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Environmental Restoration Division
ORNL Environmental Restoration Program

# Comprehensive Work Plan and Health and Safety Plan for the 7500 Area Contamination Site Sampling at Oak Ridge National Laboratory, Oak Ridge, Tennessee

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Oak Ridge National Laboratory

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## DISCLAIMER

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**Comprehensive Work Plan and Health and Safety Plan for the 7500 Area Contamination Site Sampling at Oak Ridge National Laboratory, Oak Ridge, Tennessee (ORNL/ER-93)**

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| 15.2 Purchased items and services control | N/A | N/A | 7. Purchased items and services control |
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| 15.4 Inspection, testing, and operating status | N/A | N/A | 14. Inspection, test, and operating status |
| 15.5 Control of nonconforming items | N/A | N/A | 15. Control of nonconforming items |
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| 15.7 Software | N/A | N/A | 19. Software |
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|---|---|---|---|
| 15.10 Document control | N/A | N/A | 6. Document control |
| 16. Health and safety plan | N/A | N/A | N/A |
| 17. References | N/A | N/A | N/A |

[a]*Comprehensive Work Plan and Health and Safety Plan for the 7500 Area Contamination Site Sampling at Oak Ridge National Laboratory, Oak Ridge, Tennessee*, ORNL/ER-93, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., May 1992.

[b]*Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, Interim Final, EPA/540/G-89/004, OSWER Directive 9355.3-01, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., October 1988.

[c]*Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80, EPA-600/4-83-004, NTIS PB-83-170514, Office of Monitoring Systems and Quality Assurance, Office of Research and Development, U.S. Environmental Protection Agency, December 1980.

[d]*Quality Assurance Program Requirements for Nuclear Facilities*, ANSI/ASME NQA-1, American Society of Mechanical Engineers, New York, N.Y., 1989.

# FIGURES

# TABLES

# ABBREVIATIONS

| | |
|---|---|
| ACGIH | American Conference of Governmental Industrial Hygienists |
| ACS | American Chemical Society |
| ANSI | American National Standards Institute |
| APM | analytical project manager |
| ASME | American Society of Mechanical Engineers |
| BNA | base/neutral acid |
| BNC | standard size coaxial connector |
| CAT | Chemical Assessment Team |
| CGI | combustible gas indicator |
| CLP | Contract Laboratory Program |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| ER | environmental restoration |
| FID | flame ionization detector |
| GC | gas chromatography |
| GFAA | graphite-furnace atomic absorption spectroscopy |
| GM | Geiger-Mueller |
| HASRD | Health and Safety Research Division |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| HAZWRAP | Hazardous Waste Remedial Action Program |
| HEPA | high-efficiency particulate air |
| HNU | brand name of a typical ultraviolet photoionization detector |
| ICP | inductively coupled plasma spectroscopy |
| IH | industrial hygiene |
| ILM | inorganic laboratory management |
| LCS | laboratory control sample |
| LEL | lower explosive limit |
| LUFT | leaking underground fuel tank |
| MAD | Measurement Applications and Development Group |
| MDA | minimum detectable activity |
| MHV | standard size high-voltage connector |
| MS | mass spectrometry |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| MSHA | Mine Safety and Health Administration |
| NIOSH | National Institute for Occupational Safety and Health |
| NIST | National Institute of Science and Technology |
| OLM | organic laboratory management |
| ORNL | Oak Ridge National Laboratory |
| OSHA | Occupational Safety and Health Administration |
| OVM | organic vapor monitor |
| PA | public address |
| PEL | permissible exposure limit |

| | |
|---|---|
| PID | photoionization detector |
| QA | quality assurance |
| QAC | quality assurance coordinator |
| QAO | quality assurance officer |
| QAS | quality assurance specialist |
| QAPjP | quality assurance project plan |
| QC | quality control |
| RCRA | Resource Conservation and Recovery Act |
| RF | response factor |
| RFI | RCRA Facility Investigation |
| RPD | relative percent difference |
| RSD | relative standard deviation |
| SHSO | site health and safety officer |
| SOP | standard operating procedure |
| SOW | Statement of Work |
| SPM | site project manager |
| TCE | trichloroethylene |
| TIC | tentatively identified compounds |
| TLD | thermoluminescent detector |
| TLV | threshold limit value |
| TRU | transuranic |
| VOA | volatile organic analysis |
| VOC | volatile organic compound |

# EXECUTIVE SUMMARY

As part of the Environmental Restoration Program sponsored by the U.S. Department of Energy's Office of Environmental Restoration and Waste Management, this plan has been developed for the environmental sampling efforts at the 7500 Area Contamination Site, Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee. This plan was developed by the Measurement Applications and Development Group (MAD) of the Health and Safety Research Division of ORNL and will be implemented by ORNL/MAD.

Major components of the plan include (1) a quality assurance project plan that describes the scope and objectives of ORNL/MAD activities at the 7500 Area Contamination Site, assigns responsibilities, and provides emergency information for contingencies that may arise during field operations; (2) sampling and analysis sections; (3) a site-specific health and safety section that describes general site hazards, hazards associated with specific tasks, personnel protection requirements, and mandatory safety procedures; (4) procedures and requirements for equipment decontamination and responsibilities for generated wastes, waste management, and contamination control; and (5) a discussion of form completion and reporting required to document activities at the 7500 Area Contamination Site.

# 1. INTRODUCTION

## 1.1 INTRODUCTION

As part of the Environmental Restoration (ER) Program at the Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL), located in Oak Ridge, Tennessee, this work plan has been developed for the environmental sampling along waste drainage lines in the vicinity of the 7500 Area Contamination Site. The site is located in Melton Valley near ORNL grid coordinates (measured in feet) N18,100 and E32,400, north of the Radiochemical Engineering Development Center/High Flux Isotope Reactor (REDC/HFIR) and west of the REDC/HFIR access road. The area of investigation begins approximately 100 ft north of the contamination site, extends southward through the contamination area, and follows the waste lines across the unpaved parking lot, ending at the asphalt-covered parking lot, a total distance of approximately 600 ft. The area between the contamination site and the valve pit northwest of the site will also be investigated, as will the ditch on the east side of the REDC/HFIR access road at the site. The approximate positions of proposed sample locations are given in Fig. 1.1. Exact sample locations will be determined by Engineering.

## 1.2 SCOPE AND OBJECTIVES

This environmental sampling effort will be implemented to identify (1) radiological hazards that could affect the health of the human population, (2) the chemicals present at the point believed to contain the highest concentration of contaminants, and (3) the type and the location of any radiological contamination. Sampling methods and procedures will be presented in Sect. 4; analytical methods will be outlined in Sect. 7. The health and safety section (Sect. 16) specifies procedures for the safety of the sampling team and others associated with this investigation. Potentially hazardous constituents that might possibly be associated with this sampling effort are identified, to the best of our ability, in Sect. 16.3.3.

## 1.3 QUALITY ASSURANCE PROJECT PLAN

A quality assurance project plan (QAPjP) is incorporated into this document in accordance with elements described in the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.*[1] Section 15 (Additional NQA-1 Elements) of the present document also satisfies requirements of the *Quality Assurance Program Requirements for Nuclear Facilities (NQA-1).*[2] The QAPjP specifies the organization, responsibilities, and procedures for the safe completion of the project and for compliance with regulations.

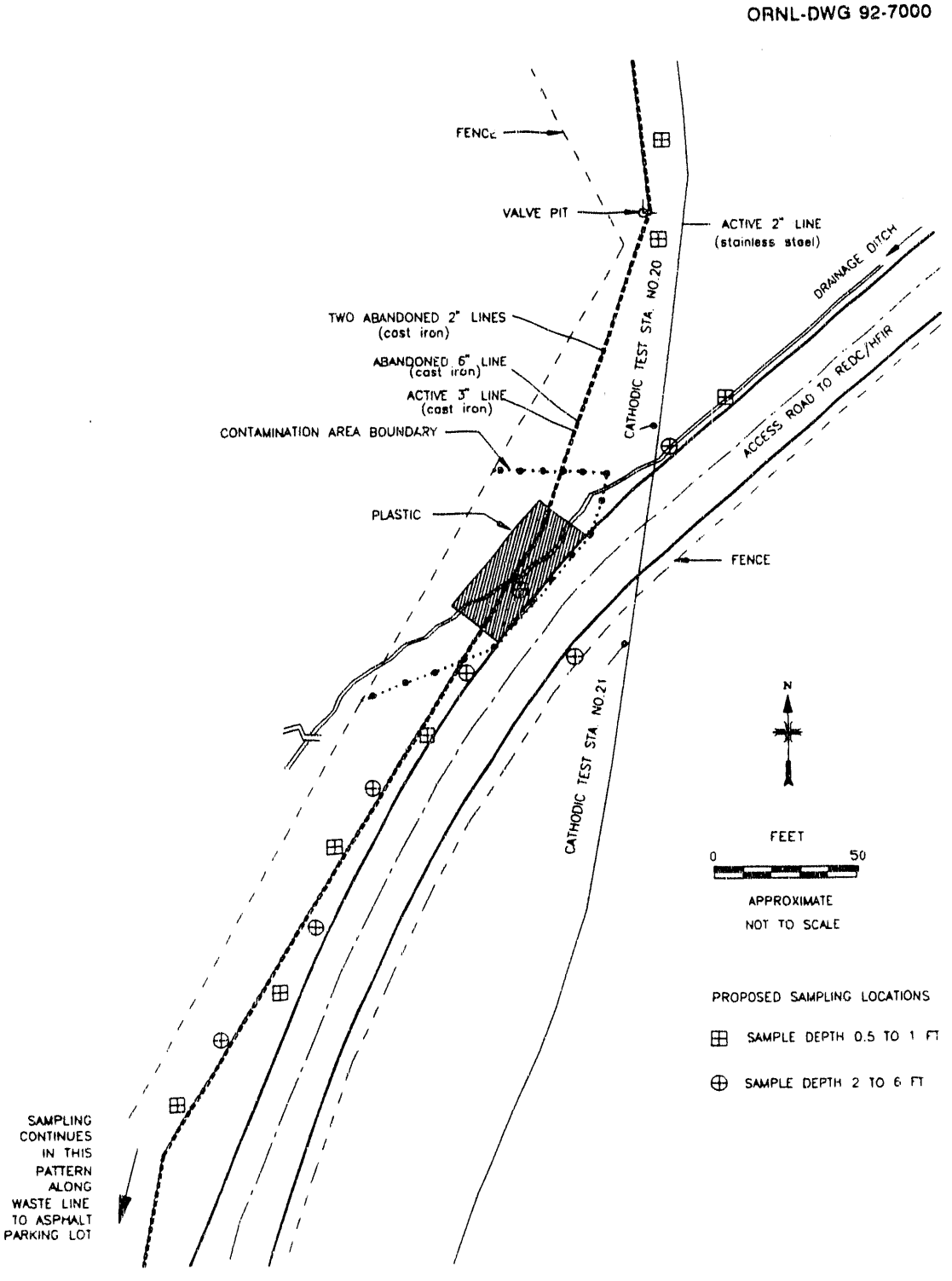


**Fig. 1.1. Diagram of the 7500 Area Contamination Site showing proposed sampling locations.** Exact sampling locations will be determined by Engineering.

# 2. PROJECT ORGANIZATION AND RESPONSIBILITIES

Health and safety aspects of this document conform to the Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.120,[3] as defined by the final rule of March 1989 and supplement to the final rule, April 18, 1991. ORNL Measurements Applications and Development Group (MAD) will designate the site health and safety officer (SHSO) and alternates, who will implement, monitor, and enforce the plan. All health and safety personnel assigned to this effort, as well as auxiliary health and safety representatives, are listed in this section; responsibilities are listed in Sect. 16.1. The emergency contingency plan and all associated numbers are listed in Sect 16.2.

Figure 2.1 is an organizational chart for management of the 7500 Area Contamination Site investigative project. Table 2.1 is a listing of key project personnel and their affiliations and phone numbers, including backups for key project personnel where appropriate. If necessary, the site project manager (SPM) or SHSO may designate qualified alternates who are not identified in the table to conduct their respective duties in the field.

## 2.1 ORNL ER PROGRAM MANAGER

The ORNL Environmental Restoration (ER) Program Manager is responsible for overall management of ORNL ER Program personnel and activities and for providing budgetary and programmatic information to the central ER and ORNL plant management.

## 2.2 ORNL ER PROGRAM REMEDIATION MANAGER

The ORNL ER Program Remediation Manager is responsible for remedial investigation efforts at ORNL, including scheduling, budgeting, project management oversight, and reporting.

## 2.3 ORNL ER PROJECT MANAGER

The ORNL ER Project Manager is responsible for managing and coordinating field activities associated with the 7500 Area Contamination Site investigation. Development and implementation of investigation efforts include

1. coordinating the support personnel required for field activities,
2. notifying the Laboratory Shift Superintendent of plans and scheduled activities,
3. obtaining required documentation and permits,
4. ensuring that all support personnel have an up-to-date medical examination and are placed in the Respiratory Protection Program if necessary,
5. oversight of sampling activities, and
6. determining and communicating site project objectives.

