	

Lab sample id	9402163-05	Client sample id	GW00239GA		Filtered
Dept sample id		Location/Matrix/Level		WATER	
Received	02/18/94	Collected/Volume/Basis	02/15/94	993 ML	
% moisture		Chain of Custody/SAS no	RFP941454		

ANALYTE	CAS NO	RESULT pCi/L	2σ ERR (TOTAL)	MDA pCi/L	RDL pCi/L	QUALI-FIERS	TEST
Gross Alpha	14127-62-9	0.37	0.44	0.58	2.0	U	GA
Gross Beta	12587-47-2	0.26	1.8	1.0	4.0	U	GB

Lab id	TMAE
Protocol	GRRASP
Version	Ver 2.1
Form	DVD-DS
Version	2.28
Report date	02/28/94

9402162-04

TMA/EBERLINE
ROCKY FLATS, SDG RF365

DATA SHEET

GW002396A

527D

SDG RF365 Client EG&G Rocky Flats
Contact Jeanette DeBar Contract

Lab sample id 9402162-04 Client sample id GW002396A
Dept sample id Location/Matrix/Level WATER
Received 02/18/94 Collected/Volume/Basis 02/15/94 7566 ML
% moisture Chain of Custody/SAS no RFP941454

ANALYTE	CAS NO	RESULT pCi/L	2σ ERR (TOTAL)	MDA pCi/L	RDL pCi/L	QUALI-FIERS	TEST
Plutonium 239/240	10-12-8	0.021	0.016	0.020	0.010		PU

Lab id TMAE
Protocol GRRASP
Version Ver 2.1
Form DVD-DS
Version 2.28
Report date 03/01/94

9402163-06

TMA/EBERLINE
ROCKY FLATS, SDG RF366

DATA SHEET

GW002380A

5570

SDG RF366
Contact Jeanette DeBar
Client EG&G Rocky Flats
Contract

Lab sample id 9402163-06
Dept sample id
Received 02/18/94
% moisture

Client sample id GW002380A
Location/Matrix/Level
Collected/Volume/Basis 02/15/94
Chain of Custody/SAS no RFP941454

Filtered
WATER
995 ML

ANALYTE	CAS NO	RESULT pCi/L	2σ ERR (TOTAL)	MDA pCi/L	RDL pCi/L	QUALIFIERS	TEST
Gross Alpha	14127-62-9	-0.1	2.4	0.77	2.0	B	GA
Gross Beta	12587-47-2	1.2	2.0	3.2	4.0	U	GB

Lab id TMAE
Protocol GRRASP
Version Ver 2.1
Form DVD-DS
Version 2.28
Report date 02/28/94

9402167-01

TMA/EBERLINE

ROCKY FLATS, SDG RF365

DUPLICATE

GW00238GA

5570

SDG	RF365			Client	EG&G Rocky Flats
Contact	Jeanette DeBar			Contract	
	DUPLICATE		ORIGINAL		
Lab sample id	9402167-01	Lab sample id	9402162-05	Client sample id	GW00238GA
Dept sample id		Dept sample id		Location/Matrix/Level	WATER
Client samp id		Received	02/18/94	Collected/Volume/Basis	02/15/94 7642 ML
% moisture		% moisture		Chain of Custody/SAS no	RFP941454

ANALYTE	DUPLICATE pCi/L	2σ ERR (TOTAL)	MDA pCi/L	RDL pCi/L	QUALI-FIERS	TEST	ORIGINAL pCi/L	2σ ERR (TOTAL)	MDA pCi/L	QUALI-FIERS	RPD %	3σ TOT	PROT LIMIT
Americium 241	0	0	0.053	0.010	U	AM	0.002	0.004	0.009	U	--		
Plutonium 239/240	0.008	0.008	0.007	0.010	J	PU	0.003	0.006	0.008	U	91	273	

Lab id	TMAE
Protocol	GRRASP
Version	Ver 2.1
Form	DVD-DUP
Version	2.28
Report date	03/01/94

9402162-05

TMA/EBERLINE
ROCKY FLATS, SDG RF365

DATA SHEET

GW00238GA

5570

SDG	RF365	Client	EG&G Rocky Flats
Contact	Jeanette DeBar	Contract	
Lab sample id	9402162-05	Client sample id	GW00238GA
Dept sample id		Location/Matrix/Level	WATER
Received	02/18/94	Collected/Volume/Basis	02/15/94 7642 ML
% moisture		Chain of Custody/SAS no	RFP941454

ANALYTE	CAS NO	RESULT pCi/L	2σ ERR (TOTAL)	MDA pCi/L	MDL pCi/L	QUALIFIERS	TEST
Americium 241	14596-10-2	0.002	0.004	0.009	0.010	U	AM
Plutonium 239/240	10-12-8	0.003	0.006	0.008	0.010	U	PU

Lab id	TMAE
Protocol	GRRASP
Version	Ver 2.1
Form	DVD-DS
Version	2.28
Report date	03/01/94

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1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

(21)

EPA SAMPLE

GW00241GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: 040216301

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6050217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/17/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 5

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		UNKNOWN	18.94	0.12	J
2.	526-73-8	BENZENE, 1,2,3-TRIMETHYL-	19.55	0.47	J
3.	3389-54-6	1-BENZOYLPYRROLIDINE	20.24	0.38	J
4.		UNKNOWN	20.72	0.22	J
5.	673-32-5	BENZENE, 1-PROPYNYL-	21.02	0.28	J

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(19)

EPA SAMPLE

GW00241GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444U

Matrix: (soil/water) WATER Lab Sample ID: Q40216301

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6050217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/17/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	0.41	U
74-83-9	Bromomethane	0.51	U
75-01-4	Vinyl Chloride	0.21	U
75-00-3	Chloroethane	0.41	U
75-09-2	Methylene Chloride	0.11	U
75-35-4	1,1-Dichloroethene	0.21	U
75-34-3	1,1-Dichloroethane	0.11	U
67-66-3	Chloroform	0.11	U
107-06-2	1,2-Dichloroethane	0.41	U
74-97-5	Bromochloromethane	0.51	U
71-55-6	1,1,1-Trichloroethane	0.11	U
56-23-5	Carbon Tetrachloride	0.21	U
75-27-4	Bromodichloromethane	0.21	U
78-87-5	1,2-Dichloropropane	0.11	U
10061-01-5	cis-1,3-Dichloropropene	0.21	U
79-01-6	Trichloroethene	0.11	U
124-48-1	Dibromochloromethane	0.21	U
79-00-5	1,1,2-Trichloroethane	0.61	U
71-43-2	Benzene	0.11	U
10061-02-6	Trans-1,3-Dichloropropene	0.41	U
75-25-2	Bromoform	0.31	U
127-18[redacted]	Tetrachloroethene	0.11	U
79-34[redacted]	1,1,2,2-Tetrachloroethane	0.21	U
108-8[redacted]	Toluene	0.11	U
108-9[redacted]	Chlorobenzene	0.21	U
100-41-4	Ethylbenzene	0.21	U
100-42-5	Styrene	0.11	U
95-47-6	O-XYLENE	0.21	U
95-50-1	1,2-DICHLOROBENZENE	0.11	U
106-46-7	1,4-DICHLOROBENZENE	0.21	U
91-20-3	NAPHTHALENE	1	X
87-61-6	1,2,3-TRICHLOROBENZENE	0.21	U
120-82-1	1,2,4-TRICHLOROBENZENE	0.31	U
108-67-8	1,3,5-TRIMETHYLBENZENE	0.21	U
95-63-6	1,2,4-TRIMETHYLBENZENE	0.21	U
104-51-8	N-BUTYLBENZENE	0.21	U

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98-06-6	TERT-BUTYLBENZENE	0.21U
106-43-4	4-CHLOROTOLUENE	0.21U
541-73-1	1,3-DICHLOROBENZENE	0.21U
135-98-8	SEC-BUTYLBENZENE	0.21U
103-65-1	N-PROPYLBENZENE	0.21U
95-49-8	2-CHLOROTOLUENE	0.31U
87-68-3	HEXACHLOROBUTADIENE	0.21U
99-87-6	4-ISOPROPYLTOLUENE	0.21U
98-82-8	ISOPROPYLBENZENE	0.21U
108-86-1	BROMOBENZENE	0.21U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.41U
96-18-4	1,2,3-TRICHLOROPROPANE	0.41U
630-20-6	1,1,1,2-TETRACHLOROETHANE	0.21U
106-93-4	1,2-DIBROMOETHANE	0.31U
563-58-6	1,1-DICHLOROPROPENE	0.11U
142-28-9	1,3-DICHLOROPROPANE	0.21U
594-20-7	2,2-DICHLOROPROPANE	0.11U
74-95-3	DIBROMOMETHANE	0.31U
75-69-4	TRICHLORFLUOROMETHANE	0.21U
75-71-8	DICHLORODIFLUOROMETHANE	0.21U
156-60-5	TRANS 1,2-DICHLOROETHENE	0.21U
156-59-2	CIS 1,2-DICHLOROETHENE	0.21U
136777-61-2	M,P-XYLENE	0.21U

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98-06-6---------TERT-BUTYLBENZENE	50	U
106-43-4---------4-CHLOROTOLUENE	50	U
541-73-1---------1,3-DICHLOROBENZENE	50	U
135-98-8---------SEC-BUTYLBENZENE	50	U
103-65-1---------N-PROPYLBENZENE	50	U
95-49-8---------2-CHLOROTOLUENE	75	U
87-68-3---------HEXACHLOROBUTADIENE	50	U
99-87-6---------4-ISOPROPYLTOLUENE	50	U
98-82-8---------ISOPROPYLBENZENE	50	U
108-86-1---------BROMOBENZENE	50	U
96-12-8---------1,2-DIBROMO-3-CHLOROPROPANE	100	U
96-18-4---------1,2,3-TRICHLOROPROPANE	100	U
630-20-6---------1,1,1,2-TETRACHLOROETHANE	50	U
106-93-4---------1,2-DIBROMOETHANE	75	U
563-58-6---------1,1-DICHLOROPROPENE	25	U
142-28-9---------1,3-DICHLOROPROPANE	50	U
594-20-7---------2,2-DICHLOROPROPANE	25	U
74-95-3---------DIBROMOMETHANE	75	U
75-69-4---------TRICHLORFLUOROMETHANE	50	U
75-71-8---------DICHLORODIFLUOROMETHANE	50	U
156-60-5---------TRANS 1,2-DICHLOROETHENE	50	U
156-59-2---------CIS 1,2-DICHLOROETHENE	50	U
/36777-61-2------M,P-XYLENE	50	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

(1) 5670A

EPA SAMPLE NO.

