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Health and Safety Plan for Operations Performed for the Environmental Restoration Department at UO 2-09 (Test Reactor Area Sewage Leach Pond) Track 2 Sampling

Idaho

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National

Engineering Laboratory

Managed by the U.S.

Department of Energy Hopi Salomon Robert T. Evans Roy W. (Bud) Jones



Mork performed under DOE Contract No. DE ACO7 76/D01670

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Idaho National Engineering Laboratory EG&G Idaho, Inc. Idaho Fails, ID 83415

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# Health and Safety Plan for Operations Performed for the Environmental Restoration Department at OU 2-09 (Test Reactor Area Sewage Leach Pond) Track 2 Sampling

# **INFORMATION ONLY**

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### ABSTRACT

This document constitutes the health and safety plan for activities at the Test Reactor Area (TRA) Sewage Leach Pond (SLP) performed for the Environmental Restoration Department (ERD). It addresses the health and safety requirements of the Comprehensive Environmental Response, Compensation, and Liability Act; Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120 standard; and EG&G Idaho, Inc.

# **INFORMATION ONLY**

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# ACRONYMS

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ALARA	as low as reasonably achievable
ARDC	Administrative Records and Document Control
ATR	Advanced Test Reactor
CFA	Central Facilities Area
CFR	Code of Federal Regulations
cpm	counts per minute
DAC	derived air concentration
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Field Office
dpm	disintegrations per minute
DRD	direct-reading dosimeter
ERD	Environmental Restoration Department
ERP	Environmental Restoration Program
ETR	Engineering Test Reactor
FTL	Field Team Leader
gpm	gallons per minute
H&S	health and safety
HAZMAT	hazardous materials
HNu	photoionization detector
HPT	Health Physics Technician
HSO	Health and Safety Officer
IH	Industrial Hygienist
INEL	Idaho National Engineering Laboratory
mR	millirem
mR/hr	millirem per hour
MTR	Materials Test Reactor
NIOSH	National Institute of Occupational Safety and Health
NRTS	National Reactor Testing Station
OMP	Occupational Medical Program
OSHA	Occupational Safety and Health Administration
pCi/g	picocuries per gram
PD	Program Directive
PPE	personal protective equipment
QAPjP	Quality Assurance Project Plan
QE	Quality Engineer
QPP	Quality Program Plan
RE	Radiological Engineer
SAP	Sampling and Analysis Plan
SCBA	self-contained breathing apparatus
SE	Safety Engineer
SLP	Sewage Leach Pond
TBD	to be determined
TLD	thermoluminescent detector

TRA	Test Reactor Area
WCB	Willow Creek Building

# Health and Safety Plan for Operations Performed for the Environmental Restoration Department at OU 2-09 (Test Reactor Area Sewage Leach Pond) Track 2 Sampling

## 1. INTRODUCTION

This Health and Safety (H&S) Plan establishes the procedures and requirements that will be used to minimize health and safety risks to persons working at the Test Reactor Area (TRA) Sewage Leach Pond (SLP) site. This H&S Plan has been prepared to meet the requirements of the Occupational Safety and Health Administration (OSHA) standard, 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response." It has been prepared in recognition of and is consistent with the National Institute of Occupational Safety and Health (NIOSH)/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Publication No. 85-115, October 1985 (NIOSH 10/85); the EG&G Idaho Company Procedures Manual; the EG&G Idaho Safety Manual; the EG&G Idaho Industrial Hygiene Manual; and the EG&G Idaho Radiological Controls Manual.

This H&S Plan shall govern all work at the SLP site that is performed by employees of EG&G Idaho, Inc., subcontractors to EG&G Idaho, and employees of other companies. Persons who meet the definition of "occasional site worker" per 29 CFR 1910.120, such as representatives of the Department of Energy (DOE), the State of Idaho, OSHA, and the U.S. Environmental Protection Agency (EPA) representatives, are also subject to the requirements of this H&P Plan.

In addition, this H&S Plan will be reviewed and revised by the Health and Safety Officer (HSO) in conjunction with the Field Team Leader (FTL) and other health and safety professionals as necessary to ensure the effectiveness and suitability of the H&S Plan for SLP sampling.

### **1.2 Site Description**

The Idaho National Engineering Laboratory (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). The United States Atomic Energy Commission, now DOE, established the NRTS in 1949 as a site for building and testing a variety of nuclear reactors. INEL has also been the storage facility of transuranic radionuclides and low-level radioactive wastes since 1952. At present, the INEL supports 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 technology development, and energy technology/conservation programs. The DOE Idaho Field Office (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



Figure 1. Location of the INEL and various facilities.

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 Laboratory - West, Westinghouse Electric Corporation, and Babcock and Wilcox Company.

TRA was established in the early 1950s in the southwestern portion of the INEL, approximately 47 miles west of Idaho Falls. The facility houses high neutron flux test reactors. Only one reactor, the Advanced Test Reactor, is in operation today. More than 73 buildings and 56 structures have been constructed at TRA, providing four major types of functional support: reactor, laboratory, office, and crafts.

This H&S Plan was written to cover work at one of the four wastewater disposal ponds located outside of the security fence at TRA.