# PROJECT ORGANIZATION CHART
# 7500 AREA CONTAMINATION
# SITE SAMPLING

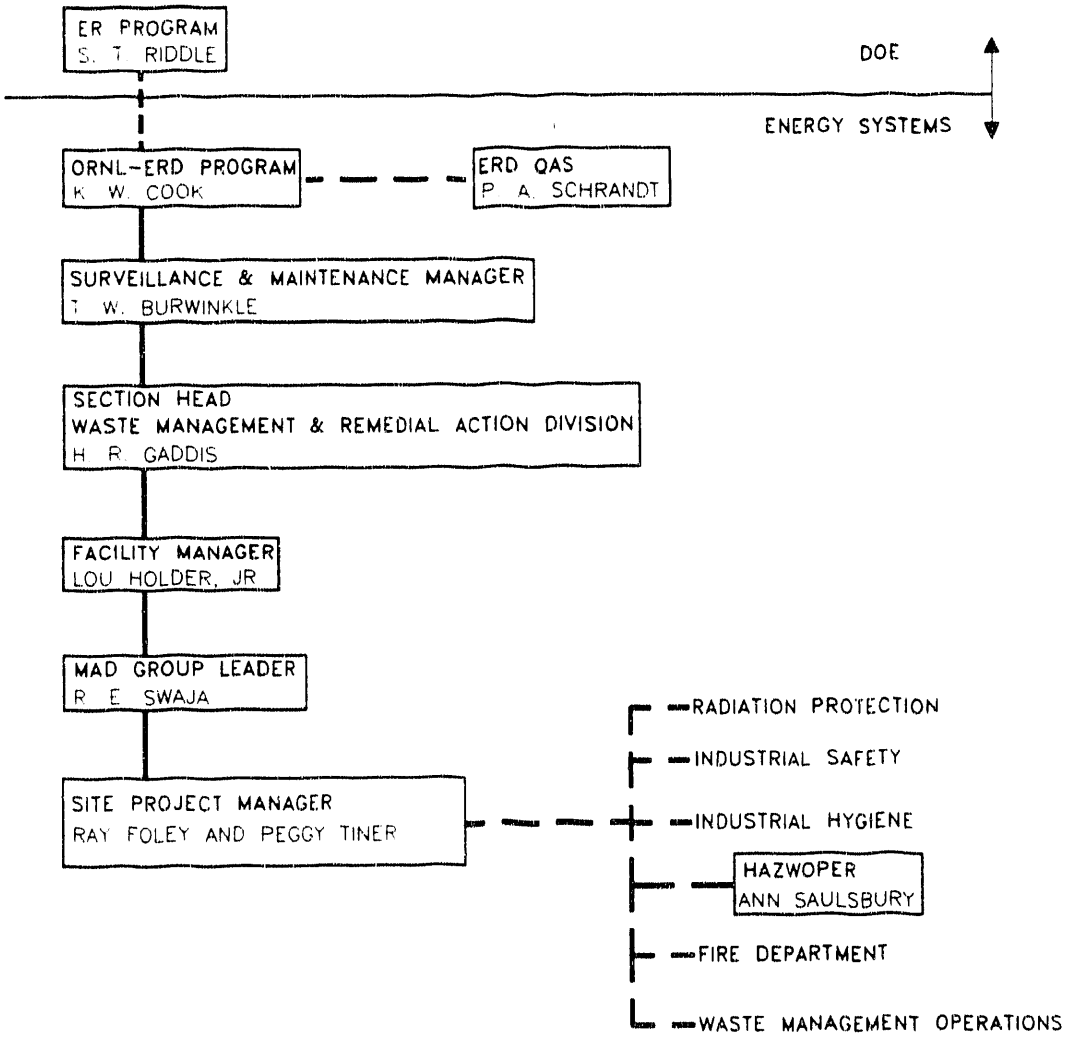


**Fig. 2.1. Organizational chart.**

**Table 2.1. Key project personnel and affiliations**

| Responsibility | Name | Telephone |
|---|---|---|
| ORNL Technical Project Oversight | Ray Foley | 574-1777 |
| Alternate Technical Project Oversight | Debbie Roberts | 574-5836 |
| ORNL Site Project Manager (SPM) | Peggy Tiner | 574-5379<br>or on site |
| Alternate SPMs | Ray Foley | 574-1777 |
| Site Health and Safety Officer (SHSO) | Paul Abston | 576-7362<br>or on site |
| Alternate SHSOs | Glen Cofer | 576-7362 |
| ORNL/MAD Analytical Project Manager (APM) | Terry Hatmaker | 574-9940 |
| ORNL/MAD Group Leader | Dick Swaja | 576-5212 |
| ORNL/MAD Quality Assurance Officer | Richard Mathis | 574-5832 |
| ORNL ER Program Manager | Ken Cook | 576-0311 |
| ORNL ER Program Remediation Manager | Sid Garland | 574-8581 |
| ORNL ER Project Manager | Ray Gaddis | 576-0224 |
| ORNL ER Quality Assurance Specialist | Pete Schrandt | 576-9926 |
| Industrial Hygiene<br>HAZWOPER | Ann Saulsbury<br>Pager number | 576-5064<br>564-5805 |
| Industrial Safety | J. D. Miller | 574-6680 |
| Radiation Protection | Hal Butler or<br>Ron Mlekodaj | 574-6692<br>574-4996 |
| HP Technician by Area of Responsibility | To be determined | 574-0371 |
| ER Field Coordination Manager | Charles Clark | 574-8268 |
| ORNL Waste Management Operations | Tom Scanlan | 574-4562 |
| Office of Environmental Compliance & Documentation (Spill Containment) | Bill Alexander | 574-8770 |
| Laboratory Shift Superintendent | | 574-6606 |

## 2.4 ORNL/MAD QUALITY ASSURANCE OFFICER

The ORNL/MAD Quality Assurance Officer (QAO) is responsible for the following:

- assisting the SPM in resolving quality-related issues;
- reviewing QAPjPs;
- reviewing project plans and procedures to ensure that all aspects of quality requirements have been adequately considered and addressed;
- conducting quality surveillances (see Sect. 10), as necessary, of ORNL/MAD activities to verify and document compliance with established procedures; and
- following up corrective actions associated with audit or surveillance reports.

Quality-related reports for ORNL ER Program projects will be provided to the ORNL ER Program Remediation Manager.

## 2.5 ORNL ER QUALITY ASSURANCE SPECIALIST

The Quality Assurance Specialist (QAS) is responsible for the following items:

- assisting the SPM to resolve quality-related issues;
- reviewing and approving QAPjPs;
- reviewing project plans and procedures to ensure that all aspects of quality requirements have been adequately considered and addressed;
- conducting quality audits and surveillances (see Sect. 10), as necessary, to verify and document compliance with established procedures; and
- following up on corrective actions associated with audit or surveillance reports.

Quality-related reports for ORNL ER Program projects will be provided to the ORNL ER Program Remediation Manager. The ORNL ER QAS will compile all quality-related reports, audit findings and surveillance observations, and coordinate with other members of the quality team to ensure that each member receives the appropriate information.

## 2.6 RESPONSIBILITIES OF THE SPM

The SPM is responsible for oversight of the entire environmental sampling effort. He/she will be responsible for site accessibility, safety, quality assurance (QA), and waste management and will delegate further responsibilities to other members of the ORNL/MAD sampling team that are determined to be qualified by the SPM. Responsibilities of the SPM require him/her to access all zones (support, contamination reduction, and exclusion) (see Sect. 16.5 ); therefore, he/she may potentially be exposed to all hazards associated with all duties at the site. Prior to entering the contamination reduction zone or exclusion zone, the SPM shall don

the protective equipment required by the SHSO for activities within that area of the site. Specific responsibilities of the SPM are listed below.

1. coordinates site operations, including logistics;
2. interfaces with plant and project personnel;
3. assists the SHSO when necessary;
4. participates in site characterization activities;
5. assures that all quality-related activities are conducted in accordance with prescribed QA procedures;
6. notifies appropriate personnel of work schedules;
7. maintains and controls all site records (maintains training records on-site);
8. determines in-field procedural variances in response to changing site conditions (see Sect. 13.2);
9. documents and reports unforeseen site changes and corrective actions; and
10. coordinates waste disposal following procedures established by ORNL ER and ORNL Waste Management Operations.

## 2.7 RESPONSIBILITIES OF THE ORNL/MAD ANALYTICAL PROJECT MANAGER

The ORNL/MAD Analytical Project Manager (APM) coordinates the sampling and analysis for this project with the analytical laboratory. The APM ensures that the proper analytical methodology and quality assurance/quality control (QA/QC) is implemented.

# 3. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The procedures in this comprehensive work plan have been written to ensure accuracy, precision, completeness, representativeness, and comparability of field monitoring, procedural activities on site, and the resultant analytical data. QC Level III[4] will be required for the analytical data. The precision and accuracy of analytical methods outlined in Sect. 7 are provided in Table 3.1. The values in Table 3.1 represent the total of the historical data currently available to the U.S. Environmental Protection Agency (EPA). Level I[4] instrumentation (see Table 3.2) will be employed for field monitoring activities.

**Table 3.1. Summary of precision, accuracy, and completeness criteria for soil sample analytes**

| | | Criteria | | |
|---|---|---|---|---|
| Analytes | Technique | Precision (% RSD)[a] | Accuracy (% Bias) | Completeness (%) |
| | | *Volatiles* | | |
| Chloroform | Purge & | 8.0 | -0.1 | 90% |
| 1,2-Dichloroethane | trap GC/MS | 13.1 | +11.1 | 90% |
| Dibromochloromethane | " | 35.0 | -12.0 | 90% |
| Benzene | " | 32.1 | -10.3 | 90% |
| Bromoform | " | 16.6 | -12.1 | 90% |
| 2-Hexanone | " | 16.6 | -45.5 | 90% |
| Toluene | " | 13.8 | +13.7 | 90% |
| Chlorobenzene | " | 21.2 | +13.2 | 90% |
| | | *Semivolatiles* | | |
| 1,4-Dichlorobenzene | GC/MS | 27 | -51 | 90% |
| Nitrobenzene | GC/MS | 21 | -48 | 90% |
| Isophorone | GC/MS | 24 | -47 | 90% |
| 2-Nitrophenol | GC/MS | 35 | -36 | 90% |
| 2,4-Dichlorophenol | GC/MS | 31 | -59 | 90% |
| 1,2,4-Trichlorobenzene | GC/MS | 28 | -43 | 90% |
| Penta chlorophenol | GC/MS | 17 | -48 | 90% |
| Pyrene | GC/MS | 25 | -15 | 90% |
| 2-Methylnaphthalene | GC/MS | 26 | -42 | 90% |
| bis-(2-Ethylhexyl)phthalate | GC/MS | 33 | -2 | 90% |
| Phenol | GC/MS | 38 | -27 | 90% |
| Acenaphthylene | GC/MS | 26 | -27 | 90% |
| Diethyphthalate | GC/MS | 16 | -20 | 90% |

**Table 3.1 (continued)**

| Analytes | Technique | Criteria: Precision (% RSD)[a] | Criteria: Accuracy (% Bias) | Criteria: Completeness (%) |
|---|---|---|---|---|
| | | *Metals* | | |
| Aluminum | ICP | 14.4 | -79.8 | 90% |
| Cadmium | ICP | 33.3 | +2.9 | 90% |
| Calcium | ICP | N.A.[b] | -4.2 | 90% |
| Chromium | ICP | 7.8 | -6.1 | 90% |
| Copper | ICP | 11.2 | -2.5 | 90% |
| Iron | ICP | 10.7 | -27.0 | 90% |
| Lead | Furnace AA | 9.2 | -2.2 | 90% |
| Magnesium | ICP | 7.5 | -10.6 | 90% |
| Manganese | ICP | 9.4 | -15.1 | 90% |
| Mercury | Cold vapor | 25.0 | -9.1 | 90% |
| Nickle | ICP | 15.0 | -17.0 | 90% |
| Tin | ICP | 44.1 | N.A.[b] | 90% |
| Zinc | ICP | 5.8 | -6.2 | 90% |

[a]Percent relative standard deviation.
[b]Not available.

*Source: Quality Control in Remedial Site Investigation: Hazardous and Industrial Solid Waste Testing*, Fifth Volume, ASTM STP 925, C. L. Perket, Ed., American Society for Testing Materials, Philadelphia, 1986.

**Table 3.2. Summary of sensitivity, precision, and accuracy criteria for Level I monitoring instrumentation**

| Analytes | Instrument technique | Instrument range | Sensitivity | Precision | Accuracy |
|---|---|---|---|---|---|
| Organics | OVM photoionization | 0.1-2000 ppm isobutylene ($C_4H_8$) | 0.1 ppm isobutylene ($C_4H_8$) | N.A. | N.A. |
| Organics | HNU photoionization | 0.1-2000 ppm benzene ($C_6H_6$) | 0.1 ppm benzene ($C_6H_6$) | ±1% scale deflection | N.A. |
| Alpha emitters | ZnS scintillation | 0-3x$10^6$ dpm | 25 dpm | N.A. | ±20% |
| Beta & gamma emitters | GM pancake gas ionization | 0-500x$10^3$ dpm $^{90}Sr$ | Background dependant | N.A. | ±20% |
| Beta & gamma emitters | GM side window gas ionization | 0–250 mR/h $^{137}Cs$ | Background dependant | N.A. | ±20% |
| Gamma emitters | NaI scintillation | 0-3 mR/h $^{137}Cs$ | Background dependant | N.A. | ±20% |

# 4. 7500 AREA CONTAMINATION SITE SAMPLING PROCEDURES

Sampling activities at the 7500 Area Contamination Site will include the collection of two types of samples: chemical and radiological. Three different methods may be employed for the collection of sample material for analytical interpretation: (1) stainless steel T-handled barrel auger, (2) stainless steel split spoon, and (3) stainless steel trowel or scoop for shallow samples. All personnel-protective equipment and clothing requirements for workers on this investigative site can be found in Sect. 16.6 of this document.