GW00237GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: Q40216401

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6020218D

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/18/94

Column: (pack/cap) CAP Dilution Factor: 250

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	100	U
74-83-9	Bromomethane	120	U
75-01-4	Vinyl Chloride	50	U
75-00-3	Chloroethane	100	U
75-09-2	Methylene Chloride	310	
75-35-4	1,1-Dichloroethene	50	U
75-34-3	1,1-Dichloroethane	25	U
67-66-3	Chloroform	2200	
107-06-2	1,2-Dichloroethane	100	U
74-97-5	Bromochloromethane	120	U
71-55-6	1,1,1-Trichloroethane	25	U
56-23-5	Carbon Tetrachloride	8800	
75-27-4	Bromodichloromethane	50	U
78-87-5	1,2-Dichloropropane	25	U
10061-01-5	cis-1,3-Dichloropropene	50	U
79-01-6	Trichloroethene	25	U
124-48-1	Dibromochloromethane	50	U
79-00-5	1,1,2-Trichloroethane	150	U
71-43-2	Benzene	25	U
10061-02-6	Trans-1,3-Dichloropropene	100	U
75-25-2	Bromoform	75	U
127-18-4	Tetrachloroethene	620	
79-34-5	1,1,2,2-Tetrachloroethane	50	U
108-88-3	Toluene	25	U
108-90-7	Chlorobenzene	50	U
100-41-4	Ethylbenzene	50	U
100-42-5	Styrene	25	U
95-47-6	O-XYLENE	50	U
95-50-1	1,2-DICHLOROBENZENE	25	U
106-46-7	1,4-DICHLOROBENZENE	50	U
91-20-3	NAPHTHALENE	50	U
87-61-6	1,2,3-TRICHLOROBENZENE	50	U
120-82-1	1,2,4-TRICHLOROBENZENE	75	U
108-67-8	1,3,5-TRIMETHYLBENZENE	50	U
95-63-6	1,2,4-TRIMETHYLBENZENE	50	U
104-51-8	N-BUTYLBENZENE	50	U

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DATE: 2-25-94

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1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE

GW00237GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: 040216401

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6020218D

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. _____ Date Analyzed: 02/18/94

Column (pack/cap) CAP Dilution Factor: 250

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

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VOLATILE ORGANICS ANALYSIS DATA SHEET

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EPA SAMPLE NO.

GW00238GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: 040216201

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6020217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. _____ Date Analyzed: 02/17/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	Q
74-87-3	Chloromethane	0.41U
74-83-9	Bromomethane	0.51U
75-01-4	Vinyl Chloride	0.21U
75-00-3	Chloroethane	0.41U
75-09-2	Methylene Chloride	0.11U
75-35-4	1,1-Dichloroethene	0.21U
75-34-3	1,1-Dichloroethane	0.11U
67-66-3	Chloroform	0.11U
107-06-2	1,2-Dichloroethane	0.41U
74-97-5	Bromochloromethane	0.51U
71-55-6	1,1,1-Trichloroethane	0.11U
56-23-5	Carbon Tetrachloride	0.21U
75-27-4	Bromodichloromethane	0.21U
78-87-5	1,2-Dichloropropane	0.11U
10061-01-5	cis-1,3-Dichloropropene	0.21U
79-01-6	Trichloroethene	5
124-48-1	Dibromochloromethane	0.21U
79-00-5	1,1,2-Trichloroethane	0.61U
71-43-2	Benzene	0.11U
10061-02-6	Trans-1,3-Dichloropropene	0.41U
75-25-2	Bromoform	0.31U
127-18-4	Tetrachloroethene	0.11
79-34-5	1,1,2,2-Tetrachloroethane	0.21U
108-88-3	Toluene	0.11U
108-90-7	Chlorobenzene	0.21U
100-41-4	Ethylbenzene	0.21U
100-42-5	Styrene	0.11U
95-47-6	O-XYLENE	0.21U
95-50-1	1,2-DICHLOROBENZENE	0.11U
106-46-7	1,4-DICHLOROBENZENE	0.21U
91-20-3	NAPHTHALENE	0.21U
87-61-6	1,2,3-TRICHLOROBENZENE	0.21U
120-82-1	1,2,4-TRICHLOROBENZENE	0.31U
108-67-8	1,3,5-TRIMETHYLBENZENE	0.21U
95-63-6	1,2,4-TRIMETHYLBENZENE	0.21U
104-51-8	N-BUTYLBENZENE	0.21U

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98-06-6	TERT-BUTYLBENZENE	0.21U
106-43-4	4-CHLOROTOLUENE	0.21U
541-73-1	1,3-DICHLOROBENZENE	0.21U
135-98-8	SEC-BUTYLBENZENE	0.21U
103-65-1	N-PROPYLBENZENE	0.21U
95-49-8	2-CHLOROTOLUENE	0.31U
87-68-3	HEXACHLOROBUTADIENE	0.21U
99-87-6	4-ISOPROPYLTOLUENE	0.21U
98-82-8	ISOPROPYLBENZENE	0.21U
108-86-1	BROMOBENZENE	0.21U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.41U
96-18-4	1,2,3-TRICHLOROPROPANE	0.41U
630-20-6	1,1,1,2-TETRACHLOROETHANE	0.21U
106-93-4	1,2-DIBROMOETHANE	0.31U
563-58-6	1,1-DICHLOROPROPENE	0.11U
142-28-9	1,3-DICHLOROPROPANE	0.21U
594-20-7	2,2-DICHLOROPROPANE	0.11U
74-95-3	DIBROMOMETHANE	0.31U
75-69-4	TRICHLORFLUOROMETHANE	0.21U
75-71-8	DICHLORODIFLUOROMETHANE	0.21U
156-60-5	TRANS 1,2-DICHLOROETHENE	0.21U
156-59-2	CIS 1,2-DICHLOROETHENE	0.71X
36777-61-2	M,P-XYLENE	0.21U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

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EPA SAMPLE NO

GW00238G

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: Q40216201

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6020217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/17/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

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EPA SAMPLE N

GW00238GADL

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: 040216201

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6030217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. _____ Date Analyzed: 02/17/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	0.4	U
74-83-9	Bromomethane	0.5	U
75-01-4	Vinyl Chloride	0.2	U
75-00-3	Chloroethane	0.4	U
75-09-2	Methylene Chloride	0.1	U
75-35-4	1,1-Dichloroethene	0.2	U
75-34-3	1,1-Dichloroethane	0.1	U
67-66-3	Chloroform	0.1	U
107-06-2	1,2-Dichloroethane	0.4	U
74-97-5	Bromochloromethane	0.5	U
71-55-6	1,1,1-Trichloroethane	0.1	U
56-23-5	Carbon Tetrachloride	0.2	U
75-27-4	Bromodichloromethane	0.2	U
78-87-5	1,2-Dichloropropane	0.1	U
10061-01-5	cis-1,3-Dichloropropene	0.2	U
79-01-6	Trichloroethene	5	
124-48-1	Dibromochloromethane	0.2	U
79-00-5	1,1,2-Trichloroethane	0.6	U
71-43-2	Benzene	0.1	U
10061-02-6	Trans-1,3-Dichloropropene	0.4	U
75-25-2	Bromoform	0.3	U
127-18-4	Tetrachloroethene	0.1	U
79-34-5	1,1,2,2-Tetrachloroethane	0.2	U
108-88-3	Toluene	0.1	U
108-90-7	Chlorobenzene	0.2	U
100-41-4	Ethylbenzene	0.2	U
100-42-5	Styrene	0.1	U
95-47-6	O-XYLENE	0.2	U
95-50-1	1,2-DICHLOROBENZENE	0.1	U
106-46-7	1,4-DICHLOROBENZENE	0.2	U
91-20-3	NAPHTHALENE	0.2	U
87-61-6	1,2,3-TRICHLOROBENZENE	0.2	U
120-82-1	1,2,4-TRICHLOROBENZENE	0.3	U
108-67-8	1,3,5-TRIMETHYLBENZENE	0.2	U
95-63-6	1,2,4-TRIMETHYLBENZENE	0.2	U
104-51-8	N-BUTYLBENZENE	0.2	U

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98-06-6	TERT-BUTYLBENZENE	0.21U
106-43-4	4-CHLOROTOLUENE	0.21U
541-73-1	1,3-DICHLOROBENZENE	0.21U
135-98-8	SEC-BUTYLBENZENE	0.21U
103-65-1	N-PROPYLBENZENE	0.21U
95-49-8	2-CHLOROTOLUENE	0.31U
87-68-3	HEXACHLOROBUTADIENE	0.21U
99-87-6	4-ISOPROPYLTOLUENE	0.21U
98-82-8	ISOPROPYLBENZENE	0.21U
108-86-1	BROMOBENZENE	0.21U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.41U
96-18-4	1,2,3-TRICHLOROPROPANE	0.41U
630-20-6	1,1,1,2-TETRACHLOROETHANE	0.21U
106-93-4	1,2-DIBROMOETHANE	0.31U
563-58-6	1,1-DICHLOROPROPENE	0.11U
142-28-9	1,3-DICHLOROPROPANE	0.21U
594-20-7	2,2-DICHLOROPROPANE	0.11U
74-95-3	DIBROMOMETHANE	0.31U
75-69-4	TRICHLORFLUOROMETHANE	0.21U
75-71-8	DICHLORODIFLUOROMETHANE	0.21U
156-60-5	TRANS 1,2-DICHLOROETHENE	0.21U
156-59-2	CIS 1,2-DICHLOROETHENE	0.71X
136777-61-2	M,P-XYLENE	0.21U

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(9)

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE

GW00238GAI

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: Q40216201

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6030217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/17/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

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VOLATILE ORGANICS ANALYSIS DATA SHEET

(10)

EPA SAMPLE NO

GW00239GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: Q40216203

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6040217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. _____ Date Analyzed: 02/17/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	Q
74-87-3	Chloromethane	0.41U
74-83-9	Bromomethane	0.51U
75-01-4	Vinyl Chloride	0.21U
75-00-3	Chloroethane	0.41U
75-09-2	Methylene Chloride	0.11U
75-35-4	1,1-Dichloroethene	0.21U
75-34-3	1,1-Dichloroethane	0.11U
67-66-3	Chloroform	0.11U
107-06-2	1,2-Dichloroethane	0.41U
74-97-5	Bromochloromethane	0.51U
71-55-6	1,1,1-Trichloroethane	0.11U
56-23-5	Carbon Tetrachloride	0.21U
75-27-4	Bromodichloromethane	0.21U
78-87-5	1,2-Dichloropropane	0.11U
10061-01-5	cis-1,3-Dichloropropene	0.21U
79-01-6	Trichloroethene	0.11U
124-48-1	Dibromochloromethane	0.21U
79-00-5	1,1,2-Trichloroethane	0.61U
71-43-2	Benzene	0.11U
10061-02-6	Trans-1,3-Dichloropropene	0.41U
75-25-2	Bromoform	0.31U
127-18-4	Tetrachloroethene	0.11U
79-34-5	1,1,2,2-Tetrachloroethane	0.21U
108-88-3	Toluene	0.11U
108-90-7	Chlorobenzene	0.21U
100-41-4	Ethylbenzene	0.21U
100-42-5	Styrene	0.11U
95-47-6	O-XYLENE	0.21U
95-50-1	1,2-DICHLOROBENZENE	0.11U
106-46-7	1,4-DICHLOROBENZENE	0.21U
91-20-3	NAPHTHALENE	0.21U
87-61-6	1,2,3-TRICHLOROBENZENE	0.21U
120-82-1	1,2,4-TRICHLOROBENZENE	0.31U
108-67-8	1,3,5-TRIMETHYLBENZENE	0.21U
95-63-6	1,2,4-TRIMETHYLBENZENE	0.21U
104-51-8	N-BUTYLBENZENE	0.21U