### 1.2.1 Sewage Treatment Plant and Sludge Pit and the Final Sewage Leach Pond

The Sewage Treatment Area is located 150 ft east of the TRA security fence (Figure 2) and is comprised of an Imhoff tank, trickling filter, chlorination basin, sludge pit, and SLP containing two cells into which effluent is discharged. The dimensions of the northern cell are approximately 250 x 50 x 14 ft, and the dimensions of the southern cell are approximately 250 x 80 x 18 ft. Since 1952, the system has been used continuously, receiving effluent from sanitary sewer drains throughout TRA at average discharges of 20 to 30 gallons per minute (gpm). Effluent to the SLP has been routinely monitored by the EG&G Idaho Environmental Monitoring Unit since 1986. The nonradiological monitoring program analyzes for various metals, anions, and total organic carbon. A more detailed description of the sanitary sewage system, including results of effluent monitoring, can be found in the Environmental Characterization Report for the Test Reactor Area.<sup>1</sup>

As part of a characterization program conducted during 1990, a borehole (SB-09) was drilled and soil samples collected near the SLP (Figure 3) to investigate potential contamination from the SLP. Soil samples collected 25 to 47 ft below land surface indicated the <u>possible</u> presence of <sup>90</sup>Sr (beta-emitter) and alpha-emitting radioisotopes, and no detectible levels of man-made, gamma-



Figure 2. Location of the Sewage Leach Pond with respect to other wastewater disposal ponds.

Sample #	Soil concentration by radionuclide (pCi/gm)								
	<sup>60</sup> Co	<sup>103</sup> Agm	<sup>137</sup> Cs	<sup>152</sup> Eu	<sup>154</sup> Eu	<sup>241</sup> Am	Total		
1	50.11	-	114.30	-	-	+	164.41		
2	11.24	-	17.69	-	-	•	28.93		
3	30.84	0.68	58.06	-	-	-	89.58		
4	163.10	4.05	262.30	-	-	-	429.45		
5	66.39	1.57	121.90	-	-	2.55	192.41		
6	47.27	0.89	77.07	-	-	-	125.23		
7	327.10	6.5	590.10	5.93	5.71	-	935.34		





emitting radioisotopes. Results from the analysis of metals at SB-09 showed the presence of metals slightly above background levels, which is common for sewage leach ponds.<sup>2</sup>

In 1991, during routine operational monitoring, the bottom of the southern cell of the SLP was sampled for gamma-emitting radioisotopes and surveyed for general radiation fields. Results indicate the presence of gamma-emitting radionuclides in the soil as high as 935 picocuries per gram (pCi/g) and radiation fields as high as 2 millirem (mR)/hr in the pond. In addition, low levels of gamma-emitting isotopes were found in vegetation within the pond.<sup>a,b</sup> Figure 3 indicates the distribution of the radiation fields and lists the results of the sampling in the southern cell of the SLP. As part of the preparation for field sampling, the northern cell of the SLP was surveyed in March 1992. Figure 4 shows the results of that survey.

The sludge pit, located 20 ft south of the Sewage Treatment Plant, is sampled so the sludge can be disposed when capacity is reached. Results have indicated the sludge is contaminated with low levels of gamma-emitting radionuclides<sup>c</sup> and low gross alpha/beta content.<sup>d</sup> This sludge will not be sampled during this investigation.

a. S. T. Laflin correspondence to L. C. Van Deusen, "Radioisotope Sample Results from the TRA Sewage Pond," STL-35-91, July 5, 1991.

b. R. D. Sayer Office Vision note to H. Salomon, "Steve Laflin's Letter (STL-35-91)," December 6, 1991.

c. T. J. Haney correspondence to J. A. Johnson, "RML Gamma-Ray Analysis of One Solid TRA Drying Bed Sample," TJH-102-91, September 23, 1991.

d. EG&G Idaho, Inc., Radiochemistry Gross Alpha/Beta Screening, Sample I.D. = TRA Drying Beds, Computer File Name = 911002A3, Analysis Date = 9-27-91.



Figure 4. Radiological survey of the northern cell of the SLP.

## 2. TASK DESCRIPTION

The primary activity conducted during this sampling program will be the collection of surface soil samples. In addition, two shallow borings will be drilled to a depth of about 6 ft and samples taken near the inlet to each cell of the SLP. This operation will be performed using a small trailer mounted auger rig or equivalent. A water sample will be collected from the shallow perched water in well SB-09 (Figure 3). The sampling is expected to start in early May 1992 and last approximately one week.

### 2.1 Task Site Responsibilities

The organizational structure for this task reflects the resources and expertise required to perform the task while minimizing risks to personnel health and safety. Key personnel and lines of responsibility/communication are shown on the organizational chart for the SLP sampling (Figure 5). The following sections outline responsibilities of key site personnel.

#### 2.1.1 Environmental Restoration Department Manager

The Environmental Restoration Department (ERD) Manager is responsible for investigation and remediation activities performed by ERD. This manager provides technical coordination and interfaces with the DOE-ID Environmental Support Office. The ERD 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 ERD Manager has primary responsibility for the technical quality of all projects and safety of personnel.

#### 2.1.2 Project Manager

The Project Manager (PM) has the responsibility for ensuring that all tasks conducted during the project are in compliance with EGG-WM-8676, *Implementing Program 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 Environmental Restoration Program (ERP) Quality Program Plan (QPP), Quality Assurance Project Plan (QAPjP), H&S Plan, Program Directives (PDs), Sampling and Analysis Plan (SAP) of ERP, the EG&G Idaho Radiological Controls Manual and EG&G Idaho Safety Manual. The PM coordinates all field, laboratory, and modeling activities.