Duplicate samples of soil will be collected, using the procedures described below, and analyzed for all site-specific analyte parameters. The number of duplicate samples collected should equal ~10% of the total number of samples collected. Results from these duplicate samples will not be used solely to judge laboratory performance; this is a reconnaissance soil sampling program in which an assessment of sampling variability will be useful.

## 4.1 ESTABLISHING SAMPLING LOCATIONS

For the collection of soil samples destined for chemical analysis, a single sampling location, determined by ORNL ER, will be established within the confined, plastic-covered area along the REDC/HFIR access road (see Fig. 1.1). The samples will be collected as close to the waste lines as possible at depths even with or below the lines. For the collection of soil samples destined for radiological analysis, both biased and systematic sampling locations will be established. Shallow surface biased samples, to depths of ~12 in., utilizing a breaker bar or auger, will be collected at hot spots identified during the surface gamma and beta-gamma scan recently conducted by ORNL/MAD. Systematic samples will be of two types: (1) subsurface soil samples, to depths of 2 to 6 ft, utilizing either the split spoon tube or the barrel augering system with intervals of 50 ft between sampling locations and, (2) shallow punch holes, to depths of ~12 in., made with a breaker bar or auger at the midpoints of the 50-ft-sample intervals or 25 ft from the last deep sample. The hole will be checked with a beta-gamma detector and a gamma detector, and readings will be recorded on the Hole Logging and Sample Data Sheet (Fig. 4.1). The soil removed from the hole will be checked for radiological contamination, and readings will be recorded on the same data sheet. If the beta-gamma count rate in any of the shallow holes is 50% greater than the surface reading, or if contamination is detected in the soil removed from the hole, that hole will be further sampled by means of the split spoon to a depth of 2 to 6 ft, the depth depending upon subsequent readings in the hole. A water sample will be collected, after a rain, at the culvert next to the construction access road and analyzed for radiological contamination.

## 4.2 SAMPLING PROCEDURES USING A BARREL AUGER

This procedure describes the method used for collecting subsurface soil samples using a manually operated barrel auger. This procedure can be found in ESH/Sub/87/27/106/1,[5] Sect. ESP 303-2. This method of collecting soil samples is best employed in soils with little or no gravel. A barrel auger is used to penetrate soil to a desired depth and obtain a soil sample. The auger consists of a barrel attached to an orchard bit. The bit cuts the soil and

HOLE LOGGING AND SAMPLE DATA SHEET

DATE:_____ SURVEYORS:_____

PROPERTY: _____ INSTRUMENTS: _____ _____

_____ _____ _____

HOLE NO._____ GRID LOCATION:_____

| γ SCINT. LOGGING DATA | | | β/γ LOGGING DATA | | | SAMPLE NO. | SAMPLE DEPTH ( ) |
|---|---|---|---|---|---|---|---|
| DEPTH ( ) | Shielded CTS/ | Unshielded CTS/ | DEPTH ( ) | Shielded CTS/ | Unshielded CTS/ | | |
| | | | | | | | |
| | | | | | | | |
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Fig. 4.1. Hole Logging and Sample Data Sheet.

the cuttings are forced into the barrel. The barrel holds the sample and prevents contact of the sample with the sidewalls of the borehole, which eliminates the potential for cross contamination of the soil sample with other parts of the borehole. The method is designed to collect a shallow soil sample (0 to 6 in. maximum depth per barrel auger). Multiple augering, with the addition of extension poles, can result in the collection of deeper samples. Continued augering and collection of soil is required until enough soil has been retrieved for analysis. Normally, four barrel augers of soil are required to provide a sufficient sample for all the analyses that are required.

Down hole, borehole logging will be conducted for the detection of both beta and gamma radioactivity throughout the hole. For beta, the Bicron Analyst with the G-M side window probe will be utilized. The probe will be wrapped in plastic and lowered to the bottom of the bore hole. The probe will be raised slowly, and the readings will be recorded (at the bottom and every 6 or 12 in. moving upward) on the Hole Logging and Sample Data Sheet (See Fig. 4.1).

### 4.2.1 Equipment

- safety goggles/glasses
- stainless steel clay auger ( 3 in. i.d.)
- permanent marker
- stainless steel spoon or scoop
- stainless steel homogenizing pan (for soil samples)
- field logbook and data sheets
- stainless steel auger equipment
- sample containers

### 4.2.2 Procedure

1. Decontaminate or clean the sampler and all down hole equipment prior to use according to procedures outlined in this plan. (See Sect. 16.9.)
2. Follow sampling procedure ESP 303-2, "Soil Sampling With An Auger," *Environmental Surveillance Procedures Quality Control Program*, ESH/Sub/87-21706/1,[5] for soil samples collected at this site.
3. Take radiological surface readings at the spot to be sampled and record the pertinent data in the field logbook or on the Hole Logging and Sample Data Sheet form.
4. Begin augering and continue until the desired sample volume has been successfully retrieved.
5. Carefully remove the auger from the sampling borehole.
6. Carefully transfer the material from the auger bucket into a precleaned stainless steel or onto a plastic sheet.
7. Scan the sample for radiological contamination and record the results in the field logbook or on the Hole Logging and Sample Data Sheet form.
8. Scan sample with the photoionization detector (PID). Collect the sample to be analyzed for volatile organics.
9. Isolate any elevated radiological material, containerize, and submit for analysis. Homogenize the rest of the sample with a stainless steel trowel or sampling tool and

transfer the material to precleaned jars according to sample jar/volumes required for each analysis (Sect. 4.6). The jars must be precleaned to EPA specifications.

10. If no elevated readings were found with the HNU or organic vapor monitor (OVM), return any excess soil to the borehole, following accepted procedures.
11. Record all data on the sample label and the chain-of-custody form (Fig. 4.2) and enter the appropriate information in the field logbook.
12. Place sample containers in cooler with frozen reusable ice packs (Blue Ice® or equivalent) for sample preservation and transportation. (Cooling will not be required for soil samples destined for radiological analysis.)
13. Decontaminate each piece of sampling equipment as described in Sect. 16.9, Equipment Decontamination Procedures.

## 4.3 SHALLOW SURFACE HAND TROWEL SAMPLING

Shallow sampling of soil (depths of 0 to 6 in.) for radiological contamination will be accomplished with a hand trowel. Procedures for sampling with a hand trowel can be found in the *Environmental Surveillance Procedures Quality Control Program*, ESH/Sub/87-21706/1, ESP-303-1.[5] The trowel will be composed of stainless steel and decontaminated prior to use. This method is best employed for areas of known radiological contamination.

### 4.3.1 Equipment

- stainless steel trowel
- plastic sheeting
- paper towels
- sample jars
- sample labels
- indelible black ink marker
- cooler
- frozen reusable ice packs
- field logbook and data sheets

### 4.3.2 Procedure

1. Using radiological instrumentation, locate the area that is to be sampled.
2. Place a piece of plastic next to the sampling location.
3. Record the radiological readings in the field logbook or on the Hole Logging and Sample Data Sheet form.
4. With vinyl gloved hands, dig a area about 6 in. in diameter and 6 in. deep; place the soil on the plastic sheet.
5. With the trowel, mix and composite the soil to a manageable consistency
6. To determine the areas of highest contamination in the soil to be sampled, scan it with the pancake detector.

ORNL/MAD CHAIN-OF-CUSTODY RECORD VERSION 1.5 PAGE ___ OF ___
OAK RIDGE NATIONAL LABORATORY, BLDG. 7503, MS-6382, P.O. BOX 2008
OAK RIDGE, TENNESSEE 37831-6382 TELEPHONE (615) 576-5212

SITE:_____ SAMPLE TYPE:_____ CONTAINER ID:_____

DATE SEALED:_____ SEAL TYPE:_____ SEAL NO:_____

| SAMPLE ID | LOCATION | DATE/TIME | REMARKS |
|---|---|---|---|
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CONTAINER GAMMA COUNT RATE:_____ INST. NO.:_____

CARRIER:_____ WAYBILL NO._____ DATE:_____

ORIGIN:_____ DESTINATION:_____

| RELINQUISHED BY | DATE/TIME | RECEIVED BY | DATE/TIME |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3 | | | |

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Fig. 4.2. ORNL/MAD Chain-of-Custody Record.

7. Without touching the soil, scoop up the sample with the trowel and place the soil into the precleaned sample bottle and secure the lid.
8. Affix the proper sample label and cap the jar
9. Scan the outside of the sample container, record the results in the field logbook, and place the container in a cooler with coolant packs (Blue Ice® or equivalent) at 4 ± 2° C. (Cooling will not be required for soil samples destined for radiological analysis.) Contact ORNL Radiation Protection for scanning before transport.
10. Following accepted procedures, place remaining soil back into the sampling hole.
11. Record all data on the sample label, chain-of-custody form, and enter the appropriate information in the field logbook.
12. Decontaminate each piece of sampling equipment as described in Sect. 16.9, Equipment Decontamination Procedures.

## 4.4 SPLIT SPOON SAMPLING

The split spoon sampler allows the collection of a continuous core sample with one application. Procedures for split spoon sampling are elaborated in the *Environmental Surveillance Procedures Quality Control Program*, ESH/Sub/87-21706/1,[5] ESP-303-4. The split spoon is composed of a stainless steel hollow stem tube, which, when pushed or drilled into the soil, allows for a continuous core sample to be obtained. If a depth of 4 or 6 ft is required, a second or third application into the same sample hole can be accomplished. The split spoon is threaded on each end with the nose of the tube designed for the acceptance of the shoe. A special extension device, an AW rod, is utilized to achieve support for the spoon. The AW rod has a metal plate and chain welded to one end and the sub, which accepts the threaded end of the split spoon, welded to the other end. The spoon can be threaded directly to the AW rod and held over the sampling location. A large piece of boomed equipment, like a track-hoe or back-hoe, can then place its bucket on the flat piece of metal and push the split spoon to the desired depth. When that depth has been achieved, the chain is looped over a tooth of the bucket and the spoon is physically extracted from the soil. Once the split spoon has been retrieved, the spoon is removed from the AW rod, the shoe is removed, and the spoon can be split in half to retrieve the sample inside. If an insufficient amount of sample is obtained from the first split spoon, a second attempt will be made right next to the first sample location in order to collect enough sample volume for analysis.

Before any split spoon sampling is undertaken at the 7500 Area Contamination Site, the exact depth and width of the trench holding the waste lines must be investigated. After the location of the waste lines has been surveyed and marked by Engineering, ORNL/MAD will attempt a careful excavation down to the lines at three or more points. To accomplish the excavation, a backhoe will be used to remove the hard-packed gravel on the surface; then a narrow trench, approximately 1 ft deep, will be dug by hand, and the backhoe will be used to widen this trench. This procedure will be repeated until the lines are reached; at this point, the digging will be completed by hand until the width of the trench holding the lines can be observed. The actual depth and width will be checked against the information obtained from

Engineering. If the information appears to be correct, sampling will be carried out as planned. Otherwise, sampling plans will be changed to make accommodation for the new information.

### 4.4.1 Equipment

- stainless steel split spoon sampler
- heavy equipment, i.e., back-hoe or track-hoe
- stainless steel pan or plastic sheet
- stainless steel trowel
- sample containers
- sample labels
- paper towels
- cooler
- frozen reusable ice packs
- field logbook and data sheets

### 4.4.2 Procedure

1. Locate the sampling location.
2. Scan the sampling spot with radiological instruments and record the results in the field logbook or on the Hole Logging and Sample Data Sheet form.
3. Attach precleaned split spoon to the sub, which is welded to the AW rod.
4. Stand the split spoon on end with the shoe on the sampling spot and the flat plate directly in the air.
5. Guide the bucket of the track-hoe to apply pressure to the AW rod until it does not need assistance to remain upright.
6. Stand clear of the boom when pressure is applied.
7. Use the track-hoe to apply pressure on the rod, forcing the split spoon to the desired depth (depth will vary based on the depth of the waste line at the sampling point).
8. Loop chain over a tooth of the bucket and lift the split spoon out of the ground.
9. Remove the split spoon from the sub.
10. Remove the shoe from the split spoon.
11. Separate the two sections of the spoon.
12. Scan the sample with radiological instruments.
13. Scan the sample with the PID. Select the area of the sample that has the highest PID reading and submit for volatile organic analysis. Record the depth that the sample was taken from in the field logbook or on the Hole Logging and Sample Data Sheet.
14. Select the areas of the sample with the highest radiological readings and submit for the appropriate radiological analysis. Record the depth that the sample was taken from in the field logbook or on the Hole Logging and Sample Data Sheet.
15. Place sample in appropriate containers (see Sect. 4.6) and cap.
16. Place label on jars.
17. Record all data on the sample label and chain-of-custody form and enter the appropriate information in the field logbook.

18. Scan sample container with radiological instruments.
19. Place samples in cooler at 4°C for shipment. (Cooling will not be required for soil samples destined for radiological analysis.)
20. Decontaminate each piece of sampling equipment as described in Sect. 16.9, Equipment Decontamination Procedures.

## 4.5 WATER SAMPLING

A water sample and a duplicate quality control water sample will be collected at the culvert near the area of new construction. To maximize the sample volume, the sample will be collected after a rain. The water sample will be analyzed for radiological contamination only (See Sect. 7).

