EGG-WM-10132
December 1992
Revision 0

FINAL WORK PLAN FOR THE ORGANIC CONTAMINATION IN THE VADOSE ZONE--OPERABLE UNIT (OU 7-08) PILOT SCALE TREATABILITY STUDY

M. Herd
K. Galloway
W. C. Downs
N. W. Spang

EGG-WM-10132
Revision 0

Final Work Plan for the Organic Contamination in the Vadose Zone--Operable Unit (OU 7-08) Pilot-Scale Treatability Study

M. Herd
K. Galloway
W. C. Downs
N. W. Spang

Published December 1992

Idaho National Engineering Laboratory
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Office of Environmental Restoration and Waste Management
Under DOE Idaho Field Office
Contract DE-AC07-76ID01570

FINAL WORK PLAN FOR THE ORGANIC CONTAMINATION IN THE VADOSE ZONE - OPERABLE UNIT (OU 7-08) PILOT-SCALE TREATABILITY STUDY

December 1992
EGG-WM-10132

Prepared by:

Gene A. Barry — 12-9-92

G. A Barry, Environmental Engineer
MSE, Inc., Idaho Falls Office — Date

Kelly J. Galloway — 12/10/92

K. J. Galloway, Engineer
Modular & Mechanical Engineering Support
EG&G Idaho, Inc. — Date

12/9/92

R. G. Schwaller, Environmental Engineer
MSE, Inc., Idaho Falls Office — Date

for J.B.S. — 12/10/92

J. B. Sisson, Senior Scientist
Quantitative Hydrology Unit, Geosciences
EG&G Idaho, Inc. — Date

FINAL WORK PLAN FOR THE ORGANIC CONTAMINATION IN THE VADOSE ZONE - OPERABLE UNIT (OU 7-08) PILOT-SCALE TREATABILITY STUDY

December 1992
EGG-WM-10132

Approved by:

M. D. Herd, Manager TRU Rod Unit EG&G Idaho, Inc.	12/10/92 Date

Reviewed by:

G. M. Matthern, Project Manager OU 7-08 EG&G Idaho, Inc.	12/10/92 Date
W. C. Downs, Project Technical Coordinator OU7-08 EG&G Idaho, Inc.	12/10/92 Date
J. P. Shea, Chairman ERD Independent Review Committee EG&G Idaho, Inc.	12/10/92 Date

ABSTRACT

In November 1989, the Radioactive Waste Management Complex (RWMC) was placed on the National Priorities List and became subject to the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). During 1990-1991, an action plan was negotiated between the U.S. Department of Energy, Idaho Field Office (DOE-ID), Idaho Department of Health and Welfare (IDHW), and the U.S. Environmental Protection Agency (EPA) to implement the Idaho National Engineering Laboratory (INEL) Federal Facility Agreement and Consent Order. The INEL has been divided into 10 waste area groups (WAGs) to facilitate the remediation process. WAG-7 covers the RWMC at the INEL. Each WAG is further divided into Operable Units (OUs) which focus on specific concerns. The Organic Contamination in the Vadose Zone (OCVZ) OU (OU 7-08) is in WAG-7. IDHW was granted regulatory jurisdiction over the WAG-7 site under the Resource Conservation and Recovery Act and will be the lead agency during the characterization and alternative evaluation phases which will be conducted by DOE-ID.

OCVZ OU 7-08 is defined as having volatile organic compound (VOC) contamination in the vadose zone beneath and adjacent to the Subsurface Disposal Area (SDA) of the RWMC. The vadose zone begins at the ground surface and extends to the top of the Snake River Plain Aquifer. VOCs are assumed to be released to the atmosphere and the aquifer. The vadose zone OU extends 1,000 ft laterally beyond the boundaries of the SDA.

A focused Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the OCVZ have been approved. The principal objectives of this RI/FS are: (a) to determine the extent of the volatile organic contamination in the vadose zone beneath and adjacent to the SDA, (b) to determine the current and future risk posed by the VOCs to human health and to the environment, (c) to conduct treatability studies to develop and evaluate candidate remedial technologies, and (d) to develop and select the appropriate remedial alternative.

Vapor Vacuum Extraction (VVE) is one alternative being considered in the RI/FS for remediation of the vadose zone. The proposed pilot-scale treatability study (TS) will evaluate and optimize the VVE system, and, in concert with the RI, provide information for the design of the potential scale-up of the system.

The TS work plan will provide the management framework and requirements for conducting the TS for VVE. Detailed guidance for performing treatability studies is found in "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA 1989)." The TS work plan will: identify the types of treatability tests to be conducted at the SDA in support of the vacuum extraction technology evaluation; identify the specific tasks needed to implement the treatability tests; provide criteria to measure the success of the treatability tests; describe the Quality Assurance and Quality Control requirements and how they will be met in the testing program; provide a schedule for completing the activities; and specify necessary equipment, vendors, and analytical services.

The data collected from the specific TS tests will support the TS objectives. These objectives are:

- Provide data to determine the VOC mass extraction rate with the VVE system at three different flow rates at each incremental depth
- Define the optimal vertical zone of extraction and optimize the VVE system performance at that level
- Provide operation, maintenance, and capital cost data to assist in the technology feasibility evaluation
- Provide system design information which could be used to assess the feasibility of technology scale-up.

In pilot-scale studies, testing is usually limited to evaluating a few critical parameters in order to optimize the technology's performance. Several treatability tasks are to be performed. A key task is the extraction well testing (flow, pressure, and VOC concentrations) in which discrete vertical intervals are isolated and examined for air permeability in relation to VOC concentration. Tracer tests in the most promising extraction zone will yield information on vapor travel times and diffusivities.

Additional TS tasks will be performed to support the operational test design. These tasks include flux-chamber measurement of source-term emissions (RI/FS planned task), off-gas treatment technology evaluation, cold weather operations, monitoring well installation within the SDA, and data collection to support extended vacuum extraction operation. The TS tasks are detailed in this work plan.

Vapor port monitoring wells outside the SDA are being installed in conjunction with the Track 2 groundwater investigations. These monitoring wells will provide information about the lateral and vertical extent of the VOC contaminant plume down to the water table.

The activities described in this TS Work Plan have received the critical review of a committee of independent VVE experts. On May 20, 1992, Dr. Ryan DuPont, Utah State University; Dr. David Ostendorf, University of Massachusetts; Dr. Daniel Evans, University of Arizona; and Dr. Michael Marley, VAPEX, Inc. met in Idaho Falls and thoroughly discussed the goals and activities of the TS. The tasks outlined in this document represent their views.

CONTENTS

VOLUME I

VOLUME II

FIGURES

TABLES

ACRONYMS and ABBREVIATIONS

ARAR	Applicable or Appropriate and Relevant Requirement
CAM	Cost Account Manager
CCl_4	carbon tetrachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
$CHCl_3$	chloroform
CRP	Community Relations Plan
CV	coefficient of variation
DAS	Data Acquisition System
DMP	data management plan
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Field Office
DQO	data quality objective
EDF	engineering design file
EPA	Environmental Protection Agency
ERD	Environmental Restoration Department
ERIS	Environmental Restoration Information System
ERP	Environmental Restoration Program
FS	feasibility study
FSP	field sampling plan
FTL	field team leader
GC	gas chromatograph
HEPA	high-efficiency particulate air
HSP	Health and Safety Plan
IDHW	Idaho Department of Health and Welfare
INEL	Idaho National Engineering Laboratory
LCS	laboratory critical sample
MCL	maximum contaminant level
MS	matrix spike
MSD	matrix spike duplicate
NOAA	National Oceanic and Atmospheric Administration
OCVZ	Organic Contamination in the Vadose Zone
O&MM	Operation and Maintenance Manual

OU	Operable Unit
ppm	parts per million
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethylene
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
RCT	radiological control technician
RI	remedial investigation
RML	Radiation and Measurements Laboratory
ROC	regional off-Site contact
RPM	Remedial Project Manager
RSD	relative standard deviation
%RSD	percent relative standard deviation
%R	percent recovery
RPD	relative percent difference
RWMC	Radioactive Waste Management Complex
s	standard deviation
SAP	sampling and analysis plan
scfm	standard cubic feet per minute
SDA	Subsurface Disposal Area
SDWA	Safe Drinking Water Act
SITE	Superfund Innovative Technology Evaluation
SMO	ERP Sample Management Office
SOP	standard operating procedures
SOW	statement of work
SRP	Snake River Plain
TCA	triclorethane
TCE	trichloroethylene
TP	test plan
TRU	transuranic
TS	treatability study
USGS	United States Geological Survey
VOC	volatile organic compound
VVE	vapor vacuum extraction

Final Work Plan for the Organic Contamination in the Vadose Zone - Operable Unit (OU) 7-08 Pilot-Scale Treatability Study

1. PROJECT DESCRIPTION AND SITE BACKGROUND

The following sections describe the vapor vacuum extraction (VVE) pilot-scale treatability study (TS) project and provide site background information.

1.1 Problem Statement

The vadose zone (the subsurface zone that is not saturated with groundwater) beneath the Subsurface Disposal Area (SDA) at the Idaho National Engineering Laboratory (INEL) Radioactive Waste Management Complex (RWMC) is known to be contaminated with a vapor plume of volatile organic compounds (VOCs). The TS work plan will provide the necessary information to further the design and development of the VVE system as a possible remedial alternative for organic contamination in the vadose zone (OCVZ) at the SDA. A thorough evaluation of alternatives will be completed in the upcoming feasibility study (FS).

The TS work plan will identify the types of treatability tests to be conducted at the SDA in support of the vacuum extraction technology evaluation; identify the specific tasks needed to implement the treatability tests; provide criteria to measure the success of the treatability tests; describe the Quality Assurance (QA) and Quality Control (QC) requirements and how they will be met in the testing program; provide a schedule for completing the activities; and specify necessary equipment, vendors, and analytical services.

1.2 Project Background

The INEL, which encompasses 890 mi^2 of semiarid land near the Lemhi and Lost River mountain ranges and is located in southeastern Idaho, is a government-owned reservation managed by Department of Energy Idaho Field Office (DOE-ID). The RWMC is located in the southwestern section of the INEL (see Figure 1-1). During the 1960s and early 1970s, barreled mixed waste containing VOCs and radioactive waste was buried at the RWMC SDA (see Figure 1-2). This waste is estimated to contain approximately 88,400 gal of organics, 24,400 gal of which are carbon tetrachloride (CCl_4), 25,000 gal of other volatile chlorinated hydrocarbons, and 39,000 gal of oil used in machining processes (Rauen 1990).

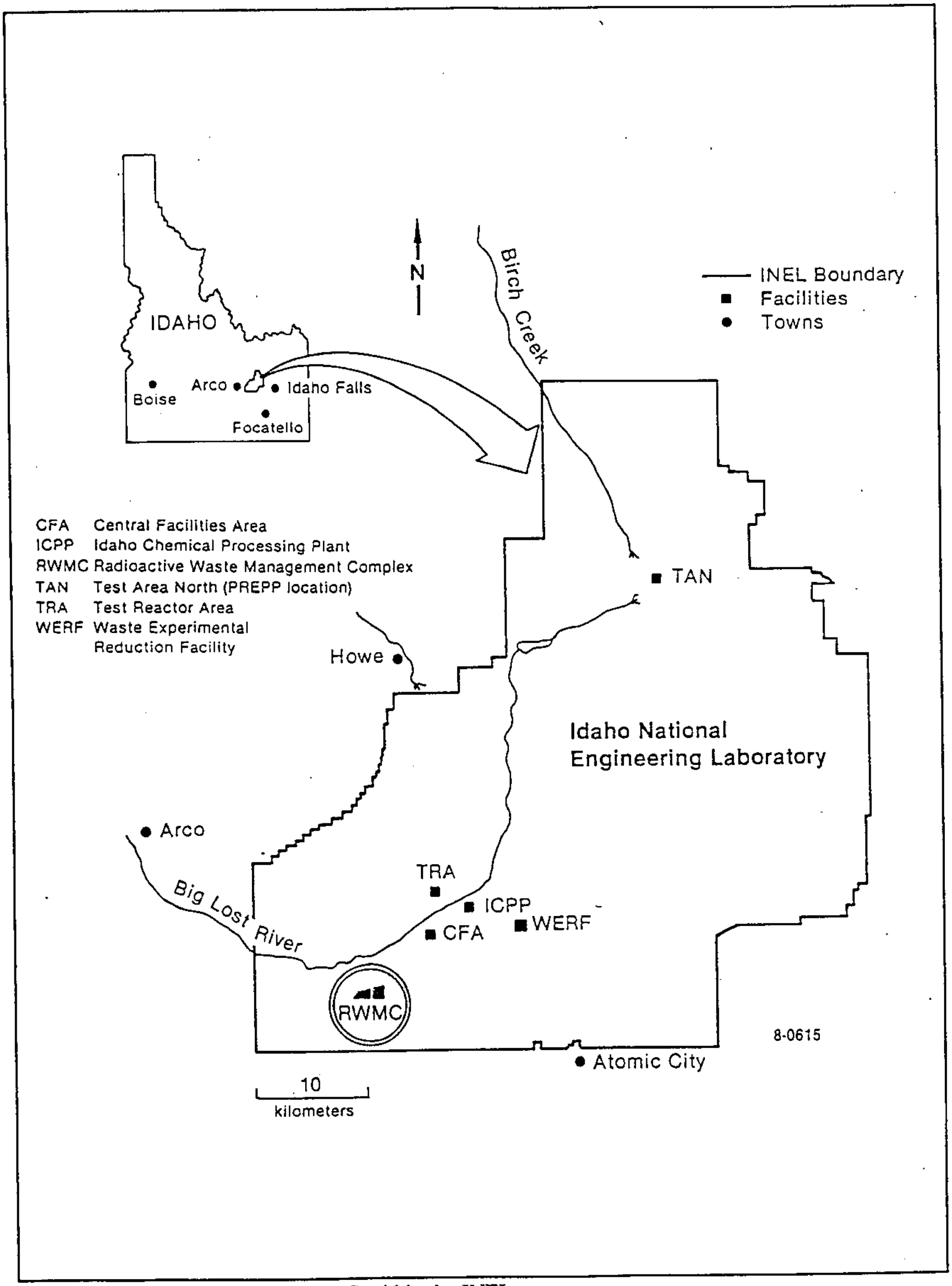

Figure 1-1. Location of the RWMC within the INEL.

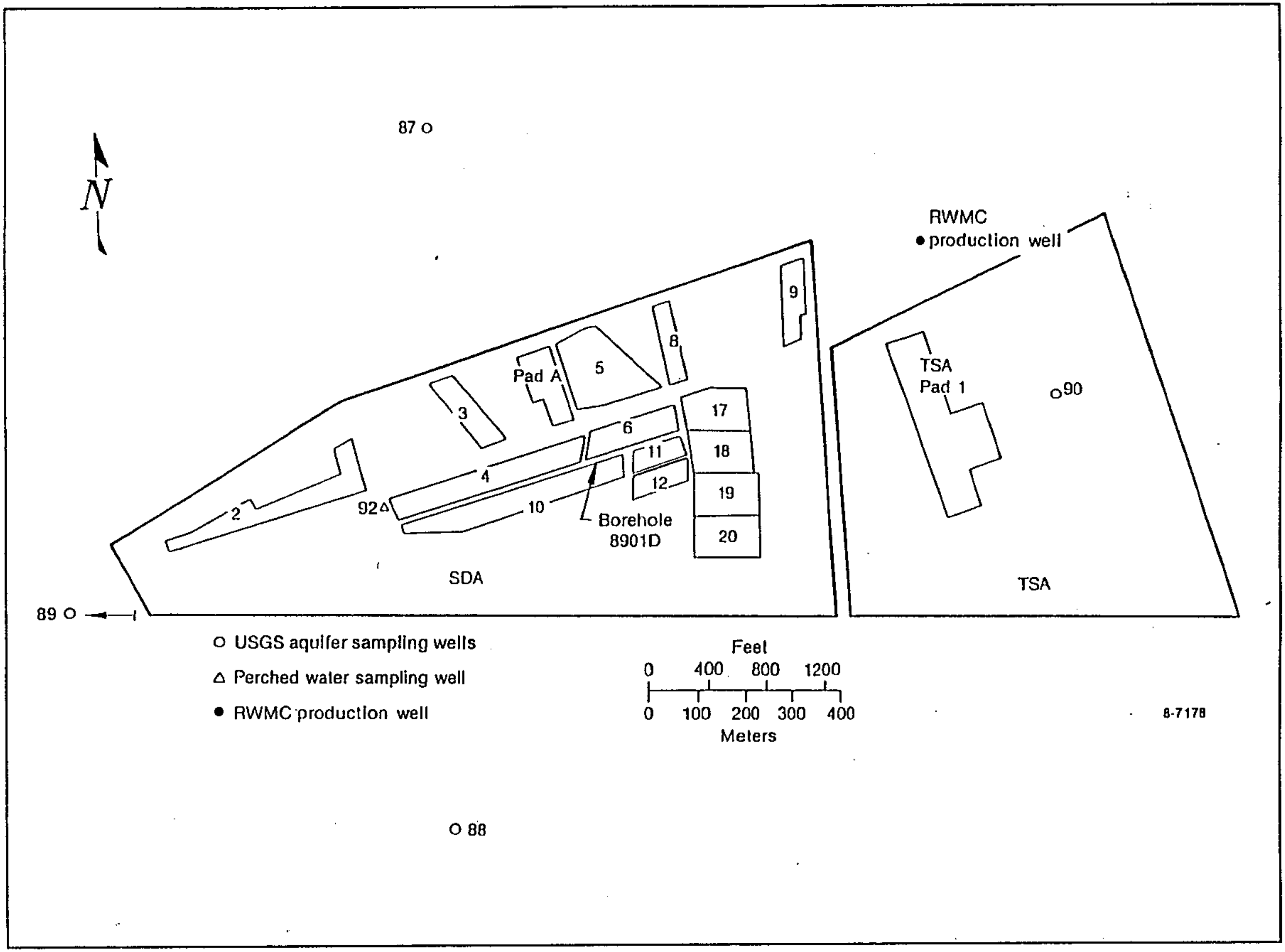

Figure 1-2. The RWMC SDA.

Much of this waste was disposed in Pits 2, 4, 5, 6, 9, and 10. Over time, some of the barrels have deteriorated allowing VOC vapors to be released into the vadose zone. The potential for aqueous transport of organic contaminants is being investigated during the groundwater Track 2 drilling activities. Vadose contamination has resulted in contaminant concentrations being detected in groundwater monitoring wells adjacent to the SDA. Figure 1-3 illustrates the conceptual model of VOC migration at the SDA. Currently, VOC contamination in the groundwater is below drinking water standards. Vapor plume migration predictions indicate, however, that VOC contamination could increase if no action is taken (Walton et al. 1989). More information on the estimated plume migration is found in the OCVZ remedial investigation (RI)/FS work plan (EG&G 1992).

1.2.1 Environmental Investigations

Since 1971, the U.S. Geological Survey (USGS) and DOE-ID have drilled over 75 wells in and near the RWMC (Matthern 1990). The purpose of the drilling has been to study the characteristics of the geology and hydrology and to study the extent of contamination in the vicinity of the disposal area. Recent sampling indicates concentrations of organic compounds are present in groundwater monitoring wells near the SDA (Mann et al. 1987). These studies suggest that organic vapors have moved downward through the subsurface and have formed a relatively large vapor plume (Laney 1988).

Air, soil, surface water runoff, and groundwater are pathways for human exposure to VOCs released from the water. Groundwater is believed to be the main pathway through which VOCs will reach humans (Scoping Meeting). The primary VOC contaminants of concern are CCl_4 and trichloroethylene (TCE); however, chloroform ($CHCL_3$); tetrachloroethylene (PCE); 1,1,1-trichloroethane (TCA); and 1,1,2-trichlorotrifluoroethane have also been detected (Sisson et al. 1991). The VOCs were detected in the soil gas and perched water below the SDA. Although there is no immediate threat to human populations, small concentrations (below drinking water standards) of VOCs have been found in the RWMC production well that is used for the facility's drinking water.

1.2.2 Vapor Vacuum Extraction System Description

The VVE process removes VOC-contaminated soil gases and replaces the soil gases with atmospheric air. The VVE process apparatus then treats the soil gas to remove VOC's. The vacuum created by the pump located at the end of the process apparatus draws air through the surrounding vadose zone and causes VOC laden air to flow from the extraction well through the extraction apparatus for processing (see Figure 1-4). Additional information for the various tests and components of the VVE system is provided in Sections 4 and 5 and Attachment II, the Test Plan of this TS Work Plan. The VVE system consists of an extraction well (Borehole 8901D), VVE process apparatus, monitoring wells with sampling ports (8801D, 8902D, D02, 78-4, 77-1, and WWW-1), a data acquisition system (DAS), and a gas sampling and analysis system. Well locations are discussed in Sections 2.2 and 2.3. The major

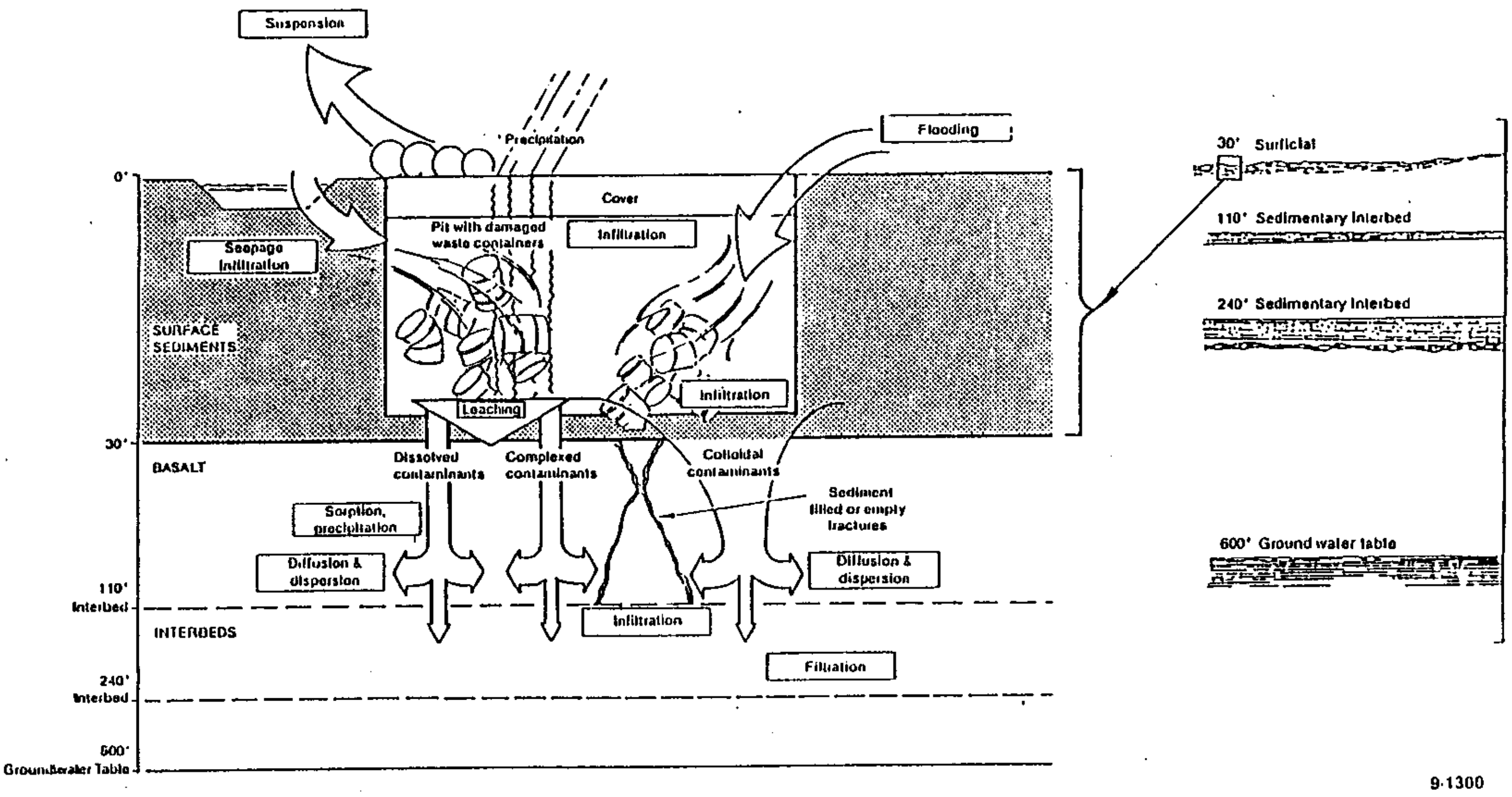

Figure 1-3. Conceptual model of volatile organic chemical contaminant migration at the SDA.

components of the VVE process apparatus are the extraction pump, the inline heater, the cyclone separator, the prefilter, the high-efficiency particulate air (HEPA) filters, and the carbon bed adsorber (see Figure 1-4 for the conceptual view of VVE in operation within the SDA). The extraction well, 8901D, is located in a waste-free corridor between Pits 6 and 10.

Two additional monitoring wells were installed near the extraction well to allow a better definition of the radius of influence of the extraction well. Monitoring Well 9301D is located approximately 20 ft west of Extraction Well 8901D on a line between 8901D and Monitoring Well 8801D. Monitoring Well 9302D is located approximately 65 ft east of Extraction Well 8901D on a line between 8901D and Monitoring Well 8801D. Both new wells, 9301 and 9302, were drilled and instrumented in a similar configuration as 8902D, as shown in Figure 1-5. They were drilled to the top of the 240-ft interbed and instrumented with vapor monitoring ports and pressure transducers. Section 2 details the locations and depths of the monitoring wells. Power will be supplied to the wells by the VVE system power station. The wells are covered at ground surface with a shack to protect the instrumentation from inclement weather conditions. Pressure, flow, and concentration measurements made at these new wells will add to the understanding of vapor flow near the extraction well.

1.2.3 Results of Previous Testing

Two-week and four-month VVE tests have been conducted previously at the SDA. The objectives of these previous tests were to determine if radionuclides would appear in the extraction stream and to determine if VVE was a viable interim action at the SDA.

The two-week test was conducted in 1989. The objective was to determine if radionuclides would appear in the extraction stream. No manmade radionuclides were detected, although naturally occurring radon was found only on initial startup of the system (Sisson et al. 1991).

Subsequent to the two-week test, the four-month test was conducted from May to August 1990. This four-month test was designed to provide information about geological properties pertaining to VOC transport and acquire experience in operating a vacuum extraction system under conditions found at the INEL. No radionuclides were detected during the four-month test. VOC contaminants (429 kg of CCl_4 and 164 kg of TCE) were removed from beneath the RWMC. The previous testing identified two zones of primary interest. The first zone (referred to as the 110-ft zone) is the relatively high VOC concentration zone between the 50- and 110-ft depths (> 1,000 ppm in Monitor Well 8801, which is 70 ft west of the extraction well). This zone is shown in Figure 1-6, which presents the CCl_4 concentration as a function of depth in Well 8801. The second zone of interest is the relatively high-permeability, rubble zone at the 190- to 195-ft depth (referred to as the 190-ft rubble zone) in the extraction well. The results of the extraction well flow test performed during the 4-month VVE test are presented in Figure 1-7, which shows the significant flow from the 190-ft rubble zone when pumping the extraction well. Thus, it was determined that these two zones have the highest probability of delivering sustained flows

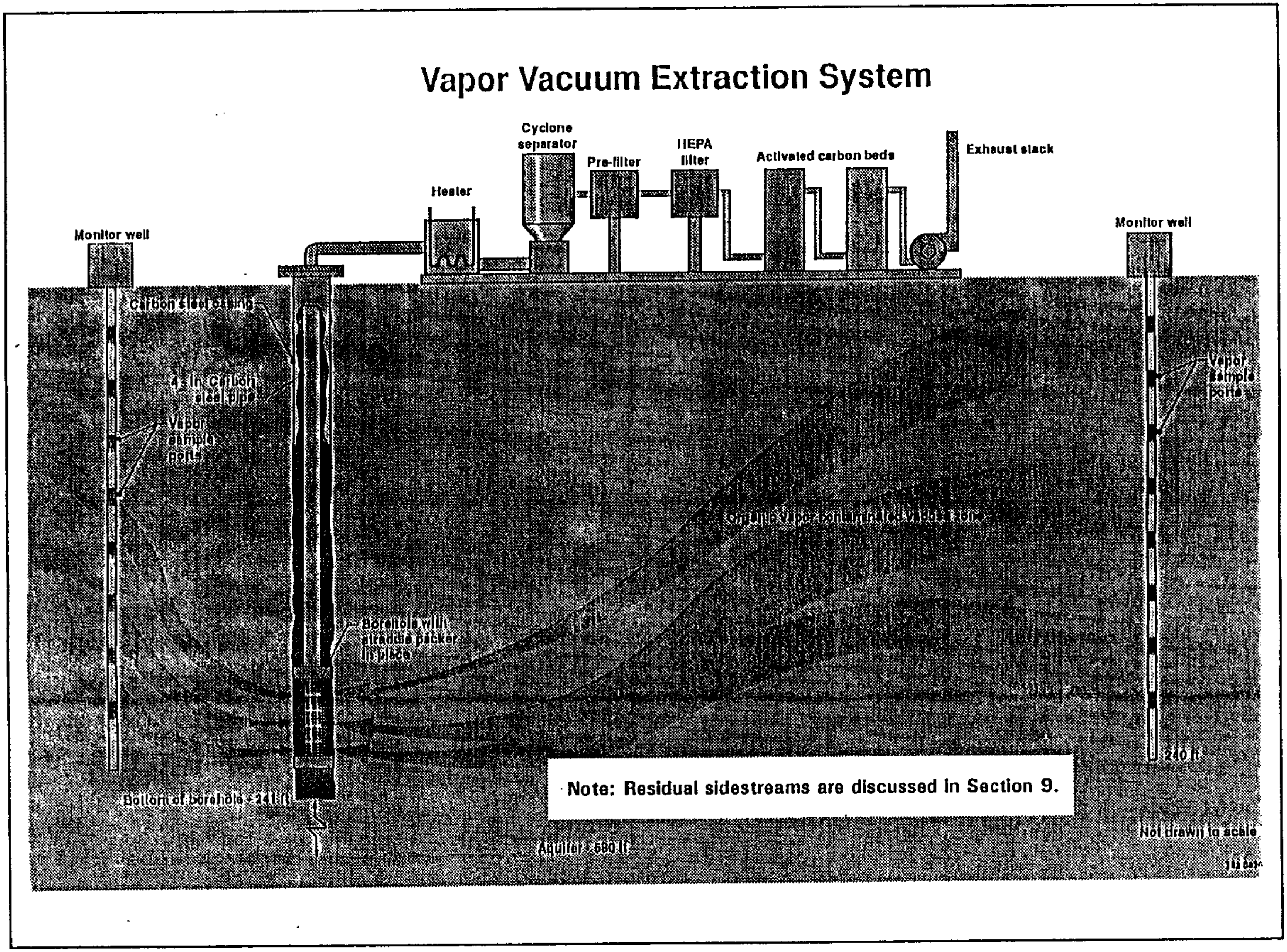

Figure 1-4. Conceptual view of VVE in operation within the SDA of the RWMC.

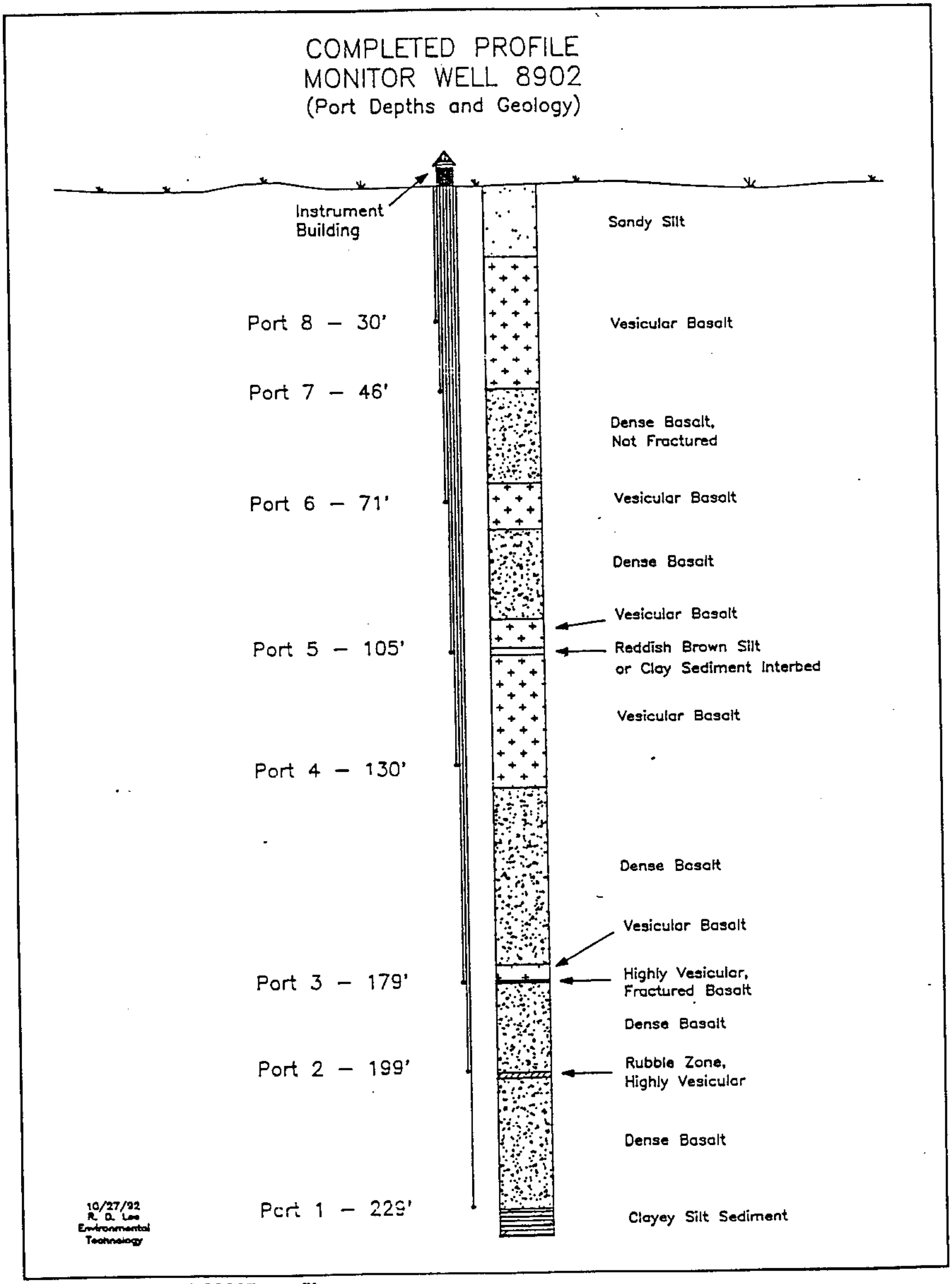

Figure 1-5. Well 8902D profile.

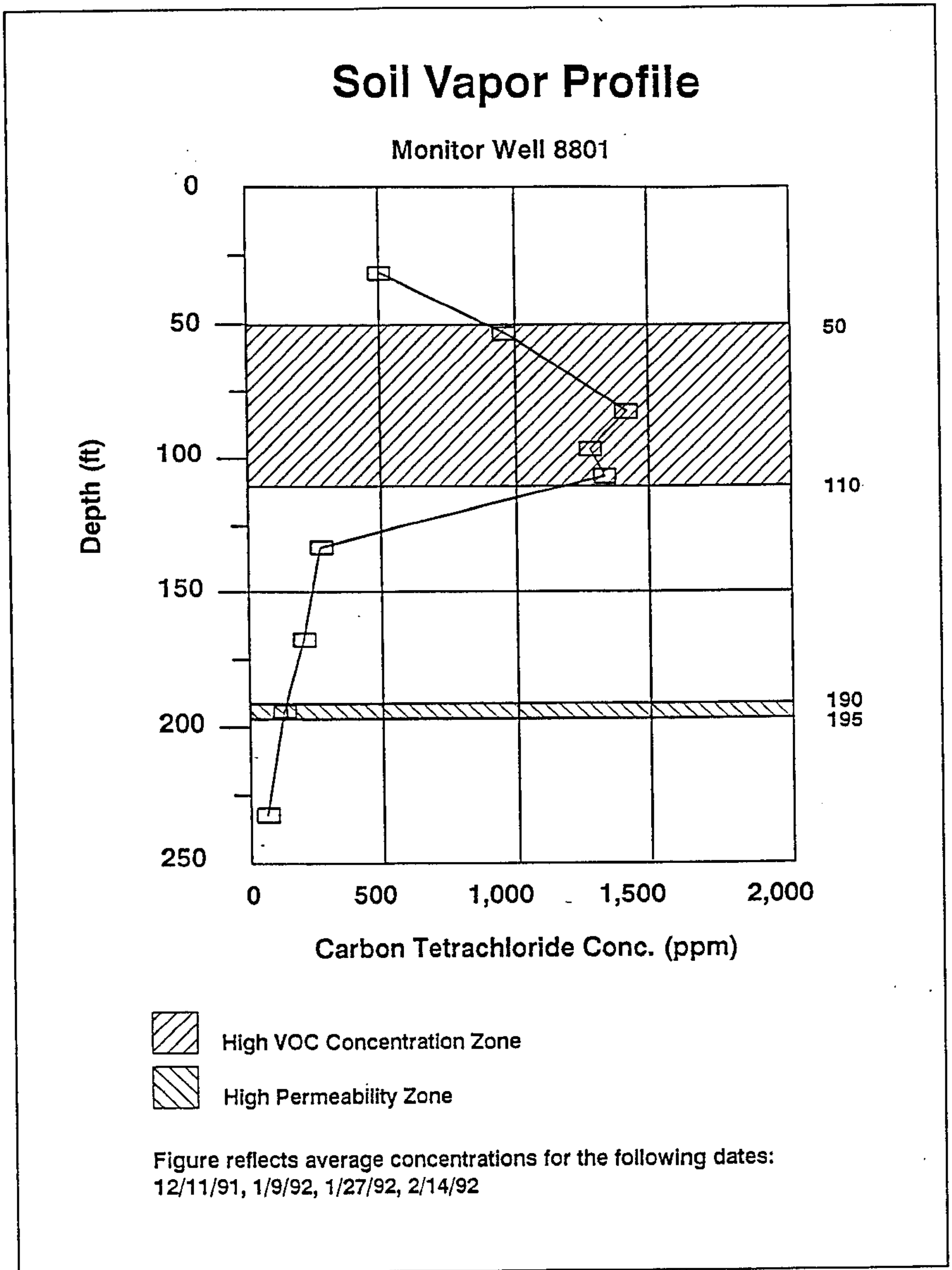

Figure 1-6. VOC concentration as a function of depth in Well 8801.

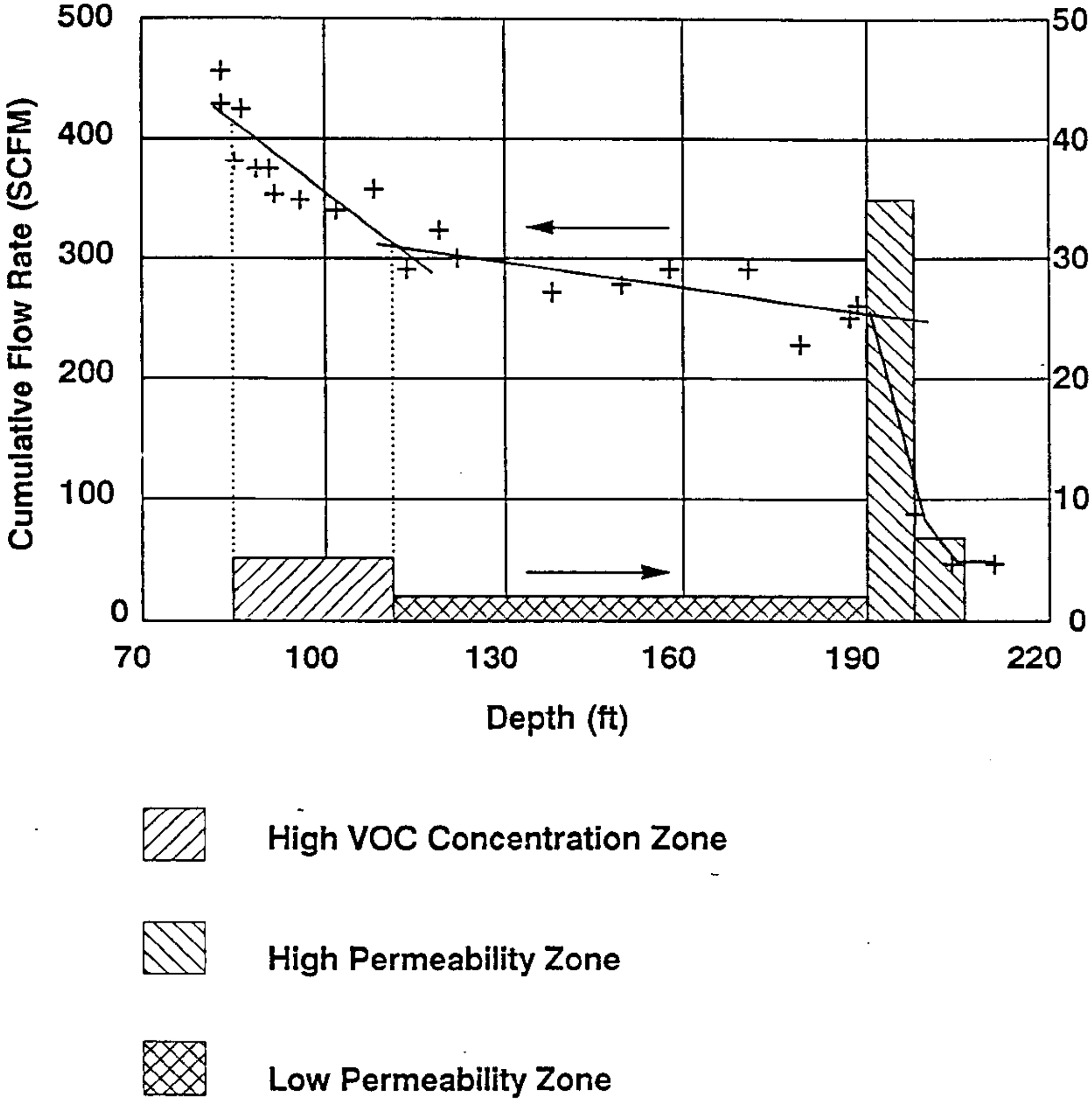

Figure 1-7. Extraction well flow test results.

of contaminated soil vapors (Sisson et al. 1991).

The information from these previous tests has been used to design the tests in this work plan. The 4-month VVE demonstration data showed that a more concentrated VOC extraction gas was needed to increase the VVE system effectiveness. The location of the vertical extraction zone will define the VOC concentration and total flow in the extraction gas. The 110-ft zone has been identified as having high local VOC concentrations [>1,000 parts per million (ppm)]. The 195-ft rubble zone has been identified as having high local permeability with lower VOC concentrations (~100 ppm). The permeability of both zones will be evaluated by flow, pressure, and tracer tests.

1.2.4 Need for Further Testing

Organic contamination in the vadose zone has lead to the detection of organic contaminants in groundwater monitoring wells adjacent to the SDA. This aquifer serves as a drinking water source. Vapor plume migration predictions indicate that VOC concentrations could increase if no action is taken, potentially exceeding Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) (Walton et al, 1989). SDWA MCLs would be considered applicable or relevant and appropriate requirements (ARARs) to any remedial action taken at this operable unit (OU). Thus, investigation of the vadose zone is being undertaken, as described in the OCVZ RI/FS work plan (EG&G 1992). As part of the RI/FS process, treatability testing of VVE is necessary in order to evaluate the technology's applicability to the OCVZ operable unit, including its ability to satisfy probable ARARs.

Although, the goals for the previous tests were met, the operation of the extraction well did not allow optimization of the extraction process. Thus, additional testing is required to maximize the efficiency of the VVE system. The VVE process can then be thoroughly analyzed as to its viability as a remedial action at the SDA.

Additional testing is required to provide the following necessary data:

- The optimal vertical zone for extraction
- The optimal gas flow rate (at the identified extraction zone) to provide the most efficient VOC removal rate
- Operation, maintenance, and capital cost data
- System design information to assess the feasibility of scale-up.

1.3 Subsurface Disposal Area Site Background

The RWMC is located in the southwest corner of the INEL, 3.5 mi north of the southern boundary of the INEL, 54 mi west of Idaho Falls; and about 22 mi southeast of Arco. It was established in 1952 as a disposal site for solid, low-level waste generated by INEL operations. Its current mission is to provide waste management for the present and future needs of the INEL and to retrieve, examine, and certify waste for shipment to the U.S. Department of Energy Waste Isolation Pilot Plant in Carlsbad, New Mexico.

The RWMC encompasses 144 acres and consists of two main disposal and storage areas: the Transuranic Storage Area and the SDA. This work plan focuses specifically on the 88-acre SDA. Within the SDA are smaller, specialized disposal and storage areas consisting of pits, trenches, and aboveground storage pads (see Figure 1-2). The OCVZ RI/FS work plan (EG&G 1992) provides additional detail for site background.

1.3.1 Climate and Seismic Activity

The INEL is situated in a semiarid sagebrush ecosystem on the Snake River Plain (SRP) in southeastern Idaho. The annual average temperature at the INEL is 42°F. The average summer daytime maximum temperature is 28°C (83°F), and the average winter daytime maximum temperature is -0.5°C (31°F). The highest temperature recorded is 39°C (103°F), and the lowest temperature recorded is -41°C (-43°F). The average relative humidity at the INEL ranges from a monthly average minimum of 15% in August to a monthly average maximum of 81% in February and December. The average annual precipitation for the INEL is 8.5 in., with the highest precipitation rate occurring in May.