#### 2.1.3 Field Team Leader

The FTL is the individual with the ultimate responsibility for the safe and successful completion of activities at the task site. The FTL manages field operations and executes the work plan and schedule, enforces site control, and documents task site activities. Health and safety issues at the task site may be directed to the FTL.



Lines of communication and responsibility

T92 0226

----- Lines of communication



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If the FTL leaves the task site, an alternate individual will be appointed to act as FTL. Persons acting as FTL on the task site must meet all training requirements for the FTL, as outlined in Section 3. The identity of the acting FTL shall be recorded in the FTL logbook and communicated to the facility representative, when appropriate.

#### 2.1.4 Task Site Personnel

All task site personnel, including EG&G Idaho and subcontractor personnel, are responsible for understanding and complying with requirements of this H&S Plan. Task site personnel will be briefed by the FTL at the start of each shift before starting activities. They should identify potentially unsafe situations or conditions to the FTL or HSO for corrective action. If unsafe conditions develop, task site personnel are authorized to stop work and notify the FTL or HSO of the unsafe condition.

#### 2.1.5 Occasional Site Workers

The definition of an occasional site worker per the OSHA standard is:

"Workers on site only occasionally for a specific limited task (such as, but not limited to, groundwater monitoring, land surveying, or geophysical 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."

Individuals meeting the definition above, such as representatives of DOE or State/Federal regulatory agencies, may not proceed beyond the support zone without receiving a safety briefing and wearing the appropriate protective equipment, and providing proof of meeting the training requirements outlined in Section 3 of this H&S Plan.

#### 2.1.6 Health and Safety Officer

The HSO serves as the primary contact for health and safety issues at the task site. The HSO advises the FTL on all aspects of health and safety, and is authorized to stop work at the site if any operation threatens worker or public health or safety. The HSO has other specific responsibilities as stated in other sections of this H&S Plan. The HSO is supported by other health and safety personnel at the task site [Safety Engineer (SE), Industrial Hygienist (IH), Health Physics Technician (HPT), Radiological Engineer (RE), and facility representative as necessary]. The HSO may also be the IH, SE or HPT at the site.

#### 2.1.7 Industrial Hygienist

The IH will perform monitoring to determine worker exposures to hazardous agents in accordance with EG&G Idaho Company Procedures Manual and the EG&G Idaho Industrial Hygiene Manual. Job hazard analyses will be completed per EG&G Idaho Company Procedure 11.9 by the IH, who will recommend appropriate hazard controls for protection of task site personnel. The IH

will review the effectiveness of monitoring and personal protective equipment (PPE) required in this H&S Plan, and recommend changes as appropriate. Following an evacuation, the IH will assist in determining whether conditions at the task site are safe for reentry. Employees showing health effects resulting from possible exposure to hazardous agents will be referred to the Occupational Medicine Program (OMP) by the IH.

### 2.1.8 Safety Engineer

The SE offers guidance on all safety issues arising at the task site, observes site activity, advises the FTL on required safety equipment, and recommends solutions to safety issues that arise at the task site.

### 2.1.9 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:

- Prescribing the appropriate anti-contamination (anti-C) clothing
- Ensuring radiological equipment is calibrated and functioning properly
- Radiological surveying of the task site, equipment, and samples
- Collecting and analyzing smears
- Providing guidance for radiological decontamination of equipment and personnel
- Providing task site personnel 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 the victim to the nearest INEL Medical Facility for evaluation if significant radiological contamination occurs.

#### 2.1.10 Radiological Engineer

A RE is a 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, and other sources
- Identifying the type(s) of radiological monitoring equipment necessary for the task
- Advising FTL and HPT of changes in monitoring or PPE, and advising on task site evacuation and reentry.

#### 2.1.11 Occupational Medical Program

The INEL OMP has the following responsibilities for hazardous waste site work:

- Reviewing and commenting on H&S plans
- Diagnosing and providing medical advice and treatment for INEL employees with occupational illnesses or injuries
- Assisting in the documentation and investigation of work-related illnesses or injuries
- Providing medical opinion of the ability of the employee to perform assigned work or work being considered for assignment
- Providing emergency medical care in support of individuals and area emergency actions.
- Maintaining and operating a radiation and chemical decontamination facility at Central Facilities Area (CFA)
- Providing medical surveillance for workers who are identified as having been, or likely to be, exposed to hazardous agents at or above designated action levels.

#### 2.1.12 Facility Manager

The Facility Manager is responsible for managing all aspects of their assigned area, and must be cognizant of work being conducted in the area.

#### 2.1.13 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 may serve as advisor to task operations personnel with regard to the area operations.

#### 2.1.14 Environmental Engineer

The Environmental 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 Environmental Engineer include:

- Acting as advisor for environmental concerns associated with ERP task activities
- Maintaining a library of applicable environmental information.

#### 2.1.15 Quality Engineer

The Quality Engineer (QE) provides guidance on task site quality issues. 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.

## 2.2 Administrative Record and Document Control

The ERD Administrative Records and Document Control Office (ARDC) is responsible for organizing and maintaining data and reports generated by ERD 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. Copies of the this H&S Plan, the QAPjP, and Field Sampling Plan for this project will be maintained in the project file by the ARDC.

The IH will record air monitoring and personal sampling data on Form EGG-737, "Industrial Hygiene Monitoring Data Form." IH data is treated as limited access information per EG&G Idaho Company Procedure requirements. The HPT keeps a logbook of all radiological monitoring, daily operational activities, and instrument calibrations. All project records and logbooks, except IH and HPT logbooks, shall be forwarded to ARDC within 30 days after completion of the task.