### 4.5.1 Equipment

- stainless steel dipper on an extension pole
- sheet plastic
- paper towels
- sample containers
- sample labels
- cooler
- frozen reusable ice packs
- field logbook and data sheets

### 4.5.2 Procedure

1. Place sheet plastic close to the water's edge.
2. Members of the sampling team wear vinyl gloves.
3. Gently lower a precleaned stainless steel dipper into the water.
4. Try to avoid debris when acquiring the sample.
5. Remove the dipper, which now contains the sample.
6. Remove the cap from the proper sample container (see Sect. 4.6).
7. Hold the sample vial over the stream and slowly pour the sample into the container, which contains preservative (see Sect. 4.6).
8. Try to fill the container as full as possible.
9. Slowly screw the cap back on the container.
10. Pour the remaining water back into the stream.
11. Wipe any moisture from the sides of the container.
12. Affix the completed sample label to the jar.
13. Record all data on the sample label and chain-of-custody form and enter the appropriate information in the field logbook.
14. Place sample in cooler with ice packs at 4 ± 2°C and transport to the laboratory.

15. Record all data in the appropriate section of the field logbook.
16. Decontaminate each piece of sampling equipment as described in Sect 16.9, Equipment Decontamination Procedures.

## 4.6 PACKAGING AND PRESERVATION OF SOIL SAMPLES

1. Prior to use, the glass jars for samples must be cleaned to EPA specifications. Sample jars for the collection of soil samples at the site will be purchased precleaned to EPA specifications from I-CHEM Research, 104 Quigley Blvd., New Castle, Delaware 19720, (302) 322-2808 or (800) 443-1689. (Refer to Tables 4.1 and 4.2 for bottling requirements, preservatives, and holding times.)

2. While wearing chemically resistant gloves and using a stainless steel trowel, fill the sample jar as full as possible with the soil sample. Wet soils should have enough head space to allow for expansion. Extreme care must be taken to avoid contamination of the jars or caps. The cap should be removed from the jar just prior to filling and should be rescrewed on the jar securely as soon as an adequate sample volume is obtained. Any contact with the inside of the jar or lid by anything other than the sample must be avoided. For chemical samples only, gloves should be discarded after the sample collection at each sample location to prevent cross contamination of samples.

3. Label sample bottles according to the requirements of this plan.

4. Place a layer of frozen coolant packs (Blue Ice® or equivalent) on the bottom of an insulated ice chest. Sample bottles should be stacked upright on the coolant packages. Care should be taken to pad the jars from each other to avoid breakage. Coolant packs should be placed on top of the samples to ensure adequate chilling; the samples should be chilled to 4 $\pm$ 2°C. Cooling will not be required for soil samples destined for radiological analysis.

5. Samples will be delivered to ORNL Analytical Chemistry under chain-of-custody.

## 4.7 SAMPLE DOCUMENTATION

This procedure applies to soil and water samples collected for laboratory analysis. Sample documentation begins with a 7-character description that is written in permanent black ink on the sample label and the chain-of-custody form.

Each sample is assigned an identifier, using the following format (where A = alpha, N = numeric).

| A | AA/NN/AN/NA | A | NN | A |
|---|---|---|---|---|
| Source | Location | Matrix/Type | Depth (ft) | Analysis |

Source: One letter identifying the sample source.

**Table 4.1. Sampling analysis, bottle requirements, and holding times for surface water and equipment rinsate/quality control samples**

| Analysis[a] | Container type & size | Preservative[b] | Amount of preservative | Holding time |
|---|---|---|---|---|
| Metals (CLP) | 1 1000-mL polyethylene bottle | 50% nitric acid ($HNO_3$) pH < 2[c]; cool, 4°C | 3 mL in a 1000 mL bottle | 6 months |
| Volatiles | 2 40-mL amber glass vials | Conc. hydrochloric acid (HCl)[d]; cool, 4°C | 4 drops | 14 days |
| Semivolatile organics (BNA) | 2 1-L amber glass bottles[e] | Cool, 4°C | No preservative | 7 days |
| Kerosene (California method) | 2 1-L amber glass bottles[e] | Cool, 4°C | No preservative | 7 days |
| EPA method 8015 | 2 40-mL amber vials | HCL, 4°C | 4 drops | 14 days |
| EPA method 8020 | 2 40-mL amber vials | HCL, 4°C | 4 drops | 14 days |
| Radiologicals | 1 1-L polyethylene bottle | 50% nitric acid ($HNO_3$) pH < 2[c]; cool, 4°C | 3 mL in a 1000 mL bottle | 6 months |

[a]Equipment rinsate samples will undergo all analytical analyses; environmental water sample and duplicate will only be analyzed for radiologicals.

[b]Dilution is recommended when using acid preservatives in the field in order to avoid handling/transporting concentrated acid, the acid fumes that result when a concentrated acid container is open, and the possible discoloration of plastic sample containers over time when a concentrated acid is added and the container stored for future use.

[c]The preservative is a dilution of 1:1 (50%), one part concentrated $HNO_3$ to one part distilled water (type 1). Concentrated $HNO_3$ should be approximately 70% $HNO_3$ by weight, which represents a normality (N) value of 16, American Chemical Society (ACS) grade or better.

[d]Concentrated HCl should be approximately 38% HCl by weight, which represents an N value of 12, ACS grade or better.

[e]A single 1-L amber glass bottle provides sufficient sample material for analyses of kerosene and semivolatile organics.

**Table 4.2. Sampling analysis, bottle requirements, and holding times for surface and subsurface soil samples**

| Analysis | Procedure | Container | Preservative | Holding time | Amount[b] |
|---|---|---|---|---|---|
| Metals | CLP | 1 1000-mL glass jar with Teflon-lined lid[a] | Cool, 4°C | 6 months | 10 g |
| VOA | CLP | 1 125-ml glass jar with Teflon-lined lid | Cool, 4°C | 14 days | 10 g |
| VOA | 8015 | 1 125-ml glass jar with Teflon-lined lid | Cool, 4°C | 14 days | 10 g |
| VOA | 8020 | 1 125-ml glass jar with Teflon-lined lid | Cool, 4°C | 14 days | 10 g |
| Semivolatiles | CLP | 8-oz wide-mouth glass jar with Teflon-lined lid | Cool, 4°C | Extract within 14 days; analyze within 40 days | 50 g |
| Radiologicals | | 1 1000-mL wide poly jar with Teflon-lined lid[a] | None | 6 months | |

[a]A single 1000-mL container provides sufficient material for analyses of metals (CLP) and radiologicals.
[b]Additional sample material must be collected for matrix spike and matrix spike duplicate samples.

B = borehole
H = laboratory

Location: Denotes the location of the sample.

Matrix and type of sample:

S = soil original
D = soil duplicate
W = water original
X = water duplicate
E = equipment rinsate
B = field blank
T = trip blank
O = other original (defined in the logbook)
P = other duplicate (defined in the logbook)

Depth: NN is the recorded depth in feet (or other unit of measure as defined in the field logbook) from which the sample was taken; for instance, the depth from which a volatile sample was collected. For samples that are composited over intervals of several feet, the number will signify the final depth from which the sample was collected. For equipment rinsate samples, the depth at which the equipment was last used will be recorded.

Analysis: The single letter qualifier will denote what type of analysis is required. In addition, the analysis required will be recorded for each sample on the chain-of-custody form.

A = VOA
B = metals
C = semivolatiles
D = radiologicals (limited)
E = radiologicals (comprehensive)
F = radiological Screen
P = polychlorinated biphenyls (PCBs)

Example: B01S02F

B: The sample was collected from a borehole
01: The sample was collected from location number 1
S: The sample was a soil original
02: The sample depth from which the sample was collected was 2 ft
F: The sample analysis will be a radiological screen

## 4.8 FIELD LOGBOOK

Field records should be completed at the time a sample is collected and should be signed or initialed, including date and time, by the sample collector(s). Entries entered in error will be lined through with a single line and initialed. Field records will be maintained in a bound,

project-specific logbook and should contain the following information written in indelible black ink:

- project name or identification;
- initials, names, and affiliations of sample collector(s) and all individuals involved in the project (at one place in the logbook, initials must be entered by each individual in the style or format that he/she will use in the logbook and on data sheets);
- general description of the day's field activities;
- documentation of weather conditions;
- unique sample number;
- date and time of sampling;
- source/location of the sample;
- method of sample collection;
- analysis required;
- serial number(s) on seal(s) and transportation case(s), if any;
- records of daily instrumentation calibrations and response checks (when this information is not recorded on the Daily Instrument Calibration/Response Check Form);
- name of person/organization transporting samples;
- name of radiation protection technician who scans sample containers.

When samples are delivered to the laboratory for analysis, entries should be made in the logbook to note the chain-of-custody record number, date of shipment, number of shipping containers, samples sent, and delivery person.

## 4.9 SAMPLE LABEL

At the time of sample collection, each sample should be identified by a pressure-sensitive gummed label affixed to the container. Notations on the label should be made in indelible ink and should include

- unique sample number,
- project number or identification,
- analysis required,
- name of collector(s), and
- date and time of collection.

A facsimile of a sample label is shown in Fig. 4.3.

## 4.10 DISPOSAL OF WASTE

The SPM shall coordinate the disposal of any waste generated from this investigation. Compactible waste will be placed in a 17-C drum, and fluids from the equipment decontamination process will be placed in a 17-E drum. Each drum will be labeled by a member of the investigation team and placed in a controlled area at the time the drum is placed in commission. Upon completion of the investigation, the SPM will coordinate the timely disposal of these drums in accordance with approved procedures established by ORNL ER and ORNL Waste Management Operations. The ORNL ER Waste Management

Planning Checklists and Weekly Waste Generation Summary Report are included in Appendix A and Appendix B of this document.

## 4.11 CONTAMINATION CONTROL

Care will be taken to prevent the spread of contamination. Any contaminated items that cannot be decontaminated will be wrapped in aluminum foil and/or plastic to contain contamination until the item can be disposed of properly. No contaminated items will be placed directly on the ground at the site.

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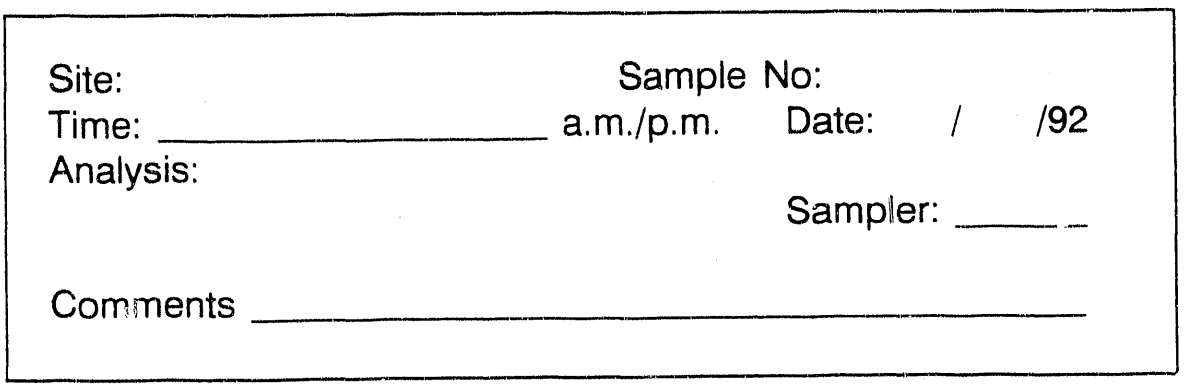


**Fig. 4.3. Facsimile of sample label.**

# 5. SAMPLE CUSTODY

Sample custody is an integral part of the collection and reporting of sound analytical results. Custody procedures have been developed in order to produce an accurate written record that can be used to trace the handling and possession of the sample from the time of its' collection through analysis. Within this section, sample custody will be addressed with respect to field and analytical laboratory requirements.

A sample is in someone's custody if

1. it is in one's actual possession, or
2. it is in one's view after being in one's possession, or
3. it is in one's physical possession and then locked up so that no one can tamper with it, or
4. it is kept in a secured area, restricted to authorized personnel only.

## 5.1 FIELD OPERATIONS

### 5.1.1 Sample Preservation

Sample preservation is necessary to ensure sample integrity between the time of sample collection and sample analysis. Sample preservation methods are based upon predetermined procedures identified for each analytical method. Sample preservation methods for each analyte are detailed in Tables 4.1 and 4.2.

### 5.1.2 Sample Tracking and Handling

Standardized field tracking of the samples collected in the field is necessary to avoid breaches in sample custody and tracking prior to shipment. The sample label information is recorded in the field logbook at the time of collection by the in-field sample custodian. The field logbook serves as the sample tracking record. In addition, the chain of custody shall be generated in the field by the sample custodian.

To ensure proper sample tracking and handling, ORNL/MAD has enacted a tracking procedure. This procedure tracks the sample container from the opening of the manufacture's sealed box to the placing of the sample container with contents into a cooler for transportation to the laboratory. All recordable information from the following steps should be recorded in a designated section in the field logbook.

1. When the manufacturer's box is opened, the manufacturer-supplied label containing a QC lot number is placed on each of the containers. The sample custodian shall also write the particular analysis on the label.

2. The manufacturer's "Certificate of Analysis" should be placed in a file, and the QC lot number shall be written in the logbook.

3. If the prelabeled containers are not to be used immediately, the containers should be placed back in the box. The box should then be closed and a custody seal attached.

4. If the containers are to be used immediately, the sampler will assume custody and take the containers to the field for sample collection.

5. During the sampling process, the sampler will fill the appropriate prelabeled containers with sample material destined for that specific analysis.