Prevailing winds are from the southwest and average 7.5 mph on an annual basis with monthly average wind speeds ranging from a maximum of 9.3 mph in April and May to a minimum of 5.1 mph in December. The average absolute barometric pressure for the INEL is 25.06 in. mercury with monthly averages ranging from 25.0 in. mercury to 25.13 in. mercury.

The INEL has been designated a Uniform Building Code Seismic Zone II. The largest earthquake recorded for the Idaho seismic zone occurred on October 28, 1983 and measured 7.3 on the Richter scale. Although the earthquake was felt at the INEL, there was no structural or safety-related damage.

1.3.2 Stratigraphy of the Vadose Zone at the Subsurface Disposal Area

The vadose zone is defined as the subsurface zone located between the soil surface and the groundwater. Soil depth at the SDA ranges from one to 23 ft. The stratigraphy at the SDA consists of basalts interbedded with sediments. The basalts are intercalated with seven known sedimentary interbeds above the water table. Three of the largest interbeds, which have been studied previously at the SDA, are located at approximately 30, 110, and 240 ft below land surface. The 30-ft interbed is thickest to the southwest, thins and disappears in the southeastern part of the SDA and does not appear to be important for this study.

The 110-ft interbed thickens to the west and thins to the north and south. Soil boring logs show the top of the 110-ft interbed starts at depths ranging from 87 to 131 ft, is relatively flat, and slopes to the east at an average rate of about 20 ft per mile. The presence and thickness of the 110-ft interbed varies from 0 to 40 ft, averages 13 ft, and is greatest in the western part of the SDA.

The 240-ft interbed is thickest near the center of the SDA and in the southern portion of the RWMC. The top of the 240-ft interbed occurs at a depth of 218 to 253 ft. It ranges in thickness from five to 32 ft, averages 17 ft, and is greatest throughout the central portion of the RWMC area.

The composition of the interbeds also varies. Silty clays, sands, gravels, and organic rich Paleosols are predominant. These interbeds and the dense, unfractured basalt layers are thought to act as barriers to the downward migration of the VOCs to the SRP Aquifer.

The highest concentrations of VOCs observed at the SDA are at and above the 110-foot interbed. Thus, it is anticipated that this interbed is acting as a barrier to downward VOC migration in the area. Also, it is anticipated that the most efficient zone for VOC removal by VVE will be at and directly above this interbed.

1.3.3 Snake River Plain Aquifer

The SRP Aquifer is approximately 585 ft below the land surface of the SDA. The aquifer is about 206 mi long, 30 to 60 mi wide, and covers an area of about 9,600 mi^2. Water enters the regional aquifer from the west, north, and east. The configuration of the water table indicates that water in the SRP Aquifer moves regionally from the northeast to the southwest, approximately parallel to the longitudinal axis of the plain. The aquifer contains approximately 2×10^9 acre-ft of water, 5×10^8 acre-ft of which might be recoverable (Robertson et al. 1974). The aquifer discharges about 6.5×10^6 acre-ft of water annually through springs in the area from Twin Falls to Hagerman, Idaho. The estimated average flow rate of the groundwater within the aquifer ranges from four to 20 ft per day (Robertson et al. 1974).

1.3.4 Perched Water at the SDA

Perched water has been found in six of the 45 wells drilled at the RWMC. Perched water is found in the basalt at two depths, 80 to 100 ft and 180 to 220 ft, below soil surface. These two depths where perched water has been found in the basalt are above the two sedimentary interbeds (110 and 240 ft) found at the SDA. Of the six wells where perched water has been found, two wells have detected perched water above the 110-ft interbed, and the other four wells have found perched water above the 240 ft interbed. Both perched water layers are discontinuous beneath the RWMC, with the perched water layer above the 240-ft interbed being more laterally extensive. Annual precipitation contributes water to the perched water layer above the 110-ft interbed, while spreading areas contribute water to the perched water above the 240-ft interbed (Hubbell 1990). This perched water should not affect the VVE system or any of the treatability study tests.

Various radionuclides were detected in the 1976 to 1980 time frame but only in USGS Well 92. No radionuclides have been detected in perched water wells since 1980. Purgeable organic compounds have been detected in USGS Well 92 (see Figure 1-2) and Well 8802D. If perched water begins to enter the extraction well during testing, the VVE system will be shut down and the project managers will determine how to proceed.

2. REMEDIAL TECHNOLOGY DESCRIPTION

Vapor Vacuum Extraction is a process where VOC vapors are extracted from the vadose zone below the SDA through an extraction well. The vadose zone is defined as the subsurface soil zone located between the soil surface and the groundwater. The VVE is a technique that does not require extensive disturbance of the subsurface.

2.1 Vapor Vacuum Extraction Process

The VVE system apparatus is connected to a well drilled to a depth that penetrates the vadose zone. The vacuum pump induces air flow through the subsurface, stripping and volatilizing the VOCs from the subsurface matrix into the air stream. Subsurface air and vapors migrate toward the extraction well in response to the negative pressure in the well. The air stream containing VOCs is then drawn up the borehole and through the extraction apparatus for processing. The design, with the vacuum pump at the end of the treatment train, serves to prevent leaking of VOC vapors from the system. Figure 1-4 illustrates the conceptual operation of the VVE system; Figure 2-1 diagrams the VVE system piping, components, and process instrumentation.

Once the air stream containing VOCs exits the extraction well, the stream passes through an isolation valve. From the isolation valve, the stream flows to the electric heater, where it is heated to reduce condensation of water in the treatment train by decreasing the relative humidity from 100% to 50%. A portion of the air stream may be diverted at the isolation valve to the particulate filter when a sample is to be collected. After the heater, the stream passes through a three-stage particulate removal process to remove particulate matter greater than 0.3 μm in diameter (Matthern 1990).

The first stage of particulate removal is a cyclone separator, which removes material 15 μm or greater in diameter. The second stage of particulate removal is a prefilter with an American Society of Heating, Refrigeration, and Air-Conditioning Engineers efficiency of 55 to 60%. The final stage is a HEPA filter, which removes particulate of 0.3 μm at an efficiency of 99.97%. The HEPA filter serves as a safeguard for removing radioactive particulate, although no manmade radioactive particulates have been found during prior tests. Radon, a radioactive gas that occurs naturally, was present in the extraction gas stream on system startup, but has not been found since. Samples will be taken of the particulate matter collected by each particulate removal stage (cyclone, prefilter, HEPA filter, and pump prefilter) before disposal of any particulates or filters for characterization of radionuclide content and composition, as explained in Section 9.2.

The VOCs are removed from the stream by a bed of activated carbon prior to being discharged to the atmosphere. The effluent from the bed is monitored continuously for the total concentration of VOCs in the air stream to ensure that the quality of the exiting air steam meets Occupational Safety and Health Administration workplace air contaminant limits. To monitor VOC discharges to the atmosphere following carbon bed treatment, a VOC detector in the form of a gas analyzer samples the discharge stream and will shut down the VVE system when total VOC concentrations reach 2 ppm. The limit of 2 ppm is an Environmental Protection Agency (EPA) regulatory requirement to protect workers.

The VVE system is equipped with several emergency shutdown devices to protect against abnormal conditions. The potential abnormal shutdown scenarios are examined in Addendum B, Rev. 1, *Safety Assessment for the Vapor Vacuum Extraction at the Radioactive Waste Management Complex* (EG&G 1990).

2.2 Extraction Well

The VVE apparatus and extraction well used for the previous VVE tests (the two-week and four-month tests) will be used for the pilot-scale TS tests. The screen in the extraction well has been removed. The extraction well, Borehole 8901D, was completed to a depth of 234 ft. The screen in this boring has been removed, leaving the rough borehole from 90 ft to the total depth of the boring for VVE treatability testing. The boring is cased from the surface to a depth of 90 ft. An attempt was made to raise the casing from 90 ft to 50 ft to allow for additional treatability testing. However, it was not possible to move the casing from it's existing depth of 90 ft. This extraction well is strategically located between Pits 4, 6, and 10 of the SDA and at the center of VOC plume as defined by the soil gas survey (Laney 1980). Figure 2-2 contains a schematic diagram of the extraction well. At the present time, only one extraction well and VVE apparatus exists at the SDA.

2.3 Monitoring Wells

The six monitoring wells, 8801D, 8902D, D02, 78-4, 77-1, and WWW-1, used in the previous VVE demonstrations will be used during pilot-scale TS test activities. Two additional wells (9301D and 9302D) have been added. Figure 2-3 shows the physical layout of the monitoring wells and the extraction well at the SDA. Each monitoring well is equipped with sampling ports at depths ranging from 30 to 240 ft. Table 2-1 presents the depth of vapor monitoring ports in the existing VOC vapor monitoring wells. Each well has between five and nine sampling ports. All of the sampling ports were constructed by centering a short length of stainless steel well screen at the desired depth and packing a 5-ft section of the wellbore with gravel. The gravel pack was capped with a bentonite plug and the wellbore was filled with cement grout to the elevation of the next sample port. Each well screen was connected to the ground surface by 3/8 in. stainless steel tubing. Three of the monitoring wells are located inside the SDA. The sampling ports within those wells are terminated at ground surface with a pressure transducer and sample-pump connection (Sisson et al. 1991). Table 2-2 lists the distances each monitoring well is from the Extraction Well 8901D. Six new groundwater monitoring wells are being installed outside the SDA as part of the groundwater Track 2 studies. These new wells and USGS 118 will be instrumented

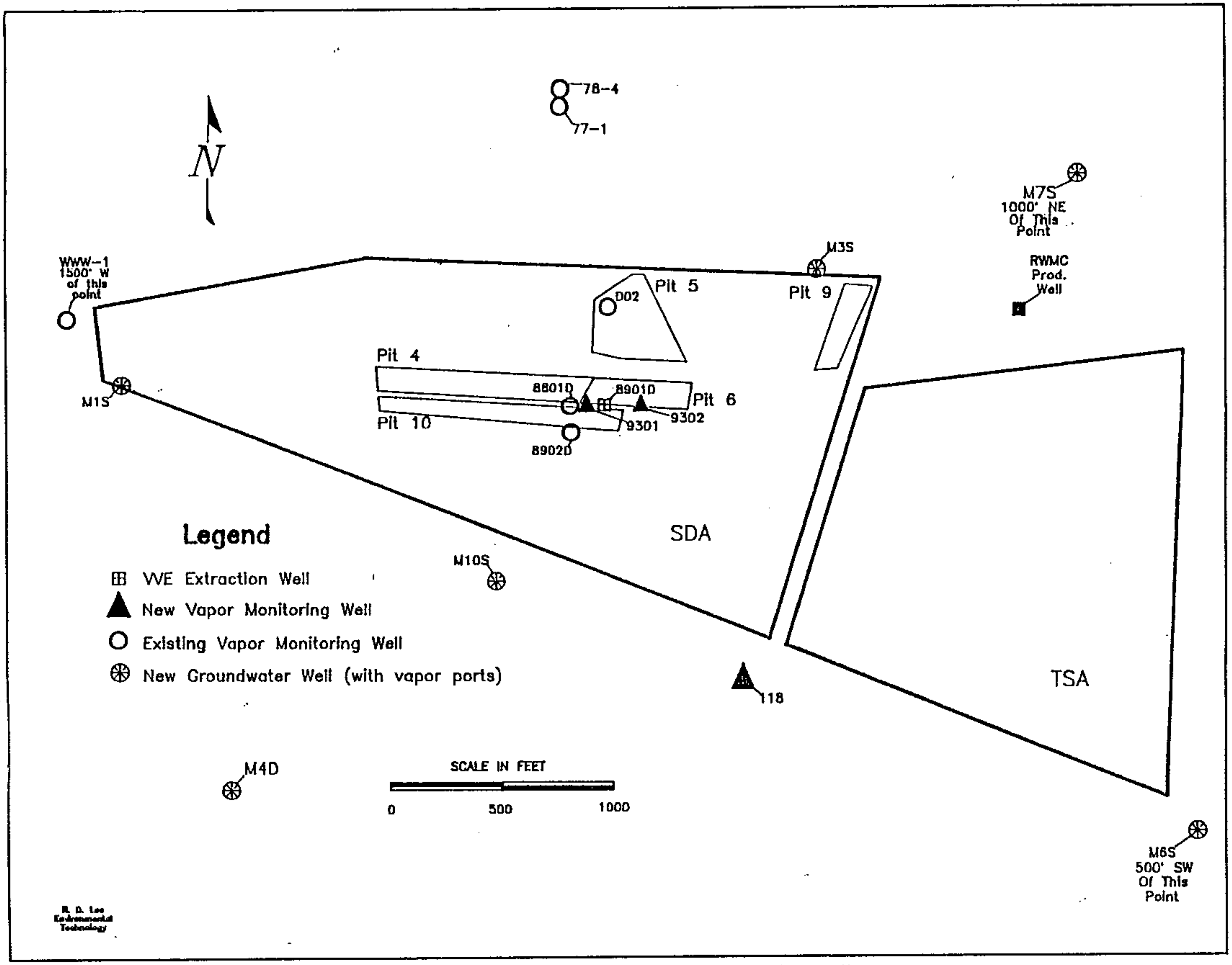

Figure 2-3. Physical layout of the pilot-scale VVE system; extraction and monitoring wells.

Table 2-1. Depth of Vapor Monitoring Ports (ft).[a]

	Vapor Monitoring Wells					
	8801D	8902D	D02	78-4	77-1	WWW-1
Depth to Monitoring Ports (ft)	32.8	30	27.5	76.7	64.2	15.3
	50.5	46	59.5	118.4	102.4	48
	77.5	70.5	68.5	149.1	110.5	74
	92.5	104.5	100	25.1	149.6	112
	102.5	130	125	333	189.7	135
	131	179	165.5			180
	167.2	198.7	192.5			240
	192.5	229	231			
	230					

a. Wells 9301D and 9302D have been installed with vapor ports similar to 8902D. Exact placement will depend on well log information.

with vapor ports and will be used for long-term VOC monitoring during and after the TS. The two new monitoring wells inside the SDA have been installed near the extraction well (See Section 1.2.4)

2.4 Data Acquisition System

Data will be acquired at the extraction well and the five surrounding monitoring wells inside the SDA (8801D, 8902D, DO2, 9301D and 9302D) using a variety of transducers connected to Wavetek Model 52A data loggers. These data loggers have an analog to digital conversion resolution of ±0.0001 V, and a stability accuracy of ±0.005% of range. The data loggers are connected to Compaq SLT/286 portable computers for data storage.

For the purpose of measuring pressure fluctuations both downhole and at the ground surface, the monitoring wells are instrumented with Setra Model 270 absolute pressure transducers. These pressure transducers have a measurement range of 600 to 1100 mbar and a voltage output of 0 to 5 V dc. This output is specified by the manufacturer to have operational uncertainties of ±0.1% of range for its set zero reading (600 mbar), a preset gain uncertainty of ±0.1%, and a voltage linearity of ±0.5% for

Table 2-2. Distances from the monitoring wells to the Extraction Well 8901D.[a]

Well	Distance from 8901D (ft)
77-1	1,342 ft
78-4	1,414 ft
WWW-1	3,885 ft
M10S	910 ft
D-02	450 ft
8801D	74 ft
8902D	164 ft
9301D	20 ft (approximate drill site)
9302D	65 ft (approximate drill site)

a. See Figure 2-3 for well placement.

output data. Thus, the transducers and data loggers have a combined measurement uncertainty of ±0.60 mbar (Sisson et al. 1991).

The extraction well stream flow is measured with a Kuru Model 555 mass flow sensor, a Setra Model C239 differential pressure transducer that measures the vacuum generated in the system by the extraction process, and three type T thermocouples for monitoring ambient temperature, stream temperature, and DAS enclosure temperature. Data from these instruments is recorded by a data logger as well as by the operator.

2.5 Gas Sampling and Analysis System

The gas samples from the extraction well and monitoring wells will be collected following the same procedures. The sampling procedures use Tedlar bags and Itech vacuum boxes. Refer to Appendices G and H of the Test Plan for detailed sampling procedures. Tedlar bags are preferred over syringes for the following reasons: large volume samples can be taken with tedlar bags and stored; samples can be reanalyzed from each tedlar bag if needed; and samples can be diluted if needed. Each sample port will be purged of three sample volumes. A Tedlar sampling bag will be connected to an Itech vacuum sample collection box. A Swagelok quick-connect will connect a sample line from the box to the purged well sampling port. The sample pump creates a vacuum in the sample box, forcing well gas into the sample bag without contaminating the pump. When the samples from each sampling port of a well are collected, they will be transported to the laboratory for analysis. The soil gas samples will be transported for analysis to the laboratory as soon as possible to prevent degradation of the samples as a result of analyte decomposition and to prevent dilution of the sample with ambient air.

Gas samples will be transported to a laboratory for Level II VOC analysis. VOC analysis will be via modified method TO 14 (EPA, 1988) or by modified method 8240 (EPA 1986). VOC analytes will include CCl_4, TCE, $CHCl_3$, PCE, 1,1,1-TCA, and toluene. In addition to the compounds specified to be detected by these methods, other organic compounds may be detected. These compounds, which may include other organic contaminants disposed at the SDA, may be identified (if the resolution is high) through library searches and quantified (if the peaks are large enough to warrant concern).

For the Level IV confirmation sampling, samples will be split by the laboratory and one of the splits will be analyzed at Level II and the other will be analyzed at Level IV. For sample populations greater than 100, 5% of the samples will be split, and for sample populations less than 100, the split sample frequency will be increased to 10%. Only the long term VVE operational test is anticipated to have sample numbers greater than 100. Field blanks, which will consist of tedlar bags filled with nitrogen, will be treated the same as regular samples. Sampling frequency of field blanks will be 10% of the total regular sample taken, and will be used to assure cross-contamination is not occurring and that the reused tedlar bags have been properly decontaminated.

3. TEST OBJECTIVES

This section defines the objectives of the pilot-scale TS and the intended use of the data from the specific TS test activities. The test objectives should be based on a projected level of cleanup that is protective to human health and the environment (EPA 1989a).

Review of VVE literature and previous SDA testing results show that VVE is a viable alternative for remediation of organic contaminants with high Henry's constants in the vadose zone (EPA 1989b, EPA 1987, and Malot 1989). Thus, VVE is considered a potential remedial alternative for the OCVZ OU. A general objective of this TS is to provide data to determine if this technology is capable of satisfying probable ARARs, including SDWA MCLs.

The design and operation of a remediation system such as a VVE system can be aided by appropriate analysis and modeling. The movement of organics under conditions imposed by a VVE system is dominated by gas advection (pressure induced flow). Other transport mechanisms such as diffusion, which are important under ambient conditions, can be considered negligible within the influence of an extraction well.

To determine the feasibility of VVE remediation and to design an effective system, it is advantageous to estimate vapor flow rates, mass removal rates, and the time required to achieve a given level of remediation. This requires knowledge of the contaminant locations relative to the vapor flow paths introduced by extraction wells. Current levels and locations of the contamination can be determined by sampling. Flow paths are determined by the geologic and hydrologic make-up of the subsurface, induced vacuum, and construction of the extraction wells. The flow paths and vapor flow rates can be estimated from a combination of tracer tests and pressure measurements during operation. This information can in turn be used to estimate flow and transport parameters for modeling. Modeling can then be used to examine other scenarios such as various extraction zones, well placements, and operating parameters.

To support the TS and design of a VVE remediation system, a phased modeling approach will be used. Simple screening models will be used to estimate the performance of soil venting operations and to interpret the results of field tracer tests and pump tests to determine air permeability/conductivity. These screening models assume simple geometries and may not yield the necessary information to understand the system. As knowledge of the flow system and the controlling factors increases, it would be worthwhile to include effects of a heterogeneous and "layered" subsurface. Detailed information on the models is included in the OCVZ RI/FS work plan (EG&G 1992).

Minimum performance levels must be set for the VVE system to ensure that the system can reduce VOCs in the vadose zone to levels which will ensure the groundwater will continue to meet the drinking water MCL established under the SDWA. A possible approach to determining what performance level the VVE system must obtain is to use a steady-state, diffusion-dominated transport analysis with a linear concentration gradient (Sondrup 1992). This analysis estimates a vapor concentration of 200 ppm (1250 mg/m^3) CCl_4 at a 100-ft depth in the vadose zone should meet the SDWA MCL in the groundwater of 5 parts per billion. This provides performance information which will aid in determining what performance level the VVE system must meet.

Pits containing the contamination source are not part of the OCVZ OU. These pits are part of the Transuranic (TRU) Contaminated Pits and Trenches OU. The OCVZ OU will coordinate efforts to remediate the vadose zone with the efforts of the TRU Contaminated Pits and Trenches OU to remediate the sources of the organic contamination. The pits may affect the actual length of VVE operation for final cleanup, since future release of VOCs from the pits would affect the VOC plume in the vadose zone. Model projections indicate that the major release of VOCs into the vadose zone has already occurred (Baca et al. 1990). Also, the existing VOC plume in the vadose zone may cause groundwater to exceed SDWA MCLs, as discussed in Section 1.2. For this reason, remediation of the vadose zone may begin before remediation of the sources has begun in order to prevent further accumulation of organics in the vadose zone and increased health risks. Data from the flux chambers will be used to calibrate the modeling effort to provide an estimate the length of time a vacuum extraction effort would require to effect full-scale remediation.

3.1 TS Objectives

The data and information collected from the specific designed TS tests are to support the TS objectives. The TS objectives are as follows:

- Provide data to determine the VOC mass extraction rate with the VVE system at three different flow rates at each incremental depth
- Define the optimal vertical zone of extraction and optimize the VVE system performance at that level
- Provide operation, maintenance, and capital cost data to assist in the technology feasibility evaluation
- Provide system design information which could be used to assess the feasibility of technology scale-up.

Specific tests are described in Section 4.4, and specific objectives of those tests are identified on Table 5-1. The initial effort of the TS will emplace flux chambers to sample the atmospheric release from the soil in the vicinity of the Extraction Well 8901D. This effort is critical to estimating the duration of vacuum extraction necessary to achieve eventual cleanup goals. The flux chamber tests are planned RI/FS activities (contingent) to be activated during the TS. Refer to the RI/FS work plan (EG&G 1992) for the VOC Surface Flux (Flux Chamber) Test descriptions. The flux chamber data will be fit to estimates of buried drum corrosion and release rates to establish a mass balance on the VOCs buried at the SDA. In the absence of drum retrieval and content evaluation, the flux chambers provide an inexpensive, nonintrusive estimate of the atmospheric release component of the source term.

Tracer tests will be used to determine the travel times within the optimal extraction zone selected during extraction well testing, and determine travel time between differing geologic layers in the vadose zone. Travel times between selected points in the contaminant plume will be used to improve the model of the spatial structure of hydraulic conductivity. Three tracer gases of differing molecular weights (krypton, neon, argon, or sulfur hexafluoride) will be injected in sequence or together. Their relative arrival times and slopes of their breakthrough curves will provide valuable diffusivity information. The tracer gases will be injected at monitoring wells determined to be in the zone of influence of the extraction determined by the pressure distribution test and recovered at the extraction well.

Another critical component of the TS is to evaluate the permeability of the basalt and sedimentary interbeds in the vicinity of the extraction well. Inflatable packers, which allow interval isolation yet permit flow and sampling within the interval, will be used to evaluate the interbed characteristics at 5-ft intervals in the extraction well. The four-month test has revealed two zones which are of particular interest, as explained in Section 1.2.3.

The level of VOCs to reach the SRP Aquifer is a function of the hydrological and geological properties of the vadose zone, the concentration and location of VOCs present, and the mechanisms forcing the contaminants downward to the aquifer. These parameters will be better defined by the RI/FS; however, the TS activities will provide additional, localized, supporting information.

The TS results will be used to evaluate the effectiveness of vacuum extraction as a remedial alternative. Preliminary modeling and data analysis indicates that a majority of the plume lies slightly above the 110-ft interbed (110-ft zone). Although the plume beneath the SDA does extend to the groundwater depth (EG&G 1992), potential remediation efforts will concentrate on the 110-ft zone. The TS results will determine optimal zones and extraction rates for projected cleanup.

Defining the extent of the VOC plume and its transport to the groundwater and the atmosphere is essential for remediation. Data on the extent of the VOC plume and its transport will be collected in the OCVZ Focused RI. Data collected from the TS will relate to the operation of the VVE system (i.e., operating and maintenance costs, optimization of VVE operation, extraction well tests, off-gas treatment test). The intended purpose of VVE is to reduce the source of the VOCs in the vadose zone and prevent their migration to the groundwater.

During the operation of the VVE system, cost account records will be kept. These records will include all costs associated with VVE operation, testing, equipment, and maintenance. Tracking VVE operation and maintenance costs will aid in evaluating the cost of the VVE system in the feasibility stage, and will provide needed information for future design and cost analysis should VVE be selected as the remedial technology of choice.

3.2 Specific Field Test/Activity Objectives

Specific tests and activities in the field will be performed to meet the TS objectives. These tests and activities are designed to fill data gaps and to provide essential VVE evaluation information. A listing of the TS specific tests/activities and objectives (intended use) of each are outlined in Table 3-1. The TS tests and activities include flux chamber tests (RI/FS task), extraction well testing (extraction flow, pressure, and VOC concentrations), pressure distribution tests (monitoring wells), tracer tests, VVE operation tests (VOC concentrations, flow measurements, and pressure measurements), meteorological data, and off-gas treatment evaluations.

3.3 Objectives of Vapor Vacuum Extraction Treatability Study Compared to Conclusions of Prior Environmental Protection Agency Superfund Innovative Technology Evaluation Studies

The Superfund Innovative Technology Evaluation (SITE) program is a joint effort between the EPA's Office of Research and Development and Office of Solid Waste and Emergency Response. The program assists the development of hazardous waste treatment technologies necessary to implement new cleanup standards that require permanent remedies. This is accomplished through technology demonstrations designed to provide engineering and cost data on selected technologies.

The SITE program performed an evaluation on the Terra Vac In Situ Vacuum Extraction System as a treatment method for waste cleanup. Results from this study, along with data from other applications, were summarized in an EPA applications analysis report (EPA 1989b). Table 3-2 compares the objectives of the VVE TS to the conclusions of prior VVE tests evaluated in the EPA SITE study and identifies the areas of the TS lacking necessary information. Site-specific data gaps relating to VOC transport properties and extent of VOC plume will be addressed in the focused RI/FS. Unresolved data gaps relating to VOC remediation will be addressed in the TS.

Table 3-1. Treatability study activities and objectives.

TASKS	USES
Install monitoring well	Define pressure distribution around extraction well
Flux Chamber tests	Provide estimates for the duration of VVE necessary to achieve eventual cleanup goals, estimate release rates to establish a mass balance on the VOCs buried at the SDA
Extraction well testing	Define zones of high permeability, high extraction flow, high VOC concentrations, and extraction well pressures at specific zones
Pressure distribution tests (Monitoring wells)	Define pressure distribution around the extraction well Determine zone of influence
Tracer tests	Quantify resident time distribution Quantify operation zone gas velocities Compare with organic transport model predictions and calibrate the model
VVE Operation tests	VOC concentrations, flow measurements, and pressure measurements
Meteorological data	Monitor meteorological conditions at the site potentially affecting VVE
Off-gas treatment studies	Evaluate/select off-gas treatment system Optimize operating performance Determine cost and design data
Cold weather operations	Evaluate VVE operations in cold weather Determine costs and design data Optimize operation performance Evaluate VVE operations Provide costs and design data

Table 3-2. Objectives of the site-specific VVE TS compared to conclusions of a number of EPA SITE studies.[a]

Objectives	EPA SITE studies[a]	INEL TS[b]	
Viable remedial technology for site	Yes	Yes - Preliminary (final decision upon RI/FS results)	
- Initial recovery rate (lb/day)	20 to 2,000	14	
- Length of operation	30 days to 2.5 years	4 months	
- Compound volatility (Henry's constant at 10°C)	>0.001	CCl_4	0.6370[a]
		$CHCl_3$	0.074[a]
		TCE	0.2315[a]
		TCA	0.4152[a]
		PCE	0.3641[a]
- Dewatering site	Can remove water	Perched water in vadose zone	
- Weather conditions	Can be winterized	Winter application	
Provide cost data	\$10 to \$50/ton	Need data	
- Cost of off-gas treatment	Up to 20 % of total cost	Need data	
- Power cost	Major operating cost	Need data	
Provide design data			
- Zone of influence	Site-specific	Need data	
- Vertical zone of extraction	Site-specific	Need data	
- Cleanup criteria	Required (site-specific)	Required	
- Optimum extraction flow/vacuum	Site-specific	Need data	
- Projected cleanup time	Site-specific calculation	Need data	
Site data			
- Soil permeability	10^{-4} to 10^{-8} cm/s	10^{-4} to 10^{-7} cm/s	
- Winter operation	Use heat-traced pipe	Need data	
- Depth to groundwater	Site-specific (0 to 300 ft)	585 ft	

a. U.S. Environmental Protection Agency, *Terra Vac In Situ Vacuum Extraction System - Applications Analysis Report*, EPA/540/A5-89/003, July 1989.
b. J.B. Sisson and G. C. Ellis, *Summary Report of Results of the Vapor Vacuum Extraction Test at the RWMC*, EGG-WM-9301, Rev. 1, March 1991.

Data gaps that need to be filled by the TS activities were identified in the comparison. These data gaps include:

Cost Data

- Off-gas treatment cost
- Power costs
- Operation costs
- Maintenance costs
- Capital costs.

Design Data

- Cleanup criteria
- Zone of influence as a function of depth
- Extraction flow/vacuum/VOC concentration as a function of depth
- Optimum zone of extraction
- Projected cleanup time and rate
- Efficiency of VOC removal.

Site Data

- Winter operation
- Extent and concentration of VOC plumes
- Effective permeability of zones
- Subsurface stratigraphy.

Addressing those data gaps and the operating performance of the VVE system during the four-month VVE demonstration, performance criteria for the VVE system were established for operational parameters. Those performance criteria are listed in Table 3-3.

Table 3-3. VVE performance criteria.

1. VOC concentration of the extraction gas — >200 ppm.

2. Meet a minimum initial VOC removal rate — 50 pounds/day.

3. Meet a minimum projected cost of cleanup — $25/ton of soil-basalt.
   (cost is an estimate based on information provided in the EPA SITE studies, *Terra Vac In Situ Vacuum Extraction System - Applications Analysis Report*, U.S. Environmental Protection Agency, EPA/540/A5/-89/003, July 1989).

4. Off-gas treatment costs — <25% of total cleanup cost.

5. Atmospheric emission — meet State and Federal regulations for point source discharge for each VOC constituent.

6. No mixed waste will be transported offsite.

4. EXPERIMENTAL DESIGN AND PROCEDURES

This section provides an overview of the experimental design and procedures used to meet objectives of the TS work plan. Detailed operational procedures are found in the test plan (TP) (Attachment II).

The tests described in the work plan are:

- Flux chamber test
- Extraction well test
- Pressure distribution test
- Tracer test
- Long-term operation test
- Off-gas treatment studies.

An outline of the TS shown from the general to specific tasks is presented as follows:

- TS objectives are established (Section 3)
- Data gaps are identified (Section 3)
- Parameters needed to support the operational test are identified (Sections 3 and 4)
- The rudimentary test variables and controls needed to define the parameters are identified (Section 4)
- A test program using identified parameters and test variables is established to meet objectives (Section 4)
- Additional field tests to support the operational designed test program are defined (Section 4 and 6)
- The procedures by which data resulting from the test program are collected and analyzed (Section 8).

Figure 4-1 shows the interaction between the experimental design and other elements outlined in the TS work plan.

4.1 Test Design

The pilot-scale VVE system test is designed to optimize the removal of VOCs from the vadose zone. Packer testing in the extraction well will provide pressure, flow, and VOC concentration data. It is anticipated that the 110-ft zone and the 190-ft rubble zone are the most likely candidates for long-term VVE evaluation. The 110-ft zone has been selected for high local VOC concentrations in the subsurface gas, and the 190-ft rubble zone has been selected for high local permeability. The increments and geology of these zones were described in Section 1.2.3.

Preliminary measurements indicate that the VOC concentration of the 110-ft zone averages approximately 1,300 ppm, and the VOC concentration of the 190-ft rubble zone is about 100 ppm. Flow measurements of the upper 110-ft zone indicate that the permeability is less than that of the 190-ft rubble zone.

4.2 Pilot-Scale Testing Variables

Pilot-scale tests are designed to provide detailed cost, design, and performance data required to optimize the remediation process. The number of variables to be studied will be limited to those engineering variables that affect the cost and performance of the remedial technology (EPA 1989a).

In order for the pilot-scale testing to be effective, the number of variables must be limited. The variables to be considered in the TS are listed in Table 4-1. The initial variables are those conditions that currently exist at the site, the control variables are those variables that are controlled in the operation of the VVE system, and the response variables are those that change in response to changes in the control variables (EPA 1989b). In designing the pilot-scale TS tests, the control variables of extracted air flow/vacuum, extraction zone, and duration of operation will be evaluated for their effects on the responses.

Highly variable transport properties in fractured basalts exist not only between the vertical layers, but within a specific layer plane (Laney 1988). In other words, the layers do not have uniform properties. To address the variability of subsurface transport properties, the current extent and concentration distribution of the VOC plume will be used to derive generalized transport properties. The extent and concentration of the VOCs will be measured in the monitoring wells. The effective transport properties of the subsurface below the SDA will be estimated by using the VOC plume boundaries and concentration gradients as determined from vapor measurement obtained during the RI. Time and volume estimates of VOC releases from the buried drums and vapor transport parameters for the subsurface zones will be used in the assessment. Transport parameters that most closely conform to the empirically defined

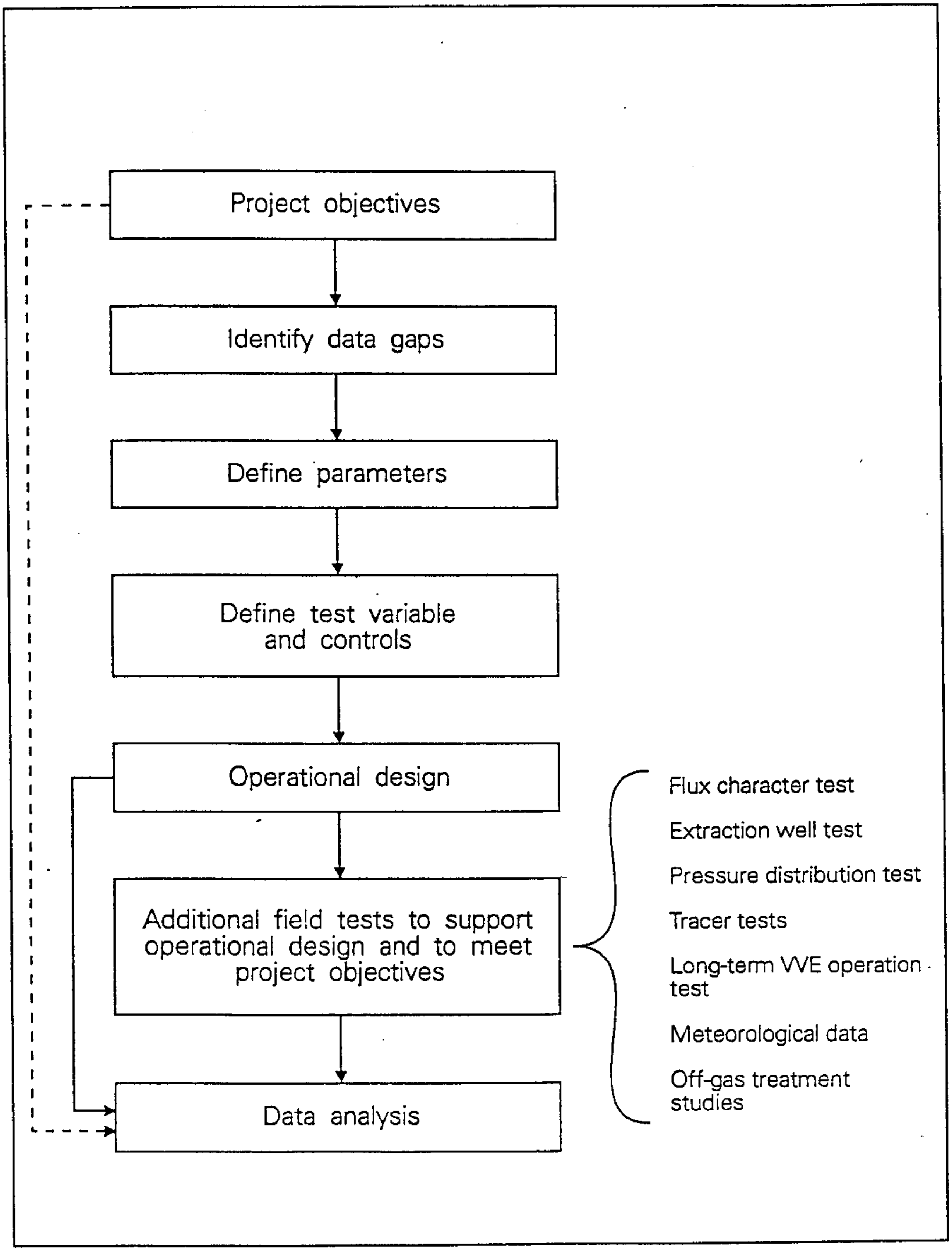

Figure 4-1. Experimental design and other project elements.

Table 4-1. System variables.[a]

Variables	Controls	Response	Initial
Initial subsurface VOCs			X
Final subsurface VOCs		X	
Depth to groundwater			X
Subsurface permeability			X
Subsurface moisture			X
Subsurface porosity			X
Subsurface organic carbon			X
Henry's constant			X
Solubility of organics			X
Subsurface temperature		X	X
Extracted air flow/vacuum	X		
Extraction Zone	X		
Duration of operation	X		
Radius of influence		X	
Power consumption		X	

a. EPA, 1989b (modified).

VOC vapor plume will be selected for computer sensitivity analyses. In that manner, the effective transport properties for the various zones will be estimated.

4.3 Treatability Study Responses

The responses that will be measured and calculated in the field to meet the project objectives include:

- VOC removal rate
- VOC removal efficiency

- Horizontal permeabilities of selected extraction zones
- Extraction well zone of influence
- Cleanup time
- Operation, maintenance, and capital costs.

4.4 Field Tests and Measurements

The TS is composed of different sets of tests. The critical test sets, designed to provide site characterization data needed for the RI/FS report, are to be performed in the first part of the TS (within the first four months). Engineering design files (EDF) will be written at the completion of each test set and will contain the data and results for that test set. The EDF's will be used as input into the RI/FS report. These test sets include the extraction well test set and the tracer test set. The last test set to be performed will be the long term VVE operation test set. The long-term VVE operation test will be used to gather operational and life cycle information of the VVE system. The test sets to be performed include:

1. Flux chamber tests (RI/FS planned activity)

2. Extraction well testing
   - Extraction flow
   - Pressure tests
   - VOC concentrations

3. Pressure distribution tests (monitoring wells)

4. Tracer tests
   - Horizontal tracer tests
   - Vertical tracer tests

5. VVE operation tests
   - VOC concentration measurements
     - Extraction well
     - Monitoring wells
   - Flow measurements (extraction well)
   - Pressure measurements
     - Extraction well
     - Monitoring wells

6. Meteorological data (Continuation of RI/FS activity)

7. Off-gas treatment studies.

The VOC surface flux (flux chamber) tests are to be performed during the RI/FS and are described in the OCVZ RI/FS Work Plan (EG&G 1992). Table 4-1 provides a summary of field tests and measurements used to determine the basic variables needed to meet the TS objectives. Table 4-2 identifies which tests will determine the parameters needed to meet the TS objectives.

4.4.1 Flux Chamber Tests

Critical to assessing the progress of the effort to remediate organic vapors in the vadose zone is an understanding of the mass of source material and its rate of release from the drums buried in the various pits and trenches. The flux chamber test is designed to trap VOCs migrating to the atmosphere from the ground surface. The flux chamber is an enclosure device that provides a defined surface area from which to sample gases moving through the soil into the atmosphere. Modeling predictions are available which fit a VOC release expression to drum decay data (Walton, 1989). This release expression (curve fit) will be fit through current release data obtained from the flux chamber test to estimate the mass of VOC remaining.

The flux chamber tests are routine monitoring tests planned to be performed as part of the RI/FS sampling tests. There are no variables to the flux chamber test, and the duration of the tests will continue through the entire TS. Flux measurements will be performed at eight locations in the SDA. Flux measurements are also planned in the Air Pathway OU (OU 7-04). The data collected from these measurements will be forwarded to the Air Pathway project managers for potential use in that OU.

Flux chamber tests are discussed in detail in the RI/FS Sampling and Analysis Plan (SAP), and testing procedures are listed there in Appendix I. Clean, dry sweep air is added to the chamber at a fixed rate. The volumetric flow rate of air swept through the chamber is recorded and the concentration of VOCs is measured at the exit of the chamber using a Tedlar bag sample and VOC analysis. Data analysis assumes that the flux from the soil surface is completely mixed with the clean air passing through the chamber and that the chamber does not significantly influence the VOC flux rate from the surface.

4.4.2 Extraction Well Testing

The extraction well flow and pressure tests will be performed to obtain better measurements of extraction flow and VOC concentrations from specific zones in the extraction well. This test will help determine the subsurface air permeability spatial distribution as a function of depth, and will define the vertical concentration gradients and high permeability zones for optimal VVE operations.

Table 4-2. Parameters determined by field tests and measurements.

Field tests and measurements	Zone permeability	Extraction well zone of influence	VOC removal rate	VOC removal efficiency	VOC plume definition
Tracer tests	Yes	Yes	No	No	No
Extraction well flow and pressure tests	Yes	Possibly	Yes (with VOC concentration)	No	No
Monitoring well pressure measurements	Yes	Yes	No	No	No
VOC concentration measurements	Yes	Possibly	Yes (with flow)	Yes	Yes

The vacuum extraction pumping well (8901D) used in previous testing will be used for the TS. Modifications to the well allow significant new information to be obtained about the well and the geologic formations which it penetrates.

The well screen has been pulled, leaving the rough borehole available for characterization studies. The elbow at the top of the well is being replaced with a "T" through which instrumentation can be inserted to monitor flow and pressure characteristics during operation.

Before beginning this test, the baseline VOC concentrations in the extraction well will be determined to compare data obtained during this test with the data obtained during the other tests. Baseline VOC samples will be collected from the 110-ft zone, as this is anticipated to be the optimum extraction zone. The baseline VOC data collected will allow comparison of baseline conditions for this test to baseline conditions for the pressure distribution test, the tracer test, and the long-term VVE test.

The control variables for this test set are the extraction zone and flow rate. Formation permeability will be measured at 5-ft increments from the bottom of the well at approximately 240 ft to the well casing at 90 ft. This will be done using two inflatable straddle-packers 5 ft apart. The upper straddle-packer will be doughnut shaped to allow a 4-in. pipe to be inserted between the two straddle-packers. This allows extraction to be performed on a 5-ft zone in the extraction well, and isolates the rest of the well from extraction. Five feet is the maximum interval that allows collection of representative geologic information based on geologic logs. However, if geologic properties of the basalt at various intervals or irregular well surface dictates, the packer increments may vary. Three different flow rates will be tested at each 5-ft extraction zone. The vacuum will be applied through the extraction system to induce flow in the extraction zone, and concentration and pressure measurements will be made for each of three flow rates. The three flow rates selected by the field team leader (FTL) and project managers for each 5-ft section of the extraction well will be determined based on the estimated permeability of the formation at the 5-ft interval tested. Since the extraction well permeability varies with depth, different flow rates will have to be selected for each extraction zone and cannot be preselected.

The extraction well testing will begin at the bottom of the boring (at a depth of approximately 240 feet) and proceed upward to the bottom of the casing (at a depth of approximately 90 feet). It is possible that a test in one 5-foot increment could affect the results at an adjoining increment if the system is not allowed to return to equilibrium between tests. However, time constraints do not allow for moving the packers to an interval far from the previous one or allowing the zone to passively return to equilibrium. Also, the system is to be operated at each chosen flow rate until "steady state" flow (defined as a variance less than or equal to 5%/15 min), or conditions chosen by the FTL before testing begins. In this way, representative testing will be ensured. Therefore, the testing will be conducted in 5-foot increments beginning at the bottom of the boring and proceeding upward.

The responses for the test are VOC concentrations and pressures in the extraction well as a function of depth and flow rate. The pressure and flow data will allow a calculation of the formation permeability in the immediate vicinity of the straddle packer. The flow and concentration data will allow a calculation of the VOC mass transfer in that interval and an initial estimate of the optimal pumping rate for that zone.

The data obtained will allow an optimal pumping zone to be selected, one which will produce the highest VOC mass removal per unit time. Further testing at varied flow rates in the selected optimal zone, as explained in Section 4.4.5, will refine the optimal pumping rate for VOC removal.

Based on existing data, the VOC extraction rate at the optimum zone is anticipated to be much greater (i.e. order of magnitude differences) than the extraction rate at other zones, and thus easily identified. Therefore, no statistical analysis of extraction zone testing results is anticipated to be necessary. However, if the optimal extraction zone is not easily identified, project management may determine to replicate the testing at selected zones. If this is done, statistical methods can be used to determine the optimal extraction zone.

4.4.3 Pressure Distribution Test

The pressure distribution test will determine the radius of influence of the extraction system. The packed zone interval will be the optimal extraction zone determined from the extraction well testing. The variables for the test will be five different flow rates spanning the range from 0 standard cubic feet per minute (scfm) to the highest safe operating range of the pump motor. The DASs for each of the five monitor wells (8902, 8801, DO2, 9301D, and 9302D) will collect pressure data (response) at 2-minute intervals to give a clear description of the time spread of the pressure profile. When the pressure profile is observed to reach steady state, the extraction well pump will be incremented to the next of the five steps and the data acquisition process repeated.