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98-06-6---------TERT-BUTYLBENZENE	0.21U
106-43-4---------4-CHLOROTOLUENE	0.21U
541-73-1---------1,3-DICHLOROBENZENE	0.21U
135-98-8---------SEC-BUTYLBENZENE	0.21U
103-65-1---------N-PROPYLBENZENE	0.21U
95-49-8---------2-CHLOROTOLUENE	0.31U
87-68-3---------HEXACHLOROBUTADIENE	0.21U
99-87-6---------4-ISOPROPYLTOLUENE	0.21U
98-82-8---------ISOPROPYLBENZENE	0.21U
108-86-1---------BROMOBENZENE	0.21U
96-12-8---------1,2-DIBROMO-3-CHLOROPROPANE	0.41U
96-18-4---------1,2,3-TRICHLOROPROPANE	0.41U
630-20-6---------1,1,1,2-TETRACHLOROETHANE	0.21U
106-93-4---------1,2-DIBROMOETHANE	0.31U
563-58-6---------1,1-DICHLOROPROPENE	0.11U
142-28-9---------1,3-DICHLOROPROPANE	0.21U
594-20-7---------2,2-DICHLOROPROPANE	0.11U
74-95-3---------DIBROMOMETHANE	0.31U
75-69-4---------TRICHLORFLUOROMETHANE	0.21U
75-71-8---------DICHLORODIFLUOROMETHANE	0.21U
156-60-5---------TRANS 1,2-DICHLOROETHENE	0.21U
156-59-2---------CIS 1,2-DICHLOROETHENE	0.21U
36777-61-2------M,P-XYLENE	0.21U

5 27D

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

(12)

EPA SAMPLE NO.

GW00239GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: D40216203

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6040217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/17/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 95-93-2	BENZENE, 1,2,4,5-TETRAMETHYL	21.72	0.33	J

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

(13)

EPA SAMPLE

GW0024OGA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04916 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: Q40216302

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6060217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/17/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	Q
74-87-3	Chloromethane	0.41U
74-83-9	Bromomethane	0.51U
75-01-4	Vinyl Chloride	0.21U
75-00-3	Chloroethane	0.41U
75-09-2	Methylene Chloride	0.11U
75-35-4	1,1-Dichloroethene	0.21U
75-34-3	1,1-Dichloroethane	0.61U
67-66-3	Chloroform	0.11U
107-06-2	1,2-Dichloroethane	0.41U
74-97-5	Bromochloromethane	0.51U
71-55-6	1,1,1-Trichloroethane	0.11U
56-23-5	Carbon Tetrachloride	0.21U
75-27-4	Bromodichloromethane	0.21U
78-87-5	1,2-Dichloropropane	0.11U
10061-01-5	cis-1,3-Dichloropropene	0.21U
79-01-6	Trichloroethene	0.11U
124-48-1	Dibromochloromethane	0.21U
79-00-5	1,1,2-Trichloroethane	0.61U
71-43-2	Benzene	0.11U
10061-02-6	Trans-1,3-Dichloropropene	0.41U
75-25-2	Bromoform	0.31U
127-18-4	Tetrachloroethene	0.11U
79-34-5	1,1,2,2-Tetrachloroethane	0.21U
108-88-3	Toluene	0.11U
108-90-7	Chlorobenzene	0.21U
100-41-4	Ethylbenzene	0.21U
100-42-5	Styrene	0.11U
95-47-6	O-XYLENE	0.21U
95-50-1	1,2-DICHLOROBENZENE	0.11U
106-46-7	1,4-DICHLOROBENZENE	0.21U
91-20-3	NAPHTHALENE	0.21U
87-61-6	1,2,3-TRICHLOROBENZENE	0.21U
120-82-1	1,2,4-TRICHLOROBENZENE	0.31U
108-67-8	1,3,5-TRIMETHYLBENZENE	0.21U
95-63-6	1,2,4-TRIMETHYLBENZENE	0.21U
104-51-8	N-BUTYLBENZENE	0.21U

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DATE: 2/24/94

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GW0024U6A

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98-06-6	TERT-BUTYLBENZENE	0.2 U
106-43-4	4-CHLOROTOLUENE	0.2 U
541-73-1	1,3-DICHLOROBENZENE	0.2 U
135-98-8	SEC-BUTYLBENZENE	0.2 U
103-65-1	N-PROPYLBENZENE	0.2 U
95-49-8	2-CHLOROTOLUENE	0.3 U
87-68-3	HEXACHLOROBUTADIENE	0.2 U
99-87-6	4-ISOPROPYLTOLUENE	0.2 U
98-82-8	ISOPROPYLBENZENE	0.2 U
108-86-1	BROMOBENZENE	0.2 U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.4 U
96-18-4	1,2,3-TRICHLOROPROPANE	0.4 U
630-20-6	1,1,1,2-TETRACHLOROETHANE	0.2 U
106-93-4	1,2-DIBROMOETHANE	0.3 U
563-58-6	1,1-DICHLOROPROPENE	0.1 U
142-28-9	1,3-DICHLOROPROPANE	0.2 U
594-20-7	2,2-DICHLOROPROPANE	0.1 U
74-95-3	DIBROMOMETHANE	0.3 U
75-69-4	TRICHLORFLUOROMETHANE	0.2 U
75-71-8	DICHLORODIFLUOROMETHANE	0.2 U
156-60-5	TRANS 1,2-DICHLOROETHENE	0.2 U
156-59-2	CIS 1,2-DICHLOROETHENE	0.2 U
36777-61-2	M,P-XYLENE	0.2 U

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1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

(15)

EPA SAMPLE

GW0024OGF

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: 040216302

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6060217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/17/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 7

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 96-14-0	PENTANE, 3-METHYL-	6.80	1.1	J
2.	UNKNOWN	7.22	0.77	J
3.	UNKNOWN	8.47	0.18	J
4.	UNKNOWN	9.44	0.40	J
5.	UNKNOWN	19.80	0.22	J
6.	UNKNOWN	22.35	0.10	J
7.	UNKNOWN	23.74	1.6	J

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

(16)

EPA SAMPLE

GW00240GARE

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: Q40216302

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6110217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. _____ Date Analyzed: 02/17/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	Q
74-87-3	Chloromethane	0.41U
74-83-9	Bromomethane	0.51U
75-01-4	Vinyl Chloride	0.21U
75-00-3	Chloroethane	0.41U
75-09-2	Methylene Chloride	0.11U
75-35-4	1,1-Dichloroethene	0.21U
75-34-3	1,1-Dichloroethane	0.71X
67-66-3	Chloroform	0.11U
107-06-2	1,2-Dichloroethane	0.41U
74-97-5	Bromochloromethane	0.51U
71-55-6	1,1,1-Trichloroethane	0.11U
56-23-5	Carbon Tetrachloride	0.21U
75-27-4	Bromodichloromethane	0.21U
78-87-5	1,2-Dichloropropane	0.11U
10061-01-5	cis-1,3-Dichloropropene	0.21U
79-01-6	Trichloroethene	0.11U
124-48-1	Dibromochloromethane	0.21U
79-00-5	1,1,2-Trichloroethane	0.61U
71-43-2	Benzene	0.11U
10061-02-6	Trans-1,3-Dichloropropene	0.41U
75-25-2	Bromoform	0.31U
127-18-4	Tetrachloroethene	0.11U
79-34-5	1,1,2,2-Tetrachloroethane	0.21U
108-88-[illegible]	Toluene	0.11U
108-90-[illegible]	Chlorobenzene	0.21U
100-41-4	Ethylbenzene	0.21U
100-42-5	Styrene	0.11U
95-47-6	O-XYLENE	0.21U
95-50-1	1,2-DICHLOROBENZENE	0.11U
106-46-7	1,4-DICHLOROBENZENE	0.21U
91-20-3	NAPHTHALENE	0.21U
87-61-6	1,2,3-TRICHLOROBENZENE	0.21U
120-82-1	1,2,4-TRICHLOROBENZENE	0.31U
108-67-8	1,3,5-TRIMETHYLBENZENE	0.21U
95-63-6	1,2,4-TRIMETHYLBENZENE	0.21U
104-51-8	N-BUTYLBENZENE	0.21U

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GW002406ARE

98-06-6	TERT-BUTYLBENZENE	0.21U
106-43-4	4-CHLOROTOLUENE	0.21U
541-73-1	1,3-DICHLOROBENZENE	0.21U
135-98-8	SEC-BUTYLBENZENE	0.21U
103-65-1	N-PROPYLBENZENE	0.21U
95-49-8	2-CHLOROTOLUENE	0.31U
87-68-3	HEXACHLOROBUTADIENE	0.21U
99-87-6	4-ISOPROPYLTOLUENE	0.21U
98-82-8	ISOPROPYLBENZENE	0.21U
108-86-1	BROMOBENZENE	0.21U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.41U
96-18-4	1,2,3-TRICHLOROPROPANE	0.41U
630-20-6	1,1,1,2-TETRACHLOROETHANE	0.21U
106-93-4	1,2-DIBROMOETHANE	0.31U
563-58-6	1,1-DICHLOROPROPENE	0.11U
142-28-9	1,3-DICHLOROPROPANE	0.21U
594-20-7	2,2-DICHLOROPROPANE	0.11U
74-95-3	DIBROMOMETHANE	0.31U
75-69-4	TRICHLORFLUOROMETHANE	0.21U
75-71-8	DICHLORODIFLUOROMETHANE	0.21U
156-60-5	TRANS 1,2-DICHLOROETHENE	0.21U
156-59-2	CIS 1,2-DICHLOROETHENE	0.21U
36777-61-2	M,P-XYLENE	0.21U

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1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

(15)

EPA SAMPLE NO

GW00240BA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P444V

Matrix: (soil/water) WATER Lab Sample ID: Q40216302

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6110217M

Level: (low/med) LOW Date Received: 02/17/94

% Moisture: not dec. ____ Date Analyzed: 02/17/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 6