6. Upon completion of sampling, the sampler will carry the filled containers back to the sample custodian. At this point the sampler will relay any information concerning the sample (stake number, borehole number, time, and depth) to the sample custodian.

7. The sample custodian will then place a complete sample label (see Sect. 4.9) over the prelabel, leaving only the QC lot number exposed.

8. The sample custodian will transfer all information from the sample label to the field logbook.

9. The sample container filled with material is placed in a cooler packed with Blue Ice®, or equivalent, for transportation to the laboratory.

10. If the cooler is to be left unattended for any amount of time, a signed and dated custody seal will be placed on the cooler by the custodian.

11. The information from the sample label, excluding the QC lot number, will be transferred to the chain-of-custody form (see Fig. 4.2).

## 5.2 LABORATORY OPERATIONS

The samples collected for this project will be received by the designated laboratory under chain of custody. The procedures that the laboratory will follow for the receipt and sample custody can be found in their Quality Control Procedure Document.

# 6. CALIBRATION PROCEDURES

Continuous real-time assessment of concentrations of potentially hazardous materials will be performed on-site during the entire 7500 Area Contamination Site sampling effort. The monitoring program is designed to protect members of the sampling team and associated auxiliary personnel from possible hazards associated with site activities. ORNL/MAD shall be responsible for providing calibration and/or response checks for field monitoring instruments. Calibration or response check requirements for both field and analytical laboratory instrumentation is provided in this section.

## 6.1 LABORATORY INSTRUMENTATION CALIBRATION

Laboratory analytical instrumentation will be controlled through a calibration program that is in accordance with the following:

- Each instrument or analytical measurement system must be calibrated before use.
- Each instrument or analytical measurement system must follow the calibration procedures specified in the designated method.

In addition, the laboratory must have detailed calibration procedures in the form of a Standard Operating Procedure and a summary of the procedure provided in the laboratory QA plan. Standards used to calibrate an instrument or analytical measurement system must be NIST- or EPA-traceable, and the laboratory must maintain supporting documentation.

## 6.2 FIELD INSTRUMENTATION CALIBRATION AND RESPONSE CHECKS

All ORNL/MAD instruments shall be calibrated within the time frame recommended by the manufacturer and according to specifications described in the manufacturer's operating manual. If the services of ORNL Industrial Hygiene or Radiation Protection are requested on-site, these groups shall abide by their approved procedures regarding calibrations and response checks. The calibration/response check readings, the lot number and manufacturer of the calibration gas cylinder, and the radiological source number will be recorded on the Daily Instrument Calibration/Response Check Form (see Fig. 6.1). This information can be recorded in the required format either directly into a section of the field logbook dedicated to calibration/response check information about the instruments or on the official form.

All chemical instrument calibration gases will be purchased from a laboratory instrumentation gas supply company. Each calibration gas cylinder must carry a manufacturer's label that shows a lot number, the manufacturer's name, the type of gas, and the ppm or percent of identified gas in the cylinder.

DAILY INSTRUMENT CALIBRATION/RESPONSE CHECK

| Instrument No. | Radiation or Chemical Detection | Date & Military Time | Battery Check | Background Reading | Source Response or Calibrant Response | Source No. or Calibrant Gas Manufacturer & Lot No. | Calibration Due Date |
|---|---|---|---|---|---|---|---|
| 3490-04P | Beta/ Gamma | 4-22-91 13:00 | OK | 33 cpm | 1846 cpm | S-04P | 8/12/92 |
| 3490-21SG | Gamma | 4-22-91 13:00 | OK | 2.5K cpm | 22K cpm | 3490-35 | 8/12/92 |
| 3490-14S | Alpha | 4-22-91 13:00 | OK | 1 cpm | 1022 cpm | S-1849 | 9/30/92 |
| CGI #3 (CGI) | LEL<br>$O_2$<br>$H_2S$<br>CO | 4-22-91 13:00 | 2.7 V | 0% LEL $CH_4$<br>20.9% $O_2$<br>0 ppm $H_2S$<br>0 ppm CO | 50% LEL $CH_4$<br>20.9% $O_2$<br>25 ppm $H_2S$<br>50 ppm CO | Gastech/0069<br><br>Alphagaz/9876<br>Alphagaz/0078 | 7/30/92 |
| OVM #1 (PID) | Volatile organics | 4-22-91 10:00 | OK | 0.00 ppm | 100 ppm Isobutylene | HNu Systems/ 5656 | 7/30/92 |
| HNu #2 (PID) | Volatile organics | 4-22-91 10:00 | OK | 1.2 ppm | Span 5.12 100 ppm Isobutylene as 66 ppm benzene | HNu Systems/ 5656 | 6/26/92 |
| Name of Calibrator: | X | | | | | Date: | |

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Fig. 6.1. Example of information for the Daily Instrument Calibration/Response Check form or the field logbook calibration page.

### 6.2.1 Calibration/Response Check Frequency

The procedures listed in this section concern only the instruments that belong to and are used by ORNL/MAD. If the services of ORNL Industrial Hygiene or Radiation Protection are requested on site, these groups shall abide by their approved procedures regarding calibration and response check frequency.

All ORNL/MAD instruments, while in service, will undergo calibration or response checks at least daily. More frequent calibration or response checks may be deemed necessary by the SHSO or the SPM if the instrument malfunctions, if the batteries are replaced or recharged, or if the first calibration/response check does not equilibrate properly. If, after the calibration or response check has been rerun, the instrument does not meet the manufacturer's SOPs, it will be removed from service and replaced with a backup instrument.

### 6.2.2 Background Readings

The procedures listed in this section concern only the instruments that belong to and are used by ORNL/MAD. Before field activities begin, background concentrations will be monitored and recorded as specified in Sect. 6.4. To obtain accurate results, daily background readings shall be made away from areas of potential contamination and those readings shall be considered when establishing action levels.

## 6.3 CHEMICAL MONITORING EQUIPMENT

ORNL/MAD shall have overall site responsibility for chemical monitoring. Equipment necessary for site environmental monitoring shall include a PID, such as an OVM or an HNU (equipped with an 11.8 or 11.7 eV lamp), and other instruments, as warranted.

### 6.3.1 Organic Vapor Monitor

The OVM uses a PID to detect trace concentrations of many volatile organic chemicals, gases, and vapors in air. Although the OVM is capable of using other lamps, an ultraviolet (11.8 eV) lamp is necessary to detect the potential contaminants of interest at this site. The OVM has an operating range of 0 to 2000 ppm and detects a minimum concentration of 0.1 ppm.

A positive displacement pump in the OVM continuously samples the ambient air by first drawing it through a filter in the instrument probe that is designed to withdraw moisture in the form of water from the air stream. An inherent problem with PIDs is that they are affected by excessive water (i.e., high humidity) in the air stream, which can cause a negative voltage drop that can render the instrument ineffective for health and safety monitoring. In many cases, excessive fluctuations in instrument readings are indicative of a moisture problem. In addition, the lamp window material is very hygroscopic, and accumulation of moisture can render the lamp inoperable. If moisture problems arise, an OVM that is less sensitive to moisture may be substituted.

From the probe, the air stream passes through the ionization chamber where trace gases and vapors that have ionization potentials close to, or below, the 11.8 eV energy may be photoionized. The positive current produced by the excitation of an electron is then amplified, and the current is related to a representative concentration in ppm. For the purposes of this investigation, the OVM is a qualitative instrument, Level I, that measures a total concentration of detectable vapors and gases in the air stream.

### 6.3.2 Calibration of the Organic Vapor Monitor

The OVM will be calibrated at least daily, or as required by the SHSO, in accordance with the manufacturer's SOPs and this plan. Calibration results shall be noted on the Daily Instrument/Response Check Form (see Fig. 6.1) or in the field logbook. The following procedures are required for calibrating the OVM.

1. Disconnect the OVM from the battery charger.
2. Insert the power plug from the OVM into the RUN/CHG receptacle.
3. Hold down the ON button on the far left of the key pad. The instrument should turn on and the pump should be audible.
4. Press the MODE/STORE button.
5. A message will appear on the screen asking if you wish to record the data point. Press (-) for no.
6. The menu screen will then appear. Select and press (-) again for the parameter mode of the instrument.
7. The screen will then display "Conc. Meter Reset." To change, press (+).
8. The instrument will then display "Auto Logging Reset." To change, press (+).
9. The next display will be "Average = 0:01 Reset." This number will enable the instrument to display an average concentration every second while monitoring. If the instrument is not averaging every second, press the RESET button and change the number. The (+) allows an increase in the time interval while the (-) allows movement of the cursor from one place to another. Press RESET when this is finished and proceed with the next step. If the instrument is already set up to average every second, depress the (+) button.
10. The next display will show that the alarm has been preset to 1.0 ppm. Depress the (+) button.
11. The next display will show that the instrument is operating with an 11.8 eV lamp. If any other is displayed, select the 11.8 eV lamp.
12. Press (+) to continue.
13. RF = 1.00 will be displayed next. The response factor should always be set at 1.00. Press the (+) button to proceed.
14. Press RESET to calibrate the instrument.
15. Depress the (-) button.
16. Depress the RESET button to zero the instrument in the ambient air. The instrument is zeroed in ambient rather than zero air so that natural background will be excluded.

17. When the instrument finishes zeroing, the display should read "Span [ ] of 100 ppm." Press (+) to continue, and the instrument will display "Span Gas Reset When Ready." Open the Tedlar® bag and attach it to the instrument. Press RESET to begin calibration. The instrument will display "Model 580 Calibrating," and when calibration is complete, "Reset to Calibrate" appears. Detach the tubing, close the Tedlar® bag, and press MODE/STORE to operate the instrument. The instrument should display "0.00 ppm" fairly consistently as the ambient air background.
18. Refer to Fig. 6.1 for the proper documentation of instrument calibration data.

A response check will be performed to verify that the alarm sounds at the specified setting programmed into the instrument. The instrument is tested against a known chemical concentration and the alarm should sound when the specified setting appears on the instrument's digital display.

### 6.3.4 HNU Photoionization Detector

The HNU uses a PID to detect trace concentrations of many volatile organic chemicals, gases, and vapors in air. Although the HNU is capable of using other lamps with separate probe combinations, the 11.7 eV lamp is necessary to detect the potential contaminants of interest with high ionization potentials. Sites that require a PID with a lower ionization potential may use the 10.2 eV probe in combination with the HNU. The HNU has an operating range of 0 to 2000 ppm and detects a minimum concentration of 0.2 ppm.

A fan in the HNU helps to continuously sample the ambient air, drawing the air through the instrument probe extension tube. An inherent problem with PIDs is that they are affected by excessive water (i.e., high humidity) in the air stream, which can cause a negative voltage drop that can render the instrument ineffective for health and safety monitoring. In many cases, excessive fluctuations in instrument readings are indicative of a moisture problem. In addition, the lamp window material of the higher ionization potential lamps is very hygroscopic, and accumulation of moisture can render the lamp inoperable.

From the probe extension tube, the air stream passes through the ionization chamber where trace gases and vapors that have ionization potentials close to, or below, the lamp's eV energy may be photoionized. The positive current produced by the excitation of an electron is then amplified, and the current is related to a representative concentration in ppm. For the purposes of this investigation, the HNU is a qualitative instrument, Level I, that measures a total concentration of detectable vapors and gases in the air stream.

### 6.3.5 Calibration of the HNU Photoionization Detector

The HNU shall be calibrated at least daily, or as required by the SHSO, in accordance with the manufacturer's SOPs and this plan. Calibration results shall be noted on the Daily Instrument Calibration/Response Check Form (see Fig. 6.1) or in the field logbook. The procedure for calibration of the HNU follows:

1. Turn the instrument control to BATTERY; record battery condition in the logbook or on the form.
2. Turn the function switch to STANDBY; zero the instrument using the zero-adjust knob.

3. Turn the function switch to the 0-200 ppm scale.
4. Connect the regulator to the isobutylene span gas cylinder. Connect the tubing to the tip of the regulator and to the tip of the instrument probe extension. It is imperative that a regulator is used that allows only approximately 0.5 L/min to reach this instrument, since more than that may cause irreparable damage.
5. Open the regulator valve completely.
6. Unlock the span control knob and allow the instrument to stabilize.
7. Adjust the span setting so that the needle is on the appropriate reading, which depends on the concentration of span gas required by the SHSO. Always check with the SHSO to determine the appropriate span setting.
8. Lock the span control knob when it provides the concentration required by the SHSO.
9. Turn off the regulator valve, disconnect the tubing from the regulator and probe extension, and disconnect the regulator from the span gas cylinder.
10. Turn the function switch to standby and determine if the instrument has held zero. If so, turn the function switch to the 0-20 scale and record the background concentration in the ambient air. Normally the instrument background concentration will be approximately 1.0 ppm or less; however, it is possible to have a higher background concentration. If the concentration is higher than 1.0 ppm, the instrument may be used only if the readings are stable and the instrument maintains zero. If the instrument becomes unstable through operation, it should be recalibrated.
11. Document the instrument calibration data (see Fig. 6.1).

A response check will be performed to verify that the alarm sounds at the specified setting. The instrument is tested against a known chemical concentration and the alarm should sound when the specified setting is indicated on the instrument's gauge.