This pressure distribution data will be used to determine the radius of influence of the extraction well, and will provide information necessary for designing a large-scale vacuum extraction system for the SDA should that option be exercised.

Before beginning this test, the baseline VOC concentrations in the extraction well will be determined to compare data obtained during this test with the data obtained during the other tests. The baseline VOC data collected will allow comparison of baseline conditions for this test to baseline conditions for the extraction well test, the tracer test, and the long-term VVE test. Baseline VOC concentrations will be determined at the optimal extraction zone as determined by the extraction well testing. This is anticipated to be the 110-ft zone.

At the FTL's and project manager's discretion, VOC samples may be collected during the pressure distribution test to provide additional VOC concentration and mass removal data.

4.4.4 Tracer Tests

Horizontal tracer tests will be conducted to determine travel times within the optimal extraction zone selected during the extraction well testing. Vertical tracer tests will be conducted to determine travel time between differing geologic layers in the vadose zone.

Before beginning these tests, the baseline VOC concentrations in the extraction well will be determined to compare data obtained during this test with the data obtained during the other tests. The baseline VOC data collected will allow comparison of baseline conditions for this test to baseline conditions for the extraction well test, the pressure distribution test, and the long-term VVE test. Baseline VOC concentrations will be determined at the optimal extraction zone as determined by the extraction well testing. This is anticipated to be the 110-ft zone.

Tracer tests will be used to determine the natural variation in hydraulic properties of the basalt and interbeds under the SDA. Travel times between selected points in the contaminant plume will be used to improve the model of the spatial structure of hydraulic conductivity. Tracer gases to be used for this test have not been established. However, gases of differing molecular weights (MW) such as krypton, neon, argon, or sulfur hexafluoride may be used for the test. Tracer gases must have low analytical detection limits so that low concentrations in air can be readily measured. The selected tracer gases must also have varying MWs to allow for different diffusion coefficients. The relative arrival times and the slopes of the break through curves of each tracer gas will provide valuable diffusivity information. The tracer data will be used to estimate the travel time from the injection port to the extraction well.

The tracer gases will be mixed into the same container at similar concentrations and will be metered into selected monitoring well ports at a constant rate until a steady concentration is observed in the extraction stream.

Monitoring wells inside the SDA (9301D, 9302D, 8801D, 8902D, and D02) which are determined to be within the zone of influence of the extraction well will be used as injection wells. The port which is closest to the optimum extraction zone determined in the extraction well test will be used for injection. Based on the current knowledge from previous tests the optimum extraction zone should be the well-connected rubble zone above the 110-ft interbed. This zone is of particular interest because of the high VOC concentrations found at this elevation in the monitoring wells in the SDA.

To determine travel time between differing geologic layers in the vadose zone, tracer gases will also be injected into two monitoring wells at ports above and below the optimum extraction zone. The monitoring wells chosen (tentatively 8801D and 9301D) for this part of the tracer test will be determined by the FTL and will be within the zone of influence of the extraction well as determined by the pressure distribution test.

At the FTL's and project manager's discretion, VOC samples may be collected during the tracer tests to provide additional VOC concentration and mass removal data.

4.4.5 Vapor Vacuum Extraction Operation Tests

The VVE operation test will examine the long-term operating characteristics of the VVE system and examine VOC concentration changes over time. Vacuum extraction operations at other sites have noted a decrease in VOC concentrations after initial start-up. If this phenomenon is observed it will require operational changes in the extraction process, most probably a decrease in the pumping rate to maximize VOC mass removal per unit time while minimizing operational costs. A decrease in pumping rate would reduce the radius of influence of the VVE system. The trade-offs between maintaining a maximum VOC mass removal per unit time and reducing the radius of influence will be examined in the evaluation of system performance over the long term. Included in the test would be an accounting of the operation and maintenance costs of the system over the test period.

Before beginning this test, the baseline VOC concentrations in the extraction well will be determined to compare data obtained during this test with the data obtained during the other tests. The baseline VOC data collected will allow comparison of baseline conditions for this test to baseline conditions for the extraction well test, the pressure distribution test, and the long-term VVE test. Baseline VOC concentrations will be determined at the optimal extraction zone as determined by the extraction well testing. This is anticipated to be the 110-ft zone.

Another component of the long-term testing is an examination of the effects of changes in barometric pressure on passive soil gas flushing. Field operators of various INEL site activities have observed air movement into and out of open wells at various times. In all probability this is due to differences in downhole and atmospheric pressure. These pressure differences are being tracked in activities related to the RI/FS. As a component of the TS, the quick-connect couplings will be removed from the vapor ports on monitor well D02, and flow meters attached. The occurrence and velocity of flow from these vapor ports will be recorded at 2-minute intervals on the DAS previously used for the pressure distribution test. The flow occurrence and velocity will be correlated with pressure from the barometric pressure testing to evaluate an effective vertical air permeability for the strata associated with each vapor port.

4.4.6 Meteorological Data Studies

Meteorological data collection is a planned RI/FS activity and will continue for the duration of the TS study activities. Meteorological data are currently collected by a variety of agencies and organizations at the INEL. The USGS maintains a weather station located within the SDA. This station provides the preferred and localized weather data for the SDA and will be the primary meteorological data source during the TS. The USGS station is presently used for microclimate and evapotranspiration studies and includes a Met One wind direction and wind speed measurement system and data logging capability. The anemometer and vane sensors are located 2.5 m above the ground surface. In addition, this station records temperature and vapor pressure.

The National Oceanic and Atmospheric Administration (NOAA) presently has a network of 33 weather stations in southeastern Idaho, with approximately one-third of these stations located at the INEL. There is a NOAA weather station located in the vicinity of the RWMC with a 10-m tower and data logging and transceiver capabilities.

EG&G Idaho operates two climatronics weather stations located at the RWMC. One station is located at Building WMF-613 and has a tower approximately 10 m high. The other station and slightly smaller tower is located at the Health Physics Building, WMF-601. Both RWMC weather stations measure wind speed, wind direction, and temperature and are equipped to measure precipitation. The WMF-613 station is presently equipped to continuously record these measurements on a chart recorder. Refer to the OCVZ RI/FS Work Plan (EG&G 1992) for additional detail on meteorological data collection.

4.4.7 Off-Gas Treatment Studies

The efficiency of the carbon adsorber beds will be analyzed during the length of the TS. The flow and concentration entering the adsorbers (mass loading) will be analyzed. The concentration leaving the number one adsorber will be monitored as a check for VOC breakthrough and an indication of the necessity of rotating the beds. Performance and cost data associated with the use of the activated carbon beds will be analyzed.

This information will be utilized in an estimation of the number and configuration of carbon beds necessary in a full-scale site remediation. Other off-gas treatment options (such as catalytic oxidation, incineration, and ozonolysis) and onsite carbon-bed regeneration will be investigated using manufacturer's specifications, other vacuum extraction experience, and the scientific literature.

5. SAMPLING AND ANALYSIS

This section addresses the specific details of the sampling tests and analysis methods that will be used to support the TS. This section is divided into two parts: (a) the TP and (b) the QA project plan (QAPjP). Data quality objectives (DQOs) are addressed in both sections. Specific DQOs for each test performed are discussed with the test procedures in the field sampling plan. An overview of the DQOs and how they apply to the TS is presented in the QAPjP.

5.1 Test Plan

The TP includes specific discussion of the extraction well testing (flow rate, pressure, and VOC concentration), tracer tests, pressure distribution tests (monitoring wells), and VVE operation tests (VOC concentration, flow rate, and pressure). The TP for VVE Testing at RWMC is presented in Attachment II of this TS document. The TP outlines test procedures, sampling and monitoring locations, and frequency of sampling. Appendix A of the TP has the sampling tables for VOC analysis for the Extraction Well Test, Tracer Test, and the Baseline Test. The Pressure Distribution Test will not have VOC analysis. A sampling table was not prepared for the Long-term Operational Test due to the magnitude of samples, however a block of number will be set aside to cover this test.

5.2 Quality Assurance Project Plan

This QAPjP has been prepared to fulfill the requirements stated in the Environmental Restoration Program (ERP) program directive (EG&G, 1991) and the EPA *Guide for Conducting Treatability Studies Under CERCLA* (EPA 1989). The project description can be found in Chapter 1 of this work plan. Organizational responsibility for this TS can be found in Attachment II, *Final Test Plan for VVE Testing at the RWMC*, Chapter 2. Sampling and analysis procedures are included in the following sections of this work plan.

5.2.1 Quality Assurance Objectives

The QA objectives specify the data quality required to support evaluation of the VVE treatment as a remedial alternative. The data will be used to evaluate the effectiveness of the VVE system. These objectives are presented in Table 5-1 for each of the tests and measurements needed in the TS. Table 5-2 is a target analyte list and detection limits for soil gas verification samples. In addition, other compounds that fall outside of the method range may be detected. These compounds may include semi-volatile compounds or PCBs that may have been disposed of at the SDA. Any large peaks outside the method range may also be identified (through library searches) and quantified. Tentatively a mobile laboratory will be set up onsite which will analyze all soil gas samples, however portable GCs will be available for Level II analysis if laboratory is overloaded or has equipment failure. Samples will be analyzed at Level II, at a minimum, preferably in the laboratory but if necessary a portable GC can be used. All

Table 5-1. DQOs summary.

Task	Method	Analytical Level	Data Uses	Precision	Accuracy	Detection limit	Critical Samples
1. Flux Chamber							
VOCs[3]	Flux Chamber (EPA/600/8-86/008)	II	APA	± 10%	± 20%[1]	1 ppm (CCl_4)	Sec. 5.2.2.2
Sweep air flow rate	Flowmeter	II	APA	± 20%	± 20%[2]	0.5L/minute	NA
Vapor temperature	K-type thermocouple	II	APA	± 1°C	±1°C[4]	0.5°C	NA
Surface permeability	Permeameter/flowmeter	NA	TM	± 20%	NA	NA	NA
Emission rate	Calculated	II	APA	± 10%	± 50%(per EPA)	1μg/min • m^2	NA
2. Extraction Well Tests							
Extraction Flow	Flowmeter	II	APA, N&E, TM, RD	± 20%		NA	NA
Pressure	Pressure Transducer	II	APA, N&E, TM, RD	± 10%	± 20%	NA	NA
VOCs[3]	Level II/Level IV analysis via modified EPA TO-14	II/IV	N&E, TM, RD	± 10% ± 20% (overall) Level IV per lab SOW	± 20%[1] Level IV per lab SOW	1ppm (CCl_4)	Sec. 5.2.2.2
3. Pressure Distribution Tests							
Vapor port pressure	Pressure transducer, DAS, flowmeter	II II	TM APA	± 1mbar ± 20%	± 1mbar ± 20%		
4. Tracer Tests							
a. Horizontal tracers							
Tracer concentrations	TBD	II	TM	± 10%	± 20%		Sec. 5.2.2.2
Elapsed time	DAS						NA
Temperature	Sensor	II	APA	± 1°F	± 1°F	NA	NA
VOCs	Level II/Level IV analysis via modified EPA TO-14	II/IV	N&E, TM, RD	± 10% ± 20% (overall)	± 20%	1ppm (CCl_4)	Sec. 5.2.2.2
b. Vertical tracers							
Tracer Concentrations	TBD	II	TM	± 10%	± 20%		Sec. 5.2.2.2
Elapsed time	DAS						NA
Temperature	Sensor	II	APA	± 1°F	± 1°F	NA	NA
VOCs	Level II/Level IV analysis via modified EPA TO-14		N&E, TM, RD	± 10% ± 20% (overall)	± 20%	1ppm (CCl_4)	Sec. 5.2.2.2

Footnotes may be found at the end of the table.

Table 5-1. (continued).

Task (Measurement)	Method	Analytical Level	Data Uses	Precision	Accuracy	Detection limit	Critical Samples
5. VVE Operation Tests							
a. VOCs[3]	Level II/Level IV analysis via modified EPA TO-14	II/IV	APA, N&E, TM, RD	± 10%	± 20%[1]	1 ppm (CCl_4)	Sec. 5.2.2.2
b. Flow measurements	Flowmeter	II	APA, N&E, TM, RD	± 20% overall		NA	NA
c. Pressure measurements	Pressure transducer	II	APA, N&E, RM, RD	± 10%	± 20%	NA	NA
6. Baseline Tests							
VOCs	Level II/IV analysis via modified EPA TO-14	II/IV	APA, N&E, TM, RD	± 10%	± 20%	1ppm(CCl_4)	Sec. 5.2.2.2
6. Meteorological Data							
Wind speed	Anemometer	II	APA	NA	NA	0.1 mph	NA
Direction	Vane	II	APA	NA	NA	1°	NA
Barometric Pressure	Barometer	II	APA	± 1 torr	± 1 torr	1 torr	NA
Temperature	Sensor	II	APA	± 1°F	± 1°F	0.1°F	NA
7. Off-gas Treatment Studies	Technology Survey	NA	NA	NA	NA	NA	NA

APA - Air Pathway Analysis
SOW - Statement of Work
N&E - Nature and extent of contamination
TM - Transport model
NA - Not Applicable
RD - Remedial Design

1. Percent of known reference value.
2. Variation from calibration value.
3. See Table 5-2 for target analyte list for VOCs.

Table 5-2. Target analyte list and detection limits for soil gas verification samples.

Volatiles	Detection Limit (ppmv)	(μg/l)[a]
1. Acetone	25	59[b]
2. Benzene	1	3.2
3. Bromoform	1	10.35
4. 2-Butanone	25	73[b]
5. $CHCl_3$	1	4.9
6. CCl_4	1	6.3
7. Chlorobenzene	1	4.6
8. 1,1-Dichloroethane	1	4.0
9. 1,2-Dichloroethane	1	4.0
10. 1,1-Dichloroethene	1	3.9
11. Ethylbenzene	1	4.4
12. Methylene Chloride	1	3.5
13. 4-Methyl-2-pentanone	25	102[b]
14. 1,1,2,2-Tetrachloroethane	1	6.9
15. Tetrachloroethene	1	6.8
16. Toluene	1	3.8
17. 1,1,1-Trichloroethane	1	5.5
18. Trichloroethene	1	5.4
19. 1,1,2-Trichlorotrifluoroethane	1	7.7
20. Xylene (meta & para)	1	4.4
21. Xylene (ortho)	1	4.4

a. - Calculated by ppmv x (molecular weight of substance/24.45).

b. - Estimate, to be determined.

Level IV confirmation samples will conducted in the mobile laboratory. The QC samples will be split and one of the splits will be analyzed at Level II and the other will be analyzed at Level IV. For sample populations greater than 100, 5% of the samples will be split, and for samples populations less than 100, the split sample frequency will be increased to 10%. Only the long-term VVE operational test is anticipated to have sample numbers greater than 100. Field blanks, which will consist of tedlar bags filled with nitrogen, will be treated similar to regular samples. Sampling frequency of field blanks will be 10% of the total regular samples taken, and will be used to assure cross-contamination is not occurring and that the reused tedlar bags have been properly decontaminated before reuse.

5.2.2 Precision

Precision is a measure of mutual agreement among individual measurements of the same property under identical conditions. Precision is assessed by means of laboratory duplicate/field replicate sample analysis. During the Level IV analyses, the objective for precision is to equal or exceed the precision demonstrated for similar samples and shall be within the established control limits for the modified TO-14 method (EPA 1988) or modified SW-846 methods (EPA 1986).

5.2.2.1 Field Precision. Field precision will be calculated using results of co-located field sample duplicates or measurements as the standard deviation (s) and the percent relative standard deviation (%RSD) or the relative percent difference (RPD). Precision is either expressed as the RPD for duplicate measurements or as the RSD for three or more replicate measurements. The s is calculated from the variance, s^2, as

$$s^2 = \frac{\Sigma (x_i - \bar{x})^2}{n - 1}$$

and

$$s = \sqrt{s^2} \quad .$$

The % RSD is then

$$\% \text{ RSD} = \left(\frac{s}{\bar{x}}\right) * 100$$

The s and %RSD are calculated on every replicate/duplicate measurement or sample analysis (three or more values).

For duplicate measurements (two values), the precision expressed as RPD is calculated as follows:

$$RPD = \frac{C_1 - C_2}{\frac{(C_1 + C_2)}{2}} * 100$$

C1 and C_2 are the two values obtained from the analysis of the duplicate samples. C_1 is the larger of the two observed values.

Results of duplicate measurements, blanks, and standard analyses will be used to create control charts for long-term monitoring of precision on the Level II analyses.

The frequency of measurement duplication will be incorporated into the individual task procedure. See Table 5-1 for task-specific precision requirements.

5.2.2.2 Critical Samples for Precision.

Baseline tests

Prior to conducting the Extraction well, Pressure Distribution, Tracer and Long-term Operational Tests, baseline VOC samples will be collected and analyzed at Level II. A minimum of five Level II samples will be collected; one split sample will be collected for Level IV data confirmation. Additional baseline samples may also be collected, up to a maximum of 20. If more than 10 baseline samples are collected, an additional split will be collected for Level IV confirmation. These baseline data will allow comparison of the baseline conditions between each test.

Extraction Well tests (Well 8901D)

VOC samples will be taken for each of the three extraction rates at each interval. This results in approximately 90 samples (30 intervals x 3 samples/interval = 90 samples) collected. 10% split samples will be collected and analyzed at Level IV for data confirmation. Once the initial extraction well testing is complete, additional extraction rate testing may be necessary to replicate critical zones or unusual results and trends. Data from VOC analysis of the exit gas stream will allow determination of the VOC mass extraction rate at each flow at each interval. A summary of the number of anticipated samples to be collected during this test is shown in Table 5-3.

Tracer tests

To confirm RGA data, samples of the extraction stream during the tracer tests will be obtained at 12-hour intervals. The samples will be collected and brought to the laboratory for Level II analysis. Based on travel time estimations and the maximum number of monitoring wells within the extraction system's radius of influence, 76 Level II samples are anticipated. Therefore, eight split samples may be collected and analyzed at Level IV to confirm the Level II data. These are the maximum number of split samples anticipated. It is probable that all 76 Level II samples will not be collected, either because of fewer than five monitoring wells within the radius of influence or shorter than predicted travel times. Therefore, there may be correspondingly fewer split samples collected. The number of splits collected should be at least 10% of the sample population.

The sampling frequency and critical sample identifications are based on experimental estimations for planning purposes. Over the course of the TS, project management may need to modify the sampling activities and tests to obtain the necessary experimental information. If additional VOC samples are collected, additional QA splits would be collected for data confirmation.

Table 5-3. Number and types of anticipated samples by test.

Test	Level II VOC Gas Samples	Level IV VOC Gas Samples	Level II Tracer Gas Samples	Level IV Tracer Gas Samples	Level II VOC Residual Management Samples	Waste Management Rad Samples[a]
Extraction Well Test Baseline	5	1				
Extraction Well Test	90	9				
Pressure Distribution Test Baseline	5	1				
Tracer Tests Baseline	5	1				
Tracer Tests	60[b]	6[b]	16[c]	2		
VVE Operation Test Baseline	5	1				
VVE Operation Test	1148[d]	58				
Residuals Management					3	3

a. Waste management rad samples will be analyzed via alpha spectroscopy at the RML.
b. Level II and corresponding number of Level IV VOC gas samples will also be analyzed for tracer gases.
c. Tracer gases (argon/neon, krypton, and sodium hexafluoride) will also be analyzed continuously with a RGA.
d. Estimated number of samples for 5-month period, sample number scheme will begin with RTL001.

VVE Operation tests

From the initial extraction well testing, an optimal extraction rate and extraction zone will be determined. It is anticipated that the start up date for the long term operation of the VVE system will be mid-January 1993. The VVE system will then be operated for a duration of approximately 5 months at the established optimal extraction rate and extraction zone. Eight monitoring wells instrumented with vapor ports located in and around the SDA will be used to monitor the effects of the VVE system on VOC concentrations. The eight wells include: 78-4, WWW-1, 77-1, D-02, 8801D, 8902D, 9301D, and 9302D. Each existing well has been instrumented with five to nine vapor monitoring ports, as shown previously on Table 2-1.

For the first three weeks of VVE operation, every port from the five "inside" wells (8801D, 8902D, 9301D, 9302D, and DO2) will be sampled on a weekly basis for VOC concentrations. "Inside" refers to those wells located inside the RWMC fenced area. The extraction well will be sampled daily based on a four day work week, and the three remaining "outside" wells will be sampled on a biweekly basis. This results in approximately 171 samples (see below) taken during the first 3 weeks of VVE operation.

Five "inside" wells:	8902D	-	8 ports
	8801D	-	9 ports
	DO2	-	8 ports
	9302D	-	8 ports (approximate)
	9301D	-	8 ports (approximate)
			41 ports total

(3 weeks)(41 ports/week) = 123 samples

Three "outside" wells:	77-1	-	6 ports
	78-4	-	5 ports
	WWW-1	-	7 ports
			18 ports total

(2 sampling periods)(18 ports/sampling period) = 36 samples

Extraction well:

(4 days/week)(3 weeks)(1 sample/day) = 12 samples

123 samples + 36 samples + 12 samples = 171 samples for 3 first weeks of VVE operation

(171 samples)(5% splits) = 9 split samples analyzed at Level IV for data confirmation

For the remaining 33 weeks, all eight monitoring wells will be sampled biweekly. The Extraction Well 8901D will be sampled on a weekly basis. If data is sufficiently consistent (the variance of the three consecutive samples equal to or less than 25%), sampling of the extraction well may also go to biweekly. This determination will be made by project management.

8902D	-	8 ports	8801D	-	9 ports
DO2	-	8 ports	77-1	-	6 ports
9301D	-	8 ports	9302D	-	8 ports
78-4	-	5 ports	WWW-1	-	7 ports

59 ports total

(16 biweekly time periods)(59 ports) = 944 samples collected

8901D sampled weekly = 33 samples

944 samples + 33 samples = 977 samples

(977 samples)(5% splits) = 49 split samples analyzed at Level IV for data confirmation

By analyzing these samples, the sustained performance of the VVE extraction and monitoring equipment as well as the status of the VOC plume in the immediate proximity of the extraction well can be evaluated.

Residuals management samples

Prior to disposal of the particulates collected in the cyclone, the pre-filter, and the HEPA filter, analysis for VOCs and radionuclides is planned. One sample each from each of the particulate collection points is planned; thus, a total of three VOC and three radionuclide samples will be collected. Before collecting these samples, the particulates and filters will be screened for radioactivity by a radiological control technician (RCT).

The radionuclide samples will be analyzed via alpha spectroscopy at the Radiation and Measurements Laboratory (RML). RML standard operating procedures (SOPs) for quality assurance will be followed. The VOC samples will be analyzed at the Level II laboratory. Additional residual management samples may be collected at the FTL's discretion or if radiological survey detects the presence of radiation in any of the residuals.

5.2.2.3 Laboratory Precision. Laboratory precision will be evaluated through matrix spikes (MS) and matrix spike duplicates (MSD) for organic analyses and laboratory duplicates for inorganic and radiochemical analyses. Precision will be calculated as RPD for duplicate measurements; %RSD calculations shall be used for assessing the precision on three or more replicate measurements. Regarding the Level IV VOC analysis of gas samples, a laboratory critical sample (LCS) and an LCS duplicate shall be used to assess precision.

5.2.3 Accuracy

Accuracy means the nearness of a result, or the mean of a set of results, to the true value. Accuracy is assessed by means of reference samples and percent recoveries.

5.2.3.1 Field Accuracy. Determining whether a sample yields results that reflect the true concentration of a contaminant in the soil, sediment, or groundwater cannot be quantitatively assessed. The sampling locations and methods described in this plan have been chosen to be representative of the media being sampled. The field accuracy objective is for the measured value to be within ± 20% of the "true value," based on a known standard. 5% or more of all vapor VOC samples will be split samples analyzed at Level II and Level IV by a contract laboratory in accordance with modified EPA Method TO-14 (EPA 1988) or SW-846 modified method 8240 (EPA 1986). This will provide confirmation/QA check on the measurements obtained using Level II. See Table 5-1 for task-specific accuracy goals.

5.2.3.2 Laboratory Accuracy. The QAPjP and the SOPs of the analytical laboratories describe procedures to evaluate laboratory accuracy. Laboratory accuracy will be used to determine if the laboratory is in control and to assign uncertainties.

Accuracy of the Level IV chemical laboratory data will be assessed through the calculation of percent recovery (%R) from MS/MSD analyses and any in-house or blind certified standards that the laboratory analyzes as part of its ongoing QA/QC program. Accuracy is expressed as the %R.

For measurements where standard reference material is used, the %R is calculated as shown below:

$$\%R=\frac{C_m}{C_{srm}}*100$$

C_m is the measured concentration value obtained by analyzing the sample, and C_{srm} is the "true" or certified concentration of the analyte in the sample.

For measurements where MS are used, the %R is calculated as shown below:

$$\%R=\frac{S-U}{C_{sa}}*100$$

S is the measured concentration in the spike aliquot, U is the measured concentration in the unspiked aliquot, and C_{sa} is equal to the concentration of the spike added.

The laboratory is also required by the laboratory statement of work (SOW) to run a sufficient number and type of blanks to detect laboratory contamination.

5.2.4 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is concerned with the proper design of the sampling program. The representativeness criterion is satisfied by making certain that sampling locations and methods are selected and documented properly and that a sufficient number of samples are collected.

Determination of the representativeness of the extent of contamination in the vadose zone vapor plume is limited by the location and depth of existing open wells and installation of six new wells. Information available from previous sampling efforts has been used to develop a sample design to sample all accessible areas that are likely to have been contaminated by waste disposal activities.

5.2.5 Completeness

Before a set of data can be used with confidence in assessing potential exposure to hazardous substances of a site or facility, the data must be complete (i.e., there must be enough valid data from analyses to make the assessment). An integral part of obtaining valid data is to design the sampling network so that the minimum data necessary for site characterization is provided, and critical samples are identified. Completeness for the project will be determined by the following calculation:

$$\%C = \frac{V}{N} \times 100$$

where

V = number of valid data points
N = total number of determinations required.

Completeness for this project will be assessed by comparing the number of samples collected to the number of samples planned. The objective for completeness is that the investigation provides enough planned data so that the objectives of the project are met. The completeness target for all parameters for the RWMC vadose zone TS sampling and analysis is outlined for each task in Table 5-1. Completeness will be calculated following data validation and reduction. Critical samples are the minimum required to support the project objectives. A 100% completeness goal is required for critical samples.

5.2.6 Comparability

Comparability is used to express the confidence with which one set of data can be compared with another set of data. To assist in comparing data, all chemical analyses will be accomplished using methods detailed in the RWMC Operation and Maintenance Manual (O&MM) and EPA or equivalent method. EPA-accepted methods for chemical analyses include the modified EPA SW-846 Method 8240 for organics (EPA 1986) and Contract Laboratory Program SOW for Inorganics [(2/89 and 6/89) perched water samples], and the EPA *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* [(EPA 1988) approximately 10% of all vapor samples]. Certain physical properties of the vadose zone soils and basalt will be measured using appropriate industry-accepted methods and equipment in accordance with documented procedures. All analytical results and field measurements will be reported in the concentration units required for entry into the Environmental Restoration Information System (ERIS) data base and needed for use in source term, transport, and risk assessment models. In order for data from subsequent sampling at the same site or facility to be compared, the specific sampling points will be established in relation to permanent reference points and documented.

Comparability will be assessed by comparing the following information on each data set:

- Field collection methods
- Field and laboratory QA/QC procedures [in accordance with QPP-149 (EG&G 1990)]
- Laboratory detection limits
- Matrix
- RPD between Level II and Level IV analytical laboratory results.

5.2.7 Calibration Procedures

Each piece of equipment shall be identified so that calibration and maintenance can be tracked. The equipment shall have an individual calibration log and be calibrated/standardized prior to use or as part of the operational use following the manufacturer's recommended procedures and the procedures detailed in this section.

Measuring and test equipment shall be calibrated at prescribed intervals and/or prior to use. Frequency shall be based upon the type of equipment, inherent stability, manufacturer's recommendations, intended use, and experience.

5.2.7.1 Field Instruments Calibration. The field instruments, including the soil moisture meter, DASs, sidewall tensiometers, flow meters, infiltrometer, permeameters, VOC monitor, etc. will be standardized and/or calibrated in accordance with the manufacturer's procedures applicable to the activity. If applicable, the frequency of standardization will be instrument-dependent. The instruments will also be restandardized/recalibrated if they are dropped, strained, or subjected to any other unusual stress. Meteorological instruments will be calibrated by either the USGS or NOAA in accordance with the manufacturer's instructions; typically at least once per year. If an instrument is affected by weather, the limitations will be noted prior to using the instrument.

5.2.7.2 Level IV Analytical Calibration. Calibration procedures and documentation for Level IV analyses (radiological and chemical) are specified in laboratory SOPs, the laboratory SOW, and EPA methods.

5.2.7.3 Calibration Records. Records shall be prepared and maintained for each piece of calibrated equipment to indicate that established calibration procedures have been followed. Calibration records for the equipment controlled by the various laboratories, offices, and groups shall be maintained by the respective organizations during sampling. A copy of the instrument logbooks for field instruments shall be provided to the FTL weekly to indicate calibration status when the samples were being analyzed. The GC calibration records are part of the computer-logged information recorded during routine operation and therefore do not require a separate instrument calibration logbook. The GC operator's log also provides a hard copy record of GC calibrations. Any necessary deviations from the specification will be documented, dated, and signed. At the end of the project, all records will be forwarded to Environmental Restoration Department (ERD) Administrative Records and Document Control for final disposition.

5.2.7.4 Calibration Failure. Field and laboratory equipment found to be out of calibration shall be recalibrated in accordance with the requirements of this section and Section 5.2.15. The FTL will be notified immediately when test equipment is found to be out of calibration, damaged, lost, or stolen, and an evaluation shall be made to ascertain the validity of previous inspection or test results and the acceptability of components inspected and/or tested since the last calibration check. When it is necessary to ensure the acceptability of suspect items, the originally required inspections and/or tests shall be repeated using properly calibrated equipment. Suspect results for which a questionable device was used shall be listed in a nonconformance report or deficiency notice, and forwarded to the ERD quality engineer, with an information copy to the FTL. Test equipment consistently found to be out of calibration shall be repaired or replaced. Inspection and test reports shall include identifying the test equipment used to perform the inspection or test.

5.2.8 Analytical Procedures

Vapor samples to be analyzed by at the contract laboratories will be analyzed in accordance with EPA Method TO-14 [EPA 1988 (modified for high VOC concentration Tedlar bag samples)] or method 8240/8260 [EPA 1986 (modified for high level gas samples and Tedlar bag sample containment)]. Procedures for collecting other field measurement data are detailed in the specific SOP for that measurement.

5.2.9 Data Reduction, Validation, and Reporting

5.2.9.1 Data Reduction and Reporting. *Data reduction* refers to computations and calculations performed on the data. This includes computing summary statistics, standard errors, confidence limits, tests of hypothesis relative to the parameters, and model validation. Standard equations and statistically acceptable procedures will be used. When appropriate, as determined by the analytical level, data will be reported with statistically supported limits of uncertainty to indicate limitations on the use of the data. All data, when reported, will be rounded to the number of significant figures consistent with the confidence limits.

Laboratory VOC and tracer gas data reduction will be addressed in the SOW issued to the analytical laboratory(ies) by EG&G Idaho. All bench chemists will document sample preparation activities in a bound laboratory notebook, which will serve as the primary record for subsequent data reduction. Final data reduction of analyses performed will be the responsibility of the individual compiling the final report. Results from each data collection activity will be reported in consistent units throughout each task. When applicable, as when presenting data on contaminant concentrations, any applicable State or Federal regulatory limits will be presented with the analytical data.

Laboratory data reporting will follow the procedures and format specified in the SOW for that laboratory. Results and QC data for each analysis will be transcribed onto analytical reporting forms specific to the particular analysis. These forms will be provided in the analytical SOW. All data will be checked for accuracy and precision at the bench and instrument operator/analyst level and at the laboratory manager's level before the data package is submitted to EG&G Idaho.

5.2.9.2 Method Data Validation. Data verification and method data validation are the processes by which a sample measurement, method, or piece of data is deemed useful for a specified purpose. ERD and WM SMO SOPs will be followed for offsite VOC vapor analyses method validation. The OCVZ analytical SOW will specify information and guidance specific to the samples to be analyzed and data reporting forms to be used. The data reporting forms will be reviewed as part of the data validation process to verify that the proper information is complete and correct.

Data obtained from the Level II sample analysis will be validated to Level C [ERP Sample Management Office (SMO)-SOP-12.1.1, "Method of Data Validation"]. Level C method validation ensures that the data have been checked so that the value returned from the laboratory or field instrument is the value that is input into the ERIS (i.e., transcription error checking). The data package will be checked for completeness and any deficiencies will be resolved. Additionally, a split sample will be taken at 5% when sample population is greater than 100 or 10% when the sample populations is less than 100 and will be analyzed at Level IV for Level A validation to confirm the Level II values. The project manager is responsible for ensuring that these checks are completed. Figure 5-1 shows the data flow for the Level II analysis portion of this sampling activity.

All of the procedures used for the data entry and automated method data validation steps that are performed by Integrated Environmental Data Management System personnel are described in EG&G Idaho Data Applications Unit operating procedures. The product of the Level C method data validation is analytical upload results to the ERIS.

Data obtained from the Level IV split sample analysis will be validated to Level A (SMO-SOP-12.1.1, "Methods of Data Validation") by the ERD SMO or a subcontracted method validator. Level A method data validation is the maximum effort for chemical analysis method validation (i.e., complete review of the raw data for a given sample analysis).

Field procedures will be validated to ensure that the procedures stated in this SAP will provide usable/defensible data. The project manager is responsible for ensuring this validation process. Validation that DQOs have been successfully fulfilled will also be performed by the project manager or designee. Data flow for Level IV analytical data will be as stated in ERP PD 3.7, "Characterization Process in the Environmental Restoration Program," Appendix A.

5.2.9.3 Uncertainty Analysis. Uncertainty measurements will be assigned to all chemical/radiological contaminant concentration data. For chemical analysis under SW-846 (EPA 1986), historical precision and accuracy measures for the water matrix will be used as uncertainties.

The uncertainty measure assigned to each concentration will be given by $\pm U$ where

$$U = (B^2 + 4S^2)^{\frac{1}{2}}$$

and

B = % Bias = %R - 100
S = % RSD = coefficient of variation x 100%.

For the standard analysis techniques (i.e., those performed under SW-846), historical values will be used to determine if the laboratory is in control.

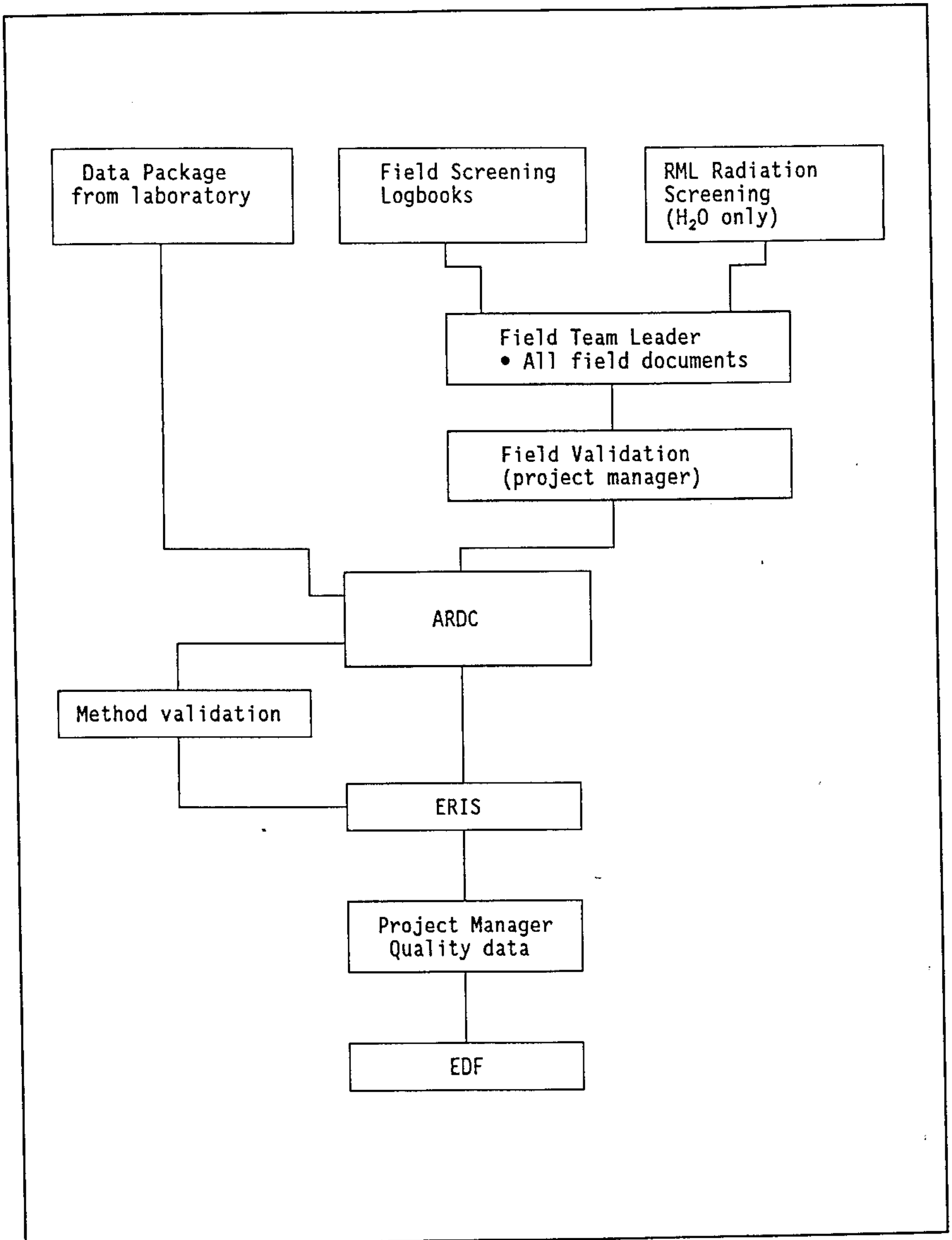

Figure 5-1. Data flow diagram for Level II chemical and radiological screening/field screening.

5.2.10 Internal QC

Internal QC will be performed in accordance with ERD QPP-149, Section 11 (EG&G 1991). Document review will be performed on all documents per ER PD 4.8, "Internal and Independent Review of Documents." Level IV laboratory QC samples and laboratory control charts will be processed as required by the Level IV laboratory SOW. Field QC samples will include trip blanks and field standards.

5.2.11 Performance and Systems Audits

Normally, at least one performance assessment will be conducted by the ERP QA officer during sampling efforts. The project manager or FTL will notify the QA officer of the start date of the sampling activities at least two weeks in advance so that the assessment can be scheduled and a checklist can be prepared. All assessment activities will be performed following guidance from the assessment requirements of QPP-149, Section 12 (EG&G 1991). All analytical support laboratories must be ERD approved.

5.2.12 Preventive Maintenance

All preventive maintenance will be performed according to the manufacturer's operating and maintenance manual or SOP for each piece of equipment used. All maintenance will be recorded in the instrument calibration/standardization logbooks, as required by ERD PD 4.2, "Logbooks." Laboratories shall provide for appropriate preventative maintenance practices in their internal QA documents.

5.2.13 Data Assessment Procedures

The results of gas samples analyzed will be at least Analytical Level II. Splits will be taken of at least 10% of the vapor samples will be analyzed at Analytical Level IV for confirmation. Data analysis and interpretation is described in Section 7.

5.2.14 Corrective Actions

Corrective actions will be conducted in accordance with ERD PD 5.13. Corrective action will be initiated when the project objectives are not met, or when assessment of the data reveals questionable or unknown data quality. Corrective action may be initiated by any individual on the project, subject to approval by the project manager. These corrective actions will include, but are not limited to, modifying the sampling procedure, sampling design, analytical techniques within EPA-approved guidelines and data reporting procedures.

5.2.14.1 Field Corrective Action. The initial responsibility for monitoring the quality of field measurements lies with the field personnel. The FTL is responsible for verifying that all QA procedures are followed. This requires that the FTL assess the correctness of field methods and their ability to meet

QA objectives, and to make a subjective assessment of the impact a procedure has on field objectives and subsequent data quality. If a problem occurs that might jeopardize the integrity of the project, cause a QA objective not to be met, or impact data quality, the FTL will immediately notify his/her project supervisor.

The FTL will document the situation, the field objectives affected, the corrective action taken, and the results of that action. Copies of the documentation will be provided to the project manager and the project QA officer.

Corrective action will be implemented when the project objectives are not met or when the conditions adverse to quality have been identified. Conditions adverse to quality shall be promptly identified and corrected as soon as possible. The identification, cause, and corrective actions to prevent recurrence shall be determined and documented for significant conditions adverse to quality.

5.2.14.2 Laboratory Corrective Action. The laboratory corrective action plan will be detailed in the laboratory QAPjP. The need for corrective action may come from several sources: equipment malfunctions, failure of internal QC checks, method blank contamination, failure of performance or system assessments, and noncompliance with QA requirements. ERD PD 5.5, "Obtaining Laboratory Services," and ERD QPP-149 (EG&G 1991) outline ERP requirements for laboratory QA/QC and reporting requirements.

6. DATA MANAGEMENT

The pilot-scale TS is an important component of the RI/FS process. It indicates the effectiveness of a selected technology to meet the expected cleanup goals for the site. The data management plan (DMP) is provided as Attachment V in the OCVZ RI/FS work plan (EG&G 1992). This DMP has been developed to ensure effective management of the significant amounts of data and information associated with the OCVZ RI/FS process. Because the TS supports the RI/FS process, the OCVZ RI/FS DMP is applicable to the TS work plan activities and will be referenced for necessary detail (EG&G 1992).

The DMP provides or references procedures and requirements necessary to develop a data base of relevant information that can be readily accessible and accurately maintained. The plan describes the data flow process, data custodianship, and organizational and individual responsibilities associated with data management. The plan also provides project file and reporting requirements and identifies extensive data base capability requirements to allow selective data sorting, analysis, formatting, and reporting.

Data acquired by the electronic data logger during field testing will be saved on a disk. These data will also be managed as per the DMP. Additionally, a hard copy of the raw data will be provided in an EDF following each scheduled test. The EDFs will summarize all data collected in the field.

7. DATA ANALYSIS AND INTERPRETATION

Upon completing the TS, the data must be summarized and evaluated to determine the validity of the data and to assess the performance of the treatment process. To accomplish this goal, results will be reduced to a useful form in accordance with the data uses as defined in Sections 3 and 4. Test results are to be interpreted on the technology's effectiveness, implementability, and costs for the various test options (high concentration zone, high permeability zone, carrier gas injection, etc.). These alternatives will be compared using graphical and statistical techniques. Note that the level of reliability of the test results is usually based on the accuracy of the analytical methods employed. Hence, some effort will be expended to increase the accuracy of the field GC results.

Anticipated results or results projected by computer modeling will be compared with actual results. Major differences between the anticipated and actual results will be scrutinized by the VVE team. Based on their judgement and expertise, they may decide to modify the work plan to retest the technology or replicate specific tests or portions of tests. In order to minimize the impact of this eventuality, the data will be continually compared to the projected results so that modifications or corrections in the TS can take place rapidly. The DOE-ID, EPA, and Idaho Department of Health and Welfare (IDHW) will be informed of the result differences and the suggested action. Any major modifications to the work plan will be done only under the direction of the DOE-ID, EPA, and IDHW. In addition, gas characteristics and emissions will be evaluated to predict the ability of a full-scale unit to respond to variations in the extraction gas and to meet performance specifications (see Table 3-3).

The purpose of a treatability evaluation is to provide information needed for the detailed analysis of alternatives and to allow selection of a remedial action to be made with a reasonable certainty of achieving the response objectives. All results are useful, even negative ones, because they can be used to eliminate technologies from further consideration. The results of pilot tests can be used to ensure that treatment technologies can be evaluated equally with nontreatment alternatives during the detailed analysis phase of the FS. Primary use of treatability results provides information for the subsequent detailed design of the selected remedial technology. Operating conditions must be carefully and completely documented so that this information can be used in the full-scale system.

The first objective of the data analysis is to determine the quality of the data collected. Hence, all data will be checked for precision (RPD for MSDs), accuracy (%R of known control samples and/or MS), and completeness (percentage of data that are valid). If the QA objectives specified in the QAPjP have not been met, IDHW, EPA, and DOE-ID will be informed and appropriate corrective action will be implemented.

The control variables are gas flow rate, extraction zone, and duration of operation. The response variables are the VOC concentration in the extracted soil gas, radius of influence, and power consumption (see Table 4-1).

The majority of the subsurface gas analyses will be performed with a field GC. To ensure that any differences in the effectiveness of the system when the control variables are changed are detected, DQOs have been established. To meet the DQOs, QA samples (duplicates, blank, and MS) will be performed as specified in the QAPjP with these analyses. In addition, 5% of the samples, and duplicates will be sent to an independent laboratory for confirmatory analysis at Level IV.

The second objective of the data analysis is to determine how critical variables (extraction zone, formation permeability, VOC concentration, and flow rate) affect the performance of the VVE system. In addition, data from the pilot-scale testing will be evaluated to provide information on operating and maintenance costs (power consumption, etc.), capital cost (number of wells, etc.), equipment design (radius of influence, extraction zone, flow rate, etc.), and the effects of inclement weather on operations.