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	7.12	0.74	J
2.	UNKNOWN	7.62	0.20	J
3.	UNKNOWN	8.80	0.18	J
4. 922-28-1	HEPTANE, 3,4-DIMETHYL-	9.72	0.49	J
5.	UNKNOWN	19.84	0.16	J
6.	UNKNOWN	23.74	1.5	J

voa DATA - February 23,1994

Loc	ST	MATRIX	QC	Sample Number	Smpl Date	Anal Date	ID	21D	Group	Chemical	Result	Unit	Error	Qual	D.LMT	VA	RN1	RN2	RN3	RN4
5071	GW	WATER	REAL	GW01715WC	16-DEC-93	29-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	82	%			0.500					
5071	GW	WATER	REAL	GW01715WC	16-DEC-93	29-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	96	%			0.300					
5071	GW	WATER	REAL	GW01715WC	16-DEC-93	29-DEC-93	TRG		VOA524.2	METHYLENE CHLORIDE	0.8	UG/L			0.100					
5071	GW	WATER	REAL	GW01715WC	16-DEC-93	29-DEC-93	TRG		VOA524.2	TETRACHLOROETHENE	0.4	UG/L			0.100					
5474	GW	WATER	REAL	GW01717WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	103	%			0.500					
5474	GW	WATER	REAL	GW01717WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	114	%			0.300					
5971	GW	WATER	REAL	GW01798WC	17-DEC-93	31-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	102	%			0.500	Y				
5971	GW	WATER	REAL	GW01798WC	17-DEC-93	31-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	100	%			0.300	Y				
5971	GW	WATER	REAL	GW01798WC	17-DEC-93	31-DEC-93	TRG		VOA524.2	ETHYLBENZENE	0.3	UG/L			0.200	Y				
5974	GW	WATER	REAL	GW01720WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	80	%			0.500					
5974	GW	WATER	REAL	GW01720WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	83	%			0.500					
5974	GW	WATER	REAL	GW01720WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	105	%			0.300					
5974	GW	WATER	REAL	GW01720WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	96	%			0.300					
5974	GW	WATER	REAL	GW01720WC	16-DEC-93	30-DEC-93	FIX	TIC	VOA524.2	UNKNOWN	0.21	UG/L		J						
5974	GW	WATER	REAL	GW01720WC	16-DEC-93	30-DEC-93	RA1		VOA524.2	CHLOROFORM	0.3	UG/L			0.100					
5974	GW	WATER	REAL	GW01720WC	16-DEC-93	30-DEC-93	TRG		VOA524.2	CHLOROFORM	0.3	UG/L			0.100					
6274	GW	WATER	REAL	GW01721WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	101	%			0.500					
6274	GW	WATER	REAL	GW01721WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	105	%			0.300					
6274	GW	WATER	REAL	GW01721WC	16-DEC-93	30-DEC-93	TRG		VOA524.2	1,1,1-TRICHLOROETHANE	0.8	UG/L			0.100					
6274	GW	WATER	REAL	GW01721WC	16-DEC-93	30-DEC-93	TRG		VOA524.2	1,1-DICHLOROETHANE	3	UG/L			0.100					
6274	GW	WATER	REAL	GW01721WC	16-DEC-93	30-DEC-93	TRG		VOA524.2	CHLOROFORM	0.1	UG/L			0.100					
6274	GW	WATER	REAL	GW01721WC	16-DEC-93	30-DEC-93	TRG		VOA524.2	TRICHLOROETHENE	1	UG/L			0.100					
6274	GW	WATER	REAL	GW01721WC	16-DEC-93	30-DEC-93	TRG		VOA524.2	cis-1,2-DICHLOROETHENE	1	UG/L			0.200					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	31-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	84	%			0.500					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	31-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	85	%			0.300					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	31-DEC-93	TRG		VOA524.2	METHYLENE CHLORIDE	2	UG/L			0.100					
6474	GW	WATER	REAL	GW01723WC	15-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	109	%			0.500					
6474	GW	WATER	REAL	GW01723WC	15-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	113	%			0.300					
6474	GW	WATER	REAL	GW01723WC	15-DEC-93	30-DEC-93	TRG		VOA524.2	VINYL CHLORIDE	20	UG/L			0.200					
6574	GW	WATER	REAL	GW01724WC	15-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	101	%			0.500					
6574	GW	WATER	REAL	GW01724WC	15-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	104	%			0.300					
6574	GW	WATER	REAL	GW01724WC	15-DEC-93	30-DEC-93	FIX	TIC	VOA524.2	FURAN, TETRAHYDRO	4.6	UG/L		J						
6574	GW	WATER	REAL	GW01724WC	15-DEC-93	30-DEC-93	TRG		VOA524.2	VINYL CHLORIDE	14	UG/L			0.200					
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	98	%			0.500	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	103	%			0.300	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	TRG		VOA524.2	1,1,1-TRICHLOROETHANE	20	UG/L			0.100	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	TRG		VOA524.2	1,1-DICHLOROETHANE	4	UG/L			0.100	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	TRG		VOA524.2	1,1-DICHLOROETHENE	4	UG/L			0.200	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	TRG		VOA524.2	CHLOROFORM	0.8	UG/L			0.100	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	TRG		VOA524.2	TETRACHLOROETHENE	4	UG/L			0.100	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	TRG		VOA524.2	TRICHLOROETHENE	42	UG/L			0.100	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	31-DEC-93	TRG		VOA524.2	cis-1,2-DICHLOROETHENE	3	UG/L			0.200	Y				
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	1,2-DICHLOROBENZENE-D4	99	%			0.500					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	30-DEC-93	FIX	SUR	VOA524.2	BROMOFLUOROBENZENE	100	%			0.300					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	30-DEC-93	FIX	TIC	VOA524.2	UNKNOWN	0.24	UG/L		J						

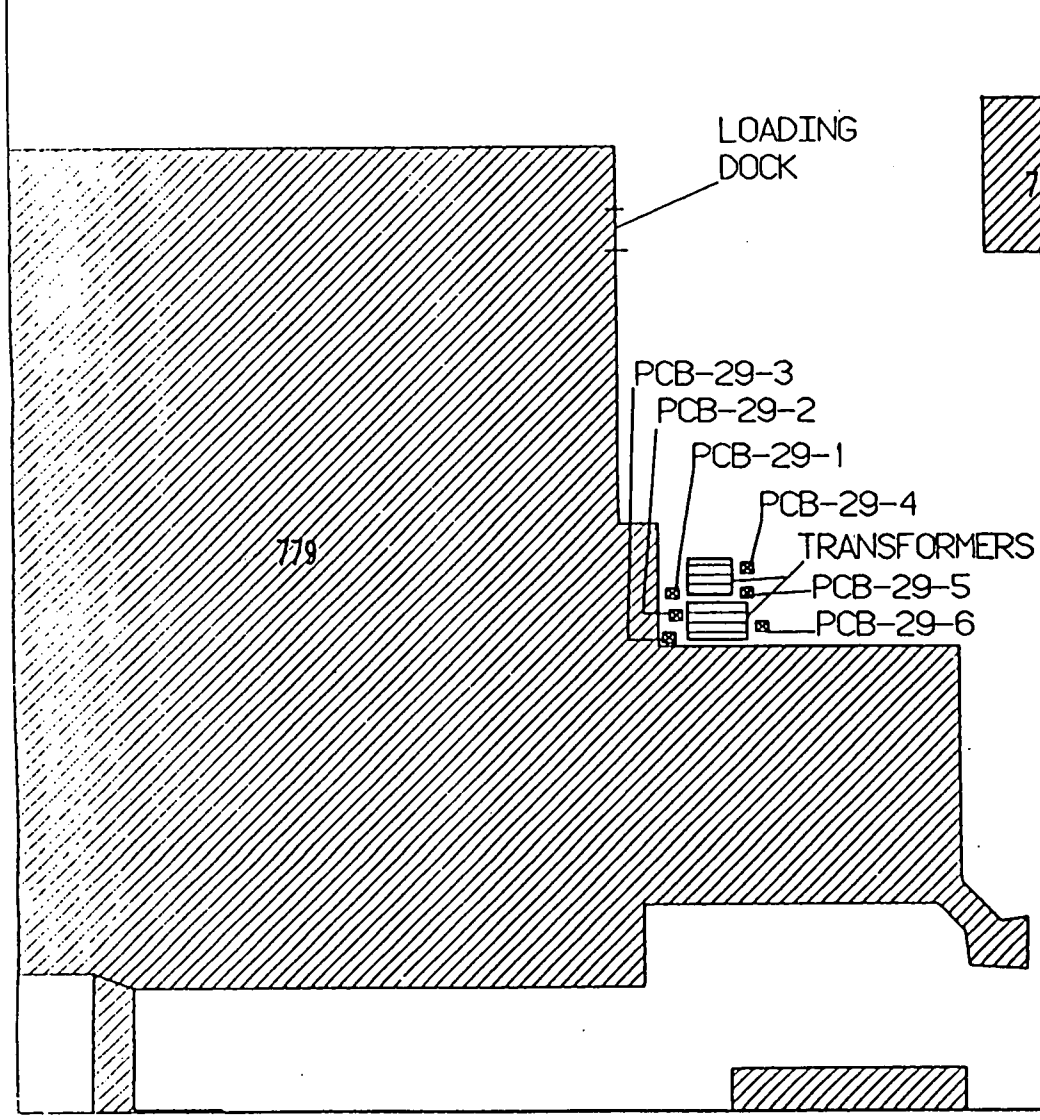
metals DATA - February 23,1994

Loc	ST	MATRIX	QC	Sample Number	Smpl Date	Anal Date	ID	2ID	Group	Chemical	Result	Unit	Error	Qual	D.LMT	VA	RN1	RN2	RN3	RN4
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	07-JAN-94	TRG		DSMETCLP	ARSENIC	1.20	UG/L		B	10.00					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	11-JAN-94	TRG		DSMETCLP	SELENIUM	226.00	UG/L		N	5.000					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DMETADD	LITHIUM	104.00	UG/L			100.0					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DMETADD	SILICON	7660.00	UG/L			100.0					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DMETADD	STRONTIUM	1060.00	UG/L			200.0					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	ALUMINUM	85.30	UG/L		B	200.0					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	BARIUM	16.20	UG/L		B	200.0					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	CALCIUM	106000.00	UG/L			5000.					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	IRON	11.80	UG/L		B	100.0					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	MAGNESIUM	34900.00	UG/L			5000.					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	MANGANESE	2.30	UG/L		B	15.00					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	POTASSIUM	2090.00	UG/L		B	5000.					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	SODIUM	107000.00	UG/L			5000.					
6374	GW	WATER	REAL	GW01722WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	ZINC	23.90	UG/L			20.00					
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DMETADD	LITHIUM	6.10	UG/L		B	100.0	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DMETADD	SILICON	10300.00	UG/L			100.0	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DMETADD	STRONTIUM	236.00	UG/L			200.0	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	ALUMINUM	252.00	UG/L			200.0	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	ANTIMONY	33.20	UG/L		B	60.00	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	BARIUM	157.00	UG/L		B	200.0	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	CALCIUM	59900.00	UG/L			5000.	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	COPPER	4.70	UG/L		B	25.00	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	IRON	335.00	UG/L			100.0	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	MAGNESIUM	6760.00	UG/L			5000.	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	MANGANESE	185.00	UG/L			15.00	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	POTASSIUM	657.00	UG/L		B	5000.	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	SODIUM	12000.00	UG/L			5000.	Y				
6674	GW	WATER	REAL	GW01725WC	16-DEC-93	27-JAN-94	TRG		DSMETCLP	ZINC	22.10	UG/L			20.00	Y				
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DMETADD	LITHIUM	3.60	UG/L		B	100.0					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DMETADD	SILICON	11000.00	UG/L			100.0					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DMETADD	STRONTIUM	126.00	UG/L		B	200.0					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	BARIUM	50.20	UG/L		B	200.0					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	CALCIUM	22400.00	UG/L			5000.					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	MAGNESIUM	4560.00	UG/L		B	5000.					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	MANGANESE	18.20	UG/L			15.00					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	POTASSIUM	515.00	UG/L		B	5000.					
6774	GW	WATER	REAL	GW01726WC	16-DEC-93	25-JAN-94	TRG		DSMETCLP	SODIUM	11400.00	UG/L			5000.					