## 2.3 Personnel Training

All task site personnel shall receive training as specified by 29 CFR 1910.120 and the EG&G Idaho *Safety Manual*, Section 8. Table 1 summarizes training requirements for task site personnel. Specific training requirements for each worker will vary depending on the hazards associated with the job assignment.

Proof of completion of all required training courses (including refresher training) must be maintained on the site at all times. Form EGG-2580, "Health and Safety Permit Card," is acceptable proof of training. A copy of the certificate issued by the institution where the training was received may be carried by task site personnel in lieu of a Form 2580.

Task/position	FTL	IH	HPT	Samplers	Visitors
Торіс	Required	Required	Required	Required	Required
Task site orientation	х	х	х	X	X
<b>Decontamination</b> <sup>a</sup>	х	х	Х	Х	Xc
Hazard communication <sup>a</sup>	х	х	Х	Х	Х
Signs, tags, warning devices <sup>a</sup>	Х	х	X	X	X
Emergency action plan for task site <sup>a</sup>	x	х	х	x	X
Hazardous waste site worker—40 hrs.	x	х	х	х	
Hazardous waste site worker—24 hrs. field experience	Х				
Hazardous waste site supervisor	Х	х			
Hearing conservation	X <sup>g</sup>	X <sup>g</sup>	X <sup>g</sup>	X <sup>g</sup>	X <sup>d</sup>
Radiation worker qualification	X	Х	Х	X	X <sup>d</sup>
First aid certification <sup>e</sup>	Х	Х	Х	Х	
Respirator qualification and fit test	х	х	х	Х	Xť
Hazardous waste site— occasional worker <sup>b</sup>					Х

Table 1. Required training for task site personnel.

a. Will be included in task site orientation.

b. Includes 24 hours classroom instruction and 8 hours on-the-job training.

c. If entering contaminated areas.

d. As appropriate.

e. At least two persons on site must be current in Medic First training.

f. If entering areas requiring respirator use.

g. If determined to be required by IH.

The FTL will conduct daily briefings at the start of the shift. The purpose of the briefings is to inform task personnel about new hazards at the site, changes to the H&S plan, changes in procedures, and a review of PPE associated with the task.

# 3. OCCUPATIONAL MEDICAL PROGRAM AND MEDICAL SURVEILLANCE

Task site personnel shall participate in the INEL 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 EGG-679, "Employee Job Task Analysis," must be supplied to the OMP at the time of initial certification of a hazardous waste site worker and when a change in job category occurs. Job-related information must be provided to the OMP for each hazardous waste site worker via completion of Form EGG-735, "Industrial Hygiene Identification of an Employee for a Medical Surveillance Program to OMP."

Areas addressed by 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 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.

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 incident).

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 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, if they are experiencing symptoms consistent with exposure to a hazardous material, or there is reason to believe that they have been exposed to toxic substances or physical agents in excess of allowable limits.

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 a known or suspected injury or illness due to exposure 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/illness. As much of the following information as is available at the time shall accompany the individual to the medical facility:

- Name, job title, work location, supervisor's name, and phone number
- Substances/physical agents (known and/or suspected); Material Safety Data Sheet
- Date of employee's first exposure to the substance/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/agent.

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

### 4. HAZARD EVALUATION

Personnel may be exposed to a variety of substances and physical agents while working at the SLP site. Exposures may be a result of contacting materials as they are stored, handled, or disposed, equipment being used, weather conditions or time of day, environmental surroundings, and other working conditions. A Form EGG-1565, "Job Hazard Analysis Form," will be completed according to EG&G Idaho Company Procedure 11.9, "Industrial Hygiene Workplace Survey," by the IH with assistance from the RE to assist in obtaining an accurate task site hazard evaluation.

## 4.1 Chemical Hazards

Based on past sampling of the effluent going to the SLP and the soil near the pond, it is known that metals are present in concentrations above background. Table 2 contains information about the metals that are expected to be encountered at the site. Although known to be present, the concentrations of these substances are not great enough to present a risk to workers, assuming safe work practices are employed. Little information is available about organic contaminants potentially present, although based on knowledge of the sewage treatment system at TRA, they are not expected to be present.

#### 4.1.1 Routes of Exposure to Chemical Agents

Personnel may be exposed to chemical contaminants through inhalation, ingestion, absorption (i.e., through the skin or eyes), and injection (e.g., a puncture wound).

Inhalation of contaminated materials can occur if windy conditions suspend sediment or water in the air. Organic vapors can also be inhaled if present in the breathing zone.

Ingestion of hazardous substances is likely when workers do not practice good personal hygiene habits. It is important to wash hands, face, and other exposed skin thoroughly after completion of work and before smoking, eating, drinking, and chewing gum or tobacco. NO SMOKING, CHEWING, EATING OR DRINKING IS ALLOWED AT THE TASK SITE. Personnel should avoid direct contact with sediment or water present at the site.

Solid, liquid, or gaseous substances may be absorbed through the eyes, skin, and cuts or abrasions. Absorption may occur when a worker does not wear proper protective clothing or when protective clothing is damaged or degraded. Chemical contaminants may also be introduced directly into the body through puncture wounds caused by contaminated equipment.

Eye irritation may result after exposure to contaminants. This may occur if a worker's unwashed hands come in contact with the eyes.

### 4.2 Radiological Hazards

In May of 1991, during routine upkeep of the SLP, the vegetation removed from the pond was found radioactive (i.e., up to 59 pCi/g). A follow-up radiological survey of the SLP found the soil within the pond contaminated up to 935 pCi/g total activity and radiation levels up to 2 mR/hr.