## 6.4 RADIOLOGICAL MONITORING

### 6.4.1 Radiological Monitoring Responsibilities

ORNL Radiation Protection will be consulted prior to entry into any posted Radiological Area and will instruct the ORNL/MAD group on their particular requirements for that particular site. The investigative team will abide by ORNL Radiation Protections' requirements as well as any self-imposed requirements levied by ORNL/MAD. ORNL/MAD personnel will be responsible for checking equipment and other possibly contaminated items and for bagging and marking any contaminated items or equipment at the end of each working day. Radiation Protection will check and tag the items prior to their removal from the site. ORNL Radiation Protection will be responsible for any necessary scanning of contract personnel and for surveying and tagging sample containers before removal from the site. ORNL Radiation Protection and ORNL/MAD shall be responsible for their respective instrumentation and calibration requirements in accordance with existing ORNL Radiation Protection and ORNL/MAD procedures.

### 6.4.2 Radiological Monitoring Equipment

The radiological monitoring equipment and response-check procedures described in the following sections shall be used by ORNL/MAD at this investigative site. ORNL/MAD is responsible for the equipment listed, for providing response checks, and for maintaining the equipment in accordance with manufacturers' specifications and ORNL/MAD procedures. ORNL Radiation Protection is responsible for its own equipment and for calibrating and maintaining it according to ORNL Radiation Protection procedures.

All ORNL/MAD radiological monitoring equipment used in the field is required to have up-to-date calibration stickers. No instrument that is out of calibration will be used. Instruments are maintained on an annual calibration schedule and are calibrated by ORNL Instrumentation and Controls in accordance with NIST standards and procedures. Instrument and probe combinations are calibrated as a set; therefore, ratemeters and probes shall not be interchanged. If interchange becomes necessary, the ratemeter and probe combination will be returned to the ORNL/MAD instrument technician who will be responsible for having the instrument calibrated. Instrument response check measures performed in the field are **not** a substitute for calibration.

Radiological equipment necessary to conduct site monitoring shall consist of the following portable detector systems or equivalents:

| | Meter | Probe | Purpose |
|---|---|---|---|
| (1) | Bicron Analyst | Geiger-Mueller (GM) pancake with No. 18 mesh screen | Monitor beta-gamma surface contamination levels |
| | | or GM side window | Down hole beta/gamma logging |
| (2) | Victoreen 490 | Victoreen 489-55, NaI scintillator | Gross gamma monitoring/scanning |
| (3) | Bicron Analyst | ORNL Q2101, "beer mug," ZnS scintillator | Monitor alpha surface contamination levels |

### 6.4.3 Response-Check Procedures for the NaI Scintillation Detector

The scintillation detector shall be maintained and response checked according to the manufacturer's specifications and ORNL/MAD procedures. Results of the response check shall be noted on the Daily Instrument Calibration/Response Check Form (see Fig. 6.1) or in the field logbook.

Each scintillation detector shall receive a daily radiation response check prior to use in the field. Affixed to each instrument is a response-check validation label that shows a source number and the maximum and minimum acceptable responses that should be obtained when the instrument is checked with the indicated source. If the detector's responses do not fall within the indicated range, the instrument must be removed from service and returned to the ORNL/MAD instrument technician (see Sect. 11). If the indicated source is unavailable, a correction factor for the desired source may be obtained from the ORNL/MAD instrument

technician, which allows correlation of the instrument response to the source with the response ranges listed on the instrument response-check validation label. Response-check procedures follow.

1. Turn the scintillator on and record the condition of the battery in the logbook or on the form.
2. Record the instrument number and the source number in the logbook or on the form.
3. Turn the selector switch to the (X10) setting; record in the logbook or on the form the background in cpm and the location where the reading was obtained.
4. Turn the selector switch to the (X100) setting.
5. Place the source against the detector portion of the probe, with the long axis of the source parallel to the long axis of the probe. Place the narrow edge of the source against the probe.
6. Rotate the source around the surface of the probe and record the highest response in cpm in the logbook or on the form.
7. Confirm that the reading is within the acceptable range denoted on the response check-validation label affixed to the side of the instrument. If it is not, return the instrument to the ORNL/MAD instrument technician.
8. If the instrument is not to be used immediately, turn it off to conserve the batteries.
9. If the instrument appears to respond abnormally during its intended use, the preceding response-check procedure should be repeated to determine whether the instrument is functioning properly.
10. Store the source in an approved storage location.

### 6.4.4 Response-Check Procedures for the GM Pancake Detector

The GM pancake detector shall be maintained and calibrated according to the manufacturer's specifications and ORNL/MAD procedures. Response-check results shall be noted on the Daily Instrument Calibration/Response Check Form (see Fig. 6.1) or in the field logbook.

Each GM pancake detector shall receive a daily radiation response check prior to use in the field. Affixed to each instrument is a source and a response-check validation label, which shows the maximum and minimum acceptable responses that should be obtained when the instrument is checked with the source. If the detector's responses do not fall within the indicated range, the instrument must be removed from service and returned to the ORNL/MAD instrument technician (see Sect. 11). If the source is not affixed to the side of the instrument, a correction factor for an alternative source may be obtained from the ORNL/MAD instrument technician, which allows correlation of the instrument response to the source with the response ranges listed on the instrument response-check validation label. Response-check procedures follow.

1. Turn the instrument on and record the condition of the battery in the logbook or on the form.
2. Record the instrument number and the source number in the logbook or on the form.

3. Obtain a 1-min background scaler reading (the instrument displays a count after a 1-min timed measurement); record this reading and the location where it was taken in the logbook or on the form.
4. Place the detector probe against the source and obtain a 1-min scaler reading (see step 3). Record this reading in the logbook or on the form.
5. Confirm that the scaler count is within the acceptable range, as indicated on the response-check validation label affixed to the instrument.
6. If the instrument is not to be used immediately, turn it off to conserve the batteries.
7. If the instrument appears to respond abnormally during its intended use, the preceding response-check procedure should be repeated to determine whether the instrument is functioning properly.
8. Store the source in an approved storage location.

### 6.4.5 Response-Check Procedures for the GM Side-Window Detector

1. Turn the instrument on and record the condition of the battery in the logbook or on the form.
2. Record the instrument number and the source number in the logbook or on the form.
3. Obtain a 1-min background scaler reading (the instrument displays a count after a 1-min timed measurement); record this reading and the location where it was taken in the logbook or on the form.
4. Place the source against the open window section of the probe with the long axis of the source parallel to the long axis of the probe. Take a 1-min scaler count at the location with the highest reading. Record this reading in the logbook or on the form.
5. Confirm that the scaler count is within the acceptable range, as indicated on the response-check validation label affixed to the instrument.
6. If the instrument is not to be used immediately, turn it off to conserve the batteries.
7. If the instrument appears to respond abnormally during its intended use, the preceding response-check procedure should be repeated to determine whether the instrument is functioning properly.
8. Store the source in an approved storage location.

### 6.4.6 Response-Check Procedures for the ZnS Alpha Scintillation Detector

The ZnS scintillation detector shall be maintained and response checked according to the manufacturer's specifications and ORNL/MAD procedures, and results of the response check shall be recorded on the Daily Instrument Calibration/Response Check Form (see Fig. 6.1) or in the field logbook.

Each ZnS alpha scintillation detector shall receive a daily radiation response check prior to use in the field. Affixed to each instrument is a response-check validation label, which details the source and the maximum and minimum acceptable responses that should be obtained when the instrument is checked with the source. If the detector does not respond within the indicated range, the instrument must be removed from service and returned to the ORNL/MAD instrument technician. If the indicated source is unavailable, a correction factor

for an alternative source may be obtained from the ORNL/MAD instrument technician, which allows correlation of the instrument response to the source with the response ranges listed on the instrument response-check validation label. Response-check procedures follow.

1. Turn the instrument on and record the condition of the battery in the logbook or on the form.
2. Record the instrument number and the source number in the logbook or on the form.
3. Obtain a 1-min background scaler reading (the instrument displays a count after a 1-min timed measurement); record this reading and the location where it was taken in the logbook or on the form.
4. Leave the source in the storage case. Open the cover and place the probe on the source inside the opened case so that the arrow on the probe is aligned with the source case. The edge of the probe should be in contact with the hinge but should not be placed on top of the hinge.
5. Obtain a 1-min scaler reading (see step 3) and determine if the counts obtained are within the acceptable range as denoted on the response-check validation label affixed to the instrument.
6. If the instrument is not to be used immediately, turn it off to conserve the batteries.
7. If the instrument appears to respond abnormally during its intended use, the preceding response-check procedure should be repeated to determine whether the instrument is functioning properly.
8. Store the source in an approved storage location.

# 7. ANALYTICAL PROCEDURES

The purpose of analyzing samples collected at the 7500 Area Contamination Site is to ascertain what contaminants are present. The samples will be collected according to procedures in Sect. 4, and custody of samples from the field to the laboratory will be governed by the procedures in Sect. 5.

The parameters of interest for this investigation include volatile organics, semivolatile organics, kerosene, metals, gross alpha activity, gross beta activity, gamma activity, and strontium-90. Volatile organics, semivolatile organics, and metals will be analyzed using approved EPA Contract Laboratory Program (CLP February 1988) and SW-846 (September 1986) methods. Kerosene will be analyzed by the California LUFT method for Total Petroleum Hydrocarbons (Modified EPA method 8015 for High Boiling Hydrocarbons). Radionuclide analysis will be performed using approved EPA procedures on analytes for which EPA procedures exist and ORNL procedures on analytes for which no approved EPA procedures exist.

## 7.1 ORGANICS

The list of the volatile and semivolatile organic compounds in Tables 7.1 through 7.4 will be analyzed using the EPA-CLP method. The compounds listed in Table 7.5 will be analyzed using EPA method 8015. The compounds of particular interest from this list are diethyl ether and ethanol since there is historical evidence of these particular compounds at this site. The compounds listed in Table 7.6 will be analyzed by EPA method 8020 because of the lower detection limits that this method provides over the GC/MS method, EPA 8240. In addition, we are interested in trichloroethylene and kerosene. The trichloroethylene will be analyzed using the EPA-CLP method. The kerosene will be analyzed using the California LUFT method (modified EPA 8015). The California LUFT method is being used because it is possible to isolate the high boiling hydrocarbons with this method. The analysis of semivolatile organic compounds will be done using the EPA-CLP method

## 7.2 METALS

The metals for this investigation will be analyzed using inductively coupled plasma spectroscopy, graphite furnace atomic absorption, and cold vapor atomic absorption. The specific EPA analytical and preparation methods can be found in Table 7.7.

## 7.3 RADIOCHEMISTRY

The radiochemical parameters to be analyzed for in this investigation are listed in Table 7.8. Since the specific contaminants are unknown, the samples will first be screened for gross alpha and gross beta activity. If the gross alpha activity is above 0.33 Bq/g or gross beta is above 1.8 Bq/g, the sample will undergo further analysis to determine the specific radionuclides present. Gamma spectrometry will be used on all samples to determine the level of each gamma emitter present.

The initial radionuclides of interest include $^{90}Sr$, $^{243}Am$, $^{244}Cm$, total Cm, $^{249}Bk$, $^{252}Cf$, $^{253}Es$, $^{65}Zn$, $^{95}Zr$, $^{95}Nb$, $^{103}Ru$, $^{106}Ru$, $^{110m}Ag$, $^{131}I$, $^{134}Cs$, $^{136}Cs$, $^{137}Cs$, $^{140}Ba$, $^{140}La$, $^{141}Ce$, $^{144}Ce$, $^{156}Eu$, $^{60}Co$, $^{235}U$. Any other radionuclides found in the scans will be included.

**Table 7.1. Analyte list for volatile organics (in soils) using EPA-CLP method**

| Analyte | Required quantitation limit (μg/kg) |
|---|---|
| Chloromethane | 10 |
| Bromomethane | 10 |
| Vinyl Chloride | 10 |
| Chloroethane | 10 |
| Methylene Chloride | 5 |
| Acetone | 10 |
| Carbon Disulfide | 5 |
| 1, 1-Dichloroethene | 5 |
| 1, 1-Dichloroethane | 5 |
| 1, 2-Dichloroethene (total) | 5 |
| Chloroform | 5 |
| 1, 2-Dichloroethane | 5 |
| 2-Butanone | 10 |
| 1, 1, 1-Trichloroethane | 5 |
| Carbon Tetrachloride | 5 |
| Vinyl Acetate | 10 |
| Bromodichloromethane | 5 |
| 1, 2-Dichloropropane | 5 |
| cis-1, 3-Dichloropropene | 5 |
| Trichloroethene | 5 |
| Dibromochloromethane | 5 |
| 1, 1, 2-Trichloroethane | 5 |
| Benzene | 5 |
| trans-1, 3-Dichloropropene | 5 |
| Bromoform | 5 |
| 4-Methyl-2-pentanone | 10 |
| 2-Hexanone | 10 |
| Tetrachloroethene | 5 |
| Toluene | 5 |
| 1, 1, 2, 2-Tetrachloroethane | 5 |
| Chlorobenzene | 5 |
| Ethylbenzene | 5 |
| Styrene | 5 |
| Xylenes (total) | 5 |