SITE #29 - North of Building 779

Transformers 779-1, and 779-2 are located at this site just north of building 779 (Photo #29). The two transformers have leaked oil containing PCBs prior to being retro-filled and relocated several feet east and north respectively in 1987 according to a conversation with personnel from Utilities. The site is located approximately 40 feet south of IHSSs 138 and 150.8, and 300 feet southeast of IHSS 121. There are concrete berms surrounding the site with rock and gravel fill surrounding the individual pads.

Site #29 is prioritized as a Category II.



SAMPLE LOCATION	SAMPLE NUMBER	SAMPLE ANALYTE(S)
PCB-29-1	SS00491ST	PCB*
	SS00497ST	Pu, Am, U
PCB-29-2	SS00492ST	PCB*
	SS00498ST	Pu, Am, U
PCB-29-3	SS00493ST	PCB*
	SS00499ST	Pu, Am, U
PCB-29-4	SS00494ST	PCB*
	SS00500ST	Pu, Am, U
PCB-29-5	SS00495ST	PCB*
	SS00501ST	Pu, Am, U
PCB-29-6	SS00496ST	PCB*
	SS00502ST	Pu, Am, U

MAP LEGEND

- 779 — BUILDINGS
- APPROXIMATE TRANSFORMER/ PAD LOCATIONS (NOT TO SCALE)
- APPROXIMATE SAMPLE LOCATIONS

N

0 feet 25 50

U.S. DEPARTMENT of ENERGY

Rocky Flats Plant
Golden, Colorado

PRELIMINARY PCB INVESTIGATION

SITE No. 29

SEPTEMBER 25, 1991

Roy F. Weston, Inc. - Gulf Coast Laboratories
PCBs by GC

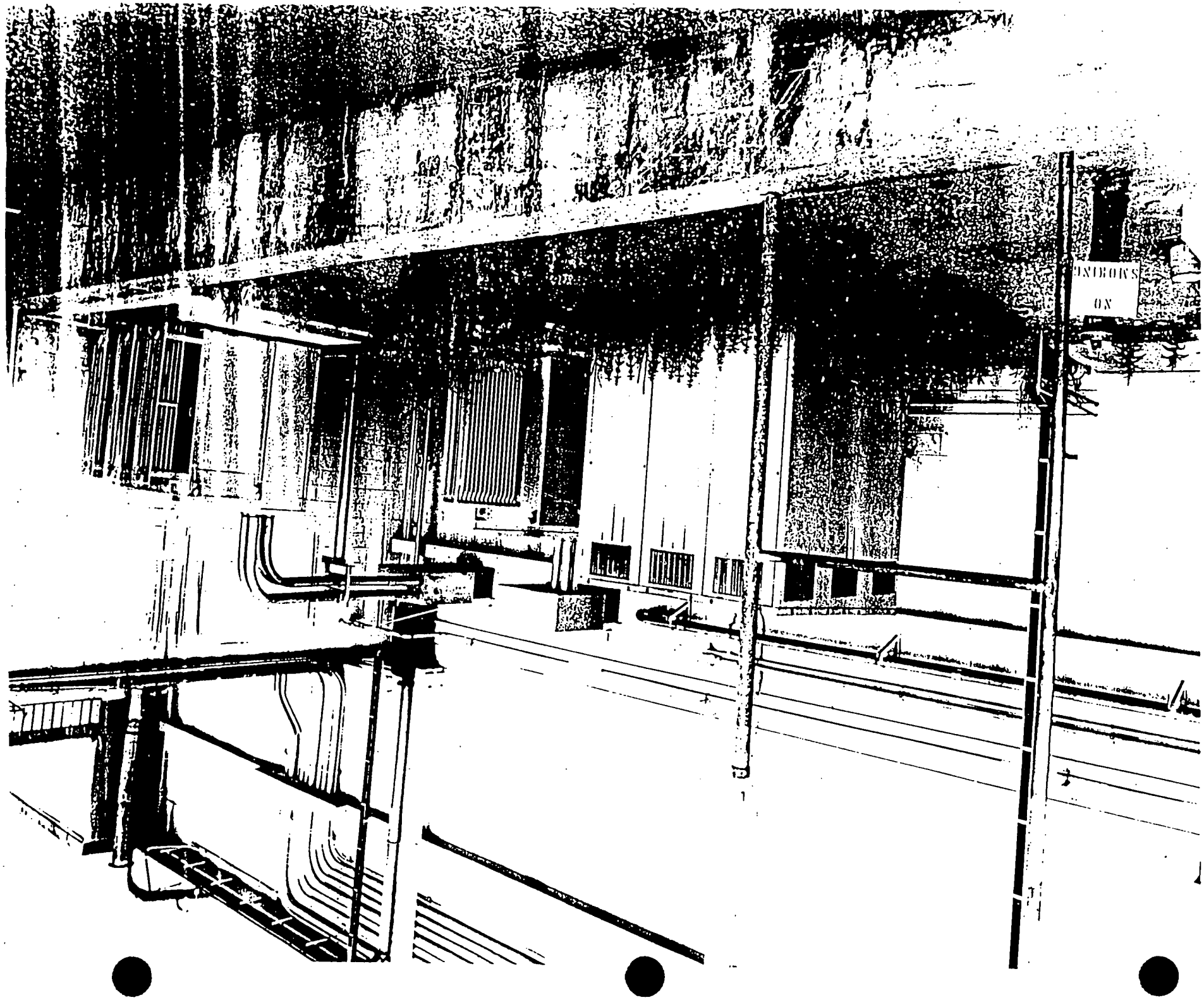
RFX Batch Number: 9107G170 Client: EG & G Rocky Flats Plant Work Order: 2029-38-01-0001 Report Date: 08/11/91 13:31 Page: 1

Sample Information						
Cust ID:	SS00491ST		SS00492ST		SS00493ST	
RFX#:	010		011		012	
Matrix:	SOIL		SOIL		SOIL	
D.F.:	250		50.0		1000	
Units:	ug/Kg		ug/Kg		ug/Kg	
Surrogate: Di-n-butylchlorendate	D	% fl	D	% fl	D	% fl
Aroclor-1016	21000	U	4000	U	81000	U
Aroclor-1221	21000	U	4000	U	81000	U
Aroclor-1232	21000	U	4000	U	81000	U
Aroclor-1242	21000	U	4000	U	81000	U
Aroclor-1248	21000	U	4000	U	81000	U
Aroclor-1254	43000	U	8100	U	160000	U
Aroclor-1260	120000		36000		680000	

Sample Information						
Cust ID:	SS00494ST		SS00495ST		SS00496ST	
RFX#:	013		014		015	
Matrix:	SOIL		SOIL		SOIL	
D.F.:	100		500		25.0	
Units:	ug/Kg		ug/Kg		ug/Kg	
Surrogate: Di-n-butylchlorendate	D	% fl	D	% fl	D	% fl
Aroclor-1016	8300	U	42000	U	2000	U
Aroclor-1221	8300	U	42000	U	2000	U
Aroclor-1232	8300	U	42000	U	2000	U
Aroclor-1242	8300	U	42000	U	2000	U
Aroclor-1248	8300	U	42000	U	2000	U
Aroclor-1254	17000	U	84000	U	4000	U
Aroclor-1260	27000		300000		15000	

U= Analyzed, not detected. J= Present below detection limit. B= Present in blank. NR= Not requested. NS= Not spiked.
%= Percent recovery. D= Diluted out. I= Interference. NA= Not Applicable. *= Outside of EPA CLP QC

Location	SI	Sample Number	Smpl Date	D	ID	Group	Chemical	Result	*Unit	Error	Qual	D.LMI	VA	RH1	RH2	RH3	RH4	V	VQUAL	VQF
PCB-29	SO	SS00497ST	01-JUL-91	N	TRG	TRADS	AMERICIUM-241	1.352	PCI/G	.221		.02								
PCB-29	SO	SS00497ST	01-JUL-91	N	TRG	TRADS	PLUTONIUM-239/240	8.857	PCI/G	.938		.03								
PCB-29	SO	SS00497ST	01-JUL-91	N	TRG	TRADS	URANIUM-233,-234	1.794	PCI/G	.377		.3								
PCB-29	SO	SS00497ST	01-JUL-91	N	TRG	TRADS	URANIUM-235	.09712	PCI/G	.0698	J	.3								
PCB-29	SO	SS00497ST	01-JUL-91	N	TRG	TRADS	URANIUM-238	1.929	PCI/G	.397		.3								
PCB-29	SO	SS00498ST	01-JUL-91	N	TRG	TRADS	AMERICIUM-241	.952	PCI/G	.119		.02								
PCB-29	SO	SS00498ST	01-JUL-91	N	TRG	TRADS	PLUTONIUM-239/240	3.689	PCI/G	.389		.03								
PCB-29	SO	SS00498ST	01-JUL-91	N	TRG	TRADS	URANIUM-233,-234	1.193	PCI/G	.293		.3								
PCB-29	SO	SS00498ST	01-JUL-91	N	TRG	TRADS	URANIUM-235	.04879	PCI/G	.0513	J	.3								
PCB-29	SO	SS00498ST	01-JUL-91	N	TRG	TRADS	URANIUM-238	1.231	PCI/G	.299		.3								
PCB-29	SO	SS00499ST	01-JUL-91	N	TRG	TRADS	AMERICIUM-241	.4617	PCI/G	.0644		.02								
PCB-29	SO	SS00499ST	01-JUL-91	N	TRG	TRADS	PLUTONIUM-239/240	1.392	PCI/G	.175		.03								
PCB-29	SO	SS00499ST	01-JUL-91	N	TRG	TRADS	URANIUM-233,-234	1.186	PCI/G	.419		.3								
PCB-29	SO	SS00499ST	01-JUL-91	N	TRG	TRADS	URANIUM-235	.07078	PCI/G	.0973	J	.3								
PCB-29	SO	SS00499ST	01-JUL-91	N	TRG	TRADS	URANIUM-238	1.549	PCI/G	.496		.3								
PCB-29	SO	SS00500ST	01-JUL-91	N	TRG	TRADS	AMERICIUM-241	19.43	PCI/G	2.35		.02								
PCB-29	SO	SS00500ST	01-JUL-91	N	TRG	TRADS	AMERICIUM-241	7.305	PCI/G	.96		.02								
PCB-29	SO	SS00500ST	01-JUL-91	N	TRG	TRADS	PLUTONIUM-239/240	115.3	PCI/G	12.3		.03								
PCB-29	SO	SS00500ST	01-JUL-91	N	TRG	TRADS	URANIUM-233,-234	1.463	PCI/G	.395		.3								
PCB-29	SO	SS00500ST	01-JUL-91	N	TRG	TRADS	URANIUM-235	.01609	PCI/G	.0369	J	.3								
PCB-29	SO	SS00500ST	01-JUL-91	N	TRG	TRADS	URANIUM-238	1.267	PCI/G	.359		.3								
PCB-29	SO	SS00501ST	01-JUL-91	N	TRG	TRADS	AMERICIUM-241	1.908	PCI/G	.227		.02								
PCB-29	SO	SS00501ST	01-JUL-91	N	TRG	TRADS	PLUTONIUM-239/240	8.17	PCI/G	.904		.03								
PCB-29	SO	SS00501ST	01-JUL-91	N	TRG	TRADS	URANIUM-233,-234	.9583	PCI/G	.324		.3								
PCB-29	SO	SS00501ST	01-JUL-91	N	TRG	TRADS	URANIUM-235	.03762	PCI/G	.061	J	.3								
PCB-29	SO	SS00501ST	01-JUL-91	N	TRG	TRADS	URANIUM-238	.8549	PCI/G	.302		.3								
PCB-29	SO	SS00502ST	01-JUL-91	N	TRG	TRADS	AMERICIUM-241	2.172	PCI/G	.258		.02								
PCB-29	SO	SS00502ST	01-JUL-91	N	TRG	TRADS	PLUTONIUM-239/240	5.833	PCI/G	.506		.03								
PCB-29	SO	SS00502ST	01-JUL-91	N	TRG	TRADS	URANIUM-233,-234	1.12	PCI/G	.392		.3								
PCB-29	SO	SS00502ST	01-JUL-91	N	TRG	TRADS	URANIUM-235	.07605	PCI/G	.0913	J	.3								
PCB-29	SO	SS00502ST	01-JUL-91	N	TRG	TRADS	URANIUM-238	1.528	PCI/G	.470		.3								