The third objective of the data analysis is to compare information obtained in the TS with projected values from computer modeling. The computer modeling is being used to predict the extent and movement of the subsurface VOC plume and the resulting risks from this release. A variable cleanup criteria based on the depth of the plume has been estimated using the health risks projected with computer modeling. Computer modeling is also being used to predict the rate of cleanup by the VVE system and the cleanup time required. Actual cleanup rate and removal of VOCs will be compared with the projected values to validate the utility and accuracy of computer models.

7.1 Peer Review

Before performing the four-month test, a peer review of the organic vapor transport model occurred. Members of the peer review panel included personnel from the U.S. EPA, Louisiana State University, and private consultants. The key findings of the peer review were (a) the modeling approach is appropriate and consistent with state-of-the-art, (b) the model and field studies should play a key role in evaluating and designing the VVE system, (c) there is concern with the limited number of observation points, (d) field and pilot studies are the key to evaluation of the VVE technology, (e) there is too great an emphasis on model validation, and (f) a more definitive characterization of the source term is recommended. The objectives of the proposed RI/FS and TS parallel these earlier recommendations. Peer review assessing the proposed RI/FS and TS work plans will result in additional independent technical review of the proposed program. As the comments are reviewed and incorporated, the RI and TS field activities will be enhanced.

Three review activities are planned: peer review of the field work in the RI/FS and TS work plans, review of the operation of the VVE system during the TS, and review of TS report. As in the earlier four-month study, computer modeling is an integral part of the field activity. Hence, comparison and evaluation of the field activity to the projected results is critical. The accuracy of both the projected risks of the contaminant release and the projected cleanup time and costs are dependent on the validity of computer modeling. The peer review panel will be selected for their experience with field operation VVE, experience with Comprehensive Environmental Response, Compensation, and Liability Act

(CERCLA) requirements, and familiarity with the INEL Site or fractured basalt. The panel will be selected from personnel from the U.S. EPA, USGS, INEL, private consultants, and universities. These reviewers will be furnished with a form for reviewing the TS operations and the TS report. This form will identify the TS objectives and the important issues related to the TS. Issues that will be addressed will include (a) field operations, (b) characterization of the source term, (c) number of observation points, (d) rate of VOC removal, (e) extraction zone, (f) flow patterns and subsurface anisotropy, and (g) zone of influence.

Reports from the peer review panel will be obtained for the assessment on the proposed RI/FS and TS work plans, review of the TS operation, and review of the TS report. These comments will be reviewed and appropriate elements will be incorporated into the treatability program.

8. HEALTH AND SAFETY PLAN

A Task Specific Health and Safety Plan (HSP) (EGG-WM-10199) is attached (Attachment I) to this document. The HSP outlines the health and safety measures to be implemented while conducting the VVE demonstration and TS field activities. It has been developed to ensure the protection of field and Site personnel and the public at large. It provides information on the personal protective equipment, the personnel sampling techniques and instrumentation, decontamination procedures, medical surveillance requirements, and applicable safety procedures. The HSP also includes relevant elements described in the *Occupational Safety and Health Manual for Hazardous Waste Site Activities* (National Institute of Occupational Safety and Health/OSHA/United States Coast Guard/EPA).

9. RESIDUALS MANAGEMENT

This section addresses the concerns of the waste streams from the treatment process and the monitoring of the process streams, the maintenance and occupational wastes from the operation of the equipment, and the disposition of all the equipment and maintenance supplies at the end of the TS. The wastes or residuals will be identified and quantified. The anticipated rate of generation and the estimated cost for disposal of the wastes will be estimated according to the proposed testing and sampling schedules. The method of analysis, the procedure for disposal, and the final status of the waste will also be discussed. The waste management is detailed in the *OU 7-08 Contamination in the Vadose Zone (VVE Project) Waste Minimization Plan*, which is included in an appendix to the RI/FS SAP (EG&G 1992b). The management organization will be identified in the final subsection and will define responsibilities for the monitoring and reporting of waste or residuals produced in the TS.

TS residuals, including any unused sample or residues, generated at an offsite laboratory or testing facility may be returned to the sample originator provided the storage time limits in 40 Code of Federal Regulations (CFR) 261.4(f) are not exceeded. Solid wastes (nonhazardous) must be disposed of at a sanitary landfill. Commercial facilities for receiving CERCLA wastes can be determined by contacting the appropriate Regional offsite Contact (ROC) as given in Table 9-1. TS residuals managed off-site must be packaged, labeled, and manifested in accordance with 40 CFR 262 and applicable Department of Transportation regulations for hazardous materials under 49 CFR 172. The Exemption Rule (40 CFR 261.4) does not specifically exempt the transfer of TS residuals from off-site disposal; therefore, off-site treatment or disposal facilities that receive these wastes must comply with Resource Conservation and Recovery Act (RCRA).

9.1 Process Wastes

The waste streams from the treatment process are the particulates collected by the cyclone separator and filters, the VOCs collected on the activated carbon in the carbon bed, the release stream from the exhaust stack, and the sampling waste.

9.2 Particulate Wastes

The particulates that are entrained in the soil gases are collected in the cyclone collection container, the prefilter, and HEPA filter. These particulates have the potential of containing radioactive particles that may be vacuumed from the extraction well. The cyclone collection container will be checked daily and if it is required, the contents of the container will be removed with a RCT present to monitor for radioactivity during the procedure. During the previous four-month test there was very little accumulation of particulate in the cyclone or filters (there was no significant change in the differential pressure across the filters). Therefore, it is assumed that the cyclone container will not need to be emptied during the treatability testing and will be emptied at the completion of all proposed tests. The

Table 9-1. ROCs for determining acceptability of commercial facilities to receive CERCLA wastes.[a]

Region	Primary contact/phone	Backup contact/phone
I	John Zipeto (617) 573-5744	Linda Murphy (617) 573-5703
II	Steven Lufftig (212) 264-8672	Dit Cheung (212) 264-6142 Joe Golumbek (212) 264-2638
III	Vernon Butler (215) 597-6681	Ruth Rzepski (215) 597-6413
IV	Alan Antley (404) 347-7603	Gregory Fraley (404) 347-7603
V	Gertrude Matuschkovitz (312) 353-7921	Joe Boyle (312) 886-4449
VI	Trish Brechlin (214) 655-6765	Randy Brown (214) 655-6745 Sam Becker (214) 655-6725
VII	David Doyle (913) 236-2891	Marc Rivas (913) 236-2891
VIII	Mel Poundstone (303) 293-1704	Mike Gansecki (303) 293-1510 Terry Brown (303) 293-1823
IX	Leif Magnuson (415) 974-7232	Jane Diamond (415) 974-8364
X	Al Odmark (206) 442-1886	Wayne Pierre (206) 442-7261

a. These contacts are subject to change. An updated list can be obtained from the Superfund docket or the RCRA/CERCLA Hotline (1-800-424-9346) volume to be removed is estimated at one quarter of a container or 0.4 liter (0.1 gal). Analysis of particulates collected that were accumulated in the filters during the previous testing indicated that alpha-emitting radionuclides are below detection at detection limits of 2 x 10^{-8} μCi/gm for Pu-239 and Pu-240, and 2 x 10^{-7} μCi/gm for Pu-238 and Am-241. Before disposal, the particulate will be sampled and analyzed for radioactive elements (Pu-238, Am-241, Pu-239, and Pu-240 as a minimum) and VOCs (CCl_4, $CHCl_3$, TCE, 1,1,1-TCA, and PCE as a minimum). If an inadequate amount of particulate can be obtained from the filters to make a sample, a portion of the filter may be cut out and submitted for analysis. Table 9-2 lists the samples to be taken. Based on the results from the previous testing, it can be assumed that the particulate will be clean of manmade radionuclides and VOCs. If analysis shows this assumption to be correct, the final disposition of particulates is placing the clean particulate back on the SDA. During the 4-month demonstration, some radioactivity was found in the carbon beds due to natural-occurring radon. Since radon has a short half-life, the resulting radioactivity was allowed to decay to normal background levels before disposal. If radon is detected in the particulates, this same procedure will be followed before disposal of the particulates. No cost is expected to be associated with this waste disposal. The particulates entrapped in the filters will be disposed of as part of the filter.

If particulates contain radioactive particles, the waste will be disposed as solid radioactive waste at the RWMC. The particulates will be placed in a plastic container and added to a solid radioactive waste container for disposal. If the particulates are analyzed as containing radioactive particles and adsorbed VOCs, the waste will be placed in a plastic container that is burnable and will be added to a container of mixed waste that can be incinerated in the future.

9.3 Volatile Organic Compounds

The VOCs which are the hazardous constituent of the soil gas stream are separated by activated carbon. The purified soil gas stream is exhausted to the atmosphere. A continuous monitor will verify that the exhaust gases do not exceed a gross VOC concentration that is 2 ppm or greater for 5 seconds. The monitor is interlocked to automatically terminate the blower operation if this concentration is present in the gas stream. When the VOC concentration limit is exceeded, another carbon bed is valved into the system before operation is continued after the shutdown of the blower. During previous testing, each carbon bed was capable of adsorbing approximately 500 lbs of VOCs before breakthrough. The carbon bed that is loaded with VOCs is a hazardous waste that will be disposed of or regenerated by removing the VOCs from the activated carbon. The current proposed disposal method is to transport the beds to an offsite regenerator who is licensed for treatment of CERCLA waste. Carbon bed regeneration desorbs the VOCs from the carbon and then oxidizes the VOCs to carbon dioxide, water, and acids. An alternative to sending the carbon beds to an offsite regenerator is to regenerate onsite or to use catalytic oxidation to destroy the VOCs. The catalytic oxidation method is the same method used to destroy the VOC's after desorbing the VOCs from the carbon filter. Commercial units could be employed on site to destroy the VOCs without using a carbon filter to capture the VOCs. Vendor information will be obtained to examine this option. All options being considered will generate a waste stream from the purification of the combustion gases prior to the release to the atmosphere. This waste will either be a

Table 9-2. Summary of particulate samples to be taken.

SAP Number: EGG-WM-10132-RM
SAP Table No. 1
Date: 12/07/92 Revision: 1.0

SAMPLING AND ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSIS

Project: OU 7-08 VVE RESIDUAL MANAGEMENT SAMPLES

Project Manager: G. MATTHERN

Form No: SAP11B

SAMPLE DESCRIPTION						SAMPLE LOCATION				ENTER ANALYSIS TYPES (AT) AND QUANTITY REQUESTED																			
										AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
SAMPLING ACTIVITY	SAMPLE TYPE	MEDIA	COLL TYPE	SAMPLING METHOD	PLANNED DATE	AREA	LOCATION	TYPE OF LOCATION	DEPTH (ft)	RF	VT																		
RTS501	REG	PARTICULATE	GRAB		10/20/93	RWMC/SDA	CYCLONE	VVE SYSTEM	N/A	1	1																		
RTS502	REG	PARTICULATE	GRAB		10/20/93	RWMC/SDA	PREFILTER	VVE SYSTEM	N/A	1	1																		
RTS503	REG	PARTICULATE	GRAB		10/20/93	RWMC/SDA	HEPA FILTER	VVE SYSTEM	N/A	1	1																		

Enter the appropriate analysis type code in the boxes between the double lines under "ENTER ANALYSIS TYPES". Refer to SAP Table 2, Sampling And Analysis Plan Table - Codes & Descriptions.
Enter the number of bottles in the single line boxes below the analysis type for each sampling activity.
Any descriptions for non-standard analysis types (not given in SAP Table 2) should be entered under "COMMENTS" on the lines below.

AT1: Pu Isotopic/Am-241
AT2: VOCs (Mod. TO-14 or Mod. 8240/8260)
AT3:
AT4:
AT5:
AT6:
AT7:
AT8:
AT9:
AT10:

AT11:
AT12:
AT13:
AT14:
AT15:
AT16:
AT17:
AT18:
AT19:
AT20:

COMMENTS

sodium salt or calcium salt. The disposal of this waste will depend on whether the waste is radioactive or not. If it is a radioactive waste it can be disposed of by the Idaho Chemical Processing Plant evaporator or solidified and sent to solid waste landfill at RWMC. The combustion gases will be monitored continuously for VOCs to obtain data that will be included in a report to the State on air emissions. The amount of VOCs to be removed depends on the flow rate that the blower is operated at and the concentration of the VOCs. For the estimation of the quantity of the VOCs and salt solution waste, the flow rate is varied from 100-700 scfm, the concentration is varied from 50-500 ppm as CCl_4, and the schedule of the testing is 202 days for CY-92 and 243 days for CY-93. Results from the four-month VVE demonstration show no indication of manmade radionuclides above the detection limit in the HEPA filter or prefilter. During the four-month demonstration, some radioactivity was found in the carbon beds due to naturally-occurring radon. Since radon has a short half-life, the resulting radioactivity was allowed to decay to normal background levels before shipping the carbon beds offsite for regeneration.

9.4 Purified Soil Gases

The purified soil gases will be released from the exhaust stack continuously during the operation of the VVE system. The gases will be monitored as previously mentioned for residual VOCs that were not adsorbed in the carbon bed. This monitoring is the analysis used to characterize this stream before releasing it to the atmosphere. The disposal method is release to the environment. The disposition is mixed with the atmosphere with no harmful constituents and only constituents that are present in the environment. The volumes released will have negligible change to the atmospheric concentration of the constituents released. It is assumed that the soil gas is adsorbed air, water vapor, and VOCs that have migrated into the vadose zone under the SDA. The volume of release is the operating flow rate. The cost is the cost of operation of the system or electricity for the blower.

9.5 Sampling Waste

The monitoring of the VOCs concentration in the extraction well, after the carbon bed, and in the exhaust stack is necessary to determine the effectiveness of the system to remove VOCs from the soil gas/vapors removed from the extraction well. The method of field analysis is GC. The gases after analysis will be disposed of by releasing the gas (1 liter) into a hood which has a carbon filter and HEPA filter. The gas samples sent to an outside vendor will be disposed of by the laboratory or returned to be disposed of like the field analysis samples. This same procedure will be followed for all outside laboratory analysis of samples which are solid or liquid. Returned solid samples will be disposed according to the results of the analysis and similar to the filter sample as mentioned above. In previous sampling there was no radioactive material above detection limits in the HEPA filters so it is assumed that there will be no mixed waste from the sampling activities. Sample containers (Tedlar bags and plastic sample bottles for liquid and solids) will be disposed as solid waste unless analysis of the sample indicates radioactivity. If there is radioactivity present the containers will be disposed of as solid radioactive waste.

9.6 Maintenance and Occupational Wastes

The maintenance and occupational wastes are lubricating grease, pulley belts, soiled laundry, soiled plastic or disposable clothing, and spare parts (filters, instruments replacements, equipment modifications, etc.). The spare parts will be excessed if it is still operable, or disposed as solid waste. All parts will be surveyed for radioactive contamination prior to disposal and if radioactive contamination is found it will be disposed as radioactive solid waste. Soiled plastic or disposable clothing will be added to solid waste unless the radiological survey indicates radioactive contamination which will cause these items to disposed as combustible radioactive solid waste. Soiled laundry will be sent to the Central Facility Area laundry and respiratory facility as clean laundry or radioactive laundry depending on the radiological survey. Pulley belts and lubricating grease for the blower are to be disposed as nonradioactive solid waste unless survey indicates otherwise and disposal as solid radioactive waste will be required.

9.7 Disposition of Equipment and Maintenance Supplies

The disposition of all the equipment and maintenance supplies at the end of the TS will be excessed to be used in the remediation. The equipment will be disposed of as indicated in the waste management plan. This is the very conservative approach and the equipment will be reused in the remediation equipment.

10. COMMUNITY RELATIONS PLAN

The community relations task is designed to ensure community understanding of actions taken during the Pilot-Scale TS and to obtain community input on the TS program. Community relations are an integral part of any CERCLA action whether or not the action is on a Federal facility. At the INEL, a DOE facility, all CERCLA actions will be subject to both CERCLA and National Environmental Policy Act community involvement requirements. The INEL Public Affairs group of EG&G Idaho has prepared a programmatic Community Relations Plan (CRP) for the OCVZ OU RI/FS (EG&G 1992). The CRP will guide the actions taken to ensure appropriate public involvement in agency decision making. The Pilot-Scale TS is a part of the RI/FS. The CRP provided in the RI/FS Work Plan, will serve as the CRP for the TS Work Plan (EG&G 1992).

11. REPORTS

During the course of the Pilot-Scale TS, open lines of communication are essential to ensure smooth and accurate flow of information to all parties directly or indirectly involved with the project. Figure 11-1 provides a graphic display of the lines of communications for the OCVZ project.

This section describes the preparation of the weekly and monthly reports detailing current and projected project progress and describes the preparation of the final report documenting the results of the TS.

11.1 Weekly Reports

Work Package Managers are responsible for submitting weekly reports updating the progress of the pilot scale TS project. As a minimum, the weekly reports will be distributed to the Program Manager, the Project Manager, the DOE-ID Remedial Project Manager (RPM), and the appropriate Cost Account Managers (CAMs). The weekly reports will provide sufficient information to assist the Cost Account Manager in compiling the monthly reports. The weekly reports shall include, but not be limited to the following:

1. Accomplishments of work performed for the week
2. Anticipated work to be performed the following week
3. Any problems or issues encountered and the actions taken
4. Upcoming travel related to the project or results of travel taken
5. Schedule.

11.2 Monthly Reports

The monthly reports shall be prepared by the CAM and will be distributed to the Program Manager, the Project Manager, and the DOE-ID RPM. Monthly reports, as a minimum, will contain:

1. A summary of project work progress
2. Summary of work completed
3. Planned work to follow
4. Problems or issues encountered and the actions taken
5. Results of any Change Control Board or Internal Change Board actions
6. Key position changes
7. Contracts awarded, completed, and terminated
8. Audits performed
9. Safety, health, and environment assessment of work performed for the month
10. Schedule and any variances

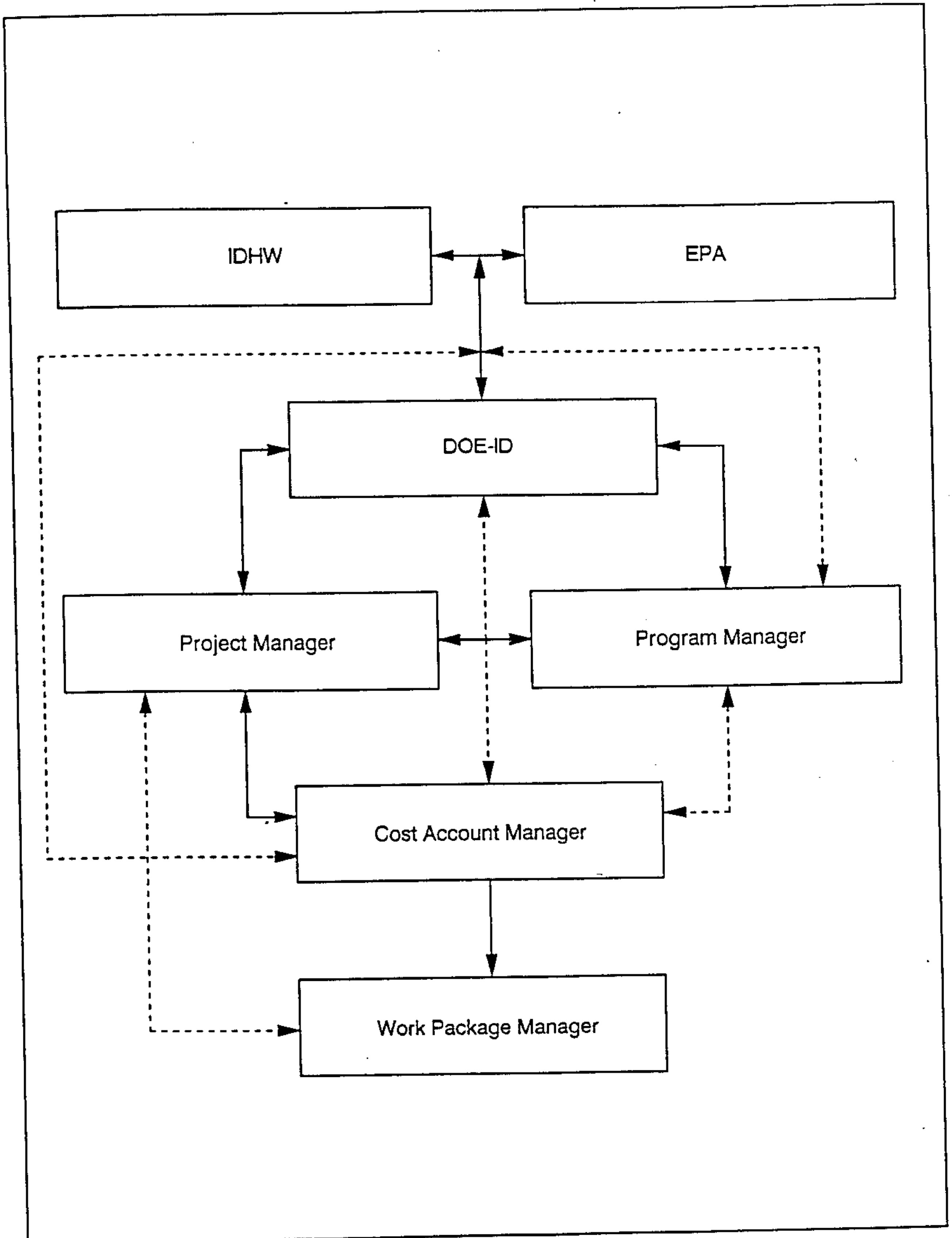

Figure 11-1. Lines of communication for the OCVZ project.

11. Cost and any variances
12. Earned Value reports.

Figure 11-2 provides a graphic illustration of report distributions.

11.3 Occurrence Reporting

During the pilot-scale TS process, unusual events may occur that fall within the scope of DOE Order 5000.3a. If such events occur, notifications will be in accordance with ER PD 6.5, which addresses the requirements of this order. Unusual events that fall outside the scope of DOE Order 5000.3a and ER PD 6.5 will be reported as follows:

- Minor problems that can be corrected on the spot will be reported to the site supervisor. If needed the site supervisor will ask the RCT, industrial hygienist, or safety representative for help in resolving the problem.

- Radiological, health, or safety problems that can not be corrected on the spot will be reported to Site supervisor and/or the Health and Safety Officer.

- Problems that could stop work more than one shift or cause a schedule change greater than 2 days, or a budget change greater than $1K will be reported to the Appropriate Work Package Manager by the site supervisor. The Work Package Manager will report these problems to appropriate CAM, Project Managers, and Program Managers.

11.4 Final Pilot-Scale TS Report

At the completion of the TS activities, the ERP will be responsible for preparing a report documenting project activities, results, conclusions, and recommendations. Complete and accurate reporting is essential, as decisions about VVE as a remedial alternative for the OCVZ will be based, in part, on the outcome of this TS. Table 11-1 outlines the final report organization for the TS. The TS Report will be submitted to the DOE-ID, EPA, and IDHW for review.

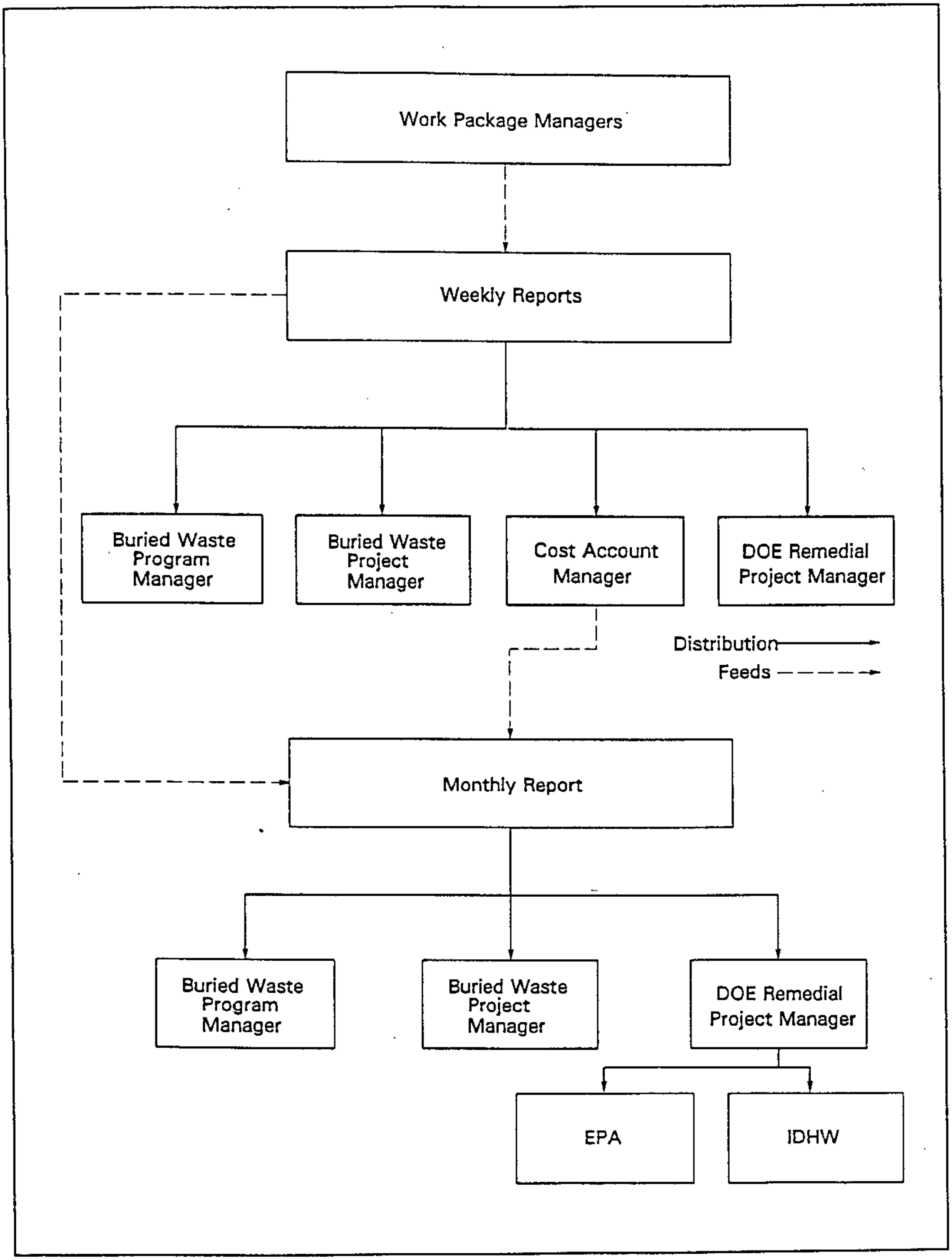

Figure 11-2. Weekly and monthly report distribution.

Table 11-1. Suggested organization of TS report.

1. INTRODUCTION
    - 1.1 Site description
        - 1.1.1 Site name and location
        - 1.1.2 History of operations
        - 1.1.3 Prior removal and remediation activities
    - 1.2 Waste stream description
        - 1.2.1 Waste matrices
        - 1.2.2 Pollutants/chemicals
    - 1.3 Remedial technology description
        - 1.3.1 Treatment process and scale
        - 1.3.2 Operation features
    - 1.4 Previous treatability studies at the site

2. CONCLUSIONS AND RECOMMENDATIONS
    - 2.1 Conclusions
    - 2.2 Recommendations

3. TS APPROACH
    - 3.1 Test objectives and rationale
    - 3.2 Experimental design and procedures
    - 3.3 Equipment and materials
    - 3.4 Sampling and analysis
        - 3.4.1 Waste stream
        - 3.4.2 Treatment process
    - 3.5 Data management
    - 3.6 Deviations from the Work Plan

4. RESULTS AND DISCUSSION
    - 4.1 Data analysis and interpretation
        - 4.1.1 Analysis of waste stream characteristics
        - 4.1.2 Analysis of TS data
        - 4.1.3 Comparison to test objectives
    - 4.2 QA/QC
    - 4.3 Costs/schedule for performing the TS
    - 4.4 Key contacts

REFERENCES

APPENDICES
- A. Data summaries
- B. SOPs

a. (EPA, 1989)

12. SCHEDULE

Table 12-1 is the working schedule for the OCVZ RI/FS. The TS and related activities fall within the RI/FS scope and are presented in the working schedule. This schedule reflects the plan of action for the current scope of the OCVZ RI/FS activities. If additional studies are required or the current scope changes, the schedule will be modified to reflect these changes.

As indicated in the TS work plan and the RI/FS work plan, VVE operation and related TS tasks are scheduled to commence November 1992 and last through mid-August 1993. The TS tasks include: flux chamber tests, extraction well flow and pressure tests (packer tests), tracer tests, long-term VVE operations and associated monitoring (high-concentration extraction, high-permeability extraction), and off-gas treatment selection and operation.

The chart presented in Figure 12-1 outlines the TS task schedule, while Figure 12-2 shows the Focused RI/FS schedule.

Table 12-1. Working schedule for the OCVZ Focused RI/FS.

Activity	Working dates	Interagency Agreement date
Complete draft RI/FS SOW	08/01/91	08/91
EPA/IDHW review draft RI/FS SOW	08/01/91 - 09/15/91	
Revise draft RI/FS SOW	09/16/91 - 10/14/91	
EPA/IDHW review draft RI/FS SOW	10/15/91 - 11/27/91	08/91
Revise draft RI/FS SOW	12/02/91 - 12/19/91	
EPA/IDHW review draft RI/FS SOW	12/20/91 - 01/03/92	
Revise draft final RI/FS SOW	01/06/92 - 01/14/92	
Transmit draft final RI/FS SOW to EPA/IDHW	01/15/92	
RI/FS SOW becomes final	02/14/92	
Draft RI/FS work plan	11/05/91 - 12/05/91	
Groundwater OU drilling	05/01/92 - 09/01/92	
Groundwater OU sampling	05/12/92 - 10/10/92	
Track II Summary Report	11/01/92	
Routine Groundwater Monitoring	10/10/92 - TBD	
DOE-ID review draft RI/FS work plan	12/06/91 - 12/12/91	
EPA/IDHW review draft RI/FS work plan	01/02/92 - 02/18/92	01/92
Revise draft final RI/FS work plan	02/19/92 - 04/24/92	
DOE-ID review draft final RI/FS work plan	04/27/92 - 5/05/92	
Transmit draft final RI/FS work plan to EPA/IDHW	05/06/92	
RI/FS work plan becomes final	06/05/92	
Draft TS work plan	12/13/91 - 05/15/92	
DOE-ID review TS work plan	05/18/92 - 06/05/92	
EPA/IDHW review TS work plan	06/16/92 - 07/16/92	
Revise & DOE-ID review TS work plan	07/17/92 - 08/17/92	
Transmit TS work plan to EPA/IDHW	08/19/92	

Table 12-1. (continued).

Activity	Working dates	Interagency Agreement date
TS work plan becomes final	09/21/92	
TS preparation	07/30/92 - 01/15/93	
TS testing	01/16/93 - 03/16/93	
TS long term testing	03/17/93 - 07/06/93	
Field sampling activities	07/08/92 - 10/30/92	
Draft RI/BRA report	08/07/92 - 01/06/93	
DOE-ID review RI/BRA report	01/07/93 - 02/08/93	
EPA/IDHW review RI/BRA report	02/25/93 - 04/12/93	
Draft RI/FS report	03/31/93 - 05/06/93	
DOE-ID review draft RI/FS report	05/07/93 - 06/04/93	
EPA/IDHW review draft RI/FS report	07/06/93 - 08/20/93	09/93
Revise draft final RI/FS report	08/23/93 - 09/20/93	
DOE-ID review draft final RI/FS report	09/21/93 - 09/27/93	
Transmit draft final RI/FS to EPA/IDHW	10/04/93	
RI/FS report becomes final	11/04/93	
Draft proposed plan	06/07/93 - 07/19/93	
DOE-ID review draft proposed plan	07/20/93 - 08/30/93	
EPA/IDHW review draft proposed plan	09/29/93 - 10/26/93	
Revise proposed plan	10/27/93 - 11/10/93	
DOE-ID review proposed plan	11/11/93 - 11/17/93	
Notice of availability for proposed plan	12/03/93	
Draft ROD	12/27/93 - 02/04/94	
DOE-ID review ROD	02/07/94 - 02/18/94	
EPA/IDHW review ROD	03/08/94 - 04/18/94	07/94
Draft final ROD	04/19/94 - 05/31/94	
ROD becomes final	06/29/94	

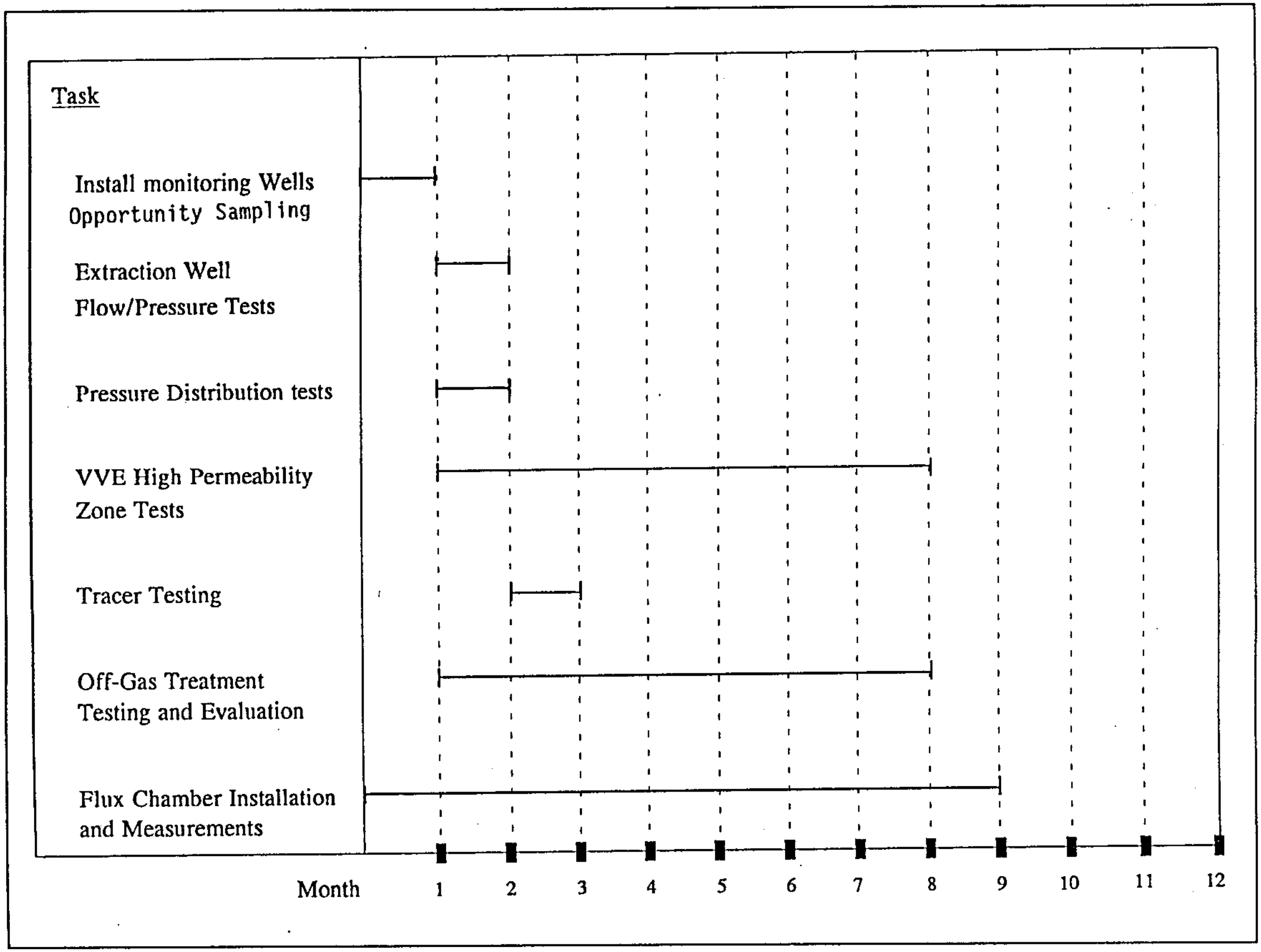

Figure 12-1. Working schedule for the TS.

13. REFERENCES

Baca, R. G., et al., 1988, *Organic Contaminant Release From a Mixed Waste Disposal Site: A Computer Simulation Study of Transport Through the Vadose Zone and Site Remediation*, Proceedings of the Tenth Annual DOE Low-Level Waste Management Conference, Denver, Colorado, August 30 - September 1, 1988, CONF-880839-Ses. II, EG&G Idaho, December.

EG&G Idaho, Inc., 1991, *Environmental Restoration Program Quality Program Plan*, QPP-149, Revision 3, November.

EG&G Idaho, Inc., 1992, *Remedial Investigation/Feasibility Study Work Plan for the Organic Contamination in the Vadose Zone - Operable Unit (OU 7-08).*

EG&G Idaho, Inc., 1992b, *Sampling and Analysis Plan for the Organic Contamination in the Vadose Zone, Operable Unit 7-08 Focused Remedial Investigation/Feasibility Study.*

EPA (U.S. Environmental Protection Agency), 1989a, *Guide for Conducting Treatability Studies Under CERCLA, Interim Final*, December.

EPA (U.S. Environmental Protection Agency), 1989b, *Terra Vac In Situ Vacuum Extraction System - Applications Analysis Report*, EPA/540/A5-89/003, July.

EPA (U.S. Environmental Protection Agency), 1988, *Compendium of Methods for Determination of Toxic Organic Toxic Compounds in Ambient Air.*

EPA (U.S. Environmental Protection Agency), 1987, *Underground Storage Tank Corrective Action Technologies*, EPA/625/6-87-015, January.

EPA (U.S. Environmental Protection Agency), 1986, *Test Methods for Evaluating Solid Waste*, SW-846, 3rd Edition.

Hubbell, J. M., 1990, *Perched Ground Water at the Radioactive Waste Management Complex of the Idaho National Engineering Laboratory*. Idaho National Engineering Laboratory, EGG-ER-8779.

Laney, P. T., et al., 1988, *Annual Progress Report: FY 1987, Subsurface Investigations Program at the Radioactive Waste Management Complex of the Idaho Engineering Laboratory*. DOE-ID-10183.

Lugar, R. M. and J. K. Galloway, 1992, *Task Specific Health and Safety Plan Addendum, Rev. 1*, EGG-WM-9732, February.

Malot, J.J., 1989, "Cleanup of Gasoline Contaminated Site Using Vacuum Extraction Technology," *Petroleum Contaminated Soils*, Volume 2, Chelsea:Lewis Publishers.

Mann, L. J. and L. L. Knobel, 1987, *Purgeable Organic Compounds in Groundwater at the Idaho National Engineering Laboratory, Idaho,*. USGS Open File Report 87-766, DOE-ID-22074.

Matthern, G. E., 1990, *Safety Assessment for the Vapor Vacuum Extraction at the Radioactive Waste Management Complex, Addendum B, Rev. 1,* WM-PD-86-011, May.

Rauen, C. D., 1990, *Sampling and Analysis Plan for the Radioactive Waste Management Complex Subsurface Disposal Area, RCRA-Facility Investigation/Corrective Measures Study, Task: Vapor Vacuum Extraction Demonstration*, EGG-WM-8381, March.

Robertson, J. B., R. Schoen, and J. T. Barraclough, 1974, *The Influence of Liquid Waste Disposal on the Geochemistry of Water at the National Reactor Testing Station, Idaho: 1952-1970,* U.S. Geological Survey Open File Report, IDO-22053.

Sisson, J. B. and G. C. Ellis, 1991, *Summary Report of Results of the Vapor Vacuum Extraction Test at the RWMC*, Idaho National Engineering Laboratory, EGG-WM-9301.

Sondrup, A. J., 1992, to H. D. Herd, Subject: " Preliminary minimum performance levels for the VVE system," AJS-05-92 December.

Spang, N. W., 1990, *Health and Safety Plan for Operations Performed for the Environmental Restoration Program Task: Vapor Vacuum Extraction, Rev. 2*, EG&G-WM-8689.

Walton, J. C., A. S. Rood, R. G. Baca, and M. D. Otis, 1989, "Model for Estimation of Chlorinated Solvent Release from Waste Disposal Sites," *Journal of Hazardous Materials*, Vol 21, Amsterdam, Netherlands.

Attach. I: Task Specific Health & Safety Plan

ATTACHMENT I

Task-Specific Health and Safety Plan

EGG-WM-10199
August 1992
Revision 0

HEALTH AND SAFETY PLAN FOR OPERATIONS PERFORMED FOR THE ENVIRONMENTAL RESTORATION DEPARTMENT

TASK: ORGANIC CONTAMINATION IN THE VADOSE ZONE (OCVZ) TREATABILITY STUDY (VAPOR VACUUM EXTRACTION/ TREATABILITY STUDY)

R. D. Lee

Note: This Health and Safety Plan incorporates the Health and Safety Plan for Operations Performed for the Environmental Restoration Program, (EGG-WM-8771, Revision 2), with Appendix A completed for the Organic Contamination In the Vadose Zone (OCVZ) Treatability Study (Vapor Vacuum Extraction/Treatability Study).

HEALTH AND SAFETY PLAN
FOR
OPERATIONS PERFORMED FOR THE
ENVIRONMENTAL RESTORATION PROGRAM

S. L. Morton

EG&G Idaho, Inc.

Idaho National Engineering Laboratory
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Office of Environmental Restoration and Waste Management
Under DOE Contract No. DE-AC07-76ID01570

HEALTH AND SAFETY PLAN
FOR
OPERATIONS PERFORMED FOR THE
ENVIRONMENTAL RESTORATION PROGRAM

Approved by:

S. G. Stiger, Manager
Environmental Restoration Program

6-21-91
Date

Reviewed by:

J. P. Shea, Chairman
ERP Independent Review Committee

6/21/91
Date

for D. E. Minner, Occupational Medical Program

6/21/91
Date

DOE-ID approval letter for this Health and Safety Plan is attached to DRR number ERP-340, dated 6/21/91.

ABSTRACT

This document constitutes the generic health and safety plan for the Environmental Restoration Program (ERP). It addresses the health and safety requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120 standard; and EG&G Idaho, Inc. This plan is a guide to individuals who must complete a health and safety plan for a task performed for the ERP. It contains a task specific addendum that, when completed, specifically addresses task specific health and safety issues. This health and safety plan reduces the time it takes to write a task specific health and safety plan by providing discussions of requirements, guidance on where specific information is located, and specific topics in the Addendum that must be discussed at a task level. This format encourages a complete task specific health and safety plan and a standard for all health and safety plans written for ERP.

CONTENTS

FIGURES

TABLES

ACRONYMS, ABBREVIATIONS, and DEFINITIONS

Acronyms:

ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ARDC	Administrative Record and Document Control
anti-c	Anti-contamination
CA	Compliance Assurance
CERCLA	Comprehensive Environmental Response Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
COCA	Consent Order and Compliance Agreement
CPR	Cardiopulmonary Resuscitation
DOE	Department of Energy
DOE-ID	Department of Energy - Idaho Operations Office of DOE
DOP	Detailed Operating Procedure
DOT	Department of Transportation
DRD	Direct Reading Dosimeter
DRR	Document Revision Request
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
FTL	Field Team Leader
H&S	Health and Safety
HAZMAT	Hazardous Materials Response
HPT	Health Physics Technician
HSO	Health and Safety Officer
HW	Hazardous Waste
IAG	Interagency Agreement
IH	Industrial Hygienist
INEL	Idaho National Engineering Laboratory
LEL	Lower Explosive Limit
MSDS	Material Safety Data Sheets
NEPA	National Environmental Policy Act
NIOSH	National Institute for Occupational Safety and Health
NRTS	National Reactor Testing Station
OMP	Occupational Medical Program
OSHA	Occupational Safety and Health Administration
PD	Program Directive
PM	Project Manager
PPE	Personal Protective Equipment
QE	Quality Engineer
QPP	Quality Program Plan
QAPjP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RE	Radiological Engineer
SAP	Sampling and Analysis Plan
SCBA	Self-contained Breathing Apparatus
SE	Safety Engineer

SOP	Standard Operating Procedure
SSWP	Special Safe Work Permit
SWIMS	Solid Waste Information Management System
SWP	Safe Work Permit
TLD	Thermoluminescent Dosimeter
TRU	Transuranic
USCG	United States Coast Guard

Abbreviations:

NIOSH, 10/85--NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985.

Definitions:

Action Limit--Any physical, chemical, or radiological limit set by a regulatory agency, EG&G Idaho, Inc., or safety individual at the task site.

Area--A geographic subdivision of the INEL or a location outside the INEL dependent on the INEL for logistical or administrative support (e.g., TAN, TRA, CFA, IF).

Facility--The minimum complete and usable unit of Real Property designed to contain an organizational unit or operational function (e.g., building, central steam station).

Hazardous Material Response (HAZMAT) employee--Member of a group of employees, designated by management, who is expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The HAZMAT Team performs responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of an incident. A HAZMAT Team is not a fire brigade nor is a typical fire brigade a HAZMAT Team. A HAZMAT Team, however, may be a separate component of a fire brigade or fire department.

Task Site--Immediate working area where ERP task operations are being performed.

HEALTH AND SAFETY PLAN FOR OPERATIONS PERFORMED FOR THE ENVIRONMENTAL RESTORATION PROGRAM

1. INTRODUCTION

This Health and Safety (H&S) Plan for operations performed for the EG&G Idaho, Inc. Environmental Restoration Program (ERP) establishes the procedures and provides general guidelines to minimize health and safety risks to the worker and public. This plan, in conjunction with associated task specific information required by this plan, shall be used during selected activities aimed at assessing and remediating past hazardous waste and/or hazardous substance disposal at the Idaho National Engineering Laboratory (INEL).