					Toxicity			
Substance	CAS number	Environmental concentration (w/units)	In sample (soil, water, air, waste)	Exposure limit	Route of exposure	Acute symptoms	Carcinogenicity	Expected exposure levels
Barium	7440-39-3	35.2 μg/ℓ	în water	0.5 µg/l	Inhalation/ Ingestion Absorption	Resp., skin & eye irritant		< 0.5 μg/ł
Cadmium	7440-43-9	16.10 µg/l	in water	0.05 µ <b>g/ℓ</b>	Inhalation/ Ingestion	Resp., irritant chest tightness	Suspect human carcinogen	< 0.05 µg/ℓ
Chromium	7440-47-3	12.30 µg/ℓ	in water	0.5 µ <b>g/ℓ</b>	Inhalation/ Ingestion	Cough, resp. irritant		< 0.5 µg/l
Copper	7440-50-8	27.30 µg/l	in water	1 μg/ℓ	Inhalation/ Ingestion	Metallic taste, resp. irritant		< 1 µg/ℓ
Lead	7439-92-1	22.60 µg/l	in water	.05 µg/ℓ	Inhalation/ Ingestion	Weakness, Abdominal pain	Possible carcinogen	≪ .05 µg/l
Zinc	1314-13-2	89.3 µg/(	in water	10 μg/ <b>ℓ</b> total dust 5 μg/ℓ resp. dust	Inhalation/ Ingestion	Metallic taste, resp. irritant		< 5 µg/ℓ

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Table 2. Known onsite contaminants and their concentrations at the SLP.

Gamma spectrometry analysis of the soil samples found:  $^{60}$ Co (up to 327 pCi/g),  $^{137}$ Cs (up to 590 pCi/g),  $^{108}$ Agm (up to 4 pCi/g),  $^{152}$ Eu and  $^{154}$ Eu (5.9 pCi/g and 5.7 pCi/g respectively—found in only one sample), and  $^{241}$ Am (2.55 pCi/g - in one sample). These levels were found in the southern cell; however, the northern cell is also contaminated. The northern cell, which was surveyed in March 1992, had beta-gamma levels up to 300 counts per minute (cpm) above background general area and up to 2,500 cpm above background beta-gamma in specific areas of the cell. These levels were found on the soil surface, but soil samples have not been taken. Direct radiation levels are 0.1 mR/hr. See Figures 3 and 4 for survey results.

Exposure to ionizing radiation and radiological contamination poses the greatest hazard to personnel taking soil and water samples. However, proper radiological controls such as anticontamination clothing, dosimetry, monitoring by the HPT, and good radiological work practices will minimize the hazard.

#### 4.2.1 Routes of Exposure to Radiological Hazards

Personnel will be exposed to direct radiation from the contaminated soil in the ponds and contaminated water from the monitoring well. To maintain as low as reasonably achievable (ALARA) goals, exposures to direct radiation will be limited to 10 mR per person per day. In addition to direct radiation, personnel will be exposed to radiological contamination during soil and water sampling. The types of contamination that personnel may be exposed to at the sampling sites are:

- 1. Loose contamination in the form of dry, loose soil; which is easily spread to adjacent areas and can be ingested or inhaled.
- 2. Airborne contamination may be of concern because personnel can inhale or ingest the airborne particulates.
- 3. Contaminated water—well SB-09 contains contaminated water, which has leached from the soil.

When inhaled, airborne particulates can deposit in the lungs and diffuse to other parts of the anatomy causing an internal exposure hazard. (Respiratory protection and anti-C clothing will be worn during the sampling activities.) Contaminated water may be absorbed through the skin; however, anti-C clothing and good work practices will mitigate the hazard.

# 4.3 Fire and Explosion

The only source of fire or explosion hazard at this site would be the hazard associated with the fuels contained in the drilling equipment and vehicles to be used on the job. No welding or cutting will be performed.

# 4.4 Confined Spaces

Work in confined spaces may subject workers to risks involving oxygen deficiency and toxic or explosive atmospheres. Low-lying areas such as pits or trenches that are present at the task site should be evaluated by an IH or SE per EG&G Idaho Company Procedure 11.3.

This sampling activity will not require any entries into confined spaces.

# 4.5 Biological Hazards

The SLP described in this plan receives effluent water from the Sewage Treatment Plant. This water has been treated or conditioned to destroy bacteria, so no bacterial hazards are expected. However, 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.

## 4.6 Temperature Extremes

Sampling activities are anticipated to be conducted during the month of May, therefore, heat or cold stress is not anticipated. Daily temperature variations may be significant due to cooler morning temperatures, wind, and the presence of water at the site. Personnel should be aware of this and dress appropriately.

### 4.7 Noise

Noise levels above acceptable limits are anticipated when using the Gidding's portable drill rig. Although the actual drilling will be of short duration, noise levels will be monitored and a hearing conservation program will be initiated for affected personnel if necessary. All personnel associated with the operation of the Gidding's drill rig will also be required to wear approved hearing protection.

## 4.8 Industrial Safety Hazards

A small trailer mounted auger rig or equivalent will be used to drill two boreholes in the SLP. This drilling equipment will be operated only by trained personnel and only those necessary for safe operation of the equipment are allowed in the drilling area.