WINDOWS
ON

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
5671

GW00442GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P461V

Matrix: (soil/water) WATER Lab Sample ID: Q40323604

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 60703235

Level: (low/med) LOW Date Received: 03/18/94

% Moisture: not dec. ____ Date Analyzed: 03/23/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	Q
74-87-3	Chloromethane	0.41U
74-83-9	Bromomethane	0.51U
75-01-4	Vinyl Chloride	0.21U
75-00-3	Chloroethane	0.41U
75-09-2	Methylene Chloride	0.21U
75-35-4	1,1-Dichloroethene	0.21U
75-34-3	1,1-Dichloroethane	0.21U
67-66-3	Chloroform	0.21U
107-06-2	1,2-Dichloroethane	0.41U
74-97-5	Bromochloromethane	0.51U
71-55-6	1,1,1-Trichloroethane	0.21U
56-23-5	Carbon Tetrachloride	0.31U
75-27-4	Bromodichloromethane	0.21U
78-87-5	1,2-Dichloropropane	0.21U
10061-01-5	cis-1,3-Dichloropropene	0.21U
79-01-6	Trichloroethene	0.21U
124-48-1	Dibromochloromethane	0.21U
79-00-5	1,1,2-Trichloroethane	0.61U
71-43-2	Benzene	0.21U
10061-02-6	Trans-1,3-Dichloropropene	0.41U
75-25-2	Bromoform	0.31U
127-18-4	Tetrachloroethene	0.21U
79-34-5	1,1,2,2-Tetrachloroethane	0.21U
108-88-3	Toluene	0.21U
108-90-7	Chlorobenzene	0.21U
100-41-4	Ethylbenzene	0.21U
100-42-5	Styrene	0.21U
95-47-6	O-XYLENE	0.21U
95-50-1	1,2-DICHLOROBENZENE	0.21U
106-46-7	1,4-DICHLOROBENZENE	0.31U
91-20-3	NAPHTHALENE	0.21U
87-61-6	1,2,3-TRICHLOROBENZENE	0.21U
120-82-1	1,2,4-TRICHLOROBENZENE	0.31U
108-67-8	1,3,5-TRIMETHYLBENZENE	0.21U
95-63-6	1,2,4-TRIMETHYLBENZENE	0.21U
104-51-8	N-BUTYLBENZENE	0.21U

FORM I VOA 1/87 Rev

REVIEWED BY: Kr
DATE: 4/5/94

98-06-6	TERT-BUTYLBENZENE	0.21U
106-43-4	4-CHLOROTOLUENE	0.21U
541-73-1	1,3-DICHLOROBENZENE	0.21U
135-98-8	SEC-BUTYLBENZENE	0.21U
103-65-1	N-PROPYLBENZENE	0.21U
95-49-8	2-CHLOROTOLUENE	0.31U
87-68-3	HEXACHLOROBUTADIENE	0.21U
99-87-6	4-ISOPROPYLTOLUENE	0.21U
98-82-8	ISOPROPYLBENZENE	0.21U
108-86-1	BROMOBENZENE	0.21U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.41U
96-18-4	1,2,3-TRICHLOROPROPANE	0.41U
630-20-6	1,1,1,2-TETRACHLOROETHANE	0.21U
106-93-4	1,2-DIBROMOETHANE	0.31U
563-58-6	1,1-DICHLOROPROPENE	0.11U
142-28-9	1,3-DICHLOROPROPANE	0.21U
594-20-7	2,2-DICHLOROPROPANE	0.31U
74-95-3	DIBROMOMETHANE	0.31U
75-69-4	TRICHLORFLUOROMETHANE	0.31U
75-71-8	DICHLORODIFLUOROMETHANE	0.21U
156-60-5	TRANS 1,2-DICHLOROETHENE	0.21U
156-59-2	CIS 1,2-DICHLOROETHENE	0.21U
36777-61-2	M,P-XYLENE	0.31U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GW00442GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P461V

Matrix: (soil/water) WATER Lab Sample ID: Q40323604

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 60703235

Level: (low/med) LOW Date Received: 03/18/94

% Moisture: not dec. _____ Date Analyzed: 03/23/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 0

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

TMA

EG&G Rocky Flats Preliminary Rush Results

TMA/Norcal N4-03-080-2621

COC# RFP941919 Well 5671 April 5, 1994

TMA I. D.	0000-2621-001		0000-2621-004			
Cust. I.D.	GW00442GA		QC DUP 1			
Coll. Date	17-MAR-94		17-MAR-94			
Analysis	pCi/L +/- 2sig		pCi/L +/- 2sig		pCi/L +/- 2sig	
Gross Alpha	239.800	38.004				
Gross Beta	209.100	20.482				
U-233,234						
U-235						
U-238						
Sr-89,90						
Pu-239,240	0.469	0.057				
Am-241			0.150	0.052		
Cs-137						
Tritium						
Ra-226						
Cm-244						

Post-it™ brand fax transmittal memo 7671 # of pages ▸ 2

To Mark Wood	From Ray Michael
Co. Golder Assoc	Co. EG&G
Dept. ~~G Wt~~ WARP	Phone # 6079
Fax # 8663	Fax #

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
5774

GW00426GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P461V

Matrix: (soil/water) WATER Lab Sample ID: Q40323603

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6100324D

Level: (low/med) LOW Date Received: 03/18/94

% Moisture: not dec. _____ Date Analyzed: 03/24/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	0.41	U
74-83-9	Bromomethane	0.51	U
75-01-4	Vinyl Chloride	0.21	U
75-00-3	Chloroethane	0.41	U
75-09-2	Methylene Chloride	0.21	U
75-35-4	1,1-Dichloroethene	0.21	U
75-34-3	1,1-Dichloroethane	0.21	U
67-66-3	Chloroform	0.21	U
107-06-2	1,2-Dichloroethane	0.41	U
74-97-5	Bromochloromethane	0.51	U
71-55-6	1,1,1-Trichloroethane	0.21	U
56-23-5	Carbon Tetrachloride	0.31	U
75-27-4	Bromodichloromethane	0.21	U
78-87-5	1,2-Dichloropropane	0.21	U
10061-01-5	cis-1,3-Dichloropropene	0.21	U
79-01-6	Trichloroethene	0.21	U
124-48-1	Dibromochloromethane	0.21	U
79-00-5	1,1,2-Trichloroethane	0.61	U
71-43-2	Benzene	0.21	U
10061-02-6	Trans-1,3-Dichloropropene	0.41	U
75-25-2	Bromoform	0.31	U
127-18-4	Tetrachloroethene	0.21	U
79-34-5	1,1,2,2-Tetrachloroethane	0.21	U
108-88-3	Toluene	17	
108-90-7	Chlorobenzene	0.21	U
100-41-4	Ethylbenzene	0.21	U
100-42-5	Styrene	0.21	U
95-47-6	O-XYLENE	0.21	U
95-50-1	1,2-DICHLOROBENZENE	0.21	U
106-46-7	1,4-DICHLOROBENZENE	0.31	U
91-20-3	NAPHTHALENE	0.21	U
87-61-6	1,2,3-TRICHLOROBENZENE	0.21	U
120-82-1	1,2,4-TRICHLOROBENZENE	0.31	U
108-67-8	1,3,5-TRIMETHYLBENZENE	0.21	U
95-63-6	1,2,4-TRIMETHYLBENZENE	0.21	U
104-51-8	N-BUTYLBENZENE	0.21	U

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REVIEWED BY: K.
DATE: 4/5/94

98-06-6	TERT-BUTYLBENZENE	U	0.21U
106-43-4	4-CHLOROTOLUENE		0.21U
541-73-1	1,3-DICHLOROBENZENE		0.21U
135-98-8	SEC-BUTYLBENZENE		0.21U
103-65-1	N-PROPYLBENZENE		0.21U
95-49-8	2-CHLOROTOLUENE		0.31U
87-68-3	HEXACHLOROBUTADIENE		0.21U
99-87-6	4-ISOPROPYLTOLUENE		0.21U
98-82-8	ISOPROPYLBENZENE		0.21U
108-86-1	BROMOBENZENE		0.21U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE		0.41U
96-18-4	1,2,3-TRICHLOROPROPANE		0.41U
630-20-6	1,1,1,2-TETRACHLOROETHANE		0.21U
106-93-4	1,2-DIBROMOETHANE		0.31U
563-58-6	1,1-DICHLOROPROPENE		0.11U
142-28-9	1,3-DICHLOROPROPANE		0.21U
594-20-7	2,2-DICHLOROPROPANE		0.31U
74-95-3	DIBROMOMETHANE		0.31U
75-69-4	TRICHLORFLUOROMETHANE		0.31U
75-71-8	DICHLORODIFLUOROMETHANE		0.21U
156-60-5	TRANS 1,2-DICHLOROETHENE		0.21U
156-59-2	CIS 1,2-DICHLOROETHENE		0.21U
36777-61-2	M,P-XYLENE		0.31U

5774

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
5774

GW00426GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P461V

Matrix: (soil/water) WATER Lab Sample ID: Q40323603

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 6100324D

Level: (low/med) LOW Date Received: 03/18/94

% Moisture: not dec. ____ Date Analyzed: 03/24/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 10