This H&S Plan and the associated task specific addendum required by this plan shall be in accordance with the Occupational Safety and Health Administration (OSHA), 29 CFR 1910.120 standard governing hazardous waste operations. It has been prepared in recognition of and is consistent with the NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985 (hereafter referenced as NIOSH, 10/85); the EG&G Idaho Company Procedures Manual; the EG&G Idaho Safety Manual; and the EG&G Idaho Radiological Controls Manual.

This H&S Plan shall be used when work is performed at ERP task investigation sites by employees of EG&G Idaho, subcontractors to EG&G Idaho and employees of other firms, and Department of Energy (DOE) Laboratories. Occasional visitors and oversight personnel [DOE, State of Idaho, and Environmental Protection Agency (EPA) representatives] are subject to the requirements of Section 2.16 of this plan.

1.1 H&S Plan Task Specific Addendum

This H&S Plan must address the many diverse conditions encountered for each task included in the ERP investigations. Therefore, an addendum shall be written for each task that requires an H&S Plan. The task addendum shall include any additions, omissions, or modifications to the main body of this H&S Plan that can individualize this plan into a task specific plan. The task specific plan need not repeat EG&G Idaho or ERP procedures for safety and health. However, these procedures shall be referenced in the Addendum.

NOTE: If an existing document meets the intent of the task specific plan [e.g., Detailed Operating Procedure (DOP)], it may be attached as the Addendum to this H&S Plan. The following statement must then be included at the beginning of the task specific addendum: "The information contained in this document contains all the elements required by the task specific addendum and therefore replaces the stated addendum." If an existing document is used for the addendum, it does not have to be in the specified format of the addendum. The task specific H&S Plan will be considered complete when the H&S Plan task addendum is reviewed and approved per ERP Program Directive (PD) 2.2.

Upon request, a copy of this generic H&S Plan and an electronic copy of the generic H&S Plan task specific addendum may be obtained from the ERP Administrative Record and Document Control Office (ARDC, 526-2650). At a minimum, the generic H&S Plan shall be reviewed annually and revised as required; therefore the requester shall verify the revision number of the generic H&S Plan with ARDC. The electronic copy of the task specific addendum is provided as a guide in producing a task specific H&S Plan. Pertinent topics referencing the main body of this H&S Plan are provided in the electronic copy of the blank H&S Plan task specific addendum to aid the author in writing a complete task specific H&S Plan.

When the electronic guide is used to produce a task specific addendum, each topic must be evaluated to determine how it applies to the specific task requiring the addendum. If the topic does not apply to the subject task, "N/A" shall be written in that portion of the task specific addendum. If additional information is required to make a complete task specific H&S Plan, additional blank pages may be added at the end of the task specific addendum. All technical information requested in the addendum must be obtained from knowledgeable individuals associated with the specific task [e.g., monitoring equipment information should be obtained from the task radiological engineer (RE) and/or industrial hygienist (IH)]. Once a task specific addendum is completed in accordance with ERP PD 4.4 and reviewed and approved in accordance with ERP PD 2.2, it shall be sent to ARDC, appended onto the generic H&S Plan and processed. ARDC is responsible for maintaining the electronic copy and originals of the task specific H&S Plans.

Any modifications to an approved task specific plan shall be implemented through a Document Revision Request (DRR), as described in ERP PD 4.1. If the change is made in an existing document used as a task specific plan but the document is not an ERP document, the changes will be made in accordance with the directives of the program/facility responsible for the document. Documentation of any changes made to documents external to ERP must be provided to ARDC.

1.2 Site Description

INEL is a multipurpose laboratory originally established in 1949 by the U.S. Government, under the direction of the Idaho Operations Office of the Department of Energy (DOE-ID). The primary mission of INEL is to support the engineering and operations efforts of DOE and other federal agencies in areas of nuclear safety research, reactor development, reactor operations and training, nuclear defense materials production, waste management and technology development, and energy technology/conservation programs.

INEL, formerly the National Reactor Testing Station (NRTS), encompasses 890 square miles and is located approximately 20 miles west of Idaho Falls, Idaho (Figure 1-1). The United States Atomic Energy Commission, now DOE, established the NRTS in 1949 as a site for building and testing a variety of nuclear facilities. INEL has also been the storage facility of transuranic (TRU) radionuclides and low-level radioactive wastes since 1952. DOE-ID has responsibility for the INEL and designates authority to operate the INEL to government contractors. The primary contractor for DOE-ID at INEL is EG&G Idaho, Inc. which provides managing and operating services to the majority of INEL facilities. Other contractors who operate facilities at the INEL but are not covered by this H&S Plan include Westinghouse Idaho Nuclear Company, Argonne National Engineering Laboratory, Westinghouse Electric Corporation, and Rockwell Corporation.

Tasks being performed for the ERP are scattered throughout INEL, and detailed facility or task site descriptions are too numerous to include in this generic portion of the H&S Plan. Therefore, specific facility and/or task site descriptions shall be provided in the task specific addendum.

1.3 Scope of Work

ERP supports the following objectives identified in Chapter 2 of the Management Plan for the EG&G Idaho Environmental Restoration Program:

- Identify and remediate all past waste units presenting a potential threat to human health or the environment.

- Comply with the Consent Order and Compliance Agreement (COCA), which will be the integration document for INEL cleanup activities, by implementing the COCA Action Plan. Comply with the Interagency Agreement (IAG) when approved by DOE, Environmental Protection Agency (EPA) Region 10, and the State of Idaho.

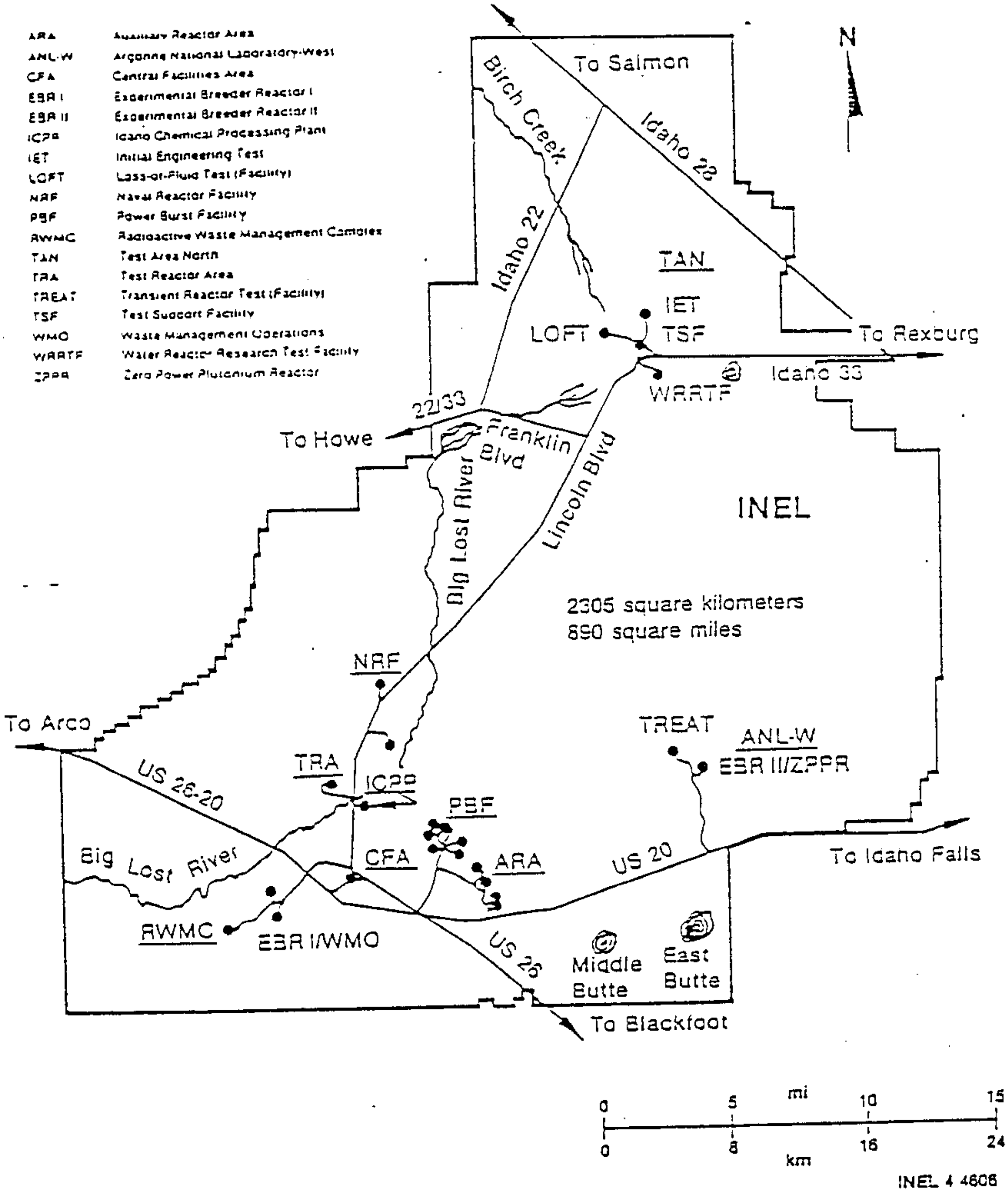

Figure 1-1. Map of INEL showing location of the major facilities.

- Comply with the Comprehensive Environmental Response Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA) as established in an IAG among DOE-ID, EPA, and the State of Idaho.

- Support the DOE Environmental Restoration Program, as directed by DOE Headquarters in Washington, D.C.

A detailed work scope shall be included in the task specific addendum.

Field activities conducted during investigations may result in an exposure to hazardous and/or radioactive materials or wastes resulting from direct contact with contaminated soil, rock, groundwater, airborne particulates, and vapors. Protecting task site personnel from occupational health and safety hazards will be of major concern during the field activities. To this end, the ERP has identified a number of subjects that will provide protection to personnel and the environment. The following major subjects are addressed:

- Health and safety responsibilities

- Personnel training

- Medical surveillance program

- Hazard evaluation

- Levels of protection and use of personal protective equipment (PPE)

- Safe work practices

- Establishment of work zones, site entry, and security procedures

- Personnel and environmental monitoring and record keeping requirements

- Decontamination procedures

- Emergency procedures, equipment, and information.

Each subject is detailed in the following sections.

2. HEALTH AND SAFETY RESPONSIBILITIES

Direct implementation of the H&S Plan is the responsibility of the Field Team Leader (FTL). The FTL and/or Project Manager (PM) shall determine the task organizational structure and expertise required to perform the task while minimizing any risks to personnel health and safety. Expertise that may be required for the task includes but is not limited to industrial hygiene, health physics, industrial safety, and essential technical skills. The FTL shall develop a task organizational chart that identifies all key personnel. Both lines of command and lines of communication shall be identified by the task organizational chart (see Figure 2-1). The task organizational chart shall be located in the addendum. A qualified person may act in dual positions for a task [e.g., IH and health and safety officer (HSO)]. An HSO shall always be identified for a task per the requirements of OSHA 1910.120. The following subsections outline the responsibilities of the most common key personnel. If warranted by the requirements of the task, additional specialized positions may be necessary.

2.1 Field Team Leader

The FTL, the individual overseeing task activities, has ultimate responsibility for the safe and successful completion of task activities and for all phases of safety at the task site. If operations have been halted due to a potentially hazardous health and safety issue, the FTL will confer with the IH, HSO, RE, PM, health physics technician (HPT), safety engineer (SE), and facility representative, as required by the situation, to provide a safe solution to the problem. In addition, the FTL must remain responsive to health and safety issues raised by task operations personnel.

The FTL will ensure an orientation meeting is conducted before the start of a task to review and discuss operating procedures and the Task Specific H&S Plan (including any attachments) with task operations personnel. If new team

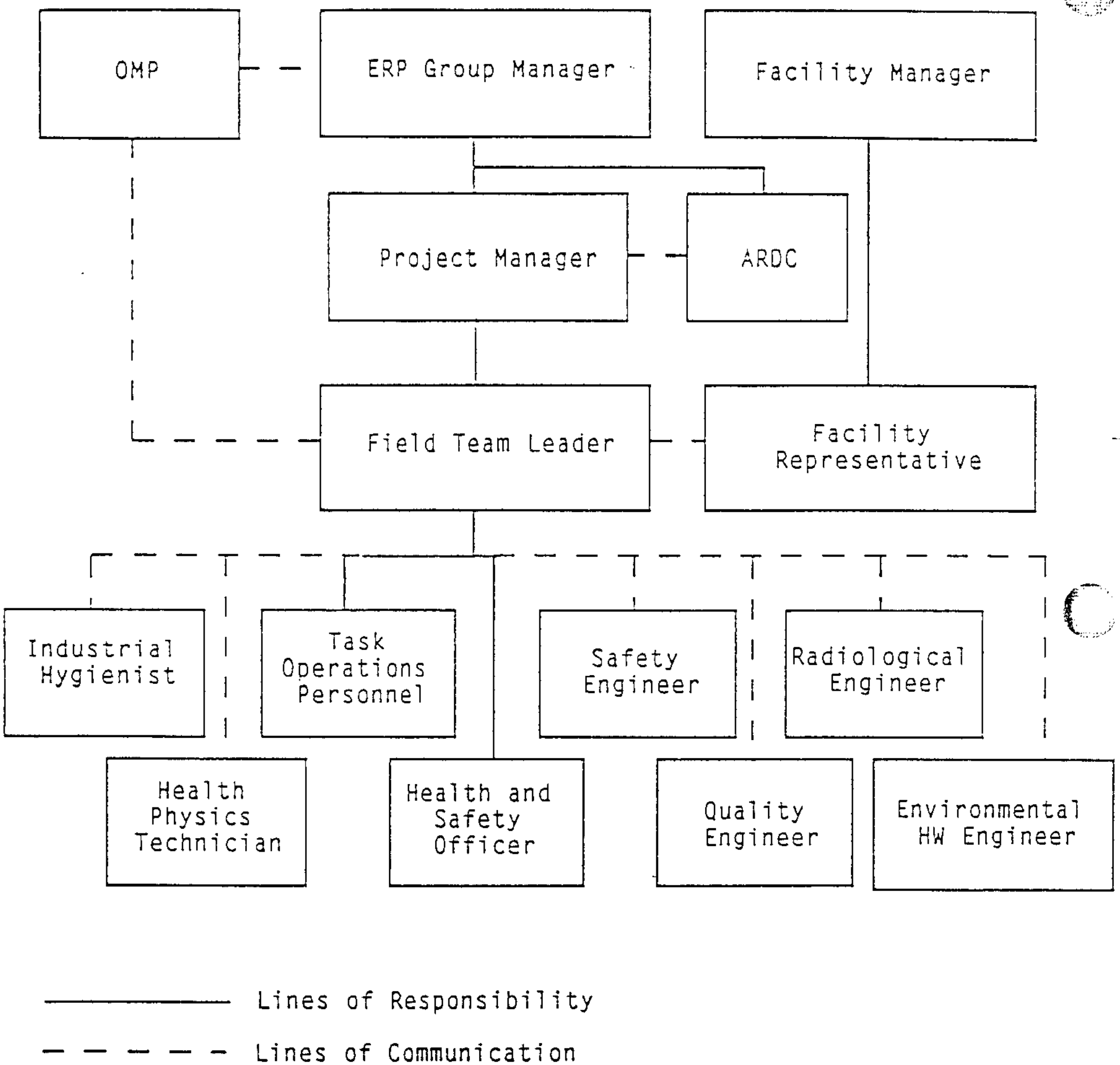

Figure 2-1. Field organizational chart.

members arrive at the task site after initiation of the task, the FTL shall ensure this orientation is presented to them.

At the beginning of each work day, the FTL (or alternate) will meet with task operations personnel to discuss the day's activities and address any health and safety issues that may have arisen or potentially could arise that day.

The FTL will ensure that all task operations personnel have received the appropriate training as required by Section 3 of this H&S Plan and that records of training for ERP personnel (including a copy of the signed Health and Safety Certification form as shown in the addendum) are submitted to the Training and Emergency Action Unit of the Waste Management Operations Support Group.

Additional responsibilities of the FTL include:

- Halting or modifying any task and/or evacuating the task site if work conditions are considered unsafe. This decision will be made after consulting with the HSO, IH, SE, and/or RE, as appropriate

- Reporting any accident, illness, or safety-related occurrence in accordance with Section 3 of the EG&G Idaho Safety Manual.

- Notifying the facility representative (if applicable) of any modifications or suspension of the task

- Ensuring that an interface exists with the analytical laboratories regarding any analyses of personnel monitoring and/or ambient air samples and provisions are made with the laboratory for a 24 to 48-hour turnaround for analysis in the event of an exposure suspected of being above an action level.

- Ensuring that all task site personnel understand and comply with all safety requirements

- Initiating corrective action for observed safety violations

- Ensuring that safety training is implemented as described in this plan (Section 3).

An FTL not at the task site must appoint an appropriate alternate to act as FTL. This change must be communicated to the facility representative, when necessary, and recorded in the FTL logbook. Appropriate alternates shall be listed in the task specific addendum.

2.2 Health and Safety Officer

The HSO is responsible for ensuring compliance with and the execution of the health and safety procedures described in this plan and the associated task specific addendum. The HSO will be supported by those personnel necessary to effectively implement the task specific H&S Plan and verify compliance (e.g., SE, IH, HPT, RE, and facility representative).

Responsibilities of the HSO include:

- Ensuring that all necessary safety equipment is located on or near the task site and properly maintained and calibrated by the appropriate personnel.

- Observing task site activities and reporting any deviations from the H&S Plan to the FTL

- Initiating contact with the INEL emergency response agencies (security, fire, medical) at the beginning of the task, ensuring personnel and environmental monitoring requirements are established by the IH and RE (Section 9), and testing the emergency phone numbers to ensure accuracy.

2.3 Industrial Hygienist

The IH is the primary source of information regarding health issues at the task site. The IH is responsible for operations and maintenance of all monitoring equipment with the exception of radiological equipment and will maintain a daily logbook of monitoring activities. The IH will conduct task site health hazard assessments and advise the FTL on adequate health protection for task operations personnel. The IH will advise the FTL on changes to monitoring or PPE requirements throughout task activities and on any conditions necessitating task site evacuation and permitting personnel reentry to the task site.

The IH is responsible for designing a practical monitoring program to determine worker exposures to hazardous substances. The IH will also log results from field samples and observations.

NOTE: Much uncertainty is involved as to the chemical hazards that may be encountered. Not everything can be monitored, and professional judgment must be exercised at all times.

The IH shall aid the FTL in identifying employees experiencing adverse health effects that may have resulted from exposure to hazardous substances and environments and identifying such workers to the Occupational Medical Program (OMP).

2.4 Health Physics Technician

The HPT is the primary source of information and guidance with regards to radiological hazards. The HPT will be present at the task site before operations begin and at any point during task operations when a radiological hazard to operations personnel may exist or is anticipated.

Responsibilities of the HPT include:

- Ensuring radiological equipment is calibrated and functioning properly
- Radiological surveying of the task site, equipment (before and after decontamination), and samples
- Collecting and analyzing smears
- Providing guidance and monitoring decontamination of equipment (radiological contaminants)
- Providing the FTL, OMP, and RE with radiological monitoring information as requested
- Immediately notifying the FTL of any radiological occurrence that must be reported as directed by the EG&G Idaho Safety Manual, Section 3, Appendix II.
- Accompanying victim to the nearest INEL Medical Facility for evaluation if significant radiological contamination occurs.

2.5 Radiological Engineer

The RE is the primary source of information and guidance for radiological controls imposed on a task. The RE will make recommendations to minimize health and safety risks of task operations personnel if a radiological hazard exists or occurs at a task site.

The responsibilities of the RE include:

- Performing radiation exposure estimates using information provided by cognizant engineers, area HPTs, history of past work evaluations, bioassays, FTLs, etc.
- Identifying the type(s) of radiological monitoring equipment necessary to maintain safe working conditions for task operations personnel
- Attending pre-job briefings if required by the FTL
- Advising FTL and HPT of changes in monitoring or PPE and task site evacuation and reentry.

2.6 Administrative Record and Document Control Office

The ARDC is responsible for organizing and maintaining data and reports (safety, sampling, and operations) generated by ERP investigations. ARDC maintains a supply of all controlled documents and provides a documented checkout system for the control and release of controlled documents, reports, and records. A copy of the H&S Plan and the associated electronic copy of the task specific addendum are available upon request by calling 526-2650.

2.7 Occupational Medical Program

The OMP is mandated by DOE 5480.8 and uses the sciences related to preventive medicine and environmental health to determine the effects of environmental stress on human health or disease.

The OMP has responsibilities in the following areas:

- Review and comment on INEL emergency plans and operations

- Provide diagnosis, medical opinion, and treatment for INEL employees with occupational or nonoccupational illness or injuries

- Assist in the documentation and investigation of work-related illnesses or injuries

- Provide medical opinion whenever there is doubt by the FTL, advisors, or employee of the ability of the employee to perform assigned work or work being considered for assignment

- Plan and provide emergency medical care in support of individuals and Area emergency actions

- Maintain and operate a radiation and chemical decontamination facility at Central Facilities Area (CFA)

- Provide medical surveillance of workers who are identified by an IH as having been or are likely to be exposed over action levels to specific hazardous environments or substances.

2.8 Facility Representative

The facility representative serves as the Area Landlord representative and is responsible for the safety of personnel and safe completion of all project activities conducted within his/her Area. Therefore, the facility representative will be kept informed of all activities performed in the Area. Where applicable, the facility representative and FTL shall agree upon a schedule for reporting task progress and plans for work. The facility representative will serve as advisor to task operations personnel with regard to the Area operations when the task is performed in his/her Area.

2.9 ERP Group Manager

The ERP Group Manager is responsible for investigation and remediation activities performed by ERP. This manager provides technical coordination and interfaces with the DOE-ID Environmental Support Office. The ERP Group Manager ensures that all activities are conducted in accordance with DOE, EPA, and State of Idaho requirements and agreements; monitors and approves program budgets and schedules; ensures the availability of necessary personnel, equipment, subcontractors, and services; and provides direction for the development of tasks, evaluation of findings, development of conclusions and recommendations, and production of reports. The ERP Group Manager has primary responsibility for the technical quality of all projects and safety of personnel.

2.10 Project Manager

The PM has the responsibility for ensuring that all tasks conducted during the project are in compliance with the Management Plan for the EG&G Idaho Environmental Restoration Program and all applicable OSHA, EPA, DOE, Department of Transportation (DOT), and State of Idaho requirements. The PM is responsible for ensuring tasks comply with the ERP Quality Program Plan (QPP) (QPP-149), Quality Assurance Project Plan (QAPjP), H&S Plan, PDs, and Sampling and Analysis Plans (SAPs) of ERP. The PM coordinates all field, laboratory, and modeling activities.

2.11 Facility Manager

The Facility Manager is responsible for managing all aspects of the Area in his charge. The Facility Manager must be cognizant of work being conducted in the Area.

2.12 Environmental Hazardous Waste Engineer

The Environmental Hazardous Waste (HW) Engineer oversees, monitors, and advises EG&G Idaho organizations performing field activities at the INEL. Responsibilities include ensuring compliance with DOE Orders, EPA regulations, and other regulations concerning effects of activities on the environment. Additional responsibilities of the HW Engineer include:

- Acting as advisor for environmental concerns associated with ERP task activities
- Maintaining a library of applicable environmental information
- Disseminating applicable environmental information where/when needed.

2.13 Safety Engineer

The SE offers guidance on all safety issues arising at the task site, observes tasks and advises the FTL on required safety equipment necessary to promote a safe work environment, advises FTL and HSO about safety concerns arising during task operations, and recommends solutions to any concerns.

2.14 Quality Engineer

The Quality Engineer (QE) provides guidance on task site quality issues when requested. The QE observes task site activities and verifies that task operations comply with quality requirements pertaining to these activities. The QE identifies activities that do not or have the potential for not complying with quality requirements and suggests corrective actions for such activities.

2.15 Task Operations Personnel

All task operations personnel, including EG&G and subcontractor personnel, are responsible for understanding and complying with requirements of the task specific H&S Plan. Task operations personnel will be briefed by the FTL before starting each day's activities. They should identify and discuss potentially unsafe task site activities or conditions with the FTL for corrective action. If unsafe conditions develop, task operations personnel are authorized to halt work and notify the FTL of the unsafe condition.

2.16 Oversight Personnel and Visitors

Oversight personnel (i.e., DOE-ID, EPA, and State of Idaho representative) and visitors shall be considered "workers on site only occasionally." To minimize risks that may result from task site activities, "workers on site only occasionally" must have official business and notify the FTL before entering the task site. All "workers on site only occasionally" shall follow the requirements of OSHA 1910.120(d)(3)(ii) which states:

> Workers on site only occasionally for a specific limited task (such as, but not limited to, groundwater monitoring, land surveying, or geo-physical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

If these individuals meet the requirements stated above, they may not proceed beyond the support zone without receiving a safety briefing and wearing the appropriate protective equipment.

3. PERSONNEL TRAINING

Task operations personnel classified by the PM and/or FTL as hazardous material workers shall receive hazardous material worker training as specified by OSHA 29 CFR 1910.120 and the EG&G Idaho Safety Manual, Section 8. Specific training requirements for each hazardous material worker may vary depending on the hazards associated with the job assignment (e.g., noise, radiation). All hazardous material workers must obtain OSHA Hazardous Waste Operator training. Additional training to be considered for hazardous material workers includes but is not limited to:

- Respirator Fit Test Qualification
- Radiation Worker
- Hearing Conservation.

In addition to the above mentioned training, at least one worker with Medic 1st [Cardiopulmonary Resuscitation (CPR) and First Aid] training shall be present at the task site when task operations personnel are present. Managers of hazardous material workers (e.g., PM, FTL) shall obtain Hazardous Waste Worker Supervisor Training. Additional safety training courses may be required as dictated by the job assignment. Section 8 of the EG&G Idaho Safety Manual contains course numbers and descriptions for all EG&G safety training courses.

Employees who attend training classes requiring an annual refresher course must attend the annual courses for as long as they remain active hazardous material workers. Proof of completion of all required training courses by employees and visitors must be provided to the Training and Emergency Action Unit of the Waste Management Operations Support Group. ERP personnel can also obtain information regarding ERP personnel training records (e.g., due dates of refresher courses) from the Training and Emergency Action Unit of the Waste Management Operations Support Group.

The FTL will ensure that all task operations personnel understand the specific site hazards associated with each task at the daily briefings. Each FTL will also design and ensure implementation of a task specific training orientation to inform task operations personnel about the unique hazards or procedures, task specific H&S Plan, DOPs, etc. associated with the task at hand. Table 3-1 summarizes the above mentioned training requirements.

The following outline shall be used as a guideline for training and orientation before the start of a task. Personnel working at the task site shall be informed of the information listed in this outline, as applicable to the specific task.

A. WORK PLAN (SAP, Test Plan, etc.)

B. HEALTH AND SAFETY ITEMS

1. Personnel responsibilities

2. Medical program

3. Task site work zones

4. Vehicle operation and parking

5. Task site air and radiological monitoring

    a. Monitoring equipment (task site and personal)
    b. Calibration
    c. Maintenance and decontamination procedures

TABLE 3-1. Training topics for ERP hazardous material workers[a]

Training Topic[b]	Personnel Job Description	Task Operations Personnel	Field Managers
OSHA Hazardous Waste Operator	Cleanup or operations of hazardous waste sites	R	R
Respirator Fit Test Qualification	Work area requires use of respirator	R	R
Radiation Worker	Level of radiation exposure determines training category	R	R
Medic 1st	First Aid, CPR	R*	O
Personal Protective Clothing and Equipment	Required to wear Chemical and/or Radiological	R	R
Site Specific Hazards (FTL develops this training)	Encounters task specific potential hazards	R	Develop
Decontamination	Chemical and/or Radiological Procedures	R	R
Hearing Conservation	IH determines exposure to noise above 8-hour time-weighted average of 85 decibels	R	R
Emergency Training	Knowledge of Area drills, rescue, response, information	R	R

R: Required
O: Optional
*: At least one worker with Medic 1st Training shall be at task site when task operations personnel are present.

a. Additional training may be required for each task or individual and should be listed in the addendum.
b. These training topics include both the initial and refresher training (See EG&G Idaho Safety Manual, Section 8 for specific safety training course descriptions and numbers).

B. HEALTH AND SAFETY ITEMS (continued)

6. Potential hazardous contaminants and chemical hazards (toxicity and symptoms) present at the task site

7. Potential radiological contaminants

8. Task Specific Hazard Communication (in addition to the General Hazard Communication) training

   a. Inventory of hazardous agents
   b. Material Safety Data Sheets (MSDSs)
   c. Container labeling
   d. Informing visitors
   e. Contractor inventory and MSDSs

9. Contingency plans and responses

   a. Spill control
   b. Work stoppage

10. Use of field equipment and supplies

   a. Drilling equipment
   b. Work tools
   c. Sampling equipment
   d. Decontamination of equipment and supplies

11. Task site control and security

12. Buddy system and hand signals

B. HEALTH AND SAFETY ITEMS (continued)

13. Work limitations

    a. Weather
    b. Fatigue
    c. Heat stress
    d. Cold stress
    e. Hours of work
    f. Illumination
    g. Lightning

C. PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING

1. General

2. Availability

3. Level D PPE and clothing, as defined by OSHA, including limitations of protection

    a. Work clothing
    b. Eye protection
    c. Foot protection
    d. Head protection
    e. Hearing protection

4. Level C PPE and clothing, as defined by OSHA, including limitations of protection

    a. Respiratory protection
    b. Work clothing
    c. Eye protection

C. PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING (continued)

d. Foot protection
e. Head protection
f. Hearing protection
g. Skin/hand protection

5. Level B PPE and clothing, as defined by OSHA, including limitations of protection

a. Air supplied hood or self-contained breathing apparatus (SCBA)
b. Disposable, chemically resistant coveralls
c. Anti-contamination (anti-c) clothing as recommended by the RE
d. Chemically resistant safety shoes with steel toe
e. Chemically resistant shoe covers
f. Hard hat
g. Inner and outer chemically resistant gloves
h. Hearing protection, as required by IH

6. Level A PPE and clothing, as defined by OSHA, including limitations of protection

a. SCBA
b. Fully encapsulating, chemically resistant suit
c. Additional anti-c clothing, as recommended by the RE
d. Chemically resistant safety shoes with steel toe
e. Chemically resistant shoe covers
f. Hard hat
g. Inner chemically resistant gloves
h. Hearing protection, as required by IH

C. PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING (continued)

7. Zone I anti-c clothing minimum requirements

   a. One pair cloth anti-c coveralls (or disposable) (as required by HPT)
   b. One yellow cloth hood (or disposable)
   c. Two pair shoe covers
   d. One pair latex gloves and cloth glove liners

8. Zone II anti-c clothing minimum requirements

   a. One pair yellow cloth anti-c coveralls (or disposable)
   b. One yellow cloth hood (or disposable)
   c. Three pairs shoe covers (two pairs must be vinyl)
   d. One pair latex gloves and cloth glove liners

9. Zone III anti-c clothing minimum requirements

   a. One pair yellow cloth anti-c coveralls and head cover (hood)
   b. One pair disposable anti-c coveralls (or plastic anti-c suit) with disposable hood
   c. Three pairs shoe covers (two pairs must be vinyl)
   d. Two pairs gloves and cloth glove liners
   e. Respiratory protection commensurate with the contamination levels

10. Decontamination procedures

   a. Chemical contaminants
   b. Radiological contaminants
   c. Mixed contaminants

D. EMERGENCY ASSISTANCE

1. Availability of emergency services and location of telephone and telephone numbers, MSDSs, and other emergency information

2. Transportation of emergency cases and accompanying medical monitoring procedures

3. Emergency assistance and review of hand and audible signals

E. SPECIAL PRECAUTIONS DURING TASK SPECIFIC OPERATIONS

1. Most dangerous times

2. Most dangerous conditions

3. Specific task checklist.

In addition, the FTL will conduct safety briefings (a) at the beginning of each shift, (b) whenever new personnel arrive at the task site, and (c) as significant changes to task site or work conditions occur.

4. MEDICAL SURVEILLANCE PROGRAM

Employees identified as hazardous waste workers as defined by OSHA (29 CFR 1910.120) require medical surveillance examinations prior to beginning duties, annually, and at the termination of hazardous waste duties (if they have not had such an examination within a year). This includes (a) employees who are or who may be exposed to hazardous substances at or above established permissible exposure limits, without regard to respirator use, for 30 or more days per year; (b) those who wear a respirator for 30 or more days per year; and (c) all HAZMAT employees. In addition, employees who must use a respirator in their job or are required to take training to use a respirator to perform their duties under this plan must be medically evaluated for respirator use at least annually.

The OMP is responsible for evaluating the physical ability of a worker to perform the task assigned. The OMP provides medical clearance to the worker for the work to be performed. The OMP may impose restrictions on the employee by limiting the amount or type of work performed. The PM (or the IH and/or HP with the approval of PM) must provide the job related background information listed below to the OMP for each hazardous material worker. This information must be submitted to the OMP before work begins and annually, one month before birth date of the employee to maintain hazardous waste/hazardous material worker medical clearance. It may be submitted on EG&G Form 3044, "Hazardous Material Worker Job Related Background Information;" EG&G Form 735, "Industrial Hygiene Identification Of An Employee For A Medical Surveillance Program To OMP;" or by other means acceptable to the OMP.

- Medical history and physical examination
  - Preemployment medical examination, for full-time employees
  - Current comprehensive medical examinations, for full-time employees, in an INEL medical facility

- Records and reports from employees' private physicians, as required by the Site Occupational Medical Director

- Medical evaluation by OMP on return to work following an absence in excess of one work week (40 consecutive work hours) resulting from illness or injury

- Medical evaluation in the event a supervisor questions the physical condition of an employee

- Medical evaluation in the event the employee questions his/her physical condition

• Job related background information (Form EG&G-3044)

  - What type of job does the individual perform?

  - When was the individual first exposed to hazardous substances or working in an environment with potential hazardous exposure at the INEL?

  - Relevant environmental monitoring (IH and HPT) data including sample dates and places (if the employee has been exposed to substances or physical agents above an action level)

  - How and when was/will the employee (be) trained in PPE including respirators?

  - What type of respiratory protective device is to be used?

  - How many days per month is respiratory protection to be used?

  - How long is this work to continue?

The above information and examinations are used to determine the following for each employee:

- Ability to perform routine occupational tasks
- Work in protective equipment and/or heat stress environments
- Use of respiratory protection
- Need to be entered into additional specific medical surveillance examination programs.

Employees are cleared as hazardous material workers with or without specific restrictions relating to heat stress, certain job tasks, and/or use of respirators. If the OMP does not have sufficient information at the time of request for clearance for respirator training, the supervisor is notified and clearance is withheld until the needed information is provided and any necessary additional examination or testing is completed.

Results of the following tests shall be made available to the OMP when any abnormal exposure is noted or a radiological contamination incident occurs:

- Whole body count (baseline, annual, and on actual or suspected radiological contamination incident)
- Bioassay (baseline, as required to assess internal radiation dose, and on actual or suspected radiological contamination incident).

Subcontractors are responsible for being in compliance with health and safety requirements as stated in 29 CFR 1910.120. All medical data collected pursuant to hazardous material worker qualification of a subcontractor worker shall be made available to the OMP. Background information about the subcontractor worker will assist the OMP in assessing the medical ability of the subcontractor worker to work should doubt arise during task operations. This information is also required from the subcontractor in order for the OMP to clear the subcontractor worker as a hazardous material worker. Subcontractor past radiation exposure history shall be submitted to the Operational Dosimetry Unit of EG&G Idaho (Section 3.5 of Chapter 2 in the Radiological Controls Manual).

It is the policy of the OMP to examine all workers, including subcontractors, when they are injured on the job or there is reason to believe that they have been exposed, over an action level, to toxic substances or physical agents.

Before initiation of any task where a chemical/radiological hazard exists, the appropriate medical facility will be notified of the start of the task, anticipated schedules, and task site locations by the HSO. In addition, the OMP shall be supplied with an inventory of the known hazardous constituents located at the task sites.

In the event of an IH and/or RE documented exposure to a hazardous substance or physical agent over an action level, the worker(s) shall be transported to the nearest medical facility for evaluation. Further medical evaluation will be in accordance with the symptoms, specific hazard involved, exposure level, medical surveillance requirements, current health and safety directives, and sound medical practices.

The following information shall be provided to the OMP:

- Name, job title, work location, supervisor's name, and supervisor's phone number
- Substances/physical agents (e.g., noise) involved

- Date the employee was first exposed to the substance/physical agent on this task
- Monitoring data including locations of samples and dates samples were taken, if exposed over action level
- PPE in use during this task
- Number of days per month PPE has been in use
- How long this employee will be exposed to the substance or physical agent
- Training the employee has received in the use of PPE
- Type of respirator, if any, being used.

5. HAZARD EVALUATION

Personnel may be exposed to a variety of substances and physical agents while working at the task site. Exposures may be a result of contacting materials stored, handled, or disposed; equipment being used; weather conditions or time of day; environmental surroundings; and/or task specific working conditions. The FTL should asterisk all suspected hazardous materials pertinent to the task on the list provided in the task specific addendum. Any additional stress agents should also be listed in the task specific addendum. A job hazard analysis using EG&G Idaho Company Procedure, Number 11.9 shall be used as appropriate to perform portions of the task site hazard evaluation. All personnel working at a task site should be aware of existing hazards.

The following sections provide general information on the types of potential exposures that may be encountered while working at task sites.

5.1 Chemical Agents

Exposure to chemical agents may result when personnel come in contact with gaseous, liquid, or solid materials encountered at the investigation sites. Personnel shall make every effort to avoid direct contact with disposed or hazardous materials. Task operations personnel may be exposed to contamination through inhalation, ingestion, absorption (skin/eye), and injection (puncture wound).

- Inhalation of hazardous materials can occur due to lack or improper use of respiratory equipment, malfunctioning monitoring equipment, presence of undetected chemicals, or chemicals in quantities greater than the respiratory equipment protection limits.

- Digestive system may be affected by hazardous substances when workers do not practice good personal hygiene habits (e.g., washing hands thoroughly after completion of work and before smoking, eating, drinking, and chewing gum or tobacco). Inhaling or swallowing airborne hazardous substances may also produce adverse effects to the digestive system.

- Skin absorption of solid, liquid, or gaseous hazardous substances can occur through cuts or abrasions. Skin absorption can occur when a worker does not wear proper protective clothing or when a breach of protective clothing has occurred.

- Eye irritation may develop from solid, liquid, gaseous contaminants. This irritation may occur when a worker does not wear proper eye protection or when unwashed hands come in contact with the eyes.

- Hazardous substances may be injected into the body through puncture wounds occurring from contaminated equipment with sharp edges or protrusions.

5.2 Fire and Explosion

Explosions and fires may occur as a result of activities such as moving drums, accidentally mixing incompatible chemicals, introducing an ignition source into an explosive or flammable environment, or refueling equipment. Intense heat, open flame, smoke inhalation, flying objects, and the release of toxic chemicals into the environment can result.

5.3 Oxygen Deficiency

Oxygen deficiency can result from the displacement of oxygen by another gas or the consumption of oxygen by a chemical reaction. Confined spaces or low-lying areas such as pits or trenches are particularly susceptible to oxygen deficiency. The EG&G Idaho Safety Manual, Section 20 Appendix A and the EG&G Idaho Company Procedures Manual, Number 11.3, should be reviewed by those working in a confined space.

5.4 Radiological Hazards

The potential exists for radiation exposure and radiological contamination to task operations personnel. Contamination is the presence of uncontained radioactive material on any object or surface or in the atmosphere, especially where the presence of radioactive material may be harmful or could be spread if disturbed by an outside agent.

Types of contamination are discussed below.

- Loose contamination is easily spread to adjacent areas and can be ingested or inhaled.
- Fixed contamination is the presence of uncontained radioactive material on surfaces which cannot be easily removed by normal decontamination techniques.
- Airborne contamination is normally in particulate form and is of concern because it can be ingested or inhaled. When inhaled, airborne particulate can deposit in the lungs and diffuse to other parts of the anatomy causing an internal exposure hazard (respiratory protection must be worn when entering an airborne contamination area.)

Contamination may enter the body through

- Absorption
- Injection
- Ingestion
- Inhalation.

Radiation is energy emitted from a source that travels in electromagnetic waves or very small particles at various speeds or energies. Ionizing radiation is energy emitted from an unstable atom in the form of particles (alpha, beta, neutron) and/or electromagnetic wave or photons (gamma and x-ray) which has enough energy to interact with other atoms and change their charge. Personnel may be irradiated without contamination but cannot be contaminated without being irradiated.

5.5 Biological Hazards

Waste from research facilities, garbage, and animal feces may contain disease-causing organisms. If these agents are present, they could infect task operations personnel and be dispersed in the environment by water and wind. It is recommended (not required) that operations personnel be immunized against tetanus bacteria, which live in the soil, to minimize the effects of possible exposure.

Encounters with wildlife may be possible at the task site. Snakes, insects, and other animals can and will bite if disturbed and avoidance is the best solution. Prompt first aid should be performed if this type of injury occurs.

5.6 Industrial Safety-Hazards

Numerous unsafe conditions or actions may be encountered. These may include:

- Existing objects and terrain
- Elevated work areas
- Lifting heavy objects
- Moving machinery and falling objects
- Personal protective equipment

- Task related equipment
- Excavation, trenching, and shoring.

Task operations personnel should look for potential hazards and immediately inform the FTL of those hazards so that action can be taken to minimize injury due to an unsafe condition or action.

5.6.1 Existing Objects or Terrain

Existing objects and terrain can present safety hazards such as:

- Holes and ditches
- Precariously positioned objects (e.g., drums or boards that may fall)
- Sharp objects (e.g., nails, metal shards, and broken glass)
- Slippery surfaces
- Overhead power lines
- Steep grades
- Uneven terrain
- Unstable surfaces (e.g., walls that may collapse or flooring that may give way)
- Ladders/stairs.

Additional safety hazards introduced by the task should be listed in the task specific addendum.

5.6.2 Elevated Work Areas

During the course of task activities, personnel may be required to work on elevated equipment. When such work must be performed, the provisions stated in Section 16 of the EG&G Idaho Safety Manual shall be followed. In addition, personnel required to work under these conditions shall be trained on the use of elevated equipment.

5.6.3 Lifting Heavy Objects

Operations personnel may risk injury by lifting heavy objects. All operations personnel should be trained in the proper method of lifting heavy equipment and cautioned against lifting objects that are too heavy. Mechanical and hydraulic assists will be used whenever possible to minimize lifting dangers.

5.6.4 Moving Machinery and Falling Objects

Task operations personnel may be subject to lacerations and contusions (cuts and bruises) when activity involves contact with moving machinery and falling objects. Injury can be minimized by wearing protective clothing, hard hats, steel-toed boots, and using mechanical assists whenever possible. Loose clothing or neck chains for security badges should not be worn and hair should be secured when personnel work around equipment with moving parts or any other potentially hazardous piece of equipment. All moving and rotating machinery must be properly guarded and guarding must remain in place.

5.6.5 Personal Protective Equipment

Wearing PPE may reduce a worker's ability to move freely, see clearly, and hear directions and noise that might indicate a hazard. Also, PPE can increase the risk of heat stress. Personnel must adjust their work activities to accommodate limitations.

5.6.6 Task Related Equipment

Hazardous equipment and/or situations not mentioned above shall be listed in the task specific addendum. The FTL shall make all personnel aware of possible dangers associated with use of hazardous equipment and/or situations.

5.6.7 Excavation, Trenching, and Shoring

Work at hazardous waste sites may involve excavations for purposes of positioning equipment, removal of contaminated soils, removal of underground tanks, or retrieval of containers such as drums, piping systems, or other buried materials. Tasks which involve work in any excavation present serious potential hazards to personnel; personnel protective systems, barricades, signs, and daily inspections are some of the safeguards required for excavation work. For more detail, see the OSHA requirements outlined in 29 CFR 1926, Subpart P - Excavations. In addition, EG&G Idaho Safety Manual Section 20.0, Appendix B, contains additional requirements which may be more restrictive than those of the OSHA standard.

5.7 Electrical Hazards

Overhead power lines, downed electrical wires, and buried cables all pose the danger of shock or electrocution of workers. Electrical equipment may also pose a hazard to workers. Careful observation for overhead electrical hazards will be performed by operating personnel before raising masts on drill rigs or using cranes. Underground utility clearances must be obtained before drilling or excavating operations by contacting Telecommunications (526-1591/526-2512). The EG&G Idaho Safety Manual, Supplement 2.2 "Safe Work Permits (SWPs)/Special Safe Work Permits (SSWPs)," and Section 10, "Electrical Safety," shall be followed for all work performed near overhead electric lines and electrical work.

5.8 Heat Stress

Workers may be required to wear protective clothing that could prevent the body from cooling naturally, thus causing a rise in body temperature. High body temperatures can result in heat fatigue, physical discomfort, and death. The IH must inform the FTL of signs and symptoms of heat stress to preserve safe work conditions at the task site. Work scheduled for summer months is subject to higher ambient temperatures than in winter. Radiant heat can create a hazard in the summer. EG&G Idaho Company Procedures Manual, Number 11.10 discusses the hazards of heat stress.

5.9 Cold Exposure

Exposure to low temperatures may be a factor if work is done in the evening hours, if winds are high, if unpredictable weather moves in, and in the winter months (e.g., at 50°F, with a 25 mph wind, the equivalent chill temperature is 32°F). EG&G Idaho Company Procedures Manual, Number 11.10 discusses the hazards of cold stress.

5.10 Noise

Task operations personnel may be exposed to high levels of noise generated by heavy equipment and other sources.