# 5. PERSONAL PROTECTIVE EQUIPMENT

The sampling activities in the SLP will require personnel protective equipment (PPE) for use in a radiological control Zone II as defined in the EG&G Idaho *Radiological Controls Manual*. Zone II contamination clothing requirements are: one pair yellow cloth anti-C coveralls (or disposable), one yellow cloth hood (or disposable), three pair of shoe covers (two pair must be vinyl or latex), and one pair of latex gloves. The requirement of Zone II level of protection is based on the fact that the soil is contaminated up to 2 mR/hr and the levels of contamination are unknown below surface level.

Task/assignment	Level of PPE	Modifications	
Soil sampling	Zone II	Full face respirator (Type H cartridge)	
Water sampling	Zone II	Full face respirator (Type H cartridge)	

Note: The respirator <u>may</u> be eliminated if air monitoring results confirm levels are less than the derived air concentration (DAC); <2.0E-09 uCi/cc if no alpha-emitters are present and <2.0E-12 uCi/cc for unknown alpha-emitters. However, respiratory equipment is advised for work in levels of 1.0% of DACs.

# 6. ENVIRONMENTAL MONITORING

# 6.1 Chemical Agent and Noise Level Monitoring

Personnel assigned to certain tasks may be exposed to hazardous materials. Although organic compounds are not anticipated based on process knowledge, it is not known that organic vapors are not present in the SLP, so organic vapor monitoring will be performed during soil sampling. Noise levels during drilling will also be monitored.

Task	Contaminant/method of monitoring
Soil sampling	Organic vapors
	- Photoionization detector (HNu)
	- Vapor badges
Drilling	Noise/noise dosimeters and/or noise meters

The following equipment may be used by the IH on the task site to monitor chemical agents and noise levels: HNu, 3M Vapor Badges, noise dosimeters, and noise meters.

 Equipment	Agent to be monitored
Noise meter & noise dosimeter	Noise
HNu	Volatile organic compounds
3M Organic Vapor Badges	Volatile organic compounds

All industrial hygiene equipment will be maintained by the IH per the manufacturer's recommendations. Instruments will be calibrated before and after use, or according to the schedule outlined in the EG&G Idaho Company Procedure 11.4, "Calibration of Industrial Hygiene Instruments."

Air sampling will be conducted using NIOSH methods and according to EG&G Idaho Company Procedure 11.5, "Industrial Hygiene Air Contaminant Sampling Procedure." Samples will be personal samples whenever possible. Results from direct-reading instruments and field observations will be recorded on Form EGG-737, "Industrial Hygiene Monitoring Form." Each day the FTL shall record the four-digit data sheet number that corresponds to the day's industrial hygiene monitoring.

# 6.2 Radiological Monitoring

#### 6.2.1 External Radiation Exposure

Personnel exposures to direct radiation will be monitored by thermoluminescent dosimeters (TLDs) and direct-reading dosimeters (DRDs). All personnel will be responsible for properly wearing the specified dosimetry during the project. Exposures to direct radiation will be maintained ALARA (10 mR/day/person). Radiation surveys shall be performed by the HPT to determine the extent and magnitude of radiation levels. For detecting beta-gamma radiation, the following direct reading instruments will be used: a Bicron 2000 or equivalent will be used to monitor personnel exposure levels and a Ludlum 14C or equivalent will be used during surveys.

#### 6.2.2 Radioactive Contamination

A Ludlum 2A or equivalent will be used to determine beta-gamma contamination levels and a Ludlum 61 or equivalent will be used to determine alpha contamination levels. These instruments can also be used for site surveys. Air sampling will be required to determine the airborne radioactivity levels. Lapel air samples or portable air samples will be required during soil sampling activities.

#### 6.2.3 As Low As Reasonably Achievable

ALARA is a process to keep doses as far below limits as reasonably achievable while operating under the conservative assumption that any dose has some probability of risk. Even though personnel ALARA goals are established on whole body, "deep dose" exposures, the process applies to annual, committed, and cumulative doses. An ALARA review and evaluation process is not required for the sampling activities contained in this H&S Plan (Appendix 2.A of Chapter 2 of the EG&G Idaho *Radiological Controls Manual*).

The 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*. All health physics equipment will be source-checked weekly and calibrated every six months. The equipment will be maintained by the HPT according to manufacturer's instructions. Survey equipment will be used to verify boundaries and work zones, survey personnel, and equipment before leaving the task site, and to confirm that waste items are sent to the appropriate disposal facility.

## 6.3 Physical Hazard Control and Monitoring

The FTL and HSO will conduct periodic inspections of the task site to ensure that barriers and signs are being maintained, unsafe conditions are corrected, and debris is not accumulating on the site. Health and safety professionals present at the task site may, at any time, recommend changes in work habits to the FTL.

Individuals working at the SLP sampling site are responsible for using safe work techniques, reporting unsafe working conditions, and exercising good personal hygiene and housekeeping habits throughout the course of their job.

# 7. SAFE WORK PRACTICES

# 7.1 General Safe Work Practices

The following general safe work practices will be followed at the task site:

- 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. Eating shall be in approved eating areas as established or designated at the particular INEL facility.
- Broken skin or other wounds shall restrict personnel from entering areas where contamination is present unless evaluated and approved by medical.
- Avoid direct contact with potentially contaminated substances. Do not walk through spills or other areas of contamination. Avoid kneeling, leaning, or sitting on equipment or ground that may be contaminated.
- Watch for dangerous situations; strong, irritating, and/or nauseating odors; airborne dusts or vapors; and broken containers. Report all potentially dangerous situations to the FTL or HSO.
- Prevent releases of oil or hazardous materials used in task operations. 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.
- Avoid splashing of contaminated materials during decontamination.
- Keep all ignition sources at least 50 ft from an explosive or flammable environment and use non-sparking, explosion-proof equipment where appropriate.
- Be familiar with the physical characteristics of the task site (including but not limited to):
  - Wind direction
  - Accessibility of 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.