**Table 7.2. Analyte list for volatile organics (in water) using EPA-CLP method**

| Analyte | Required quantitation limit ($\mu$g/L) |
|---|---|
| Chloromethane | 10 |
| Bromomethane | 10 |
| Vinyl Chloride | 10 |
| Chloroethane | 10 |
| Methylene Chloride | 5 |
| Acetone | 10 |
| Carbon Disulfide | 5 |
| 1, 1-Dichloroethene | 5 |
| 1, 1-Dichloroethane | 5 |
| 1, 2-Dichloroethene (total) | 5 |
| Chloroform | 5 |
| 1, 2-Dichloroethane | 5 |
| 2-Butanone | 10 |
| 1, 1, 1-Trichloroethane | 5 |
| Carbon Tetrachloride | 5 |
| Vinyl Acetate | 10 |
| Bromodichloromethane | 5 |
| 1, 2-Dichloropropane | 5 |
| cis-1, 3-Dichloropropene | 5 |
| Trichloroethene | 5 |
| Dibromochloromethane | 5 |
| 1, 1, 2-Trichloroethane | 5 |
| Benzene | 5 |
| trans-1, 3-Dichloropropene | 5 |
| Bromoform | 5 |
| 4-Methyl-2-pentanone | 10 |
| 2-Hexanone | 10 |
| Tetrachloroethene | 5 |
| Toluene | 5 |
| 1, 1, 2, 2-Tetrachloroethane | 5 |
| Chlorobenzene | 5 |
| Ethylbenzene | 5 |
| Styrene | 5 |
| Xylenes (total) | 5 |

**Table 7.3. Analyte list for semivolatile organics (in soils) using EPA-CLP method**

| Anylate | Required quantitation limit (μg/kg) | Anylate | Required quantitation limit (μg/kg) |
|---|---|---|---|
| Phenol | 330 | Acenaphthene | 330 |
| bis(2-Chloroethyl)ether | 330 | 2,4-Dinitrophenol | 1600 |
| 2-Chlorophenol | 330 | 4-Nitrophenol | 1600 |
| 1,3-Dichlorobenzene | 330 | Dibenzofuran | 330 |
| 1,4-Dichlorobenzene | 330 | 2,4-Dinitrotoluene | 330 |
| Benzyl Alcohol | 330 | 2,6-Dinitrotoluene | 330 |
| 1,2-Dichlorobenzene | 330 | Diethylphthalate | 330 |
| 2-Methylphenol | 330 | 4-Chlorophenyl-phenylether | 330 |
| bis(2-Chloroisopropyl)ether | 330 | Fluorene | 330 |
| 4-Methylphenol | 330 | 4-Nitroaniline | 1600 |
| N-Nitroso-di-n-propylamine | 330 | 4,6-Dinitro-2-methylphenol | 1600 |
| Hexachloroethane | 330 | N-Nitrosodiphenylamine | 330 |
| Nitrobenzene | 330 | 4-Bromophenyl-phenylether | 330 |
| Isophorone | 330 | Hexachlorobenzene | 330 |
| 2-Nitrophenol | 330 | Pentachlorophenol | 1600 |
| 2,4-Dimethylphenol | 330 | Phenanthrene | 330 |
| Benzoic Acid | 1600 | Anthracene | 330 |
| bis(2-Chloroethoxy)methane | 330 | Di-n-butylphthalate | 330 |
| 2,4-Dichlorophenol | 330 | Fluoranthene | 330 |
| 1,2,4-Trichlorobenzene | 330 | Pyrene | 330 |
| Naphthalene | 330 | Butylbenzylphthalate | 330 |
| 4-Chloroaniline | 330 | 3,3'-Dichlorobenzidine | 660 |
| Hexachlorobutadiene | 330 | Benzo(a)anthracene | 330 |
| 4-Chloro-3-methylphenol | 330 | bis(2-Ethylhexyl)phthalate | 330 |
| 2-Methylnaphthalene | 330 | Chrysene | 330 |
| Hexachlorocyclopentadiene | 330 | Di-n-octylphthalate | 330 |
| 2,4,6-Trichlorophenol | 330 | Benzo(b)fluoranthene | 330 |
| 2,4,5-Trichlorophenol | 1600 | Benzo(k)fluoranthene | 330 |
| 2-Chloronaphthalene | 330 | Benzo(a)pyrene | 330 |
| 2-Nitroaniline | 1600 | Indeno(1,2,3-cd)pyrene | 330 |
| Dimethylphthalate | 330 | Dibenz(a,h)anthracene | 330 |
| Acenaphthylene | 330 | Benzo(g,h,i)perylene | 330 |
| 3-Nitroaniline | 1600 | | |

**Table 7.4. Analyte list for semivolatile organics (in water) using EPA-CLP method**

| Anylate | Required quantitation limit (μg/L) | Anylate | Required quantitation limit (μg/L) |
|---|---|---|---|
| Phenol | 10 | Dibenzofuran | 10 |
| bis(2-Chloroethyl)ether | 10 | 2,4-Dinitrotoluene | 50 |
| Anthracene | 10 | 2,6-Dinitrotoluene | 10 |
| Di-n-butylphthalate | 10 | Diethylphthalate | 10 |
| Fluoranthene | 10 | 4-Chlorophenyl-phenylether | 10 |
| Pyrene | 10 | Fluorene | 10 |
| Butylbenzylphthalate | 10 | 4-Nitroaniline | 50 |
| 3,3'-Dichlorobenzidine | 20 | 4,6-Dinitro-2-methylphenol | 50 |
| Benzo(a)anthracene | 10 | N-Nitrosodiphenylamine | 10 |
| bis(2-Ethylhexyl)phthalate | 10 | 4-Bromophenyl-phenylether | 10 |
| Chrysene | 10 | Hexachlorobenzene | 10 |
| Di-n-octylphthalate | 10 | Pentachlorophenol | 50 |
| Benzo(b)fluoranthene | 10 | Phenanthrene | 10 |
| Benzo(k)fluoranthene | 10 | Anthracene | 10 |
| Benzo(a)pyrene | 10 | Di-n-butylphthalate | 10 |
| Indeno(1,2,3-cd)pyrene | 10 | Fluoranthene | 10 |
| Dibenz(a,h)anthracene | 10 | Pyrene | 10 |
| Benzo(g,h,i)perylene | 10 | Butylbenzylphthalate | 10 |
| orocyclopentadiene | 10 | 3,3'-Dichlorobenzidine | 20 |
| 2,4,6-Trichlorophenol | 10 | Benzo(a)anthracene | 10 |
| 2,4,5-Trichlorophenol | 50 | bis(2-Ethylhexyl)phthalate | 10 |
| 2-Chloronaphthalene | 10 | Chrysene | 10 |
| 2-Nitroaniline | 50 | Di-n-octylphthalate | 10 |
| Dimethylphthalate | 10 | Benzo(b)fluoranthene | 10 |
| Acenaphthylene | 10 | Benzo(k)fluoranthene | 10 |
| 3-Nitroaniline | 50 | Benzo(a)pyrene | 10 |
| Acenaphthene | 10 | Indeno(1,2,3-cd)pyrene | 10 |
| 2,4-Dinitrophenol | 50 | Dibenz(a,h)anthracene | 10 |
| 4-Nitrophenol | 50 | Benzo(g,h,i)perylene | 10 |

**Table 7.5. Analyte list for nonhalogenated volatile organics using EPA method 8015**

| Anylate |
|---|
| Acrylamide |
| Diethyl Ether |
| Ethanol |
| Methyl Ethyl Ketone |
| Methyl Isobutyl Ketone |
| Paraldehyde |

**Table 7.6. Analyte list for aromatic volatile organics using EPA method 8020**

| Anylate | Required quantitation limit ($\mu$g/L) | Required quantitation limit ($\mu$g/kg) |
|---|---|---|
| Benzene | 2 | 2 |
| Ethyl Benzene | 2 | 2 |
| Toluene | 2 | 2 |
| Xylenes | 2 | 2 |

**Table 7.7. Analyte list for metals**

| Anylate | Analysis method | Estimated detection limit (μg/L) | Estimated detection limit (μg/kg) |
|---|---|---|---|
| Arsenic | EPA-7060 | 1 | 100 |
| Lead | EPA-7421 | 1 | 100 |
| Selenium | EPA-7740 | 2 | 200 |
| Thallium | EPA-7841 | 1 | 100 |
| Mercury | EPA-7471 | 0.2 | 200 |
| Aluminum | EPA-6010 | 45 | 4500 |
| Antimony | EPA-6010 | 32 | 3200 |
| Arsenic | EPA-6010 | 53 | 5300 |
| Barium | EPA-6010 | 2 | 200 |
| Beryllium | EPA-6010 | 0.3 | 30 |
| Boron | EPA-6010 | 5 | 500 |
| Cadmium | EPA-6010 | 4 | 400 |
| Calcium | EPA-6010 | 10 | 1000 |
| Chromium | EPA-6010 | 7 | 700 |
| Cobalt | EPA-6010 | 7 | 700 |
| Copper | EPA-6010 | 6 | 600 |
| Iron | EPA-6010 | 7 | 700 |
| Lead | EPA-6010 | 42 | 4200 |
| Lithium | EPA-6010A | 5 | 500 |
| Magnesium | EPA-6010 | 30 | 3000 |
| Manganese | EPA-6010 | 2 | 200 |
| Molybdenum | EPA-6010 | 8 | 800 |
| Nickel | EPA-6010 | 15 | 1500 |
| Potassium | EPA-6010 | | |
| Selenium | EPA-6010 | 75 | 7500 |
| Silicon | EPA-6010 | 58 | 5800 |
| Silver | EPA-6010 | 7 | 700 |
| Sodium | EPA-6010 | 29 | 2900 |
| Strontium | EPA-6010A | 3 | 300 |
| Thallium | EPA-6010 | 40 | 4000 |
| Vanadium | EPA-6010 | 8 | 800 |
| Zinc | EPA-6010 | 2 | 200 |

**Table 7.8. Analyte list for radionuclides.**

| Anylate | Analysis method | Estimated detection limit |
|---|---|---|
| Gross Alpha | EPA-900.0 | 2 pCi/g |
| Gross Beta | EPA-900.0 | 5 pCi/g |
| Gamma Activity | EPA-901.1 | |
| Strontium-90 | EPA-905.0 | 1 pCi/g |

# 8. DATA REDUCTION, VALIDATION, AND REPORTING

## 8.1 DATA PRESENTATION

The final data record for each sampling location will be recorded in the field logbook and will include, at a minimum, the following information:

- sample location,
- site observations,
- names of SPM, SHSO, and all personnel entering the control zone,
- copies of training records,
- field measurements and notes taken for each location,
- documentation of abnormalities, and
- sample documentation.

## 8.2 FIELD MEASUREMENT DATA REDUCTION, VALIDATION, AND REPORTING

ORNL/MAD shall collect field measurement data and take notes for each of the sample locations and shall record or document the information in the project field logbook or on the appropriate data sheets. All monitoring information is maintained in a single location so that it may be reviewed in its entirety if necessary.

Upon completion of the project, if requested, all field measurement data will be compiled and presented to the ORNL ER Program Manager in a field observation report. Originals of the report will be sent to the ER Document Management Center, and copies will be forwarded to the ORNL ER Project Manager, if requested.

## 8.3 LABORATORY DATA REDUCTION, VALIDATION, AND REPORTING

The laboratory will forward all results to the ORNL/MAD SPM. The Analytical Project Manager (APM) will review the data against established EPA procedures and procedures prescribed by this document. A published report including the following information will be supplied to the ORNL ER Project Manager at the conclusion of the project.

- sample number;
- sample matrix;
- chemical and radiological parameters analyzed, their reported values and units of measure;
- detection limit as specified in Sect. 7 of this document;
- consistent significant figures for each parameter for all samples;
- results of QC samples such as matrix spike/matrix spike duplicates, duplicates, surrogate recoveries, blanks, and blank spikes where appropriate;
- copies of laboratory nonconformances, with explanations of the corrective actions;
- blank corrections (field blank, trip blank, method blank, etc.) are not necessary;

- all chain-of-custody forms and pertinent shipping information should be included in the data package;
- percent moisture shall be reported for all samples;
- a narrative, which describes circumstances where the QC criteria were not met and any instrumental, technical, and administrative problems encountered during the analysis of the samples, shall be provided with the data package. In addition, the corrective actions and resolutions to these problems shall be provided;
- all data shall be packaged regardless of QA/QC noncompliances (e.g., missed holding times).

### 8.3.1 Data Validation

The data will be screened against the requirements specified in this document. The data generated for this project cannot be validated against EPA-CLP guidelines or any guidelines written from the EPA-CLP guidelines because the sample data deliverables for the CLP protocol were not requested. If validation is required, it can only be done according to the requirements detailed in this document and the analytical methods listed in this document.

### 8.3.2 Internal Quality Control

This section outlines the requirements for the QC program. The required QC to be used for this project can be found in the CLP SOW, February 1988. For non-CLP methods, the laboratory shall perform CLP-like protocol as indicated below.

#### 8.3.2.1 Gas chromatography

- Recoveries of surrogates shall be calculated for the analysis of each GC column of each sample, blank, MS, and MSD. The QC limits will be those that have been generated by the laboratory and shall be reported with the results.
- Method accuracy for each matrix studied must be assessed and records maintained.
- The accuracy and precision limits for surrogates must be determined.
- Second column confirmation shall be performed on all positive responses for the analytes of interest. Second column confirmation must be performed with the same types of QC samples that were required for the quantitation column.
- A laboratory control sample of a concentration at method detection limits is required. If samples are not within calibration range, appropriate dilution shall be performed to bring samples into range.
- A laboratory control sample (consists of known concentrations of analytes representative of the contaminants to be determined, which are added to laboratory ASTM Type II water and carried through the entire preparation and analysis process) shall be analyzed with each batch and reported with the results.
- For each analytical batch (every 20 samples of similar matrix), a reagent blank, matrix spike (MS), and matrix spike duplicate (MSD) must be analyzed.
- Recoveries of surrogates shall be calculated for the analysis of each GC column of each sample, blank, MS, and MSD. The QC limits will be those that have been generated by the laboratory and shall be reported with the results.