5.11 Decontamination

The chemical and radiological decontamination processes for tools, equipment, clothing, and personnel to remove contaminant generated by the task site activities have the potential for spreading contamination and increasing the exposure to personnel if care is not exercised when decontamination activities are taking place. High pressure hot water and steam used in the process can present a hazard if blasts of either agent rebound into the face or onto the body. In addition, airborne contaminants may result from this process. Decontamination procedures shall be followed and appropriate personal protection shall be used during decontamination activities. Good housekeeping measures will be followed, so that decontamination liquids do not present a hazard.

5.12 Work Stress

Hazardous activities that rely on a high degree of personal alertness shall be performed under controlled conditions of job performance as outlined in Section 20 of the EG&G Idaho Safety Manual. The FTL assumes responsibility of good judgment in the assignment of personnel fatigued by excessive hours of work in psychologically and possibly physiologically stressful environments.

6. LEVELS OF PROTECTION AND PERSONAL PROTECTIVE EQUIPMENT

Selection of PPE is based on the recommendations contained in NIOSH, 10/85. Each work location will be evaluated for potentially hazardous contaminants by the SE, IH, and HPT before entry. Due to the types of known contaminants and the likelihood of unknown contaminants being present, several recommended levels of PPE are described in this section. The levels are Level A, Level B, Level C, and Level D. Radiological control levels include Zone I, Zone II, and Zone III. The required level for PPE will depend on the IH and RE task site hazard assessment, physical conditions, and monitoring data. The level of PPE used at the task site shall be specified by the IH and RE. Changes in PPE level shall be documented in the FTL logbook.

Without compromising the protection from chemical and radiological exposure, and considering the comfort of the workers, Level B and Level C clothing may be modified as stated in Chapter 8 of the referenced NIOSH, 10/85. That decision will be made by the IH and HPT and documented by the FTL in the task specific addendum.

6.1 Respiratory Protection

All personnel shall wear only those respirators for which they have been trained and acceptably fit-tested. Respirators shall be used under the recommendation of the IH and HPT. Also, guidelines for respirator use, emergency use, storage, cleaning, and maintenance, as stated in EG&G Idaho Company Procedures Manual, Number 11.1, shall be followed.

Inspection procedure performed before respirators are used:

- Check to ensure that bag containing respirator is intact and that expiration date stamped on bag has not expired.
- Check to make sure respirator is clean.

- Look for breaks or tears in the headband material. Stretch the bands to ensure sufficient elasticity.
- Ensure that all headbands, fasteners, and adjusters are in place and not bent.
- Check the facepiece for dirt, cracks, tears, or holes. Ensure that the rubber is flexible, not stiff.
- Check the shape of the facepiece for possible distortion that may occur if the respirator is not properly stored.
- Check the exhalation valve located near the chin between the cartridge holders by:

  - Unsnapping the cover,
  - Lifting the flexible rubber valve and the valve seat to check for cracks, tears, dirt, and distortion, and,
  - After replacing the cover, ensuring that it spins freely.

- Check both inhalation valves located under the respirator cartridges for the same items listed above.
- Check the cartridge holders to ensure that they are clean, necessary gaskets are in place, threads are not worn, and there are no cracks or other visible signs of damage and ensure that they are the correct type of cartridge required for the job.
- Check cartridges (especially the threaded portions) for dents or other damage.

6.2 Level D Personal Protective Equipment

Personnel working inside the task site and wearing Level D PPE shall wear, as appropriate:

- Safety glasses (see Section 16 of EG&G Idaho Safety Manual)
- Safety shoes as described in Supplement 16.4 of the EG&G Idaho Safety Manual

- Hard hat (see Section 16 of the EG&G Idaho Safety Manual)
- Hearing protection as required in the EG&G Idaho Company Procedures Manual, Number 11.7.

6.3 Level C Personal Protective Equipment

Personnel working inside the task site and wearing Level C PPE shall wear, as appropriate:

- Full-face or half-face air-purifying respirator (with appropriate filters and eye protection) as required by INEL Health Physics and the IH.

NOTE: The use of half-face respirators is not permitted in a radiological environment without authorization of the program/facility manager in consultation with a radiological engineer per EG&G Idaho Company Procedures Manual, Number 11.1.

- Disposable chemical-resistant coveralls
- Anti-c clothing as recommended by RE if radiological hazards exist (see Section 6.6 below)
- Safety shoes as described in Supplement 16.4 of the EG&G Idaho Safety Manual
- Chemically resistant shoe covers
- Hard hat (see Section 16 of the EG&G Idaho Safety Manual)
- Inner chemically resistant gloves
- Outer chemically resistant gloves
- Hearing protection as required in the EG&G Idaho Company Procedures Manual, Number 11.7
- Eye protection as required by SE (see Section 16 of the EG&G Idaho Safety Manual)
- Emergency egress respirator.

6.4 Level B Personal Protective Equipment

Level B is the same as Level C except the respiratory protection is upgraded to air supplied hood or SCBA. Personnel working inside the task site with designated Level B PPEs shall wear, as appropriate:

- Air supplied hood or SCBA
- Emergency egress respirator
- Disposable chemically resistant coveralls
- Anti-c clothing as recommended by the RE if radiological hazards exist (see Section 6.6 below)
- Safety shoes as described in Supplement 16.4 of the EG&G Idaho Safety Manual
- Chemically resistant shoe covers
- Hard hat (see Section 16 of the EG&G Idaho Safety Manual)
- Inner chemically resistant gloves
- Outer chemically resistant gloves
- Hearing protection as required in the EG&G Idaho Company Procedures Manual, Number 11.7.

6.5 Level A Personal Protective Equipment

In rare circumstances, it may be necessary for operating personnel to wear Level A PPE. Level A has the same maximum respiratory protection as Level B; however, the highest available skin and eye protection are required for Level A. All personnel required to wear Level A PPE should include, as appropriate:

- SCBA
- Escape SCBA
- Fully encapsulating, chemically resistant suit
- Additional anti-c clothing as recommended by the RE if radiological hazards exist (see Section 6.6 below)

- Safety shoes as described by Supplement 16.4 of the EG&G Idaho Safety Manual
- Chemically resistant shoe covers (if applicable)
- Hard hat (if applicable)
- Inner chemically resistant gloves
- Hearing protection as required in the EG&G Idaho Company Procedures Manual, Number 11.7.

6.6 Personnel Protection in Radioactively Contaminated Areas

Anti-c clothing shall be worn in contamination control zones. Personal clothing other than underwear and shoes shall not be worn in Zones II and III. Health Physics personnel (HPT and RE) shall define the anti-c requirements for working in areas on the basis of contamination levels determined by surveys and the guidelines below. For entry into Zones II and III, all openings between the coveralls and shoe covers, gloves, and hood shall be taped. Anti-c clothing shall be donned only at or near the contamination control point of the area to be entered. Guidelines for personnel protection in radioactively contaminated areas are contained in the EG&G Idaho Radiological Controls Manual, Chapter 4, Section 3.5.1. The minimum anti-c personal protection for each contamination zone is presented below.

6.6.1 Zone I - Low Level Contamination

The minimum requirements for Zone I anti-c personal protection include:

- One pair of cloth anti-c coveralls (or disposable)
  Note: This requirement may be deleted by the HPT for walk-through entries or health physics surveys.
- One pair of shoe covers
- One pair of latex gloves.

6.6.2 Zone II - Moderate Level Contamination

The minimum requirements for Zone II anti-c personal protection include:

- One pair yellow cloth anti-c coveralls (or disposable)
- One yellow cloth hood (or disposable)
- Three pairs of shoe covers (two pairs must be vinyl)
- One pair latex gloves.

6.6.3 Zone III - High Level Contamination

The minimum requirements for Zone III anti-c personal protection include:

- One pair yellow cloth anti-c coveralls and hood
- One pair disposable anti-c coveralls (or plastic anti-c suit) with disposable hood
- Three pairs of shoe covers (two pairs must be vinyl)
- Two pairs of latex gloves
- Respiratory protection commensurate with contamination levels.

7. SAFE WORK PRACTICES

An SWP or SSWP may be required for a task as described in Section 2.4 of the EG&G Idaho Safety Manual. That section along with Supplement 2.2 describe the types of work that require an SWP or SSWP.

Several factors may affect the safe working environment in the field (e.g., inclement weather, confined work space, extended working schedules, work in heavy PPE, temperature, and work done under artificial illumination). These factors can compromise the work performance of task operations personnel. The FTL is responsible for communicating with task operations personnel to ensure safe and efficient work conditions.

7.1 Working in Confined Spaces

If work is to be performed in a confined space, the FTL will ensure the area is safe for entry, work, and egress in accordance with EG&G Idaho Company Procedures Manual, Number 11.3. If appropriate, specific task site instructions for working in confined spaces shall be presented in the task specific addendum. Task operations personnel shall not enter the confined space until safety personnel and the FTL can ensure it to be safe and the SWP is approved.

7.2 Extended Working Schedules

If work schedules must be extended, Section 20 in the EG&G Idaho Safety Manual offers the guidelines and managerial approval needed for personnel working more than a 48-hour week. The FTL is responsible for the safety of task operations personnel; however, when work weeks are in excess of 48 hours, the FTL must realize that physiological and psychological stresses reduce the safety and efficiency of the field operations. Ultimate responsibility for safety of operations belongs to the FTL.

7.3 Working in Heavy PPE

Work performed in heavy PPE creates additional stresses which severely limit the ability of operations personnel to work long shifts. The FTL should be aware of such limitations and adjust schedules accordingly. The IH and HPT will advise the FTL on this issue.

7.4 Working with Artificial Illumination

If hot and/or windy conditions exist during the regular work shift, schedules may be changed to perform operations at night. Artificial illumination, although a necessity, can create an environment of reduced visibility for the workers. Task operations personnel must be alert and cautious as they maneuver around work areas.

7.5 Buddy System

The buddy system is an effective way to ensure each worker is monitored as to his mental and physical well being during the course of a work day. By using the buddy system, task operations personnel can reduce the chance of being ill or injured and not be noticed. This is particularly crucial for workers in the exclusion zone (Section 8.1 of this H&S Plan). The FTL will pair workers to regularly check on one another during the day's activities. Each member of the pair will observe the other for alertness, motor functions, and coherence.

7.6 Handling Drums and Containers

Drums and containers handled during the task shall be addressed in the task specific addendum. Each drum or container shall meet the appropriate DOT, OSHA, and/or EPA regulations for the wastes they contain. The addendum shall address inspection, labeling, handling operations, waste characterization, spill containment, and transportation. EG&G Idaho Company

Procedures Manual, Numbers 8.1, 8.2, and 8.3 address many of the above items. In addition, if the work plan associated with the task addresses the handling and disposing of waste, the work plan shall be referenced in the addendum.

7.7 ALARA Goals

The as low as reasonable achievable (ALARA) policy objective is to reduce personnel and environmental radiation exposures and doses to the lowest levels in keeping with good operating practices. The ALARA program establishes annual radiation dosage goals and management commitments to assist in meeting these goals.

Personnel working at the task site must strive to keep his or her radiation exposure ALARA through the following practices:

- Adhere to all written radiological requirements and verbal guidance
- Be aware of personal radiation exposure history
- Work within ALARA guidelines and make suggestions as needed
- Minimize the production of all radiological waste
- Minimize personal radiation exposure by these basic protection techniques:
    - Time - exposure is minimized as time is minimized
    - Distance - maintain a maximum distance from radiation source
    - Shielding - use any solid material (e.g., lead, steel, concrete) as a shield (Exposure amounts will vary depending on thickness and type of material.)
    - Limits - radiation exposure limits are contained in the EG&G Idaho Radiological Controls Manual, Chapter 2, Section 3.2
- Adhere to general safe work practices discussed in Section 7.9 of this plan.

7.8 Radioactive Spill Control

Contamination in uncontrolled areas is designated as a "spill"; if a spill is noticed, task operations personnel shall initiate the SWIMS approach:

- Stop the spill
- Warn area personnel and notify Health Physics
- Isolate the area
- Minimize exposure to the spill
- Secure any ventilation paths and Health Physics surveys the extent of the spill.

Radioactive spill response is discussed in greater detail in the EG&G Idaho Radiological Controls Manual, Chapter 4, Section 3.8.2.

7.9 General Safe Work Practices

The following are general safe work practices to be followed on each task (if work practices vary from those described below, the FTL must record changes in the task specific addendum):

- Contact lenses shall not be worn in company designated eye-hazard areas unless they are essential to correct a vision defect not correctable by prescription safety glasses. Additional restrictions apply as per the EG&G Idaho Safety Manual, Section 16, paragraph 3.7.

- Eating, drinking, chewing gum or tobacco, smoking, and any other practice that increases the probability of hand-to-mouth transfer and ingestion of material are prohibited within the work/radiation zones. Approved eating areas shall be established or are designated at each Area facility.

- Do not perform work where contaminated substances may be present with an open wound. If a wound is received, report to the HPT and/or IH for further direction.

- Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, etc. Avoid kneeling, leaning, or sitting on equipment or the ground.

- Task operations personnel should watch for dangerous situations (the presence of strong, irritating, and/or nauseating odors, high airborne concentrations of dust, breached drums, etc.). Personnel should report all potentially dangerous situations to the FTL.

- Prevent releases of oil or hazardous materials used in task operations to the extent possible. If spillage occurs, contain it; report it to the facility representative, where applicable; and immediately clean it up in accordance with the Emergency Preparedness Procedures for the Area. Guidelines in Appendix III of the EG&G Idaho Company Procedures Manual, Number 11.6 for spill cleanup may be useful.

- Prevent splashing of contaminated materials during decontamination.

- Keep all potential ignition sources at least 50 ft from an explosive or flammable environment and use non-sparking, explosion-proof equipment.

- Task operations personnel will familiarize themselves with the physical characteristics of the task site including but not limited to:

  - Wind direction
  - Accessibility to fellow workers, equipment, and vehicles

- Communications at and near the task site
- Exclusion zones (areas of known or suspected contamination)
- Site access (both Area and Task)
- Nearest water sources
- Warning devices
- Nearest emergency assistance.

- At all times, a worker in the exclusion zone shall be in line-of-sight contact with his partner.

- Observe your coworker. Look for signs of exhaustion, heat or cold stress, or exposure to harmful vapors. Ask regularly if he/she is okay. Talk to your partner.

- All wastes generated during the task site investigation shall be managed in accordance with the EG&G Idaho Safety Manual, Section 15.

- Adhere to strict personal hygiene practices such as washing face, neck, and hands before eating, drinking, smoking, or using the restroom. Keep hands away from mouth and eyes when working in an exclusion zone or after handling samples or sample containers. A complete shower may be required at the end of a work shift (IH or HPT discretion).

- Proceed directly to a survey station upon leaving a radiological contamination zone. Care should be taken not to touch the face, mouth, and eyes before a survey has been performed.

8. WORK/RADIATION ZONES, SITE ENTRY, AND SECURITY

Based on the expected levels of contamination and work activity anticipated by each task, several work/radiation zones may be established for the task site. If it is determined that specific zones must be established for a particular task, then entry shall be controlled. Unnecessary personnel shall be excluded. Visitors must (a) notify the FTL in advance of the visit, (b) obtain the required training as specified in Section 3 of this H&S Plan, and (c) have business at the task site to obtain access.

Figure 8-1 provides an example of an approved work site and its established work zones as recommended by NIOSH, 10/85. If work zones are deemed necessary by the FTL upon the advice of the HPT, SE, and/or IH, each project's established work zones should be documented in the task specific addendum. Several work zones required for Levels A, B, C, and D work activities are:

- Exclusion zone
- Contamination area
- Contamination reduction corridor
- Contamination reduction zone
- Support area.

Radiological control zones will be established or incorporated into the work zones as required by the RE. Task site areas with radiological contamination in excess of the limits established in Chapter 4 of the EG&G Idaho Radiological Controls Manual shall be posted or labeled as specified in that chapter of the manual.

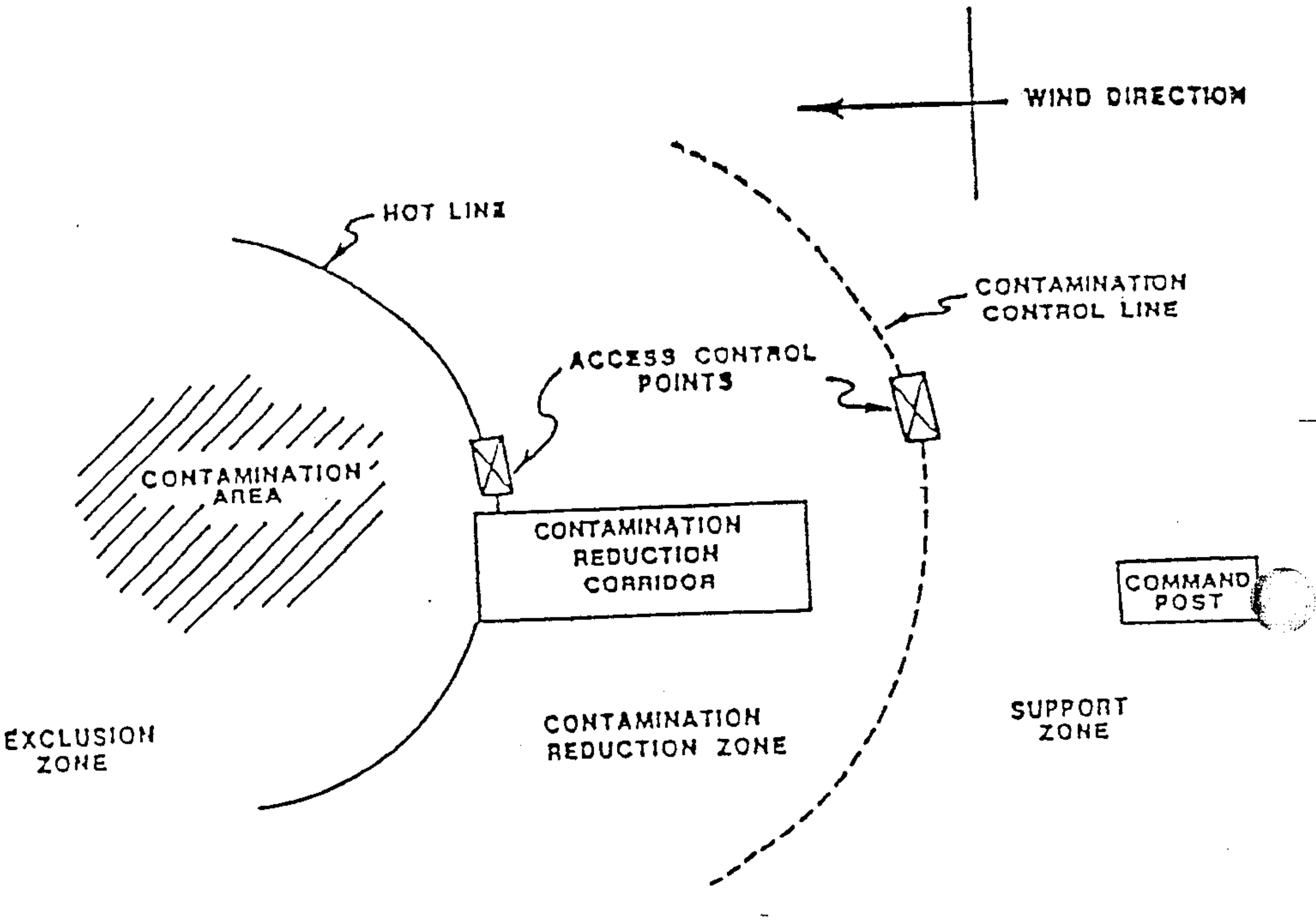

Figure 8-1. Diagram of typical hazardous material task site as recommended by NIOSH, 10/85.

8.1 Work Zones

8.1.1 Exclusion Zone

The exclusion zone includes the immediate work area around the contamination area. The minimum number of personnel required to safely perform the required operations will be allowed into the exclusion zone. The cordon around the exclusion zone is called the "Hot Line."

8.1.2 Contamination Area

The contamination area is the immediate area inside the exclusion zone where investigation activities are taking place. In this area, operations personnel may be subject to the hazards listed in Section 5 of this H&S Plan.

8.1.3 Contamination Reduction Corridor

The contamination reduction corridor is a transition area between the exclusion zone and the support zone. This area will serve as a decontamination area for equipment and a PPE removal area for task operations personnel. In addition, this area may contain emergency response equipment, equipment resupply, and a worker temporary rest area. Due to potential contamination, sample packaging and preparation equipment should not be stored here, but rather, in a contamination free area.

8.1.4 Contamination Reduction Zone

The contamination reduction zone is an area that surrounds the exclusion zone and contamination reduction corridor. This area may consist of several work stations (i.e., sampling, handling, and record keeping) as well as staging areas for equipment. The cordon around the contamination reduction zone is called the "contamination control line."

8.1.5 Support Area

The support area is the area outside the contamination reduction zone. It may contain the equipment trailer, command post, vehicle parking, equipment staging, or any support activity related to the task at hand. All personnel not trained in hazardous material work and visitors are restricted to this area.

8.2 Radiological Control Zones

External radiation control areas and radioactive contamination zones are identified and posted as radiological hazards through the use of barriers and postings. Barriers are used to help confine radiological hazards to a specific area. Yellow and magenta ribbons, ropes, tags, and signs are used to keep unauthorized personnel out of the area. External radiation control areas and radioactive contamination zones shall be posted in accordance with the EG&G Idaho Company Procedures Manual, Number 10.10 and the EG&G Radiological Controls Manual, Chapters 2 and 4. Task specific radiation control areas and contamination zones shall be determined by the RE and HPT and documented in the addendum.

8.2.1 External Radiation Exposure Control

External exposure control is accomplished by identifying areas containing sources of radiation and controlling personnel access into these areas. Section 2 of the EG&G Idaho Radiological Controls Manual discusses external radiation exposure control requirements. These areas shall be posted in accordance with the provisions stated above.

External exposure control is achieved through the following:

a. Controlled Area - Any area where radioactive materials or elevated radiation fields may be present shall be clearly and conspicuously posted as a controlled area.

b. Radiation Area - Any area within a controlled area where an individual can receive a dose equivalent greater than 5 mrem but less that 100 mrem in 1 hr at 30 cm from the radiation source.

c. High Radiation Area - Any area within a controlled area where an individual can receive a dose equivalent of 100 mrem or greater but less than 5 rem in 1 hr at 30 cm from the radiation source.

d. Very High Radiation Area - Any area within a controlled area where an individual can receive a dose of 5 rem or greater in 1 hr at 30 cm from the radiation source. Access to these areas shall be maintained, locked, or physically guarded.

8.2.2 Radioactive Contamination Control

Radioactive contamination controls limit the amount of radioactive surface contamination which individuals are exposed to minimize possible inhalation, ingestion, or absorption of radioactive material; to minimize the potential for release of radioactivity to the environment; and to prevent external contamination of personnel. Contamination limits are set primarily to define "detectability" or the lower limit of detection under ideal conditions. The fundamental philosophy is that no "detectable" contamination will be released to uncontrolled areas. The limits are not based on hazards to personnel but to maintain a high degree of control, restricting radioactive contaminants by engineered barriers. Chapter 4 of the EG&G Idaho Radiological Controls Manual discusses radioactive contamination control in more detail.

Contamination is classified as Zone I, II, or III based on contamination levels as follows:

- Zone I Limits of Contamination
  - 200 to 5000 dpm/100 cm^2 beta-gamma
    20 to 50 dpm/100 cm^2 alpha
- Zone II Limits of Contamination
  - >5000 to 20,000 dpm/100 cm^2 beta-gamma
    >50 to 250 dpm/100 cm^2 alpha
- Zone III Limits of Contamination
  - >20,000 dpm/100 cm^2 beta-gamma
    >250 dpm/100 cm^2 alpha.

9. ENVIRONMENTAL AND PERSONNEL MONITORING

Employee exposure to contaminants and physical hazards will be monitored during all task site activities using an appropriate combination of techniques. The FTL in conjunction with the appropriate personnel (e.g., IH, HSO, RE, SE, and HPT) for each task shall list any monitoring equipment requirements for specific potential hazards in the task specific addendum. An example of items that may be monitored is:

1. Organic vapor using an organic vapor monitor
2. Combustible gas using a combustible gas indicator
3. Heat or cold stress using field measurements and observations and, if necessary, body temperature measurements
4. Radiation and contamination surveys using radiological monitoring equipment
5. Personal exposure to organic vapors, particulate contamination (heavy metals) using personal monitoring pumps and appropriate filter collection media (active sampling)
6. Personal exposure to radiation using thermoluminesent dosimeters (TLDs) and direct reading dosimeters (DRDs)
7. Mercury vapors using a mercury vapor detector
8. Noise levels using a sound level meter and/or noise dosimeter
9. Loose radiological contamination using smears or large area wipes.

9.1 Chemical Exposure Monitoring

Selective monitoring of high-risk task operations personnel at the chest or face level for organic vapors may be recommended by the IH. The monitoring devices used, frequency of monitoring, designated high-risk jobs to be monitored, and action levels for hazardous contaminants shall be discussed in the task specific addendum.

Equipment for monitoring organic vapors at the task site shall be identified by the IH. The equipment, monitoring schedule, and calibration methods shall be discussed in the task specific addendum. The monitoring activities shall be initially based on the job hazard analysis results.

9.2 Combustible Gas Monitoring

If deemed necessary by the SE, the task site will be monitored for combustible gases at time intervals recommended by the SE. Elevated readings from the organic vapor detector might indicate the presence of combustible gases. The SE and IH will advise the FTL on circumstances when work at the task site will be suspended and the course of corrective action, and ensure the task site is safe before work continues. Action levels for combustible gases shall be documented in the task specific addendum.

9.3 Radiological Monitoring

The RE and HPT will be responsible for radiological monitoring in accordance with the EG&G Idaho Radiological Controls Manual, Chapters 2 and 4; and Section 10 of the EG&G Idaho Company Procedures Manual.

9.3.1 External Radiation Exposure Control

Personnel exposures are monitored by TLDs and DRDs. Personnel are responsible for properly wearing the specified dosimetry while in radiologically controlled areas. If the TLD (or other dosimetry) is lost, task operations personnel shall immediately notify the FTL and HPT. TLDs are supplied and processed by the Operational Dosimetry Unit.

Radiation surveys shall be performed by the HPT to determine the extent and magnitude of radiation levels and to enable posting of radiation areas. Surveys shall be performed in accordance with the EG&G Idaho Radiological Controls Manual, Chapter 2, Section 3.8.

9.3.2 Radioactive Contamination Control

All surfaces or areas with contamination levels in excess of those levels stated in Section 8.2 of this plan shall be monitored and controlled to prevent the spread of contamination. Contamination surveys shall be performed by the HPT in accordance with the EG&G Idaho Radiological Controls Manual, Chapter 4, Section 3.3.

All personnel shall obtain a whole body survey after exiting a contamination zone; the whole body survey must be done for two to three minutes. The following portable instruments are most commonly used to detect personnel contamination: (a) Ludlum 2a, (b) Eberline RM-14, and (c) Ludlum 177 with pancake probe (frisker), for beta-gamma contamination; and (d) Ludlum Model 61 and (e) Eberline Pac-4s, for alpha contamination. In addition to portable field instruments, the following personnel contamination monitors may be used: (a) large area detectors, (b) portal monitors, (c) personnel contamination monitors, and (d) hand and foot monitors.

9.4 Heat and Cold Stress Control and Monitoring

The FTL will set work/rest schedules as recommended by the IH. Depending upon the ambient weather conditions or work conditions and physical response of task operations personnel, the IH will suggest adjustments of the work/rest cycle to the FTL. The FTL, HSO, and/or IH will ensure that operations personnel follow established work and break schedules, adequately replace body fluids, and keep body temperatures in a normal range in accordance with the EG&G Idaho Company Procedures Manual, Number 11.10.

Workers will be interviewed by the IH and/or HSO periodically to ensure that the controls are effective and excessive heat exposure is not occurring. Workers will be encouraged to monitor their body signs and take a break if symptoms of heat stress occur.

Task operations personnel shall be aware of the following signs and symptoms of heat stress:

- CONFUSION
- FAINTING
- SLURRED SPEECH
- Clammy skin
- Dizziness
- Fatigue
- Nausea
- Profuse sweating
- Skin color change
- Vision problems.

Task operations personnel who exhibit any of these symptoms will be immediately removed from the task site. An individual who shows any of the symptoms that are capitalized and underlined, or any other evidence of change in level of consciousness, will be transported to an OMP facility for medical evaluation. Mental confusion and decreased level of consciousness must always be considered an emergency requiring medical evaluation and treatment. Transportation to a medical facility or use of an ambulance should be considered normal procedure in this situation. Individuals showing any of the remaining symptoms listed will be provided cool water and allowed to rest. On any occasion when the FTL, worker experiencing the heat stress symptoms, or IH believes the heat stress is severe or desires medical evaluation, the employee may be brought to an OMP medical facility.

Rest breaks shall include the following preventive measures:

- Drink adequate liquids
- Rest in a cool, shaded area
- Remove protective clothing to allow evaporative cooling
- Do not perform other work during the break.

If personnel are wearing semipermeable or impermeable PPE, the work/rest schedule may be adjusted and monitoring of individual personnel temperatures may be required by the IH. If ambient temperatures are considered excessive by the IH and/or symptoms outlined above exhibited, workers must be monitored for heat stress and recovery. This includes measuring heart rates and temperatures. Temperatures can be obtained using disposable thermometers. The HSO will ensure that sufficient liquids (electrolyte replacement fluids such as Gatorade) are provided and that they are consumed only in the designated and approved eating/drinking area.

Adequate protective clothing as required by IH should be worn to protect against the cold. Extra care must be exercised while working in this environment. Workers should observe each others facial extremities (ears and nose) for signs of frostbite (whitening of the skin surface). Decreased mental coherence and body movements are signs of hypothermia. Individuals with suspected hypothermia or other significant cold injury (e.g., frostbite) will be taken to an OMP medical facility.

Finally, the FTL or IH will refer a worker to the OMP for medical evaluation whenever there is doubt concerning the medical ability of an employee to continue in the assigned task.

9.5 Noise-Level Monitoring

If high noise levels are encountered by operations personnel at the task site, worker exposure will be assessed by the IH. A hearing conservation program must be developed by the IH when the sound levels exceed an 8-hour time weighted average of 85 dBA. Noise level monitoring, PPE requirements, and audiometric tests shall be outlined in the hearing conservation program for the task or employee. Requirements shall be imposed by the PM based on the advice of the IH and the requirements stated in the EG&G Company Procedures Manual, Number 11.7 and the EG&G Industrial Hygiene Manual, Section 26.

9.6 Physical Hazard Control and Monitoring

The FTL will have the primary responsibility for ensuring the task site is maintained in a safe condition by requiring maintenance of barriers and signs, correction of unsafe conditions, and cleaning of debris and trash. The appropriate personnel (e.g., IH, SE, and HPT) will inspect and recommend changes in work habits to the FTL.

Individuals working on a task have a specific responsibility to use safe work techniques, report unsafe working conditions, and exercise good personal hygiene and housekeeping habits throughout the course of their job.

9.7 Record Keeping Requirements

ERP is required to maintain the following information in the ARDC program file in accordance with 29 CFR 1910.120:

- Copies of the Management Plan for the Environmental Restoration Program, Task Specific H&S Plan, QPP, QAPjP, and work plan.

In addition, ERP shall track the following information for each ERP hazardous material worker through the Training and Emergency Action Unit of the Waste Management Operations Support Group:

- Proof of training in health and safety hazard recognition, radiation worker training, respirator training, and any other training specific to the employee

- Required training and updates

- Copy of the signed Health and Safety Certification Form.

The IH is required to maintain a logbook of air monitoring data, personal sampling data, times of sampling intervals, calibration of instruments, and identity of personnel wearing the monitoring equipment. Instrumentation detection ranges and uncertainties should also be recorded in the IH logbook. The HPT is required to keep a logbook of all radiological monitoring, daily operational activities, and instrument calibrations. All project records and logbooks, except HPT logbooks, shall be forwarded to ARDC within 30 days after completion of the task.

10. DECONTAMINATION PROCEDURES

Decontamination procedures for personnel and equipment are necessary to control contamination and to protect operations personnel. Both chemical and radiological decontamination are discussed in this section. However, combined chemical and radiation decontamination procedures are not discussed here and must be developed by the IH and RE if required for a specific task. Decontamination procedures shall be presented in the task specific addendum. These procedures can be amended upon recommendations by the IH, RE and/or HPT. When chemically hazardous material decontamination or radiological decontamination is required, the following procedures are suggested.

10.1 Modified Level A and B Decontamination Procedures

If Level A or B PPE is required, then two decontamination stations will be used at the task site--one at the hotline between the exclusion zone and the contamination reduction corridor and one at the contamination control line, which is the personnel access point to the support zone from the contamination reduction corridor. Decontamination Station A supports personnel and equipment exiting the exclusion zone. Figure 10-1 lists the recommended decontamination procedures. Steps 1 through 8 shall be completed at Station A. Coveralls shall be removed at Station B.

10.2 Modified Level C Decontamination Procedures

Decontamination Station B should be located at the personnel access to the contamination reduction corridor. It is to be used by personnel working in the contamination reduction corridor. Figure 10-2 lists the modified Level C decontamination procedures. If Tyveks are worn (if recommended by the IH), they are decontaminated and removed at Station A.

1. Remove equipment	EXCLUSION ZONE
2. Wash and rinse boot covers and gloves	
3. Remove tape	
4. Remove boot covers, outer gloves, and hood	
5. Disconnect air hose and tape end	
	HOT LINE (STATION A)
6. Wash and rinse suit and boots	
7. Remove suit	CONTAMINATION REDUCTION CORRIDOR
8. Wash, rinse, and remove inner gloves	
9. Remove coveralls	
	CONTAMINATION CONTROL LINE (STATION B)
10. Field wash/shower	
11. Put on personal clothing	SUPPORT ZONE

Figure 10-1. Recommended modified Level A and B PPE hazardous chemical decontamination steps.

1.	Remove equipment	CONTAMINATION REDUCTION CORRIDOR
2.	Wash and rinse boot covers and gloves (if worn)	
3.	Remove tape	
4.	Remove boot covers and outer gloves	
5.	Wash, rinse, and remove boots and suit (if worn)	
6.	Remove and drop respirator	
7.	Wash, rinse, and remove inner gloves	
8.	Remove coveralls	
		CONTAMINATION CONTROL LINE (STATION B)
9.	Field wash/shower	
10.	Put on personal clothing	SUPPORT ZONE

Figure 10-2. Recommended modified Level C PPE hazardous chemical decontamination steps.

At the end of the work day, a full-body shower may be required by the IH or HPT.

10.3 Radiological Decontamination

Radiological decontamination shall be done under the direct supervision of Health Physics (RE and/or HPT) and in accordance with the EG&G Idaho Company Procedures Manual, Number 10.4. Figures 10-3, 10-4, and 10-5 provide the anti-c removal steps for the three contamination control zone designations. Any personnel and personal property contamination may be removed with tape, vacuuming (vacuum must be equipped with a high efficiency particulate air filter), washing with soap and water, or by mechanical means (grinding, etc.).

10.4 Equipment Decontamination and Disposal of Contaminated Materials

Decontamination procedures for equipment shall be recorded or referenced in the task specific addendum. All waste generated by performing decontamination must be disposed in accordance with Section 15 of the EG&G Safety Manual for hazardous nonradioactive waste and radioactive mixed waste. Radioactive waste shall be handled in accordance with the EG&G Idaho Radiological Controls Manual, Chapter 6. Disposable clothing, tools, buckets, brushes, and other contaminated equipment shall be secured and disposed as stated in the task specific addendum. Unused contaminated equipment that can be used at a later time shall be placed in plastic bags and stored at the task site. Decontamination of monitoring equipment should also be addressed.

Radioactive waste shall be handled in accordance with the EG&G Idaho Radiological Controls Manual, Chapter 6. Decontamination operations for equipment and areas shall be performed in accordance with approved procedures.

Zone I Removal Barrier

1. Remove outer shoe covers
2. Remove gloves
3. Remove coveralls
4. Remove shoe covers (during the process of stepping through barrier)

EGRESS POINT

5. Remove cloth glove liners

Figure 10-3. Anti-c removal steps for radiological control Zone I.

Zone II Removal Steps

1. Remove outer shoe covers
2. Remove latex gloves
3. Remove hood, coveralls, and shoe covers (remove shoe covers during process of stepping through barrier)

EGRESS POINT

4. Remove cloth glove liners

Figure 10-4. Anti-c removal steps for radiological control Zone II.

Zone III Removal Barrier

1. Remove outer shoe covers

2. Remove latex gloves

3. Remove disposable hood, coveralls, and shoe covers (remove shoe covers during process of stepping through barrier)

EGRESS POINT A

4. Pull inner hood back and remove respirator

5. Remove inner latex gloves

6. Remove cloth hood, coveralls, and shoe covers (remove shoe covers during process of stepping through barrier)

EGRESS POINT B

7. Remove cloth glove liners

Figure 10-5. Anti-c removal steps for radiological control Zone III.

10.5 Decontamination During Medical Emergencies

If a person is injured or becomes ill and lifesaving care is required, the situation will be evaluated by the appropriate personnel (e.g., first aid personnel) on a case-by-case basis. Emergency care will be initiated in accordance with the emergency preparedness procedure for the facility at which the task is being performed. Medical care necessary to save life or limb is not delayed for decontamination. In such cases decontamination may be performed at the medical facility. The IH and/or HPT will accompany the employee to the medical facility and relay information requested by medical personnel.

11. EMERGENCY PROCEDURES, EQUIPMENT, AND INFORMATION

Work at hazardous waste sites makes emergencies a continuous possibility, no matter how infrequently emergencies may occur. Emergencies happen quickly, unexpectedly, and require immediate response. The reporting requirements of Section 3 of the EG&G Idaho Safety Manual shall be followed by personnel at the task site. Locations and telephone numbers of emergency personnel and facilities will be posted at places specified in the task specific addendum. The appropriate emergency facilities will be notified by telephone at the beginning of the task to inform personnel at the facilities that work has begun at the task site. The following sections describe the procedures used during emergency situations; equipment that will be available for emergency situations; and agencies, facilities, and personnel who must be notified in case of emergency.

11.1 Emergency Procedures

The following procedures will be used if an emergency arises:

- FTL will be notified of accidents or conditions that have the potential for adversely affecting or threatening personnel safety, property, or environment. The FTL is responsible for ensuring that the EG&G Idaho Safety Manual and the emergency action procedure for the facility are followed in the event of an accident or unusual condition.

- All safety related occurrences will be recorded in a field logbook and reported as indicated in Section 3 of the EG&G Idaho Safety Manual.

11.1.1 Personnel Occupational Injury or Illness in the Exclusion Zone

In the event of an occupational injury or illness in the exclusion zone, an assessment of the situation shall be made by the FTL using the advice of appropriate personnel (e.g., IH, SE, personnel trained in first aid). If the situation is deemed reportable as described in Section 3 of the EG&G Idaho Safety Manual, the FTL is responsible for initiating reporting procedures. In addition, task personnel shall act in accordance with the emergency preparedness procedures for the facility at which the task is being performed. In the event that the task site is shut down due to an injury, task operations personnel shall not reenter the exclusion zone until the cause of the injury or illness is identified and corrective action implemented. Decontamination shall be performed in accordance with the above mentioned emergency procedures and with recommendations made by the IH, HPT, and/or first aid personnel.

11.1.2 Personnel Occupational Injury or Illness in the Support Zone

If an occupational injury or illness occurs in the support zone, the same procedures as described in Section 11.1.1 shall be followed. If the FTL determines the cause of the occupational injury or illness and the absence of the injured or ill party does not affect the performance of other personnel, task operations will continue.

11.1.3 Transportation and Followup of Injury

An injured worker transported to a medical facility will be accompanied by at least one worker (preferably the IH and/or HPT) to inform medical personnel of the level of decontamination performed before leaving the task site and provide specific details about the illness or injury.

11.1.4 Fire/Explosion

Before initiating task activities, brush and grass will be cleared from the task site to eliminate the risk of fire. The EG&G Idaho Safety Manual, Section 11 and any applicable facility emergency preparedness procedures shall be reviewed.

In the event of a fire or explosion, all personnel not essential to controlling the situation will be evacuated from the task site, and fire and/or explosive experts will be notified. In addition, Section 11 of the EG&G Idaho Safety Manual and applicable emergency action procedures for the facility at which the task is being performed shall be followed.

11.1.5 Personal Protective Equipment Failure

If any task site worker experiences a failure or alteration of PPE, that person and his workmate shall immediately leave the exclusion zone. The HPT and IH will assess the situation and determine if exposure to hazardous substance or radiological uptake has occurred. Reentry will not be permitted until the equipment has been repaired or replaced.

11.1.6 Other Equipment Failure or Hazardous Material Spill

If task site equipment fails to operate properly, the FTL will be notified and will determine the effect of the failure on continuing operations. If the failure affects the safety of personnel or prevents completion of the tasks described in the SAP or other work plan, operations personnel shall leave the task site until the situation is evaluated and appropriate actions are taken.

If hazardous or potentially hazardous material is spilled, refer to the emergency preparedness procedure for the Area in which the task is being performed and report the spill to Area personnel as directed. Spillage of petroleum products, decontamination solutions, calibration material, equipment fuels, and other liquids containing hazardous materials must be assessed.

11.1.7 Hand Signals

Hand signals shall be used if an emergency situation arises and communication becomes impossible or unsafe. The following hand signals will be used in an emergency:

- Hand gripping throat - signals that the person is out of air or cannot breathe
- Grip partner's wrist or both hands around waist - means leave area immediately
- Hands on top of head - signals that assistance is needed
- Thumbs up - okay, I am all right, I understand
- Thumbs down - no, I am not all right, I do not understand.

11.1.8 Emergency Escape

In cases of life-threatening emergencies such as fire or explosion, personnel should leave the vicinity using the shortest possible route without regard for decontamination at that time and move upwind of the affected area. When the situation has stabilized, personnel will take necessary steps to decontaminate themselves, equipment, and other affected areas.

11.1.9 Task Operations Shutdown

Task operations may be suspended for several reasons as indicated below. However, the reasons for operations shutdown are directly related to the degree of hazard each task possesses. Specific reasons for suspending task operations should be listed in the task specific addendum. Examples include excessive vapor/gas concentrations, radiological hazards, uncovering waste, inclement weather, etc.

- If a combustible gas indication >10% of the lower explosive limit (LEL) occurs indicating a buildup of explosive vapors, work shall stop. Evaluation of the situation will be made and a course of action determined by the FTL in conjunction with the IH and/or SE.

- When significant radiological hazards are identified by an HPT at the sampling site.

- When unexpected hazardous material is uncovered or found in soil samples, even when the appearance of such material may not be associated with a rise in detected contamination levels.

- In addition, drilling, sampling, instrumentation, and other weather sensitive activities will stop during consistent high winds (i.e., >25 mph), electrical storms, or other inclement weather that may affect the work.

11.1.10 Task Site Reentry

In all situations, when a task site emergency results in evacuation of the task site, personnel shall not reenter until authorized to do so by the FTL. The FTL will ensure that:

1. The hazards have been reassessed by the HSO, IH, SE, and/or the RE.

2. The conditions resulting in the emergency have been corrected.

3. The task specific H&S Plan, SAP, Operational Safety Requirements/Safety Assessments, Standard Operating Procedures (SOPs), DOPs, and the Facility Emergency Action Plan have been reviewed as appropriate.

4. Site personnel have been briefed on any changes in the ERP task specific H&S Plan.

Reentry into an evacuated zone to monitor or collect air samples requires the more restrictive of Level C PPE or the level used by those individuals who evacuated the task site. The IH may upgrade to Level B or A if deemed necessary.

11.2 Warning Devices

Warning lights and/or audible alarms shall be installed in areas where needed to warn personnel against remaining in or entering a hazardous area. An explanatory sign or tag shall be posted immediately adjacent to a warning device to describe the hazardous condition and indicate the action to be taken. Table 12.1 in Section 12 or the EG&G Idaho Safety Manual lists various audible warning devices, their meanings, and the required personnel action. Specific warning devices for the task shall be listed in the task specific addendum. Warning devices for radiological hazards (e.g., remote air monitors) shall also be listed.

11.3 Emergency Equipment

The following emergency equipment shall be available at the task site during field operations as appropriate. (A complete emergency equipment list shall be provided in the task specific addendum.)

Fire Extinguishers: Because of the potential threat of fire at hazardous waste sites, at least one 20-lb (minimum) ABC fire extinguisher will be readily available and at hand throughout the task activities. Additional fire extinguishers may be necessary. This should be indicated in the task specific addendum.

SCBA: Two SCBAs will be available for emergencies such as reentering a contaminated zone to retrieve injured personnel.

First Aid Kits: An industrial first aid kit with sufficient supplies for five people shall be kept in the support zone. The OMP will advise on the selection of first aid supplies to be included at each task site. The HSO will be responsible for maintaining the proper level of first aid supplies in the task site first aid kit.

Eye Wash: Portable eyewash fountains with sufficient potable water for flushing will be readily available for the duration of the task. The location of the eyewash will be determined by the IH.

Communications: Emergency telephone numbers shall be included in the task specific addendum and posted for all operations personnel. Emergency communication shall be discussed in the safety training prior to initiation of site investigation activities. A two-way radio or telephone with capability to contact emergency personnel shall be located on each task site.

Personal Hygiene: A sufficient supply of clean water, hand soap, and towels will be provided at the task site.

Radiological Contamination Spill Kit: Depending on the location of the task and recommendation from RE, a spill kit shall be prepared in advance and located in appropriate work areas. These kits shall contain, at a minimum, the following radiological control equipment:

- Plastic Bags

- Absorbent materials (e.g., paper or rags)
- Latex gloves and glove liners
- Plastic shoe covers and/or rubber overshoes
- Smear paper and holders
- Pencils, grease pencils, and paper
- Radiological tags and signs and radiation rope or ribbon
- Yellow plastic sheeting and duct tape.