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	109-99-9	TETRAHYDROFURAN	9.49	0.27	J
2.	589-43-5	HEXANE, 2,4-DIMETHYL-	17.14	0.38	J
3.	1072-16-8	OCTANE, 2,7-DIMETHYL-	18.67	1.1	J
4.	1072-16-8	OCTANE, 2,7-DIMETHYL-	19.25	0.51	J
5.		UNKNOWN	19.74	0.28	J
6.		UNKNOWN	20.14	0.51	J
7.		UNKNOWN	20.37	0.34	J
8.	871-83-0	NONANE, 2-METHYL-	20.99	42	J
9.		UNKNOWN	22.24	0.32	J
10.		UNKNOWN ALKANE	24.84	1.2	J

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
5070

GW00425GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P461V

Matrix: (soil/water) WATER Lab Sample ID: Q40323005

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 60603235

Level: (low/med) LOW Date Received: 03/18/94

% Moisture: not dec. _____ Date Analyzed: 03/23/94

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane		0.41U
74-83-9	Bromomethane		0.51U
75-01-4	Vinyl Chloride		0.21U
75-00-3	Chloroethane		0.41U
75-09-2	Methylene Chloride		0.21U
75-35-4	1,1-Dichloroethene		0.21U
75-34-3	1,1-Dichloroethane		0.21U
67-66-3	Chloroform		0.21U
107-06-2	1,2-Dichloroethane		0.41U
74-97-5	Bromochloromethane		0.51U
71-55-6	1,1,1-Trichloroethane		0.21U
56-23-5	Carbon Tetrachloride		0.31U
75-27-4	Bromodichloromethane		0.21U
78-87-5	1,2-Dichloropropane		0.21U
10061-01-5	cis-1,3-Dichloropropene		0.21U
79-01-6	Trichloroethene		0.21U
124-48-1	Dibromochloromethane		0.21U
79-00-5	1,1,2-Trichloroethane		0.61U
71-43-2	Benzene		0.21U
10061-02-6	Trans-1,3-Dichloropropene		0.41U
75-25-2	Bromoform		0.31U
127-18-4	Tetrachloroethene		0.21
79-34-5	1,1,2,2-Tetrachloroethane		0.21U
108-88-3	Toluene		0.21U
108-90-7	Chlorobenzene		0.21U
100-41-4	Ethylbenzene		0.21U
100-42-5	Styrene		0.21U
95-47-6	O-XYLENE		0.21U
95-50-1	1,2-DICHLOROBENZENE		0.21U
106-46-7	1,4-DICHLOROBENZENE		0.31U
91-20-3	NAPHTHALENE		0.21U
87-61-6	1,2,3-TRICHLOROBENZENE		0.21U
120-82-1	1,2,4-TRICHLOROBENZENE		0.31U
108-67-8	1,3,5-TRIMETHYLBENZENE		0.21U
95-63-6	1,2,4-TRIMETHYLBENZENE		0.21U
104-51-8	N-BUTYLBENZENE		0.21U

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REVIEWED BY: KJ
DATE: 4/5/94

98-06-6	TERT-BUTYLBENZENE	0.21U
106-43-4	4-CHLOROTOLUENE	0.21U
541-73-1	1,3-DICHLOROBENZENE	0.21U
135-98-8	SEC-BUTYLBENZENE	0.21U
103-65-1	N-PROPYLBENZENE	0.21U
95-49-8	2-CHLOROTOLUENE	0.31U
87-68-3	HEXACHLOROBUTADIENE	0.21U
99-87-6	4-ISOPROPYLTOLUENE	0.21U
98-82-8	ISOPROPYLBENZENE	0.21U
108-86-1	BROMOBENZENE	0.21U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.41U
96-18-4	1,2,3-TRICHLOROPROPANE	0.41U
630-20-6	1,1,1,2-TETRACHLOROETHANE	0.21U
106-93-4	1,2-DIBROMOETHANE	0.31U
563-58-6	1,1-DICHLOROPROPENE	0.11U
142-28-9	1,3-DICHLOROPROPANE	0.21U
594-20-7	2,2-DICHLOROPROPANE	0.31U
74-95-3	DIBROMOMETHANE	0.31U
75-69-4	TRICHLORFLUOROMETHANE	0.31U
75-71-8	DICHLORODIFLUOROMETHANE	0.21U
156-60-5	TRANS 1,2-DICHLOROETHENE	0.21U
156-59-2	CIS 1,2-DICHLOROETHENE	0.21U
36777-61-2	M,P-XYLENE	0.31U

5070

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

GW00425GA

Lab Name: IT PITTSBURGH Contract: 304918

Lab Code: ITPA Case No.: 04918 SAS No.: _____ SDG No.: P461V

Matrix: (soil/water) WATER Lab Sample ID: Q40323005

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: 60603235

Level: (low/med) LOW Date Received: 03/18/94

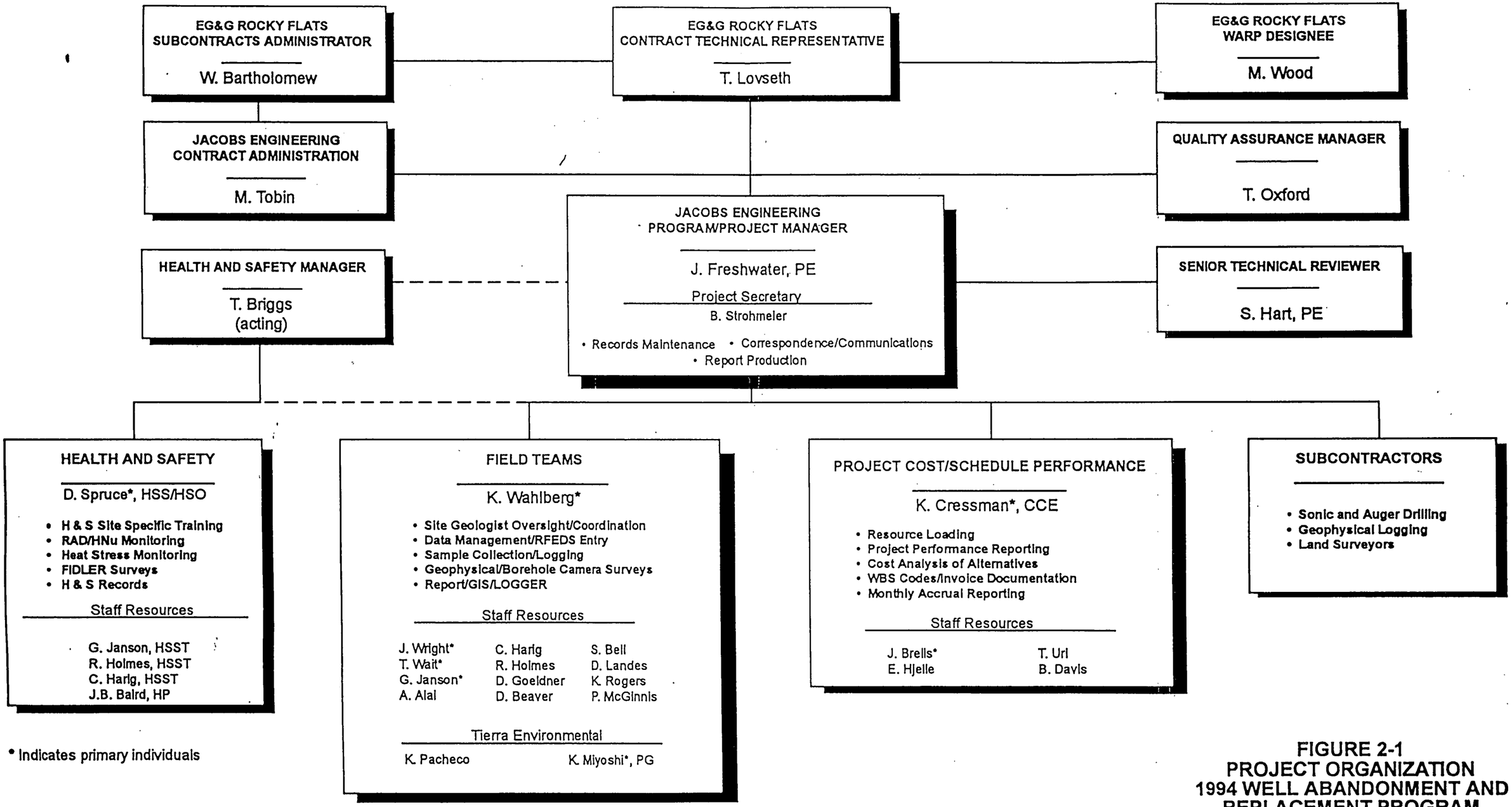
% Moisture: not dec. _____ Date Analyzed: 03/23/94

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q



* Indicates primary individuals

flats\warp\fig2-1 3/21/94 (akus)

FIGURE 2-1
PROJECT ORGANIZATION
1994 WELL ABANDONMENT AND REPLACEMENT PROGRAM
EG&G ROCKY FLATS PLANT

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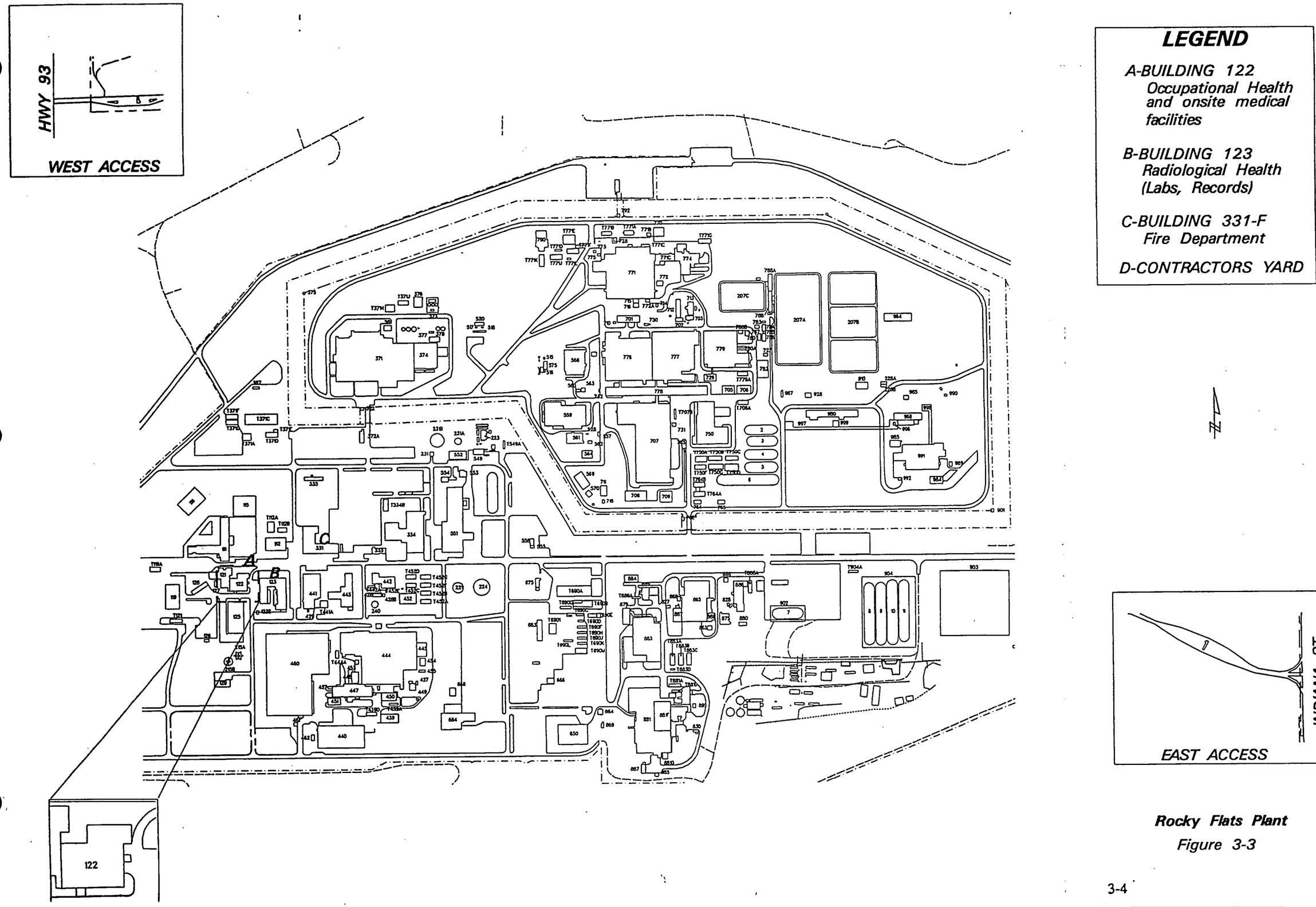
100% Recycled