- Workers in the exclusion zone shall be in line-of-sight contact and within shouting distance of their buddy at all times.
- 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.

## 7.2 Action Limits for Radiological Controls

- 1. All personnel will be limited to 10 mR/person/day. If personnel receive 10 mR in one day, the person must leave the area of exposure for the remainder of the day. Considering the highest reading in the ponds at the present time is 2 mR/hr the radiation levels must increase significantly for personnel to receive the 10 mR limit.
- 2. Work will stop if direct readings reach 5 mR/hr at any sampling location or if any sample removed from the pond reads 5 mR/hr. The area must be put into safe shutdown condition (i.e., the auger drill rig will be shut off, sampling equipment will be bagged, personnel will evacuate the sampling area, and the FTL will confer with the HPT, IH, and RE concerning PPE and documentation changes and sample analysis to determine concentration levels).
- 3. Work will stop if contamination levels exceed Zone II levels. The actions are the same as above; the area will be put into safe shutdown condition, sampling equipment will be bagged, personnel will evacuate the sampling area, and the FTL will confer with the HPT, IH, and RE concerning PPE and documentation changes.

# 7.3 Action Limits for Organic Vapors

If during initial monitoring for organic vapors at any of the sampling locations, total volatile organics are detected by the direct reading instrument (HNu or equivalent) at 10 ppm above background or greater work will be discontinued at that location until the hazard has been identified. Actions necessary for mitigation of the identified hazard will be determined by the IH, HPT, and FTL. Upon recommencement of sampling activities, periodic sampling of the breathing zone air will be monitored for organic vapors. Activities will be suspended and workers evacuated from the area if concentrations of volatile organics remain above 10 ppm in the breathing zone. Personnel will then be required to wear appropriate PPE as determined necessary by the IH before returning to work in the area.

# 7.4 The Buddy System

The buddy system will be used at the SLP sampling site to ensure each worker's mental and physical well being is monitored during the course of a work day. By using the buddy system, task operations personnel can reduce the chance of being injured or overcome by a hazardous material when they are alone and in need of immediate assistance. Task site personnel will be assigned a buddy by the FTL to work with and regularly check on during the days. Each person should be on the alert for signs and symptoms of illness and injury of their buddy.

# 8. SITE CONTROL AND SECURITY

### 8.1 Radiological Contamination Zone

Since each of the cells of the SLP are radiologically contaminated, the SLP will be the radiological contamination Zone II for contamination control. Personnel will remove anti-C clothing when exiting each cell of the pond.

# 8.2 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 exclusion zone will be the SLP surrounded by its immediate bermed perimeter (refer to Figure 2).

## 8.3 Contamination Reduction Zone

The contamination reduction zone is a transition area that surrounds the exclusion zone, and is located between the exclusion zone and the support zone. A designated portion of this zone, called a decontamination corridor, will serve as a decontamination area for equipment and a PPE removal area for task operations personnel. The contamination reduction zone may serve as a staging area for equipment and a temporary rest area for workers. Due to the potential for contamination, PPE and sample packaging and preparation equipment should <u>not</u> be stored here.

## 8.4 Support Zone

The support zone is the area outside the contamination reduction zone. It may contain the equipment trailer, command post, vehicle parking, additional equipment staging, or any support activity related to the task at hand.

## 9. DECONTAMINATION PROCEDURES

Personnel decontamination from the contamination zone will follow Zone II removal steps:

- 1. Remove outer shoe covers
- 2. Remove latex gloves
- 3. Remove hood
- 4. Remove respirator
- 5. Remove coveralls and shoe covers (remove shoe covers during process of stepping out of the contamination zone)
- 6. Remove cloth glove liners.

Note: The HPT will also provide guidance for personnel exiting the contamination zone.

All equipment used for the sampling activities will be surveyed by the HPT prior to removal from the site. For uncontrolled release, all equipment must be <100 cpm above background beta-gamma direct scan, no detectable alpha contamination by direct scan; and <200 disintegrations per minute  $(dpm)/100cm^2$  beta-gamma and <20 dpm/100cm<sup>2</sup> alpha for smearable contamination. If the equipment surveyed meets the criteria above, Form EGG-27A, "Release Tag," will be issued by the HPT.

### 9.1 Decontamination During Medical Emergencies

If a person is injured or becomes ill, the situation will be evaluated by first aid personnel on the task site. Emergency care will be initiated and the emergency preparedness procedure for the facility at which the task is being performed will be activated. Medical care for serious injury/illness will NOT be delayed for decontamination. In such cases, gross contamination may be removed by removal of the injured person's outer protective gear (if possible). Additional decontamination may be performed at the medical facility. The IH and/or HPT may accompany the employee to the medical facility to provide information and decontamination assistance to medical personnel.

# 9.2 Equipment Decontamination and Disposal of Contaminated Materials

Equipment decontamination will take place in accordance with the procedures described in the SAP for this project. Pure water and unused soil sample material will be left in the SLP as described in the SAP.