12. BIBLIOGRAPHY

American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1989-1990, Second Printing.

EG&G Idaho, EG&G Idaho Company Procedures Manual.

EG&G Idaho, EG&G Emergency Action Manual.

EG&G Idaho, Industrial Hygiene Manual.

EG&G Idaho, Radiological Controls Manual.

EG&G Idaho, Safety Manual.

EG&G Idaho Environmental Restoration Program, Health and Safety Plan for Operations Performed for the Buried Waste Program, Environmental Restoration Program, EGG-WM-8504, May 1989.

EG&G Idaho Environmental Restoration Program, Management Plan for the EG&G Environmental Restoration Program, EGG-WM-8676.

EG&G Idaho Environmental Restoration Program, Program Directives.

National Archives and Records Administration, Code of Federal Regulations, 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response."

National Archives and Records Administration, Code of Federal Regulations, 29 CFR 1926, Subpart P, "Excavations."

NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985.

Hazardous Material References:

Buried Sludge Waste Characterization, TLC-29-88, T. L. Clements, Jr. ltr to C. J. Bonzon, May 2, 1988.

Engineering Design File BWP-ISV-004, Detailed Estimate of Radioactive Contents for Pit 9, E. C. Garcia and J. L. Knight.

Estimate of Rocky Flats Plant Organic Wastes Shipped to the RWMC, D. E. Kudera, July 24, 1987.

Radioactive Waste Management Information System content code material listing, 1954 to 1970.

APPENDIX A

TASK SPECIFIC
HEALTH AND SAFETY PLAN

NOTE: This task-specific health and safety plan addendum (EGG-WM-10199) replaces the previous health and safety plan addendum (EGG-WM-9732, Rev. 0) dated July 1991. This new addendum supplements the existing *Health and Safety Plan for Operations Performed for the Environmental Restoration Program* (EGG-WM-8771, Rev. 2) dated October 1991.

TASK-SPECIFIC
HEALTH AND SAFETY PLAN

TASK: Organic Contamination in the Vadose Zone (OCVZ) Treatability Study (Vapor Vacuum Extraction/Drilling Project)

DATE: August 1992

TASK-SPECIFIC
HEALTH AND SAFETY PLAN

APPROVED BY:

M. D. Herd, TRU ROD Manager — Date: 8/27/92

REVIEWED BY:

G. E. Matthern, Task Project Manager — Date: 8-26-92

D. L. French, RWMC Facility Manager — Date: 8-26-92

J. P. Shea, Chair ERD Independent Review Committee — Date: 5/13/92

P. N. Creighton, Occupational Medical Program — Date: 5/13/92

PREPARED BY:

R. D. Lee — Date: 5/13/92

CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Government Industrial Hygienists
ANSI	American National Standards Institute
BWP	Buried Waste Program
CAM	constant air monitor
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGI	combustible gas indicator
CP	Company Procedures Manual (EG&G Idaho)
cpm	counts per minute
dBa	decibel A-weighted
DOE	Department of Energy
DOE-ID	DOE Idaho Field Office
DOP	detailed operating procedure
ERD	Environmental Restoration Department
ft	feet
FTL	field team leader
GC	gas chromatograph(y)
HEPA	high efficiency particulate air
HNu	photoionization detector
HP	health physics technician
HSO	health and safety officer
HSP	health and safety plan
ID	Idaho Field Office (DOE)
IH	industrial hygienist

INEL	Idaho National Engineering Laboratory
JSS	job site supervisor
L	liter
lb	pound(s)
LEL	lower explosive limit
mg	milligram
NIOSH	National Institute of Occupational Safety and Health
OCVZ	organic contamination in the vadose zone
OMM	Operations and Maintenance Manual
OMP	Occupational Medical Program
OSHA	Occupational Safety and Health Administration
OU	operable unit
OV/VM-TIS	designated code to access training records on OV/VM
PEL	permissible exposure limit
PPE	personal protective equipment
ppm	parts per million
RWMC	Radioactive Waste Management Complex
scfm	standard cubic feet per minute
SDA	Subsurface Disposal Area
TBD	to be determined
TLD	thermoluminescent dosimetry/dosimeter
TLV	threshold limit value
TSA	Transuranic Storage Area
TWA	time-weighted average
VOC	volatile organic compound
VVE	vapor vacuum extraction

VVED	vapor vacuum extraction demonstration
WCC	Warning Communications Center
WMF	Waste Management Facility

APPENDIX A

TASK-SPECIFIC HEALTH AND SAFETY PLAN

A-1. INTRODUCTION

Task: Organic Contamination in the Vadose Zone (OCVZ) Pilot-Scale Treatability Study (Vapor Vacuum Extraction Drilling Project)

DOE Field Office: Idaho

Project Manager: G. E. Matthern   Phone No.: 526-8747

Other Contacts:

- N. W. Spang, Project Engineer   Phone No.: 526-1628
- W. C. Downs, Task Leader   Phone No.: 525-5629
- T. B. Arrington, RWMC Technical Programs/Job Site Supervisor   Phone No.: 526-2364
- Drilling Supervisor, to be determined   Phone No.:
- D. D. Faulder, Drilling Supervisor Alternate   Phone No.: 526-0674
- T. R. Wood, Drilling Backup Alternate   Phone No.: 526-1293

Date Plan Requested: February 1992

This task-specific health and safety plan (HSP) addendum addresses the basic tasks to be performed for the Organic Contamination in the Vadose Zone (OCVZ) Operable Unit (OU) 7-08 pilot-scale treatability study at the Subsurface Disposal Area (SDA) of the Radioactive Waste Management Complex (RWMC). The activities outlined in the pilot-scale treatability study include vapor vacuum extraction (VVE) system operation with associated tests and well-drilling operations relevant to VVE operations.

Purpose of Task (VVE Operations):

The purpose of this task is to demonstrate the viability of VVE as a remedial alternative for extraction of subsurface volatile organic compounds (VOCs); optimize performance of the existing VVE system; provide design criteria and design data for site-specific remedial design; provide operation, maintenance, and capital costs; establish cleanup goals for full-scale remediation; provide additional data to aid in characterizing the VOC contaminants in the vadose zone beneath the SDA at the RWMC; calibrate the organic transport model; and aid in remedial design and remedial action.

Purpose of Task (Drilling Operations):

Monitor well - Monitor for contaminant migration from the SDA and the effects of VVE on the vadose zone and VOC extraction.

Extraction well - Remove the 8-in. casing to facilitate zone extraction investigation.

Proposed Dates of Work: June 1992 to July 1994.

A-1.1 SCOPE OF WORK

This VVE system was developed specifically for the RWMC at the Idaho National Engineering Laboratory (INEL). At the RWMC, leakage from buried waste in subsurface pits and trenches has resulted in subsurface VOC contamination. The objectives for operation of this system are to remove VOC vapors from the subsurface region, to verify the computer models of VOC migration in the subsurface using the data collected during operation of the VVE system, and to collect data for design and optimization of future VVE-based remediation activities at the RWMC.

The OCVZ pilot-scale treatability study involves sampling and analyzing gas concentrations in monitor wells and open wells, testing well flow and pressure, measuring pressure in monitoring wells, performing tracer tests, extracting high concentration zone and high permeability zone organic vapors, performing carrier-gas injection tests, testing extraction well pressure cycling; and evaluating and testing off-gas treatment. The various measurements of extraction well gas and system operational parameters support characterization of the VOC contamination plume beneath the SDA, calibration of the organic transport model, and prevailing engineering data for a final remedial system. The VVE activities are conducted under the *Draft Work Plan for Organic Contamination in the Vadose Zone Operable Unit (OU-7-08) Pilot-Scale Treatability Study* (EG&G Idaho, 1992) and the *Abbreviated Sampling and Analysis Plan for Spent Carbon Adsorbers in the Vapor Vacuum Extraction System* (EG&G Idaho, 1991a). In conjunction with VVE activities, shallow and deep wells available in and around the RWMC will be monitored for VOCs and perched water.

In addition, two monitoring wells will be installed. Locations for these wells have not yet been determined; however, the early phases of the treatability study and other recent OCVZ studies will provide the necessary information for optimal location of these wells. Moreover, the 8-in. well casing may be removed from extraction well 8901-D to facilitate investigation of the zone extraction.

A-1.2 BACKGROUND

A-1.2.1 Task Site Description

The VVE will operate in the SDA of the RWMC. Components of the VVE will be connected to borehole 8901D, which is drilled to a depth of approximately 240 ft (73 m). The borehole is in a waste-free corridor between Pit 6 and Pit 10; it is 82 ft (25 m) east of borehole 8801D.

Components of the VVE are shown in the OCVZ treatability study work plan. The vacuum, created by the pump that is located at the downstream end of the process apparatus, will pull both air and VOC vapors from the surrounding vadose zone to the borehole and through the extraction apparatus for processing. This design maintains a vacuum on the entire system and serves a safety function to prevent VOC vapors from leaking.

The extraction flow first passes through an isolation valve and is then heated by an electric gas immersion heater to prevent condensation in the lines. Next, the stream passes through a three-stage particulate removal process to remove particulate matter >0.3 µm. The first of the three-stage particulate removal process is a cyclone separator, which removes material >15 µm. The second particulate removal stage is a prefilter, with an efficiency of 55 to 60%. The final particulate removal stage is a high-efficiency particulate air (HEPA) filter, which removes the remaining particulates down to 0.3 µm. After passing through the particulate removal system, the stream is processed through either of the two activated carbon adsorbers to remove the volatile organic vapors. Downstream of the carbon adsorbers are filters to remove charcoal fines that may escape the carbon in the adsorbers. The vacuum pump is located downstream of all filtration equipment and discharges at a rate of approximately 700 scfm from the stack to the atmosphere.

All components in the system, except the carbon adsorbers, are located on an 8 × 12-ft skid. The carbon adsorbers are stand-alone units approximately 7 ft in diameter and 7 ft high. The entire system is housed in an insulated weather shelter. The exhaust is continually monitored for organic vapors using a volatile organic compound (VOC) monitor; if total organic vapors greater than 2 ppm for five seconds are detected in the exhaust, the system will automatically shut down.

A-1.2.2 Waste Description

During the 1960s and early 1970s, barreled mixed waste containing VOCs and radioactive waste was buried at the SDA of the RWMC. This waste is estimated to contain approximately 88,400 gal of organics: 24,400 gal of carbon tetrachloride, 25,000 gal of other volatile chlorinated hydrocarbons, and 39,000 gal of oil used in machining processes (Rauen, 1990). Much of this waste was disposed in Pits 2, 4, 5, 6, 9, and 10. Over time, some of the barrels have potentially deteriorated, allowing VOC vapors to be released into the vadose zone. The potential for aqueous transport of organic contaminants is being further investigated during the groundwater Track 2 drilling activities. This VOC transport resulted in contaminant concentrations detected in groundwater monitoring wells adjacent to the SDA. Dikes have since been constructed around the perimeter of the RWMC to prevent future flooding. Currently, VOC contamination in the groundwater is below drinking water standards.

Complete descriptions of waste source, waste types, and location of disposal can be found in the document titled *Preliminary Remedial Action Objectives and Remediation Technologies for the Subsurface Disposal Area*, (SAIC, 1989). See Table A-1 for list of known substances in the SDA.

A-1.2.3 Unusual Features

Figure A-1 is a map of the RWMC showing the approximate locations of the monitoring wells with respect to the existing wells and disposal pits.

All power lines are outside the vicinity of the proposed drilling activities; however, clearance approvals from the power management organizations and telephone services will be obtained prior to the start of drilling activities.

Table A-1. Known SDA substances.

Substance	CAS number	Environmental concentration (with units)	In sample (soil, water, air, waste)	Toxicity: 1990-1991 TLV	Toxicity: 1990 PEL	Toxicity: Route of exposure	Comments
Tributyl phosphate	126-73-8	ppb[a]	Soil	0.2 ppm	0.2 ppm	Inhalation	--
Carbon tetrachloride	56-23-5	ppm	Soil	5 ppm	2 ppm	Skin, inhalation	CSH
Chlorodiphenyl (.42)	53469-21-9	--[a]	Soil	1 mg/m^3	1 mg/m^3	Skin, inhalation	--
Chlorodiphenyl (.54)	11097-69-1	--[a]	Soil	0.5 mg/m^3	0.5 mg/m^3	Skin, inhalation	--
Hydrogen cyanide	74-90-8	--[a]	Soil	10 ppm	4.7 ppm	Skin, inhalation	--
1,1,1-trichloroethane	71-55-6	--[a]	Soil	350 ppm	350 ppm	Inhalation	--
Trichloroethylene	79-01-6	--[a]	Soil	50 ppm	50 ppm	Inhalation	CSA CSH
Chloroform	67-66-3	--[a]	Soil	10 ppm	2 ppm	Inhalation	CSH
Calcium hydroxide	1305-62-0	--[a]	Soil	5 mg/m^3	5 mg/m^3	Inhalation	--
Perchloroethylene	127-18-4	--[a]	Soil	50 ppm	25 ppm	Inhalation	CSH
1,1,2-trichloro-trifluoroethane (freon 113)	76-13-1	--[a]	Soil	1,000 ppm	1,000 ppm	Inhalation	--
Dichlorodifluoro-methane (freon 12)	75-71-8	--[a]	Soil	1,000 ppm	1,000 ppm	Inhalation	--
1,1 dichloroethane	75-34-3	--[a]	Soil	200 ppm	100 ppm	Inhalation	--
Vinylidene chloride	75-35-4	--[a]	Soil	5 ppm	1 ppm	Inhalation	CSH
Terphenyls	26140-60-3	--[a]	Soil	0.5 ppm (ceiling)	0.5 ppm (ceiling)	Inhalation	--
Toluene	108-88-3	--[a]	Soil	100 ppm	100 ppm	Inhalation	--
1,2 dichloroethylene	540-59-0	--[a]	Soil	200 ppm	200 ppm	Inhalation	--

T A-1. (continued).

Substance	CAS number	Concentration (with units)	Sample (soil, water, air, waste)	Toxicity: 1990-1991 TLV	Toxicity: 1990 PEL	Toxicity: Route of exposure	Toxicity: Comments
1,2 dichlorobenzene	95-50-1	--[a]	Soil	50 ppm (ceiling)	50 ppm (ceiling)	Inhalation, skin	--
1,2-dichloropropane	78-87-5	--[a]	Soil	75 ppm	75 ppm	Inhalation	--
Metals:							
Chromium	7440-47-3	--[a]	Soil	0.5 mg/m^3	1.0 mg/m^3	Inhalation	CH
Nickel	7440-02-0	--[a]	Soil	1.0 mg/m^3	1.0 mg/m^3	Inhalation	CSH
Lead	7439-92-1	--[a]	Soil	0.15 mg/m^3	0.05 mg/m^3	Ingestion/inhalation	CSH
Arsenic	7440-38-2	--[a]	Soil	0.2 mg/m^3	0.15 mg/m^3	Inhalation	--
Beryllium	7440-41-7	--[a]	Soil	0.002 mg/m^3	0.002 mg/m^3	Inhalation	CSH
Cadmium	7440-43-9	--[a]	Soil	0.05 mg/m^3	0.05 mg/m^3	Inhalation	--
Cobalt	7440-48-4	--[a]	Soil	0.05 mg/m^3	0.05 mg/m^3	Inhalation	--
Copper	7440-50-8	--[a]	Soil	1.0 mg/m^3	1.0 mg/m^3	Inhalation	--
Uranium oxide	7440-61-1	--[a]	Soil	0.02 mg/m^3	0.05 mg/m^3	Inhalation	--
Vanadium(V_2O_5)	1314-62-1	--[a]	Soil	0.05 mg/m^3	0.05 mg/m^3	Inhalation	--
Thallium oxide	7440-28-0	--[a]	Soil	0.01 mg/m^3	0.01 mg/m^3	Inhalation	--

a. Anticipated low ppb levels based on site history.

CAS - Chemical Abstract Services
CH - carcinogenicity established for humans
CSA - carcinogenicity suspected for animals
CSH - carcinogenicity suspected for humans
PEL - permissible exposure limit
TLV - threshold limit value.

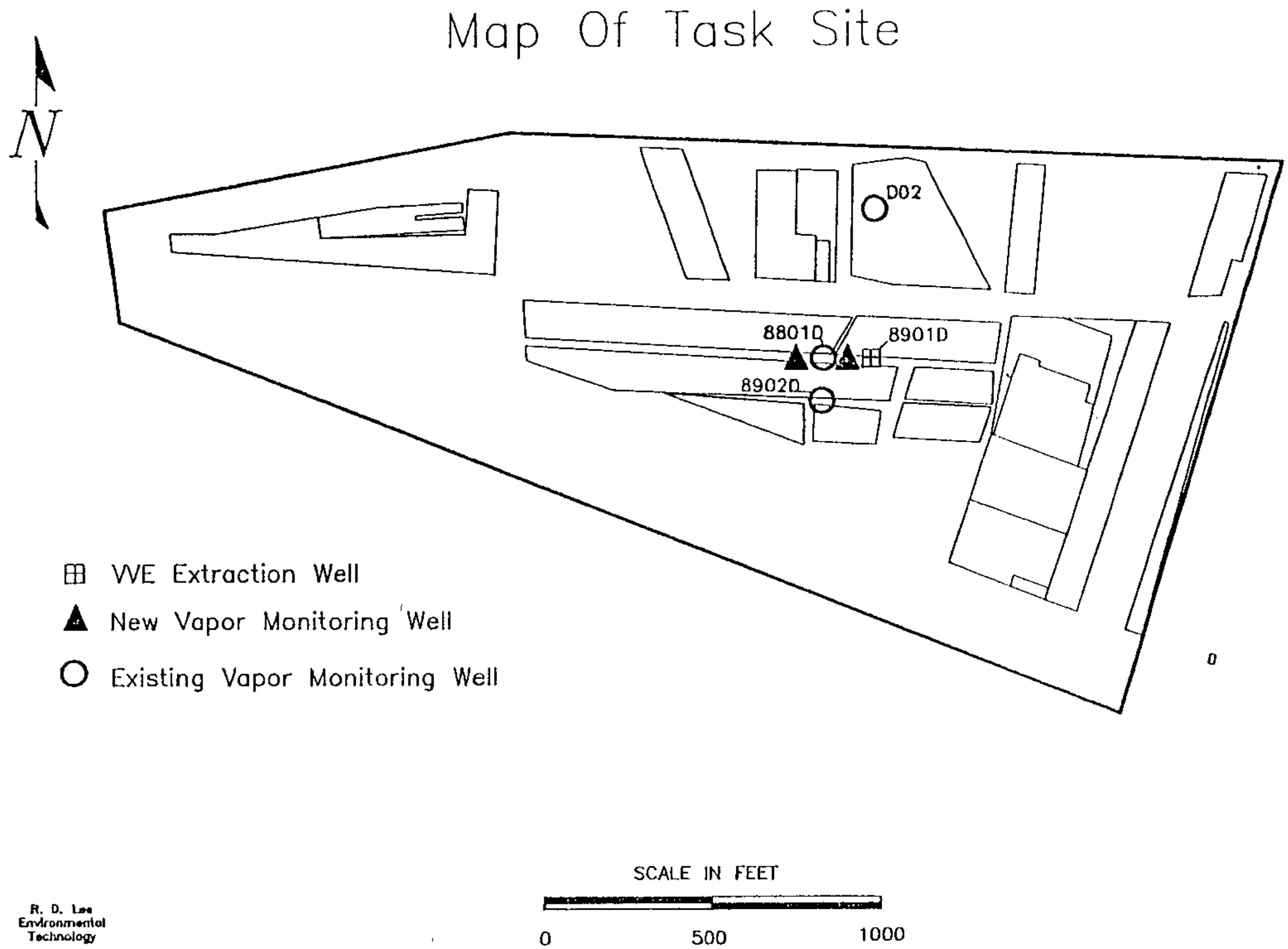

Figure A-1. Map of the task site.

A-1.2.4 Status of Task Site

The RWMC includes the SDA and the Transuranic Storage Area (TSA). The SDA is a disposal site for low-level radioactive waste. The TSA is an interim storage facility for transuranic and mixed transuranic radioactive waste. The VVE equipment is placed between two inactive covered pits located in the SDA. The VVE system is protected from the weather by an insulated weather shelter. Proposed drilling operations will occur within the RWMC boundary.

A-1.2.5 History

As early as 1960, concern for the movement of contaminants from the RWMC to the adjacent soil, underlying bedrock, and Snake River Plain Aquifer prompted environmental studies of the disposal facility. Since 1971, at least 75 boreholes and shallow auger holes have been drilled in and adjacent to the RWMC to characterize the geologic and hydrologic media, and to assess the amount of radiological and chemical contamination around and beneath the site.

A-1.2.6 Previous Onsite Monitoring—Previous Sampling Data

The *Remedial Investigation/Feasibility Study Work Plan for the Subsurface Disposal Area, Radioactive Waste Management Complex at the INEL* (EG&G Idaho, 1989) indicates that measurable concentrations of VOCs are present in water wells in and near the SDA and measurable concentrations of VOC vapors occur in the surface soil gases at distances of 2,000 to 3,400 ft from the SDA boundary. Analysis of gases collected at various depths beneath the RWMC, found in the *Annual Progress Report: FY-1987 Subsurface Investigations Program at the Radioactive Waste Management Complex of the Idaho National Engineering Laboratory* (DOE-ID, 1988), indicate maximum vapor concentrations at approximately 100 ft below land surface and measurable concentrations to 576 ft. Results of the *Soil Gas Survey and Shallow Well Screening of the Radioactive Waste Management Complex Subsurface Disposal Area* (ERP-WAG7-09) indicate that organic vapors are being emitted from surface soils. Soil gas monitoring has corroborated the locations of the organic waste producing the vapors. Available data suggest that organic liquids have migrated downward through the subsurface and have formed a relatively large vapor plume. Analysis of groundwater samples confirm that the organic plume has reached the Snake River Plain Aquifer (EG&G Idaho, 1989).

The volatile organics of primary concern at the RWMC, based on soil gas, groundwater, and well gas measurements taken to date, include carbon tetrachloride, trichloroethylene, 1,1,1-trichloroethane, chloroform, and tetrachloroethylene. Other organic vapors that have been found, but less frequently, include 1,1,2-trichlorotrifluoroethane, 1,1-dichloroethane, 1,1-dichloroethylene, dichlorodifluoromethane, toluene, methylene chloride, and acetone. Studies continue today of the subsurface geology and hydrology of the RWMC to evaluate the potential for contamination of the Snake River Plain Aquifer.

Results of monitoring during the previous two-week and four-month operations of the VVE system, documented in the *Summary Report of Results of the Vapor Vacuum Extraction Test at the RWMC* (EG&G Idaho, 1991b), indicated average carbon tetrachloride and trichloroethylene vapor concentrations in the extraction well gas stream of approximately 36 and 16 ppm, respectively, chloroform was also detected at low levels. No other VOCs were detected in the extraction gas stream. Samples of the carbon collected in November 1990 from a spent carbon bed indicate that it exhibits toxicity characterization leaching procedure (TCLP) characteristics of a hazardous waste (0.8 mg/L carbon tetrachloride, limit = 0.5 mg/L). Vapor concentrations of carbon tetrachloride measured at the three monitoring wells inside the SDA ranged from <10 to approximately 3,000 ppm.

Moreover, mercury was detected during recent Acid Pit monitoring; however, because the Acid Pit is over 100 ft from the drill task site and because drilling will not take place in a waste pit, mercury is not likely to be encountered.

SDA personnel sampling results reported in the EG&G Idaho Environmental Hygiene Laboratory Analytical Report No. 92-0133, dated December 18, 1991, found the amounts for trichloroethylene, perchloroethylene, methylene chloride, and carbon tetrachloride listed in Table A-2.

Table A-2. Amounts of substances found in SDA.

Sample identification	Trichloro-ethylene	Perchloro-ethylene	Methylene chloride	Carbon tetrachloride
01	<0.11 ppm	<0.1105 ppm	<0.25 ppm	<0.28 ppm
02	<0.10 ppm	<0.47 ppm	<0.24 ppm	<0.28 ppm

A-2. HEALTH AND SAFETY RESPONSIBILITIES

Proposed site investigation team (VVE operations): (See Figure A-2.)

Personnel	Discipline/Tasks Assigned
G. E. Matthern	Task Project Manager
W. C. Downs	Technical Leader
N. W. Spang	Task Project Engineer
T. B. Arrington	Task RWMC Technical Programs/Job Site Supervisor (JSS)
L. Lazzarotto	Data Collection Technician/Gas Chromatography (GC) Operator/VVE Operator/Alternate Field Team Leader
D. Shoop	RWMC Industrial Hygienist (IH)
D. K. Gray	RWMC Safety Engineer
To be determined (TBD)	Health and Safety Officer (HSO)
S. E. Macleod	RWMC Radiological Engineer
R. M. Lugar	Field Team Leader (FTL)/Data Evaluation and Quality Assurance/Quality Control
D. J. Bright	RWMC Technical Programs Unit Manager
S. French	RWMC Environmental Engineer
K. J. Izbicki	Data Collection Technician
TDB	RWMC Health Physics (HP) Manager
TBD	Design Engineer
TDB	Quality Engineer
TBD	Project Geologist
TBD	Environmental Coordinator
TBD	Radiological Engineer
TBD	IH/HP Technician
TBD	Operations Personnel.

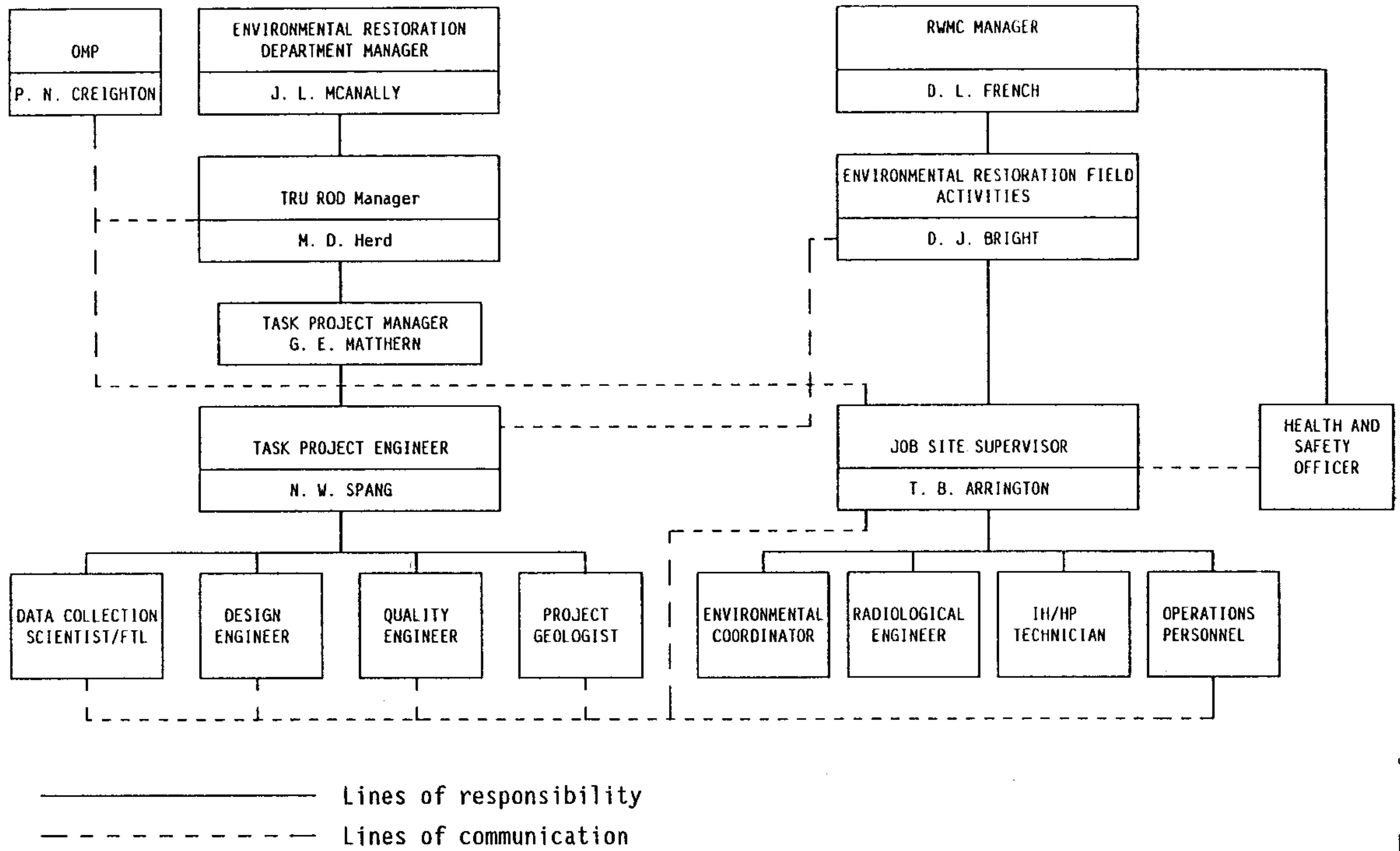

Figure A-2. VVE task organization chart.

Proposed site investigation team (drilling operations): (See Figure A-3.)

Personnel	Discipline/Tasks Assigned
To be determined (TBD)	Drilling Project Manager/Field Supervisor
TBD	Field Technical Support/Team Leader
TBD	Field Technical Support
TBD	Project Geologist/Field Supervisor
TBD	Project Geologist/Field Supervisor
TBD	Project Geologist/Field Supervisor
TBD	Health Physics Support
TBD	Industrial Hygiene Support
TBD	M-K Site Engineer
TBD	M-K Site Engineer
TBD	ERD Task Operations Personnel
TBD	Health and Safety Officer
TBD	Safety Engineer
TBD	Quality Engineer
TBD	Facility Task Operations Personnel
TBD	Environmental Coordinator
TBD	Radiological Engineer.

It is the responsibility of the HSO and JSS to ensure that all requirements stated in the base HSP and this addendum are complied with and that the effectiveness of this HSP is evaluated on a weekly basis. Evaluation of this HSP will be documented in the FTL and/or sample logbooks. This project will comply with all applicable Occupational Safety and Health Administration (OSHA) regulations, American National Standards Institute (ANSI) standards, American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLVs) for exposures to chemical and physical agents, and National Institute for Occupational Safety and Health (NIOSH) recommended exposure limits as declared in Department of Energy (DOE) 5480.10 and ID 5480.1 Chapter X, "Contractor Industrial Hygiene Program"; DOE/ID 5483.1A, "Occupational Safety and Health Standards"; DOE/ID 5480.4, "Environmental Protection, Safety, and Health Protection Standards (Industrial Hygiene Manual); DOE 5480.11, "Radiation Protection for Occupational Workers"; and the *EG&G Idaho Radiological Controls Manual*.

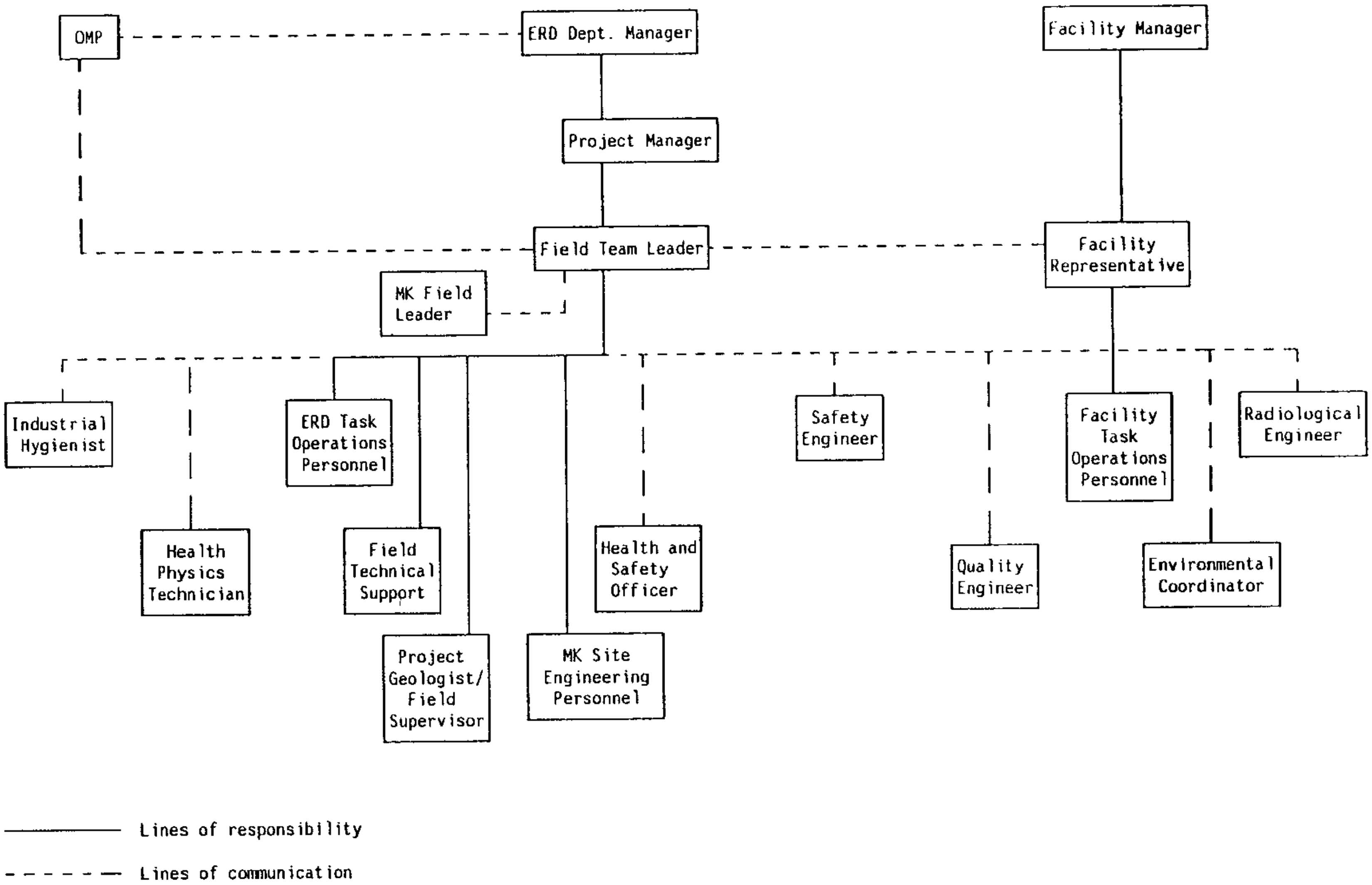

Figure A-3. Drilling task organization chart.

A-3. PERSONNEL TRAINING

Prior to the start of any task, all applicable and appropriate sections of the outline for guiding and training orientation, presented in Section 3 of the base HSP, shall be transmitted to personnel by the JSS or HSO. In addition to the general training requirements found in the base HSP, personnel working at the RWMC will receive training on the *RWMC Emergency Action Manual* and on RWMC access control requirements. Briefing by the JSS will be given to personnel prior to their working on the project (pre-work) and daily (pre-job) before performing work at the site. Major topics to be reviewed in the briefings include:

- Work plan (sample and analysis plan, safe work permit, and site work release)
- HSP
- Special precautions during task-specific operations
- Personal protective equipment (PPE) and clothing
- Emergency assistance (*RWMC Emergency Action Manual*)
- Evacuation requirements.

Normal daily operations of the VVE will be controlled by RWMC detailed operating procedure (DOP) RO 3.3.3. This DOP will be initiated by the data collection technician and will be signed by the RWMC shift manager, or alternate, prior to performing work at the VVE site. This is pre-job briefing and includes all topics identified above.

Table A-3 documents the training required for VVE operations personnel and the date it was received. The JSS will ensure that all training required for field personnel is current and that Table A-3 is completed prior to

Table A-3. Training record for task site personnel (VVE operations).

		JSS		Data Evaluation/FTL		Data Collection Technician		Data Collection Technician	
Course Number	Topic	Required	Date	Required	Date	Required	Date	Required	Date
	Task Site Orientation	Initial		Initial		Initial		Initial	
	Decontamination[a]	Initial		Initial		Initial		Initial	
	Hazard Communication[a]	Initial		Initial		Initial		Initial	
	Signs, Tags, Warning Devices[a]	Initial		Initial		Initial		Initial	
	RWMC Emergency Action Manual[a]	Initial		Initial		Initial		Initial	
	RWMC Access Requirements[a]	Initial		Initial		Initial		Initial	
TS-205	Hazardous Waste Operator	Initial		Initial		Initial		Initial	
TS-205R	Hazardous Waste Operator-Refresher	Annual		Annual		Annual		Annual	
TS-206	Hazardous Waste Supervisor	Initial		Initial		NA		NA	
TS-401	Hearing Conservation	Initial		NA		Annual[b]		Annual[b]	
TS-501	Radiation Worker Qualification	Initial		Initial		Initial		Initial	
TS-501R	Radiation Worker Qualification-Refresher	Annual		Annual		Annual		Annual	
TS-503R	Limited Radiation Worker-Refresher	NA		NA		NA		NA	
TS-701	Medic First	Initial		Initial		Initial		Initial	
TS-701R	Medic First-Refresher	Annual		Annual		Annual		Annual	
TS-801	Respirator Fit Test Qualification	Initial		Initial		Initial		Initial	
TS-802	Respirator Fit Test Requalification	Annual		Annual		Annual		Annual	
	Sentograph Gas Chromatograph Factory Operator Training	NA		Initial		Initial		Initial	
	DOP RO 3.3.3 Vapor Vacuum Extraction Demonstration (VVED)	Initial		Initial		Initial		Initial	

Table A-3. (continued).

						Site Visitors[c,d]		Carbon Bed Samplers	
Course Number	Topic					Required	Date	Required	Date
	Task Site Orientation					Initial		Initial	
	Decontamination[a]					Initial		Initial	
	Hazard Communication[a]					Initial		Initial	
	Signs, Tags, Warning Devices[a]					Initial		Initial	
	RWMC Emergency Action Manual[a]					Initial		Initial	
	RWMC Access Requirements[a]					Initial		Initial	
TS-205	Hazardous Waste Operator					NA		Initial	
TS-205R	Hazardous Waste Operator-Refresher					NA		Annual	
TS-206	Hazardous Waste Supervisor					NA		NA	
TS-401	Hearing Conservation					NA		NA	
TS-501	Radiation Worker Qualification					Initial		Initial	
TS-501R	Radiation Worker Qualification-Refresher					NA		Annual	
TS-503R	Limited Radiation Worker-Refresher					NA		NA	
TS-701	Medic First					NA		Initial[e]	
TS-701R	Medic First Refresher					NA		Annual[e]	
TS-801	Respirator Fit Test Qualification					NA		Initial	
TS-802	Respirator Fit Test Requalification					NA		Annual	
	Sentograph Gas Chromatograph Factory Operator Training					NA		NA	
	DOP RO 3.3.3 VVED					NA		NA	

a. May be part of task orientation.
b. The data collection technicians are the only project personnel exposed to noise at or above an 8-hour time-weighted average of 85 dBA and therefore, will be the only project personnel placed on the Hearing Conservation Program.
c. Site visitors include all VVE and non-VVE project personnel not normally at the site; the JSS shall ensure that their training meets the above requirements prior to visiting the site, and that appropriate escorts are provided.
d. Visitors will be briefed on task/site hazards only to the extent necessary to visit the site under supervision.
e. At least one sampler per team will have completed the Medic First course.

IA - not applicable.

operation startup. Training records can be obtained from personnel radiation worker cards, Human Resources development training, OV\VM-TIS [for Environmental Restoration Department (ERD) personnel], or facility training records. A completed Table A-3 must be kept in the FTL logbook. Visitors must meet the training requirements identified in Table A-3 prior to entry.

The training required for drilling operations and the date the training was received are presented in Table A-4. The drilling FTL will ensure that all training required for field personnel is current and that Table A-4 is completed prior to drilling operation startup. Training records can be obtained from personnel radiation worker cards, Human Resources development training, OV\VM-TIS, or facility training records. A completed Table A-4 must be kept in the FTL logbook. Visitors to the site are those not otherwise identified in Tables A-3 or A-4. Visitors must meet the training requirements identified in Table A-3 prior to entry.

Table A-4. Training record for task site personnel[a] (drilling operations).

		Drillers/Helpers		Project Geologist		Drilling Supervisor			
Course Number	Topic	Required	Date	Required	Date	Required	Date		
	Task Site Orientation	Initial		Initial		Initial			
	Decontamination[b]	Initial		Initial		Initial			
	Hazard Communication[b]	Initial		Initial		Initial			
	Signs, Tags, Warning Devices[b]	Initial		Initial		Initial			
	RWMC Emergency Action Manual[b]	Initial		Initial		Initial			
	RWMC Access Requirements[b]	Initial		Initial		Initial			
TS-205	Hazardous Waste Operator	Initial		Initial		Initial			
TS-205R	Hazardous Waste Operator-Refresher	Annual		Annual		Annual			
TS-206	Hazardous Waste Supervisor	NA		NA		NA			
TS-401	Hearing Conservation	Annual		Annual		Annual			
TS-501	Radiation Worker Qualification	Initial		Initial		Initial			
TS-501R	Radiation Worker Qualification-Refresher	Annual		Annual		NA			
TS-503R	Limited Radiation Worker-Refresher	NA		NA		Annual			
TS-701	Medic First	NA		NA		NA			
TS-701R	Medic First-Refresher	NA		NA		NA			
TS-801	Respirator Fit Test Qualification	Initial		Initial		NA			
TS-802	Respirator Fit Test Requalification	Annual		Annual		NA			

a. See Table A-3 for training requirements of RWMC IH and HP support personnel and site visitors.

b. May be part of task orientation.

NA - not applicable.

A-4. OCCUPATIONAL MEDICINE PROGRAM & MEDICAL SURVEILLANCE

Task site personnel shall participate in the INEL Occupational Medicine Program (OMP) per the requirements of 29 CFR 1910.120, which requires medical surveillance for hazardous waste site workers. This includes employees who are or who may be exposed to hazardous substances at or above established permissible exposure limits, without regard to respirator use, for 30 or more days per year, as well as those who wear a respirator for 30 or more days per year. Employees who must use a respirator in their job or are required to take training to use a respirator to perform their duties under this plan must be medically evaluated for respirator use at least annually.

The OMP is responsible for evaluating the physical ability of a worker to perform the task assigned. The OMP provides medical clearance to the worker for the work to be performed. The OMP may impose restrictions on the employee by limiting the amount or type of work performed. Form EG&G-679, "Employee Job Task Analysis," must be supplied to the OMP at the time of initial certification of a hazardous material worker and when a change in job category occurs. Job-related information must be provided to the OMP for each hazardous material worker via completion of Form EG&G-735, "Industrial Hygiene Identification of an Employee for a Medical Surveillance Program," to the OMP.

Areas addressed by the OMP for hazardous waste site workers include:

- Current comprehensive medical examinations for full-time employees in an INEL medical facility
- Records and reports from employees' private physicians, as required by the Site Occupational Medical Director
- Medical evaluation by the OMP on return to work following an absence in excess of one week (40 consecutive work hours) resulting from illness or injury

- Medical evaluation in the event that a supervisor questions the physical condition of an employee

- Medical evaluation in the event that the employee questions his/her physical condition.

The information provided by the forms and employee examination is used to determine the following for each employee:

- Ability to perform relevant occupational tasks

- Ability to work in protective equipment and/or heat stress environments

- Use of respiratory protection

- Need to be entered into additional specific medical surveillance examination programs.

If the OMP does not have sufficient information at the time of request for clearance for respirator training, the employee's supervisor will be notified and clearance will be withheld until the needed information is provided and any necessary additional examination or testing is completed.

Results of the following tests shall be made available to the OMP when any abnormal radiological exposure is noted or a radiological contamination incident occurs:

- Whole body count (baseline, annual, and on actual or suspected radiological contamination incident)

- Bioassay (baseline, as required to assess internal radiation dose, and on actual or suspected radiological contamination incidents).

Medical data from the worker's private physician, collected pursuant to hazardous material worker qualification of a subcontractor worker, shall be made available to the OMP. This will assist the OMP in assessing the medical ability of the subcontractor worker to work should doubt arise during task operations. Subcontractor past radiation exposure history shall be submitted to the EG&G Idaho Operational Dosimetry Unit (Section 3.5 of Chapter 2 in the *Radiological Controls Manual*).

It is the policy of the OMP to examine all workers, including subcontractors, when they are injured on the job, if they are experiencing symptoms consistent with exposure to a hazardous material, or if there is reason to believe that they have been exposed to toxic substances or physical agents in excess of allowable limits.

Before initiating any task where a chemical or radiological hazard exists, the appropriate medical facility will be notified of the start of the task, anticipated schedules, and task site locations by the HSO. In addition, the OMP shall be supplied with an inventory of the known hazardous constituents located at the task sites.

In the event of a known or suspected injury or illness due to a hazardous substance or physical agent, the worker(s) shall be transported to the nearest medical facility for evaluation with as much information as possible regarding the suspected cause of injury or illness. As much of the following information available at the time shall accompany the individual to the medical facility:

- Individual's name, job title, work location, supervisor's name, and phone number

- Substances or physical agents (known and/or suspected); material safety data sheet(s)

- Date of employee's first exposure to the substance or physical agent
- Locations, dates, and results of exposure monitoring
- PPE in use during this task (e.g., respirator type)
- Number of days per month PPE has been in use
- Anticipated future exposure to the substance or agent.

Further medical evaluation will be in accordance with the symptoms, specific hazard involved, exposure level, and specific medical surveillance requirements.

A-5. HAZARD EVALUATION

A-5.1 POTENTIAL ONSITE HAZARDS

Potential onsite hazards during VVE operations include:

- VOCs
- Radioactive materials/ionizing radiation (man-made radioactive particulate in gas stream and ionizing radiation from operations in the SDA)
- Industrial hazards
- Electrical hazards
- Temperature extremes
- Noise
- Fire and explosion
- Elevated work
- Hoisting and rigging.