Rocky Flats Plant

Figure 3-3

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100% Recycled

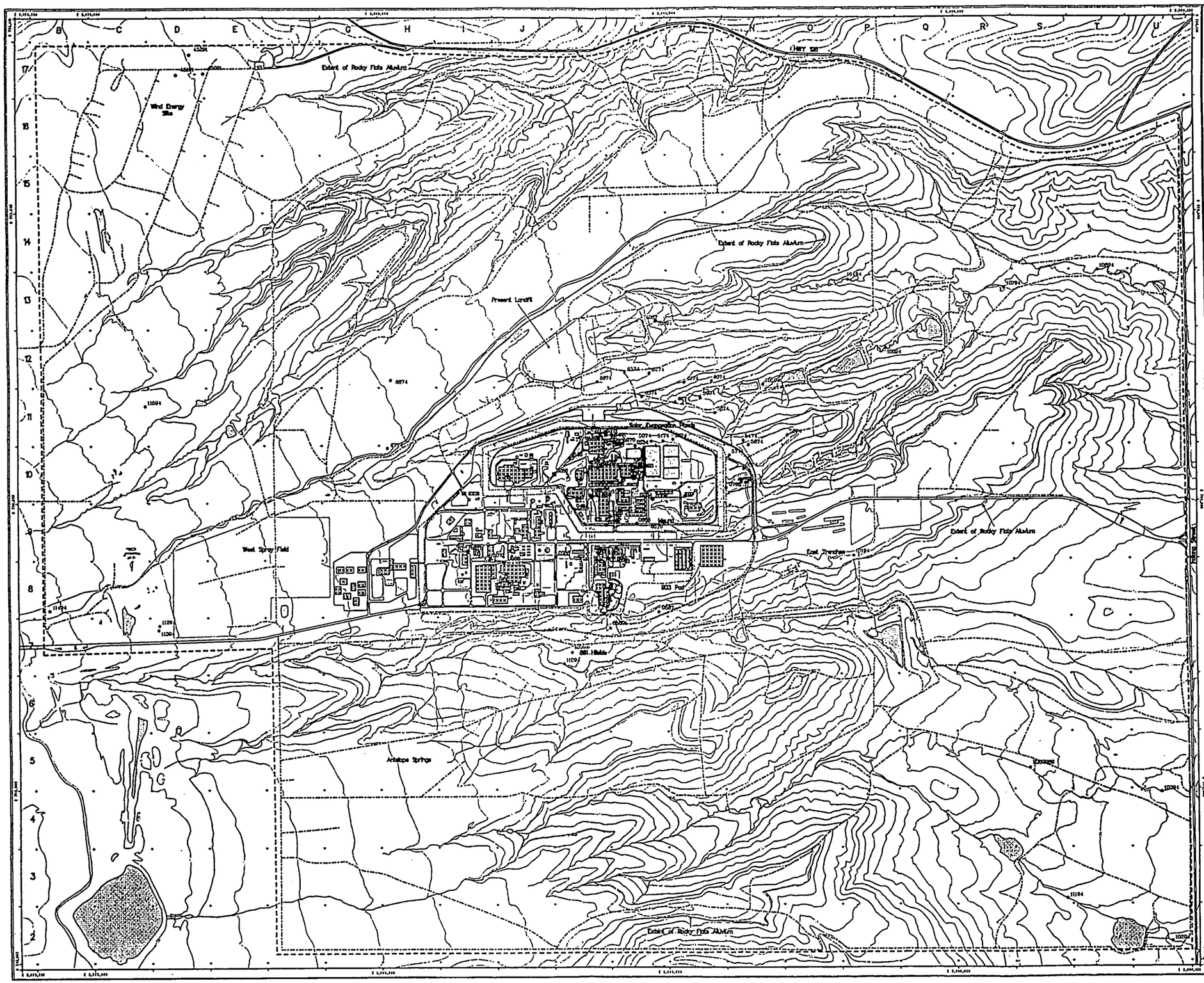

Figure 3-4

Rocky Flats Plant

WARP Location Map

FY94

Legend

- Individual Hazardous Substance Sites
- Limit of Rocky Flats alluvium
- Proposed well abandonment
- Proposed for geophysical survey
- Proposed new or replacement well

Wells 11894 and 11994 will be drilled east of Indiana Ave. on the Walnut Creek Drainage

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' intervals)
- Rocky Flats boundary
- Paved roads
- Dirt roads

Scale = 1 : 6000
1 inch represents 500 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Plant

Prepared by:

EG&G ROCKY FLATS

Rocky Flats Plant
P.O. Box 464
Golden, Colorado 80402-0464

"99088200"			
"Fig. 3-4"			
April 29, 1994			

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100% Recycled

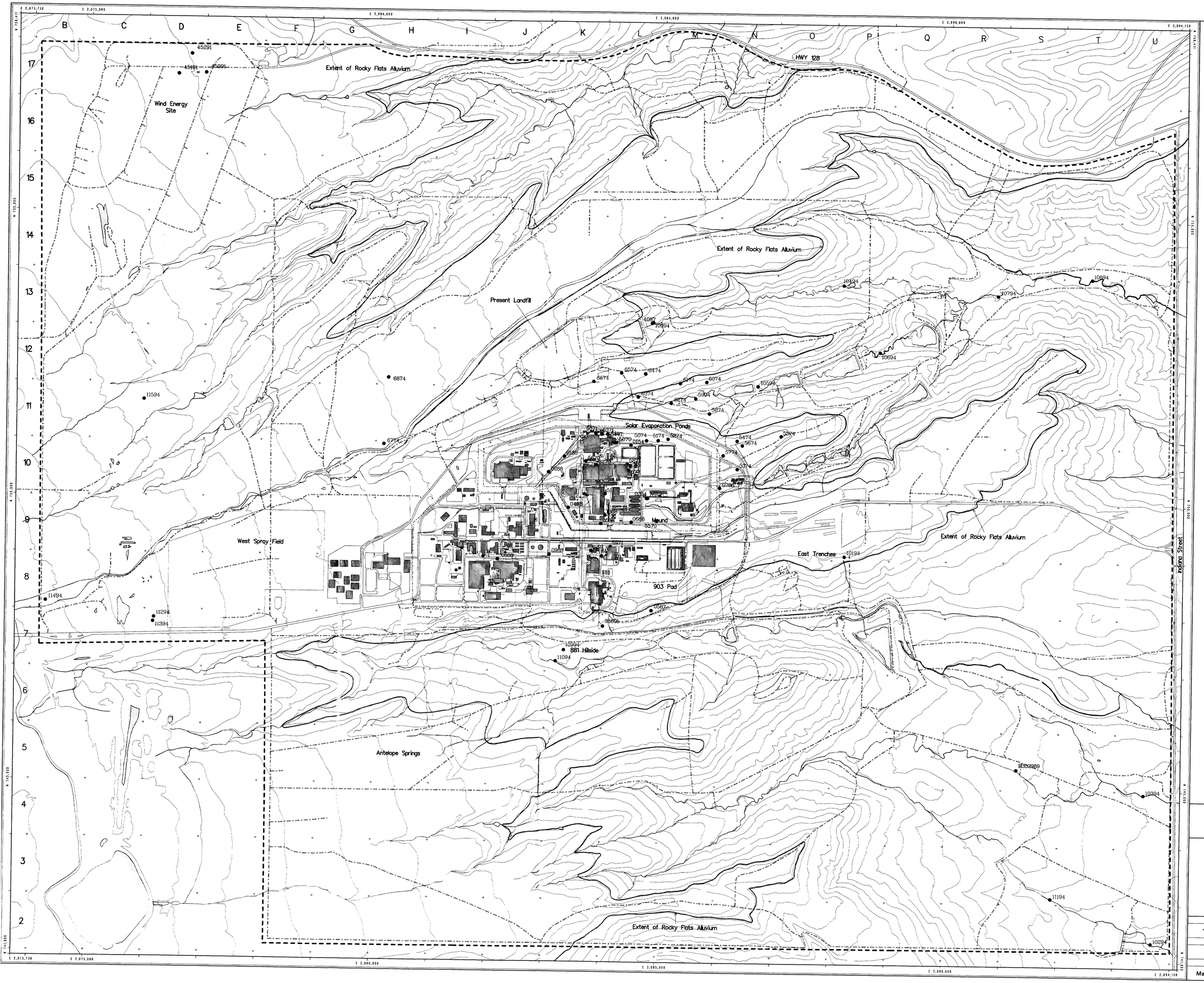

Figure 3-4

Rocky Flats Plant

WARP Location Map

FY94

Legend

- Individual Hazardous Substance Sites
- Limit of Rocky Flats alluvium
- Proposed well abandonment
- Proposed for geophysical survey
- Proposed new or replacement well

Wells 11894 and 11994 will be drilled east of Indiana Ave. on the Walnut Creek Drainage

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt roads

N

Scale = 1 : 6000
1 inch represents 500 feet

500 0 1000 2000 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Plant

Prepared by:

EG&G ROCKY FLATS

Rocky Flats Plant
P.O. Box 464
Golden, Colorado 80402-0464

PROJECT NO.		BY / DEPARTMENT	DATE
'986692 00'	GIS Analyst	Debbie Goeldner/Jacobs	05/18/94
MAP ID	Checked	Mark Wood	
'Fig. 3-4'	Approved	Kathy Wahlberg/Jacobs	
DATE CREATED			
May 18, 1994			

SW-A-002145
1 of 1