## **10. EMERGENCY PROCEDURES, EQUIPMENT, AND INFORMATION**

All personnel should be familiar with the following site-specific information. This information will be part of the pre-job briefing.

# **10.1 Emergency Actions**

The following are the responses to be taken during the specified situation. These situations will always require immediate action but do not necessarily require immediate evacuation of the site. The FTL will determine where personnel shall go for the duration of the following events:

- Lightning or approach of electrical storm—Work shall be halted until the storm has completely passed.
- Unexpected contamination—Work shall be halted until the contamination can be evaluated and proper precautions can be taken in terms of PPE and the adequate containment of the contamination.
- High winds—Work will be halted until the FTL and HSO have determined that the winds have abated enough to allow safe operations.

### **10.2 Emergency Procedures**

Response to emergencies at the work site will be coordinated between the FTL, IH, HPT, and the HSO. In emergencies that require immediate evacuation, such as fires, explosions, or other catastrophic events, personnel on the site shall be notified by the FTL or designee by radio or using the horns on vehicles at the site. Personnel inside the exclusion zone will be immediately informed by a person outside of the zone and will evacuate at once. Decontamination will be secondary to evacuating the site in a timely fashion. All personnel will meet in the support zone and await instructions from the FTL or designee. In SLP site emergencies, the FTL is responsible for calling the Warning Communications Center. If the emergency is for the INEL or TRA, the SLP personnel will follow the emergency action procedures for TRA.

### **10.3 TRA Emergency Action Procedures**

#### 10.3.1 Steady Siren

If a steady siren from TRA sounds, personnel are to take cover in the designated take cover areas within TRA; the Materials Test Reactor (MTR) basements (TRA-603, 604) and the Advanced Test Reactor (ATR) basement (TRA-670). The MTR basements are the preferred location. Personnel at the SLP site are to immediately report to the FTL. Evacuation to the TRA Guardgate will proceed in as few vehicles as practicable. After arriving at TRA, personnel will proceed to the take cover locations as directed by the security guard at the main guardgate. When traveling to the TRA facility and once inside the facility, personnel should pay close attention to the environment around them and avoid any hazardous areas.

#### 10.3.2 Alternating Siren

The alternating siren at TRA indicates that personnel must evacuate the facility. SLP personnel are to check the direction lights located on the MTR and Engineering Test Reactor (ETR) building rooftops. An "S" indicates the evacuation is to the south staging area located near the front of the TRA main guardgate; an "E" indicates the east staging area located south of the SLP. If an "S" is shown on the rooftops personnel will report to the FTL and evacuation will proceed to the staging area in as few vehicles as practicable. Once at the staging area personnel will line up at the sign marked "VISITORS AND OTHERS" while waiting for the evacuation buses. If an "E" is shown on the rooftops, personnel are to report to the east staging area and line up at the sign marked "VISITORS AND OTHERS" while waiting for the evacuation buses.

Changes to this evacuation procedure, if required due to relocation of the evacuation buses in the east staging area, will be communicated to all task workers prior to beginning work.

## **10.4 Emergency Equipment**

Personnel will be briefed on the location of emergency equipment onsite.

The following equipment will be on hand at all times:

- Fire extinguishers (1) 20-lb ABC fire extinguisher
- First aid kits (1)
- 15-min eye wash
- FNET two-way radios (2)
- Radiological spill kit
- Sufficient supply of clean water and hand soap
- Self-contained breathing apparatus (SCBA)
- Decontamination wash solution.

The FTL is responsible for ensuring that this equipment is on hand and for verifying its readiness for use prior to beginning work.

### **10.5 Evacuation Route**

The main evacuation route from the SLP site will be by dirt roads to the east and south to the TRA guard gate depending on conditions present. Figure 6 is a map of the evacuation route. Because of the proximity of the site to the TRA facility and the Warm Waste Pond, all evacuations will be the east and/or south. If the emergency is site-wide, the evacuation from the site will be to the area designated by the TRA emergency evacuation procedures.



Figure 6. Emergency evacuation route between TRA and the CFA dispensary.

# Emergency Reference List for (TRA Sewage Pond Sampling)

To be posted at the trailer or staging area.

•	Warning Communications Center	526-1515
•	Area Emergency Action Director TRA (W. W. Gay III)	526-4438
•	First Aid (CFA Dispensary CF-603)	526-2356
•	Occupational Medical Program (Willow Creek Building (WCB) Dispensary)	526-1596
•	Fire	777
•	Security	777
٠	Explosives expert (R. C. Green)	526-2702
٠	Hazardous Materials (HAZMAT) Team (CFA Fire Station)	777
•	Environmental Engineer (R. D. Johnson)	526-4201
•	Radiological Engineer (S. T. Laflin)	526-4840
•	Safety/Industrial Hygiene (R. T. Evans) (D. K. Nims)	526-5741 526-5935
•	Health Physics (R. D. Sayer, CFA Health Physics Mgr.)	526-6619
•	Project Manager (H. Salomon)	526-8021
•	Program Manager (L. C. Van Deusen)	526-6383

• Field Team Leader (Environmental Technology Group Unit personnel to be determined (TBD))

# **11. REFERENCES**

- 1. M. H. Doornbos, et al., Environmental Characterization Report for the Test Reactor Area, Rev. 0, EGG-WM-9690, EG&G Idaho, Inc., September 1991, pp. 4-1 - 4-10.
- 2. R. D. Kuchenrither and S. I. McMillan, "Preview Analysis of National Sludge Survey," BioCycle, 31, 7, July 1990, pp. 60-62.