Potential hazards during drilling operations include:

- VOCs
- Radioactive materials/ionizing radiation (man-made radioactive particulate in gas stream and ionizing radiation from operations in the SDA)

- Metals such as cadmium, beryllium, and mercury adsorbed to dust particles
- Industrial hazards
- Electrical hazards
- Temperature extremes
- Noise
- Fire and explosion
- Elevated work
- Hoisting and rigging.

A-5.2 HAZARDS ANALYSIS

A-5.2.1 Chemical Agents

There were three volatile organic contaminants noted in the gas stream during past VVE and drilling operations: carbon tetrachloride, chloroform, and trichloroethylene. The other VOCs (1,1,1-trichloroethane and perchloroethylene) and radioactive contaminants identified in Table A-5 have the potential to be present in low concentrations in the gas stream.

SDA personnel sampling results reported in the EG&G Idaho Environmental Hygiene Laboratory Analytical Report No. 92-0133, dated December 18, 1991, found the amounts for trichloroethylene, perchloroethylene, methylene chloride, and carbon tetrachloride shown in Table A-2.

Table A-5. Chemical hazards.

Chemical	Physical state	Exposure limit	Health hazard	NFPA[a]
Carbon tetrachloride	Gas	NIOSH[b] (REL) 2 ppm STEL OSHA (PEL) 2 ppm TWA ACGIH (TLV) 5 ppm TWA	Symptoms CNS depressant, nausea, skin irritation Target Organs CNS, eyes, lungs, liver, kidneys, skin	3-0-0
Chloroform	Gas	NIOSH[b] (REL) 2 ppm STEL OSHA (PEL) 2 ppm TWA ACGIH (TLV) 10 ppm TWA	Symptoms Dizziness, metal dullness, nausea, disorientation, irritated eyes, skin Target Organs Liver, kidneys, heart, eyes, skin	2-0-0
Nitric acid	Liquid	NIOSH (REL) 4 ppm STEL OSHA (PEL) 2 ppm TWA ACGIH (TLV) 2 ppm TWA	Symptoms Irritated eyes, irritated mucous membranes, skin Target Organs Eyes, respiratory system, skin, teeth	3-0-0
Trichlorethylene	Gas	NIOSH[b] (REL) 25 ppm TWA OSHA (PEL) 50 ppm TWA/200 ppm STEL ACGIH (TLV) 50 ppm TWA/200 ppm STEL	Symptoms Headache, vertigo, nausea, eye irritation Target Organs Respiratory system, heart, liver, kidneys, CNS, skin	2-1-0
Tetrachloroethylene	Gas	NIOSH[b] No recommended exposure level OSHA (PEL) 25 ppm TWA ACGIH (TLV) 50 ppm TWA	Symptoms Eye irritation, nose, throat, nausea, flushed face and neck, vertigo, dizziness, incoherentness, erythema (reddening) Target Organs Liver, kidneys, eyes, upper respiratory, CNS	2-0-0
1,1,1-trichloroethane	Gas	NIOSH (REL) 350 ppm ceiling OSHA (PEL) 350 ppm TWA/450 ppm STEL ACGIH (TLV) 350 ppm TWA/450 ppm STEL	Symptoms Headache, CNS depressant, poor equilibrium, irritated eyes, dermal Target Organs Skin, CNS, cardiovascular system, eyes	2-0-0

Table A-5. (continued).

Chemical	Physical state	Exposure limit	Health hazard	NFPA[a]
Isopropanol	Liquid	NIOSH (REL) 400 ppm TWA OSHA (PEL) 400 ppm TWA ACGIH (TLV) 400 ppm TWA/500 ppm STEL	<u>Symptoms</u> Mild eye irritation, nose, throat, drowsiness, dizziness, headache, dry, cracking skin <u>Target Organs</u> Eyes, skin, respiratory system	1-3-0
1,1,2-trichloro-1,2,2-trifluoroethane	Gas	NIOSH (REL) 1000 ppm TWA OSHA (PEL) 1000 ppm TWA ACGIH (TLV) 1000 ppm TWA/1250 ppm STEL	<u>Symptoms</u> Irritated throat, drowsiness, dermal irritation <u>Target Organs</u> Skin, heart	1-1-0

a. Health - Fire - Reactivity.
b. NIOSH-suspected human carcinogen.

ACGIH - American Conference of Governmental Industrial Hygienists
CNS - central nervous system
NFPA - National Fire Protection Agency
NIOSH - National Institute of Occupational Safety and Health
OSHA - Occupational Safety and Health Administration
PEL - permissible exposure limits
REL - recommended exposure limits
STEL - short-term exposure limits
TWA - time-weighted average
TLV - threshold limit value

Several factors that provide protection from chemical exposure in the VVE system include:

- The pump, which pulls air through the filtration system, provides a negative flow in the system. Any leakage will be inward through the filter system.

- The exhaust stack is monitored for total organic vapors and is set to shut down if concentrations downstream of the filter system reach 2 ppm for five seconds.

The following are VVE system failure concerns and associated safeguards to control the chemical (VOC) vapor hazard:

- Exhaust monitor could fail

  Safeguards: Monitor is calibration-checked weekly and portable GC grab sample analysis is performed daily to verify exhaust monitor readings.

- Carbon bed may saturate and breakthrough may occur

  Safeguards: At past operating parameters, the carbon beds took approximately 1.5 months to saturate. Past test runs show that saturation does not occur instantaneously; exhaust concentration will increase slowly over days. The carbon beds will be monitored for exhaust concentration.

A-5.2.2 Fire and Explosion

VVE Operations:

The VOCs identified in the gas stream in past VVE tests are all noncombustible, with the exception of trichloroethylene, and will not pose a hazard at current concentrations and removal rates. In addition, monitoring during the four-month demonstration indicated that the extraction well gas stream is not explosive; however, continued monitoring is recommended in the event that the VVE system is modified for improved removal efficiency.

Drilling Operations:

Past drilling operations produced no other flammable gases than the one noted in the above fire hazard analysis for VVE operations. However, during drilling operations there will be occasions when machinery will need to be refueled and decontaminated. Therefore, the potential for fire is present if fuels or decontamination fluids come in contact with open flames.

A-5.2.3 Oxygen Deficiency/Confined Space

VVE Operations:

The potential for an oxygen-deficient atmosphere or confined space hazard exits during normal VVE operations only if personnel enter the carbon beds. Because personnel will not be allowed in the carbon beds, no hazard is anticipated. Signs indicating personnel are not to enter the carbon beds will be posted.

Drilling Operations:

There is no oxygen-deficient or confined space hazard anticipated during normal drilling operations.

A-5.2.4 Radiological Hazards

VVE Operations:

Radon and its daughter products occur naturally in the soil and are present in the gas stream. Radon accumulation on the carbon adsorbers was estimated in Engineering Design File BWP-VVED-023, Rev. 2. Radon adsorption on activated carbon beds was estimated and confirmed by field radiological measurements to pose no radiological hazard. Most of the naturally occurring nuclides will be in gas form and are expected to pass through the filters and be released to the air. Nuclides that would exist as particulates will be removed from the gas stream by the cyclone separator, prefilter, and HEPA filter. The collection bin of the cyclone separator, prefilter, and HEPA filter may contain radionuclides; however, radiochemistry analysis of the filters and the activated carbon adsorbers after the two-week and four-month tests indicated that no man-made radionuclides were extracted from the vadose zone. Observation during VVE operation indicated a reduction in radon levels exiting the extraction well because of the reduction of radon levels within the subsurface interstitial spaces.

Drilling Operations:

The potential exists for exposure to radiologically contaminated materials, either in borehole cuttings or in waste material, that might accidentally be encountered during the drilling process. The radiological contaminants that have been encountered during past drilling operations at the RWMC include plutonium-239, thorium-230, and cesium-244. The health physics technician (HP) on the drill site will be monitoring all material and equipment coming from the hole. RWMC policy requires personnel entering the SDA to wear a thermoluminescent dosimetry (TLD) monitoring badge and pencil dosimeter to monitor individual dosages.

A-5.2.5 Biological Hazards

No biological hazards are anticipated during VVE or drilling operations.

A-5.2.6 Industrial Safety Hazards

VVE Operations:

Changeout of the carbon beds and repair or replacement of VVE system components are activities that may pose industrial safety hazards. Adherence to lockout/tagout procedures, approved rigging sketches, and appropriate requirements of the hoisting and rigging manual will be followed.

Drilling Operations:

A number of industrial safety hazards may exist during drilling operations, including:

- Existing hazardous objects and terrain
- High work areas
- Lifting heavy objects
- Moving equipment and falling objects
- PPE
- Drill rig equipment.

PPE can restrict visibility and movement. This increases the risk of falling over objects, striking objects, or being struck by them. PPE may also elevate the risk of heat stress.

A-5.2.7 Electrical Hazards

VVE Operations:

The vacuum pump motor and associated system controls and instrumentation are electrically powered. Appropriate lockout/tagout procedures will be followed prior to servicing. Only qualified RWMC electrical repair personnel shall perform servicing at all times.

Drilling Operations:

Overhead power lines, downed electrical wires, and buried cables all pose a danger of shock or electrocution if workers contact or sever them during site drilling operations. Electrical equipment used on site, such as generators and portable electric tools, may also pose a hazard to workers. All portable electric lines will be ground fault circuit interrupter equipped. Careful observation for overhead electrical hazards will be performed prior to raising masts on drill rigs or using cranes. The appropriate INEL operating group will be contacted for underground utility clearances prior to drilling or excavating operations. EG&G Idaho requirements for work permits and clearances for operations near power lines will be followed.

A-5.2.8 Heat/Cold Stress

VVE Operations:

Exposure to temperature extremes is generally in short durations, less than 30 minutes, during normal subsurface gas sample collection activity. Certain VVE activities (e.g., filter changeout or sampling) may subject individuals to increased heat stress. During extreme weather conditions, proper exposure monitoring, clothing, fluid intake, and work/rest regimens will be implemented by the task IH or safety engineer per the EG&G Idaho *Industrial Hygiene Manual*, Section 20.

Drilling Operations:

During the winter months, adequate protective clothing to ensure warmth will be necessary, but extra care must be taken while working in this environment. Heavy clothing impairs movement and hearing. Observation is required of coworkers' facial extremities (ears and nose) for signs of frostbite and of workers mental coherence and body movements to avoid hypothermia. Heat/cold stress training will be addressed in the initial safety meeting before personnel perform any field activities.

During extreme weather conditions, proper exposure monitoring, clothing, fluid intake (for emergency use only), or work/rest regiments will be implemented by the task IH or safety engineer per the *Industrial Hygiene Manual*, Section 20.

A-5.2.9 Noise Hazards

VVE Operations:

Hearing protection is required for work performed within the weather shelter when the VVE system is operating or for other work involving VVE as required on the safe work permit. Data collection technicians who work daily within the shelter will be placed on the Hearing Conservation Program per the EG&G Idaho *Company Procedures Manual*, Section 11.7 (CP 11.7), and *Industrial Hygiene Manual*, Section 26.

Drilling Operations:

The field team may be exposed to excessive noise levels from drilling equipment and other sources during drilling activities. Hearing protection will be worn by all task site personnel and visitors until the task IH determines that noise levels are below hazardous. The task IH will perform a baseline noise monitoring test of the drilling operations to make this determination. All personnel in the proximity of the drill rig while it is in operation will wear the hearing protection prescribed by the IH.

A-5.2.10 Other Hazards

VVE Operations:

Additional hazards that may exist during VVE operations include fire within the building, poor lighting, and tripping hazards.

Drilling Operations:

Field team members for drilling operations may be exposed to injury caused by lifting heavy objects, since drilling operations involve manual movement of heavy drilling casing, auger flights, and various other pieces of equipment. All field team members should be trained in the proper method of lifting heavy equipment and cautioned against lifting objects that are too heavy for one person. Mechanical and hydraulic assists will be used whenever possible to minimize lifting dangers.

The drilling field team may be subjected to cuts and bruises since drilling activities usually involve contact with moving machinery and possible falling objects. In order to minimize this injury, workers will wear protective clothing, hard hats, and steel-toed boots, and will use mechanical assists whenever possible. Loose clothing or neck chains for security badges should not be worn around rotating drilling equipment. Badges may be worn inside the worker's outer layer of clothing or in their pocket during drilling equipment operation.

A-6. LEVELS OF PROTECTION AND PERSONAL PROTECTIVE EQUIPMENT

A-6.1 PERSONAL PROTECTION USED ON PREVIOUS SITE VISITS

Protection Levels B, C, and D were used during previous borehole drilling for VVE (1987); however, previous observation visitors were required to wear only Level D protection or less. Data collection activities require Level D protection. Any breach of the VVE system (filter changeout/sampling) will require the use of Level C PPE with the use of organic/particulate combination cartridge until the task IH and HP can verify that contaminant levels are below levels requiring respiratory protection as defined by the EG&G Idaho *Radiological Controls Manual* and *Industrial Hygiene Manual*.

A-6.2 PERSONAL PROTECTIVE EQUIPMENT

Levels of Protection Required for this Task: A____ B____ C__X__ D__X__
See Table A-6.

A-6.2.1 Respiratory and Dermal Requirements—Personal Protective Equipment

VVE Operations:

Activities during normal VVE system operations do not present a respiratory or skin hazard to personnel; therefore, Level D (RWMC work uniform) will meet the PPE requirements. Until the task IH and HP can determine contamination levels within the system, Level C PPE and respirators with HEPA and organic filtration cartridge will initially be worn during the changing of filters or during the sampling of the particulate collection bin or carbon bed. Any additional respiratory protection requirements will be determined by the HP or taks IH using criteria found in the *Industrial Hygiene Manual* and *Radiological Controls Manual*, as well as substance-specific requirements from sampling results. Table A-6 identifies the PPE requirements for each aspect of the VVE operation.

Table A-6. Required levels of protection.

Job to be performed	PPE level	Other modifications
Data collection (pressure, temperature, vapor, extraction well gas, sampling/analysis)	D	Latex gloves optional
VVE system operation and routine maintenance on exterior of system	D	Protective equipment for electrical work will be specified by the safety engineer
Sampling of carbon adsorbers, changeout of HEPA filter, or maintenance on open system	C	Viton gloves with cotton liners and respiratory protection are required until contaminant levels can be determined by the task IH and HP
Gas and water sampling from well in and around the RWMC	D	Latex gloves required to handle samples
Monitor well drilling and installation	C	Nitrile gloves (when refueling), hard hat, pencil dosimeter, hearing protection, leather gloves, and steel-toed footwear are required. Respiratory protection until contaminant levels can be determined by the IH and HP, and hearing protection until IH determines it is not necessary

Drilling Operations:

Drilling operations in non-waste areas of the SDA have not required PPE above level D in the past; however, because the potential for contaminants to become airborne with dust that is generated from the drill rig exists, Level C PPE and respirators will be worn. The HP or task IH may downgrade the PPE requirements using criteria found in the *Industrial Hygiene Manual* and *Radiological Controls Manual*, as well as substance-specific requirements from sampling results. Table A-6 identifies the PPE requirements for drilling operations.

A-6.2.2 Selection Criteria

Respiratory protection will be required whenever personnel are exposed to concentrations of organic vapors greater than the lowest exposure limits (TWA) for the potential contaminants identified in Table A-5, or if the VVE system is to be opened and contaminant levels are unknown. Respiratory protection for particulate radionuclides will be required when surface contamination levels exceed Zone I (>5000 dpm/100cm^2 beta-gamma and/or >50 dpm/100cm^2 alpha), when the VVE system is open and contamination levels are unknown, or if radioactive airborne concentrations exceed the specific levels found in Section 3 of the *Radiological Controls Manual*. All exposure limits are selected to ensure the health and safety of all those working directly with the equipment, as well as the health and safety of the general public.

Levels of organic vapors and respirable dust are expected to be below allowable limits during drilling activities; however, Level C PPE and respirators will be required until the HP or task IH can determine otherwise. Section A-6.3 identifies action levels that may require upgrading PPE and the potential for exposure to airborne radionuclides, aerosols, or fumes.

A-6.2.3 Personal Protection Requirements

In addition to Level C PPE, respiratory protection will be required for system breach or sampling because of the physical form in which the contaminants will be found (primarily VOCs in their vapor state) and because of the concentrations to which personnel may be exposed. Hearing protection requirements are detailed under Section A-5.2.9, Noise Hazards. Additional modification to personal protection requirements will be as directed by the task IH or HP.

A-6.2.4 Levels of Protection

List of Level C PPE:

Level C protection should be selected when the type of hazardous airborne substance is known, concentrations are measured, criteria for using air-purifying respirators are met, and skin and eye exposure is unlikely. Monitoring of the air must be performed to comply with OSHA regulations and to ensure respirator adequacy. Modified Level C PPE will be used during VVE operations involving the opening of the system (bed sampling, HEPA filter changeout, maintenance). Visual or voice communication will be used. Level C PPE includes:

- Full-face, air purifying respirator (Mine Safety and Health Administration/NIOSH-approved) with type GMC-H cartridge or type GMR-I canister
- Tyvek coveralls
- TLD badge for radiation
- Pencil dosimeter

- Chemical-resistant inner and outer gloves; latex gloves and cotton liners.

- Boots with steel toe.

List of Level D PPE:

Level D protection is primarily a work uniform. It should not be worn on any site when respiratory or skin hazards exist. Level D PPE includes:

- Work coveralls (RWMC work uniform or equivalent)

- TLD badge for radiation

- Pencil dosimeter

- Boots or shoes with steel toe

- Safety glasses (with side shields)

- Leather gloves.

List of Anti-C PPE:

The anti-C requirements will be per the EG&G Idaho *Radiological Controls Manual*, as dictated by the level of contamination detected or anticipated.

A-6.3 Action Levels Regarding Limitations in Tasks Assigned, PPE Requirements, and Withdrawal From Site

VVE Operations:

If the VOC monitor measures a total organic concentration of 2 ppm or greater for five seconds in the stack, the system will automatically shut down.

Drilling Operations:

A portable organic vapor analyzer will be used to measure total volatile organic vapor concentrations in the breathing zone of site personnel during sampling and drilling activities. If total volatile organic vapors are detected at or above 1 ppm for a minimum of 1 minute in the breathing zone, work will cease and the area will be evacuated until the specific contaminant(s) can be identified and quantified or until the total organic vapor concentration in the breathing zone have decreased to below 1 ppm. If specific contaminant levels exceed 1/2 the current ACGIH TLV, OSHA PEL or NIOSH REL (which ever is most restrictive) additional engineering controls and personal protective equipment (PPE) may be required to ensure the health and safety of site personnel. The task industrial hygienist will determine the necessity for and type of additional engineering controls and PPE to be used.

Note: If breathing zone volatile organic vapor levels are substantially greater than 1 ppm but are sustained for <u>less</u> than 1 minute on a consistent basis, the specific contaminant(s) shall be identified and quantified.

Hearing protection will be worn continuously by the drilling crew and personnel in proximity of the drill rig until the task IH has determined that noise levels are below recommended levels. If the daily combustible gas indicator (CGI) readings exceed 10% of the lower explosive limit (LEL) in the borehole, work will be halted until the situation is further assessed by safety personnel.

A-7. SAFE WORK PRACTICES

A-7.1 Variations to Safe Work Practices Listed in Section 7 of this HSP

No variances are anticipated for VVE operations; however, if radiological or hazardous contamination is encountered during field drilling operations or if CGI readings increase above 10% of the LEL, all work will halt until safety personnel have made an assessment of the situation and have deemed the site safe for workers to occupy. Cold/heat stress conditions will by monitored and dealt with according to ACGIH guidelines and at the direction of the task IH.

A-7.2 Additional Safe Work Practices for the Task Site

- The buddy system will be used during all nonroutine VVE operations. This field team will have radio communications present at the site in the event of an emergency.

- Rigging sketches will supplement site work releases for removing the roof sections of the weather shelter and for lifting the carbon adsorbers.

- Changeout of the prefilter and HEPA filter will be per the *RWMC Operations and Maintenance Manual* (OMM).

- Gasoline will be stored in grounded gasoline drums or tanks with National Fire Protection Association (NFPA) labels and signs to prevent ignition sources from entering the storage area. Containers will be closed at all times except when workers are filling or dispensing the contents. The containers will be bonded while the contents are being dispensed. The storage area will be surrounded by a dirt berm covered with plastic to prevent any spilled liquid from escaping. Maximum quantities of gasoline on site will be 110 gal or less. Drilling machinery should be cooled prior to refueling.

- Eating, drinking, chewing gum or tobacco, smoking, and any other practice that increases the probability of hand-to-mouth transfer and ingestion of material are prohibited within the RWMC operations area except at approved eating areas.

A-7.3 DRUMS AND OTHER CONTAINERS

Carbon adsorber handling will be per a site work release and "charcoal adsorber unit" rigging sketch.

A-8. WORK/RADIATION ZONES, SITE ENTRY, AND SECURITY

A-8.1 PERIMETER ESTABLISHMENT

Site Secured: ______ Containment Zones Mapped: ______

Perimeter Identified: Yes Containment Zones Identified: ______

A-8.2 DESCRIPTION OF WORK/RADIATION ZONES INCLUDING SITE ENTRY AND SECURITY

The weather shelter is defined as the boundary of the work zone for perimeter control purposes. The area within the weather shelter is considered to be a support zone because of the closed/negative flow of the system. The doors of the VVE weather shelter are permanently posted, requiring hearing protection and hazardous waste operator training to enter. Changes to the shelter entry requirements will be as required by the HP, IH, or safety engineer, and will be approved by the JSS and shift manager.

Communications during normal VVE operations will be performed using a radio carried by the data collection technician. Communications during maintenance, carbon bed sampling, and well gas sampling will be performed visually or by voice on site and by radio to the shift manager's office as necessary in an emergency.

The drilling work site perimeter will be established and marked as diagrammed in the map of the work site (Figure A-4). Access will be controlled by the drill site supervisor through an exit/entrance corridor. Hearing protection required signs will be posted at the perimeter of the exclusion zone. All personnel entering or exiting the drill site will sign in and out via a logbook.

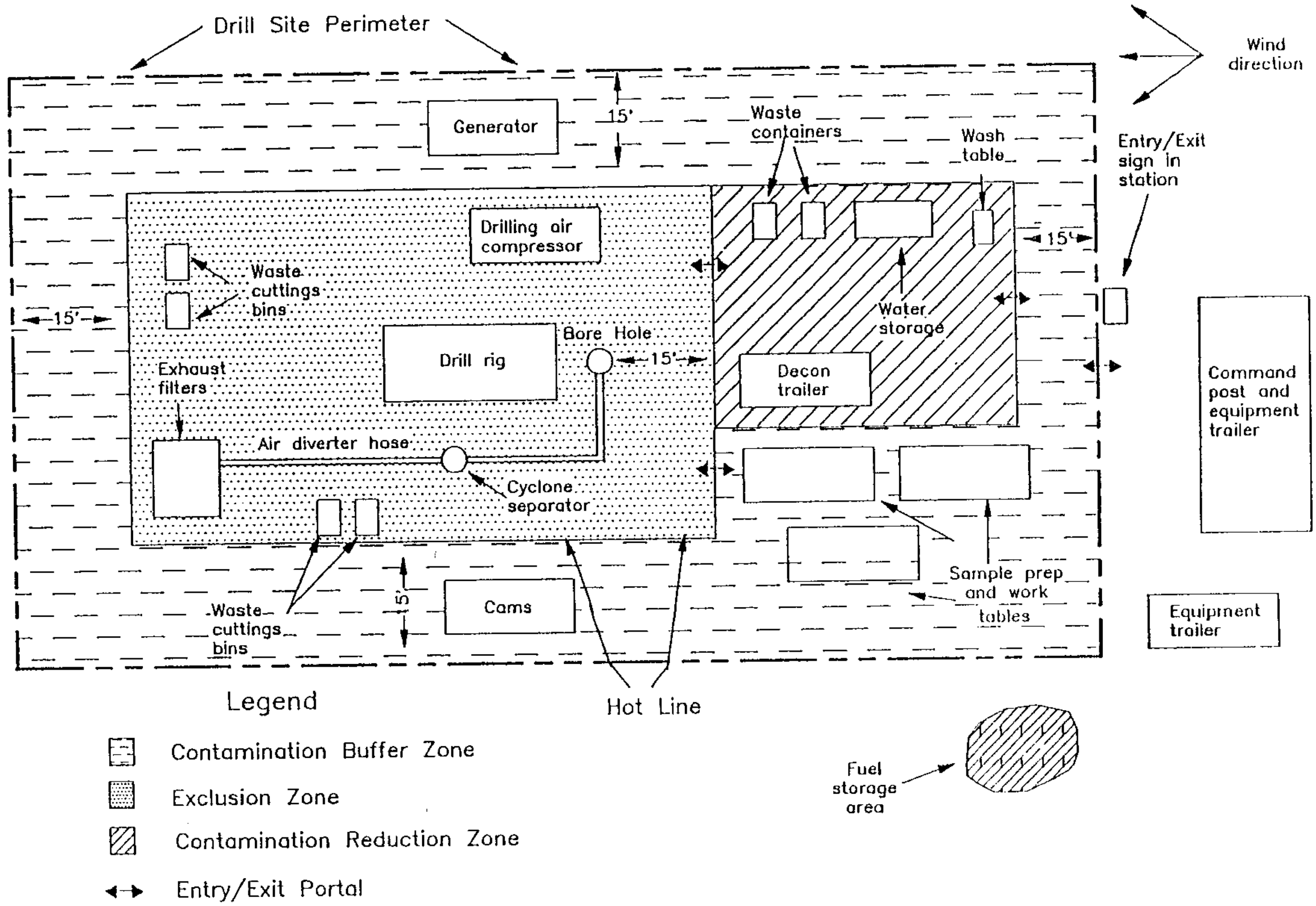

Figure A-4. Example schematic diagram for drill site work zones.

A-9. ENVIRONMENTAL AND PERSONNEL MONITORING

A-9.1 OPERATIONS AND MONITORING EQUIPMENT CHECKLIST

Table A-7 lists the equipment to be calibrated and the frequency of calibration.

Table A-7. Frequency and type of equipment to be calibrated.

Type of equipment	Number needed	Calibrated
Photoionization detector, VOC monitor (for stack exhaust)	1	Weekly as required
Portable HNu or equivalent	1	Daily before use
Gas chromatograph	1	Daily per standard operating procedure
Portable alpha survey, Ludlum 61 or equivalent	1	Semiannually
Portable beta-gama survey, Ludlum 2A or equivalent	1	Semiannually
Low-range direct, Ludlum 14C or equivalent	1	Semiannually
Combustible gas indicator	1	Daily as required

Portable radiological survey instrumentation will be calibrated every six months by the Health Physics Instrument Laboratory using calibration procedures that conform to ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration," and CP 10.6, Appendix I, and using sources directly or indirectly traceable to the National Institute of Standards and Technology. The portable HNu will be calibrated by the manufacturer annually; in addition, the instrument will be field calibrated daily prior to use, using the calibration procedure found in CP 11.4. User calibration data shall be maintained on an instrument calibration log similar to the one in CP 11.4. Combustible gas meters will have preventive maintenance performed on them biannually by the calibration laboratory at the Central Facilities Area (CFA). The combustible gas meter will be calibrated using the procedure found in CP 11.4.

The HP will use survey equipment on borehole cuttings several times a day, appropriate to the type(s) of radiation expected, to verify and establish boundaries of work zones not already posted. Appropriate survey instruments will also be used for contamination surveys and to survey personnel and other materials before they leave the task site.

A-9.2 MEDICAL SURVEILLANCE PROCEDURES

Personnel exposure to VOCs is not anticipated. Levels of organic vapors and respirable dust are expected to be below allowable limits during VVE and drilling operations. If the task IH suspects that personnel are being exposed to VOCs at or above the lowest recommended contaminant exposure limits (Table A-5), air sampling will be performed to determine if exposure is greater than the TLV/PEL/REL. If necessary, medical surveillance will be initiated on those individuals for the specific substances to which they were exposed. Enrollment in the EG&G Idaho Medical Surveillance Program for hazardous waste site workers is required for all task site workers. Enrollment in the Hearing Conservation Program may be required for some persons, if noise exposures exceed the 8-hour TWA of 85 dBA. Noise exposures will be evaluated on an individual basis, as needed.

A-9.3 PERSONNEL MONITORING

Potential personnel exposure to chemical and radiological contaminants will be monitored by the task IH/HP whenever the VVE system is activated and following work performed.

Job to be Performed	Personal Monitoring Device(s)
Cyclone separator cleanout and HEPA filter cleanout	Survey on completion using a Ludlum Model 2A and 61 and portal monitor located at WMF-601. VOC exposure monitoring using an HNu or equivalent when opening the system.
Normal VVE operations	Personal monitoring for radioactive contamination is not required prior to leaving the weather shelter.
Gas and water sampling	Survey using a Ludlum Model 2A and 61 and a portal monitor located at WMF-601 when perched water or downhole equipment has been handled. VOC exposure monitoring using an HNu or equivalent when opening wells.

All site personnel will be required to wear a TLD and pencil dosimeter while on site in order to evaluate exposure to ionizing radiation. The HP will make recommendations for other dosimetry if it is required.

Personnel monitoring for airborne chemical contaminants will be accomplished through the use of passive lapel samplers, which will be worn by team members at the discretion of the task IH or HSO.

Hearing protection is required for work performed within the weather shelter when the VVE system is operating or for other work involving VVE as required on the safe work permit. Data collection technicians who work daily within the shelter will be placed on the Hearing Conservation Program per CP 11.7 and the *Industrial Hygiene Manual*, Section 26.

The field team may be exposed to excessive noise levels from drilling equipment and other sources during drilling activities. Hearing protection will be worn by all task site personnel and visitors until the task IH determines that noise levels are below hazardous levels. The task IH will perform a baseline noise monitoring test of the drilling operations to make this determination. All personnel in the proximity of the drill rig while it is in operation will wear the hearing protection prescribed by the task IH.

A-9.4 Operating Procedures and Methods for Surveillance

VVE operating requirements, including survey and safety requirements, are included in RWMC DOP RO 3.3.3 VVED.

Heat/cold stress: See CP 11.10.

Barriers, signs, and tags: See CP 4.4 "Lock and Tag Procedure," CP 10.10, "Posting Radiological Control Areas," CP 11.2, "Hazard Communication," and CP 11.7, "Hearing Conservation." Also, see the EG&G Idaho *Safety Manual*, Section 7, "Lock and Tag," and Section 12, "Sign, Tags, Warning Devices, and Color Codes."

Physical hazards: Hearing protection and full-face respirators will be available if deemed necessary by the task IH. Physical hazards include uneven or sloped ground and the sampling equipment. All work will be performed in a controlled manner, and according to RWMC health and safety operations and all applicable EG&G Idaho waste management directives.

Work stress: During the course of drilling operations, a workweek in excess of 48 hours requires approval of a Level 2 or 3 manager, or the general manager. In the event that Level C PPE is used, the work/rest periods and length of the workday will be determined by the task IH using guidelines in the EG&G Idaho *Industrial Hygiene Manual*, Section 20; EG&G Idaho *Safety Manual*, Section 20, Appendix B; and biological exposure indices, 1987-88. This statement applies to all personnel at the drill site, including EG&G Idaho employees, and contractors and subcontractors of EG&G Idaho. Work fatigue will be constantly monitored by the FTL and other samplers.

A-10. DECONTAMINATION PROCEDURES

A-10.1 Personnel Decontamination Procedures

A-10.1.1 Chemical Decontamination

Contamination of personnel by volatile organic vapors is not expected during normal operating conditions. If personnel chemical contamination is encountered, the affected area shall be immediately flushed with water and the IH will be notified for further instructions.

A-10.1.2 Radiological Decontamination

Radiological contamination of personnel is not expected. Precautions for sampling and system breach are provided in the following documents:

- *Draft Work Plan for the Organic Contamination in the Vadose Zone-Operable Unit (OU 7-08) Pilot Scale Treatability Study* (EG&G Idaho, 1992)
- *Abbreviated Sampling and Analysis Plan for Spent Carbon Adsorbers in the Vapor Vacuum Extraction System* (EG&G Idaho, 1991a)
- "RWMC OMM HEPA Filter Change-Out" procedure.

If personnel or personal property become contaminated during any phase of the VVE operations, CP 10.4 will be followed.

A-10.1.3 Mixed Contaminants Decontamination

No mixed contamination of personnel is expected during normal operating conditions. Contaminants involved with the VVE operations are of two types: particulate radioactive contamination, and VOCs in the vapor state or that have been adsorbed in the carbon beds. The filtration system is designed to remove particulates separately from VOCs. If personnel mixed contamination is encountered, the most restrictive decontamination and chemical decontamination will be followed.

Chemical, radiological, and mixed decontamination procedures will be followed as stated in Section 10 of the base HSP.

A-10.2 Decontamination of Sampling and Monitoring Equipment

Chemical and/or radiological contamination of sampling and monitoring equipment is not expected. The grain thief sampling device used to collect samples of carbon from the carbon adsorbers will be smeared for radiological contamination, then (if releasible) bagged, and transported to CFA-606 for post-sampling cleaning. See *Abbreviated Sampling and Analysis Plan for Spent Carbon Adsorbers in the Vapor Vacuum Extraction System* (EG&G Idaho, 1991a).

Prior to the release of materials or equipment for unrestricted use, all equipment will be surveyed per CP 10.11 and the *Radiological Controls Manual*, Chapter 4.

A-10.3 Decontamination Modification (e.g., Personnel, Surfaces, Materials Instruments, Equipment)

No decontamination modification is anticipated for this project.

A-10.4 Disposal Procedures

On Site:

No generation of mixed or hazardous waste requiring onsite disposal is anticipated from the normal operation of the VVE system and associated data collection activities. During both the previous two-week and four-month VVE test demonstrations, no man-made radionuclides were detected in the HEPA filters. Because the RWMC is a radioactive storage and disposal site, however, there is potential for radioactive waste detection. Because of this potential, DOE currently mandates that the spent carbon adsorbers be processed on site for carbon regeneration and/or VOC incineration. Radioactive waste may be generated at the time of filter changeout. This waste will be disposed of in compliance with the RWMC low-level waste acceptance criteria.

During drilling operations, only nonradioactive waste will be generated; however, if any radioactive material is found it will be disposed of in compliance with the RWMC low-level waste acceptance criteria. Decontamination waste will be contained in appropriate containers until it can be sampled and determined to be nonhazardous. If the waste is hazardous, it will be disposed of appropriately per the RWMC shift supervisor or HP.

Off Site:

In the event that no man-made radiological contaminants are detected and at the discretion of DOE, the Environmental Protection Agency, State of Idaho, and EG&G Idaho, the spent carbon adsorbers may be transported off site to an ERD-approved vendor for carbon regeneration and/or incineration of VOCs.

For drilling activities, offsite (non-INEL) disposal will occur only in the event of an accidental spill in which the spilled substance is determined to be hazardous.

A-11. EMERGENCY PROCEDURES, EQUIPMENT, AND INFORMATION

A-11.1 EMERGENCY REFERENCE LIST

VVE Operations:

• Warning Communications Center (WCC)	777
• Area Emergency Action Director	526-6260
• First Aid (CFA-603)	526-2356
• Occupational Medical Program	526-2356
• Ambulance/Fire/Security	777
• Waste Management Dept. ESH&Q Safety Support:	526-4301
- Industrial Hygiene (RWMC)	
D. Shoop	526-6653
- Industrial Safety (RWMC)	
D. K. Gray	526-5179
- Explosives Expert	
R. C. Green	526-2702
• Health Physics (RWMC)	526-2710
• Area Operations Shift Manager (RWMC)	526-2766
• Field Team Leader/Monitoring Equipment	
R. M. Lugar	525-5649
• Field Team Leader Alternates	
I. R. Anderson	525-5648
J. M. Hubbell	526-1747
L. Lazzarotto	526-2465
• Task Project Engineer	
N. W. Spang	526-1628
• Project Manager	
G. E. Matthern	526-6914
• Technical Lead	
W. C. Downs	525-5629
• Job Site Supervisor/Operations Engineer	
T. B. Arrington	526-2364

Drilling Operations:

• Drilling Supervisor	
To be determined	526-0945
• Drilling Supervisor Alternate	
D. D. Faulder	526-0674
W. E. Harrison	526-1970
T. R. Wood	526-1293

NOTE: The emergency reference list will be posted inside the VVE weather shelter, in the sampling and/or FTL logbooks, in drilling and sampling staff vehicles, at all drill sites, in the office trailer, and attached to each radio. Initial notification to WCC or the shift manager may be made using radio communications.

A-11.2 EMERGENCY ROUTES

INEL Medical Facility:

Medical emergencies will be handled by the dispensary at CF-603, per the base HSP. Notification will be to the dispensary directly, by calling WCC, or by contacting the shift manager. Response time from CFA is approximately eight minutes. If an ambulance is required, transportation of injured persons will only be performed by medical facility personnel.

Medical emergency procedure information will be posted at the task site, at the following locations:

- VVE weather shelter
- Field logbooks (drilling operations)
- Sign-in logbook (drilling operations)
- Sampling and drilling personnel vehicles.

A-11.3 EMERGENCY PROCEDURES

A-11.3.1 Additional or Modified Emergency Procedures (see Section 11 of the base HSP)

The RWMC shift manager and operations manager will take additional/ appropriate action as required by the *RWMC Emergency Action Plan* and project directives for the RWMC. Spill containment during well-gas and perched water sampling will be performed under the supervision of the HP, using spill control equipment specified in the *Abbreviated Sampling and Analysis Plan for Carbon Adsorbers in the Vapor Vacuum Extraction System* (EG&G Idaho, 1991a).

A-11.3.2 Requirements for Task Site Evacuation

VVE and sampling activities will cease if the constant air monitors (CAMs) alarm. The alarm levels for the CAMs are set at 25 cpm above background alpha and 10,000 cpm (1.3 derived air concentrations-hour) for beta and gamma as set forth in CP 10.6. The CAMs are part of the SDA operations.

The VVE system will be shut down and the weather shelter will be evacuated if CAMs alarm or if site personnel determine an evacuation is necessary because of abnormal operations of the VVE system. If an evacuation is performed, the evacuation will be upwind and to the appropriate staging area identified in the *RWMC Emergency Action Manual*. The facility shift manager will be notified of the evacuation and will direct the emergency as necessary.

The following standard emergency procedures will be used by onsite drilling personnel. The IH and drilling supervisor will be notified of any onsite emergencies. Site personnel will assemble at the support zone and await further instructions from the FTL. Emergency signals at the task site will be responded to appropriately by site personnel. The FTL will be responsible for ensuring that the appropriate procedures are followed.

All injuries, regardless of severity, will be reported to the FTL and recorded in a field logbook. The safety engineer will determine whether or not the injury is OSHA reportable. All injuries or illnesses deemed reportable, vehicle accidents resulting in damage or losses above $500.00, and property damage occurrences resulting in losses of $1,000.00 or more will be reported on DOE Form 5484X. The form will be completed and transmitted to the EG&G Idaho Environmental Safety and Quality Department on or before the 10th of the month following the date of the accident.

Reasons for suspension of drilling task operations include, but are not limited to:

- Background organics in the breathing zone >10% LEL
- High winds >25 mph
- Radiation contamination (100 counts above normally occurring background levels of beta/gamma or any alpha-emitting radiation)
- Combustible gas readings that exceed 10% of the LEL.

A-11.3.3 Task Site Warning Devices

Radio—Portable two-way carried with data collection technician

CAM—(Located in the SDA) Red rotating beacon and fast ringing bell

VVE system lights—Green (running) and amber (abnormal condition related to pump failure or VOCs >2 ppm for five seconds)

Facility/SDA—Amber beacons and sirens on power poles to warn personnel of alert or evacuation conditions.

A-11.3.4 Task Site Emergency Responsibilities

Name	Responsibility	Action
T. Arrington	Job Site Supervisor	Direct task site emergency
L. Lazzarotto	Data Collection	Evacuate as directed
D. Shoop	RWMC Industrial Hygienist	Recommend protective measures
K. Branter	Health Physics	Recommend protective measures
J. Bishoff	RWMC Operations Manager	Initiate emergency action
T. Cline	Shift Manager (after hours)	Initiate emergency action
To be determined	Drilling Supervisor	Notify WCC/EG&G Idaho management and DOE-ID, and direct site evacuation.

A-11.3.5 Procedures for Inclement Weather

The weather shelter currently over the VVE system protects the system from severe weather. The building is not designed for full-time occupancy and will be evacuated if winds reach 50 mph. Also, precipitation (rain or snow) may prohibit task personnel from reaching the task site to perform duties. If there is a question of conditions affecting movement in and out of the SDA, the shift manager should be consulted for current recommended actions. The JSS will be notified by the shift manager in the event that weather conditions could shut down the task site.

During drilling operations, in the event of winds exceeding 25 mph, lightning, extreme heat, or extreme cold, work at the site will be stopped or altered until conditions improve.

A-11.3.6 Reentry Procedures

Reentry into the task site will be directed by the JSS using recommended protective measures given by the IH or HP.

A-11.4 EMERGENCY EQUIPMENT

VVE Operations:

Fire Extinguishers - No.: 2 (20-lb ABC)
Location(s): Inside weather shelter, command trailer, and fuel storage area
Maintenance schedule: Monthly

Self-Contained Breathing Apparatus - No.: 2
Location(s): WMF-601 HP office and HP emergency response vehicle
Maintenance schedule: Monthly

First Aid Kits - No.: 1
Location(s): WMF-601 HP office and HP emergency response vehicle
Maintenance schedule: Monthly

Portable Eyewashes - No.: 1
Location(s): In office trailer
Maintenance schedule: Monthly

Radiological Spill Kit - No.: 1
Location(s): WMF-601 HP office and HP emergency response vehicle
Maintenance schedule: Monthly

Contents: Anti-C gloves and shoecovers, Tyvek coveralls, wipes, signs, HP instruments, and rope.

Location of emergency equipment at facility: Because of the low hazard potential during normal operations, the emergency equipment (excluding fire extinguishers) will be maintained at WMF-601 (see Figure A-1).

Drilling Operations:

Fire Extinguishers - No.: Two 20-lb extinguishers per drill rig
Location(s): One inside and one outside the exclusion zone
Maintenance schedule: Monthly

First Aid Kits - No.: 1 (per drill rig)
Location(s): In office trailer
Maintenance schedule: Inspected daily by the HSO or FTL

Portable Eyewashes - No.: 1 (per drill rig)
Location(s): In office trailer
Maintenance schedule: Inspected daily the HSO or FTL

Spill Kit - No.: As needed
Location(s): Near liquid use/handling jobs
Maintenance schedule: Used supplies replaced by FTL

SCBA Respirator - No.: 2 (per drill rig)
Location(s): In office trailer
Maintenance schedule: Inspected daily the HSO or FTL

Other -
Two-way radios will be located at each drill site.
Emergency equipment will be located in the site trailer.

A-11.4.1 First Aid Supplies

The first aid kit used is the one approved by the OMP. The designated HSO will be notified if any items are used or removed from the kits so that the kits can be replenished.

A-12. ADDITIONAL INFORMATION

The HSO will perform a daily walk-through of the site, as well as periodic reviews. This HSP will be reviewed periodically and updated if necessary.

A-13. REFERENCES

DOE-ID, 1988, *Annual Progress Report: FY-1987 Subsurface Investigation Program at the Radioactive Waste Management Complex of the Idaho National Engineering Laboratory*, DOE/ID-10183, April 1988.

EG&G Idaho, 1989, *Remedial Investigation/Feasibility Study Work Plan for the Subsurface Disposal Area, Radioactive Waste Management Complex at the INEL*, Draft, Idaho National Engineering Laboratory, EGG-WM-8876.

EG&G Idaho, 1991a, *Abbreviated Sampling and Analysis Plan for Carbon Adsorbers in the Vapor Vacuum Extraction System*, EGG-WM-9602, October 1991.

EG&G Idaho, 1991b, *Summary Report of Results of the Vapor Vacuum Extraction Test at the RWMC*, EGG-WM-9301 Rev. 1, March 1991.

EG&G Idaho, 1992, *Draft Work Plan for the Organic Contamination in the Vadose Zone - Operable Unit (OU 7-08) Pilot-Scale Treatability Study*, EGG-WM-10132, February 1992.

Rauen, C. D., 1990, Sampling and Analysis Plan for the Radioactive Waste Management Complex Subsurface Disposal Area, RCRA-Facility Investigation/Corrective Measures Study, Task: Vapor Vacuum Extraction Demonstration. EGG-WM-8381, March 1990.

SAIC, 1989, *Preliminary Remedial Action Objectives and Remediation 3 Technologies for the Subsurface Disposal Area*, SAIC-89/1199, Science Applications International Corporation.

A-14. HEALTH AND SAFETY CERTIFICATION FORM

Task Title: OCVZ Pilot-Scale Treatability Study (Vapor Vacuum Extraction/ Drilling Operations)

Project Manager: G. E. Matthern

Field Team Leader: R. M. Lugar (L. Lazzarotto, I. Anderson, alternates)

I certify that I have been given a copy of the task-specific Environmental Restoration Department HSP for the *Draft Work Plan for the Organic Contamination in the Vadose Zone - Operable Unit (OU 7-08) Pilot-Scale Treatability Study* task and agree to comply with the procedures described therein. I further certify that I understand the potential health and safety hazards of the program (as outlined in this HSP) and have been trained in the use of the personal protective equipment selected for this task.

Employee:

____

(Print) (Signature) (Date)

Company of Employment: ______________________

Field Team Leader: R. M. Lugar (L. Lazzarotto, I. Anderson, alternates)

____

(Print) (Signature) (Date)

Health and Safety Officer: To be determined

____

(Print) (Signature) (Date)