- The accuracy and precision limits for surrogates must be determined.
- Second column confirmation shall be performed on all positive responses for the analytes of interest. Second column confirmation must be performed with the same types of QC samples as were required for the quantitation column.

#### 8.3.2.2 Radiochemical

- Matrix spike and duplicate are required for every 20 samples of similar matrix.
- A laboratory control sample (consists of known concentrations of analytes representative of the contaminants to be determined, which are added to laboratory ASTM Type II water and carried through the entire preparation and analysis process) shall be analyzed with each batch and reported with the results.
- Method accuracy for each matrix studied must be assessed and records maintained.

# 9. INTERNAL QUALITY CONTROL REQUIREMENTS

Field QC samples are used to assess sample-handling techniques, equipment and container decontamination procedures, and chain of custody. Strict QC requirements for instrumentation procedures are defined throughout this document and will be employed during this project.

Field monitoring and laboratory activities are subject to QC requirements Levels I and II and Levels III, IV, and V QC, respectively. Items covered in laboratory QC include

- replicates,
- spiked samples,
- split samples,
- control charts,
- blanks,
- internal standards,
- zero and span gases, and
- quality control samples.

Quality control requirements are listed with the analytical procedures in Sect. 7. Any deviation or modification must be approved prior to analysis by ORNL/MAD Analytical Project Manager.

# 10. PERFORMANCE AND SYSTEM AUDITS AND SURVEILLANCES

There are no audits currently planned for the activities being performed in accordance with this specific work plan. If an audit of field activities is required, it shall be scheduled, planned, performed, and documented according to the requirements set forth in the *Environmental Restoration Division Quality Assurance Program Plan.*[6] The ORNL ER Program QAS will conduct audits and surveillances for this project.

An audit is a planned and documented activity performed to determine, through investigation, examination, or evaluation of objective evidence, (1) the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents and (2) the effectiveness of implementation. Audits shall be performed by personnel who are independent of (external to) the organization or entity being evaluated.

Surveillance is the act of monitoring or observing to verify that requirements have been specified and that items or activities conform to those specified requirements. A surveillance is a periodic internal evaluation performed by line management personnel or their representatives to assess the adequacy and effectiveness of that part of the QA program for which they are responsible. Surveillance of activities associated with this work plan will be performed as indicated in Sect. 10.2, Surveillances.

A performance audit or surveillance evaluates the effectiveness of the project in fulfilling its objectives. A system audit or surveillance examines project activities to determine if they are in compliance with procedures and other applicable documents.

## 10.1 AUDITS

There are no audits anticipated for this investigation; however, in the event a field audit is requested, it will proceed as follows.

1. The QAS shall prepare and send the audit schedule to the manager of the organization to be audited.

2. The QAS shall prepare an audit plan that identifies the scope, audit requirements and objectives, lead auditor and team member(s), activities to be audited, organizations or people to be notified, applicable requirements for documentation, schedule for the audit, documented audit procedures to be used, and any other information necessary for the successful conduct of the audit.

3. At least two weeks prior to the audit, the lead auditor shall review the scope, verify the schedule, and coordinate audit activities with the manager of the affected organization to ensure that the selected activity is ready to be audited.

4. The auditor shall conduct the audit in accordance with the audit plan and specific checklists.

5. Audit findings and observations shall be presented to the auditee at a closeout meeting. Observations that may have an impact on site personnel health and safety shall be reported immediately to the SHSO, with no exceptions. Failure to adhere to this procedure shall result in expulsion of the QA representative from the site. It is the responsibility of all personnel while on site to inform the SHSO of potential hazards. The formal report shall be issued within 30 days.

6. The auditee shall respond in writing to the report within 30 days.

7. Audit findings shall be validated by the responsible project management and processed in accordance with the *Environmental Restoration Division Quality Assurance Program Plan.*[6]

## 10.2 SURVEILLANCES

Surveillance of field activities shall be performed early in the project and regularly during the lifetime of the project to determine if personnel are adhering to procedural and documentation requirements. The ORNL/MAD QAO or the ER QAS will perform a minimum of one surveillance during the time frame of this investigation. The surveillance procedure follows.

1. Prior to initiating field work, the ORNL ER Project Manager shall notify the MAD QAO and the ER QAS of the schedule of field activities.

2. The MAD QAO, or the ER QAS, or his/her designated representative shall prepare a surveillance plan that identifies the scope, surveillance requirements and objectives, lead surveillant and team member(s), activities to be evaluated, organizations or people to be notified, required documentation, schedule, documented surveillance checklist, and any other information necessary.

3. Prior to the surveillance, the lead surveillant shall review the surveillance scope, confirm the schedule, and coordinate surveillance activities with the ORNL ER Project Manager to ensure that the selected activity is ready to be evaluated.

4. The surveillance shall be conducted in accordance with the surveillance plan and checklist.

5. Surveillance findings and observations shall be presented to the project manager as they are determined. Short-term fixes may be required for problems of immediate concern; however, root causes of problems must be determined and permanent corrective action taken.

6. The formal report shall be addressed to the ORNL ER Project Manager and the ORNL/MAD SPM and shall be issued within 30 days.

7. The ORNL ER Project Manager for this investigation shall respond in writing to the report within 30 days.

8. Findings shall be validated by the responsible project management and processed in accordance with the *Environmental Restoration Division Quality Assurance Program Plan.*[6]

## 10.3 FIELD AUDITS AND SURVEILLANCES

Audits and surveillances of field activities should consider the following or any other topics relevant to the investigation:

- permits and document approvals;
- availability and use of procedures;
- personnel training and qualifications;
- equipment calibrations and response checks;
- site control and identification;
- pre-entry briefings;
- personnel protection equipment;
- health and hazardous material monitoring;
- equipment cleanliness and decontamination;
- waste collection, preparation, and controls;
- waste controls and disposal; and
- corrective actions.

# 11. PREVENTIVE MAINTENANCE

ORNL/MAD maintains the equipment listed in this document in accordance with manufacturers' SOPs. ORNL Industrial Hygiene and Radiation Protection departments are responsible for their own equipment and maintain it in accordance with their own departmental procedures.

## 11.1 FIELD MONITORING INSTRUMENTS

To ensure that field sampling instruments comply with regulations and to minimize instrument malfunctions and failure, the ORNL/MAD group implements a preventive maintenance program for group-owned equipment. ORNL/MAD chemical detection instruments are sent annually to the manufacturer for maintenance and factory recalibration. Instruments whose annual factory calibration is overdue shall not be used in the field until they have been calibrated by the manufacturer or an approved service center.

The ORNL/MAD instrument technician employs a data base to track maintenance histories and calibration dates for each group-owned instrument. When an instrument is returned to the technician due to failure or expiration of its factory calibration, the technician records the information in the data base, then either repairs the instrument or returns it to the manufacturer. Upon receipt of the instrument from the manufacturer, the instrument technician records in the data base the next scheduled maintenance, factory calibration dates, and any new settings and then attaches a sticker to the instrument detailing this information. The instrument is then returned to the field for use.

A daily calibration or instrument response check is performed (see Sect. 6) on each instrument before it is used in the field. Instruments that do not meet factory standards for operation are removed from service, the removal is documented in the field logbook, and the instrument is returned to the ORNL/MAD instrument technician. If the ORNL/MAD instrument technician cannot make repairs, the instrument is returned to the manufacturer or an approved service center.

The nature and intended use of instruments in the field require anticipation of potential problems. In order to minimize downtime due to instrument failure, backup instruments will be calibrated and maintained in the support zone, when possible.

## 11.2 RADIOLOGICAL INSTRUMENTS

All ORNL/MAD radiological instruments are maintained and calibrated in accordance with manufacturers' specifications and NIST Standards, and each instrument will have a valid calibration certificate before it is taken into the field. Response check requirements for each instrument and additional requirements for radiological field screening instrumentation may be found in Sect. 6.

Critical parts lists for the radiological instruments:

**NaI Scintillator (Gamma)**

Depleted uranium check source
D-cell batteries
BNC-BNC cable
Head phones (optional)

**GM Pancake Probe (Beta-Gamma)**

Thorium check source
9-V batteries
BNC-MHV cable
Head phones (optional)

**GM Side Window (Beta-Gamma)**

Depleted uranium check source
9-V batteries
D-cell batteries
Head phones (optional)

**ORNL Q2101, "beer mug" ZnS Scintillator (Alpha)**

Thorium-230 check source
9-V batteries
Head phones (optional)

## 11.3 CHEMICAL DETECTION INSTRUMENTS

All chemical detection instruments are maintained and calibrated by ORNL/MAD in accordance with manufacturers' SOPs. Parts may be replaced and/or repaired without returning the instrument to the factory; therefore, whenever possible, critical replacement parts will be maintained to ensure uninterrupted monitoring.

Preventive maintenance for all instruments is performed in accordance with manufacturers' SOPs or other approved procedures. Preventive maintenance schedules and listings of critical replacement parts follow for each class of detection instrument that is most commonly kept in stock.

**PID**

Preventive maintenance on the PID should be performed weekly while the instrument is in use or as needed when not in service. Maintenance consists of a general cleaning of the instrument, the lamp, and the ion chamber.

Critical parts list for the PID:

replacement lamps for particular PIDs,
lamp cleaning compounds and solutions,
replacement battery packs,
calibration equipment, and
backup instrument.

## 11.4 LABORATORY PREVENTIVE MAINTENANCE

A program of preventive maintenance reduces the likelihood of analytical problems and unexpected delays from equipment failure. The following comprises the preventive maintenance system:

- Determination and listing of measurement system components that require preventive maintenance.
- For each measurement component, development of a schedule of routine tasks that must be carried out to minimize downtime.
- Notation of preventive maintenance activities in a maintenance log.
- Inventory of critical and frequently required spare parts.

The responsibility for routine preventive maintenance is assigned to particular individuals. More specialized maintenance is provided by a trained instrument technician, either in-house or through a service contract. The laboratory responsible for analyzing samples for this project is required to have a formal preventive maintenance program. This program must be made available to the QA officer or his designee, if requested.

# 12. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA (PRECISION, ACCURACY, AND COMPLETENESS)

Laboratory instruments are included under QC Level III and are subject to formal validation procedures. The field instruments used on this project fall under QC Level I, making them exempt from validation procedures. Level I measurement data will be used in this investigation for health and safety screening (see Table 3.2).

# 13. CORRECTIVE ACTIONS

Conditions adverse to quality, which may adversely affect safety, health, the environment, or the reliability of sampling methods and/or data, must be promptly identified and corrected by authorized personnel. The root cause of these significant conditions also must be properly documented and reported to management in a timely manner.

Conditions adverse to quality are defined as conditions that exceed predetermined acceptability limits, deviate from prescribed methods, fail to meet performance requirements, or fail to meet customer or regulatory requirements and expectations. Typical reasons for corrective action include nonconformances; occurrences; management reviews; appraisals; audits; problem investigations; and external appraisals, reviews, and audits.

## 13.1 PROCEDURE

The following corrective action procedure shall be used by project personnel when responding to conditions adverse to quality.

1. The person who detects the adverse condition shall immediately provide the appropriate supervisor with the time, date, location, personnel involved, and a description of the situation.

2. The supervisor or SHSO shall immediately determine if work should be stopped and/or a short term fix is needed. If conditions are immediately threatening to life and health, the Laboratory Shift Superintendent's office shall be contacted to determine whether the situation should be entered into the Occurrence Reporting System in accordance with the *Environmental Restoration Division Quality Assurance Program Plan.*[6] If conditions are not immediately threatening to life and health, the ORNL ER Project Manager shall be notified, and he or she shall report the situation to the ORNL ER Program Remediation Manager, who will determine the action to be taken.

3. The supervisor or SHSO shall notify the ORNL ER Project Manager of the conditions.

4. The ORNL ER Program Manager will assemble a team to perform root cause analysis and determine corrective action.

5. Prior to implementing the corrective action, the QA specialist, with technical assistance as needed, shall verify that the proposed corrective action will prevent recurrence of the conditions.

6. The QA specialist shall verify that the corrective action is properly implemented.

7. Any findings resulting from a QA audit/surveillance will be addressed by the SPM. A written statement explaining why the discrepancy occurred and what corrective action has been taken to ensure that it does not recur should be forwarded, along with the finding, to each QAO or QAS involved in the project.

## 13.2 FIELD CHANGES AND VARIANCES

Any deviation from the work plan or change in procedure must be reported and recorded when it occurs in a specified section of the field logbook designated for field changes and variances. A Field Change/Variance Form (Fig. 13.1) will be completed and signed by the appropriate parties listed at the bottom of the form in the event of any deviation from the approved plans.

A variance is a departure from a requirement. The variance must provide an acceptable alternative having defined boundaries within the parameters of the requirement. If a variance from the plan occurs, the box marked "Variance" is checked on the Field Change/Variance Form and the SPM is required to sign the form. A copy of the form is distributed to the QA representative(s) and the original is maintained by the SPM. All personnel involved in the work process will be informed of the changes.

A field change is a deviation that could adversely affect health and safety. For major alterations or field changes, the "Field Change" box on the form is checked and additional signatures are required at the bottom of the form. Changes must be explained to everyone on the investigation team. Each signee will receive a copy of the Field Change/Variance Form explaining the deviation and the substituted method or rationale for the change.

# FIELD CHANGE REQUEST / VARIANCE FORM

☐ Field Change  Change Number: _____

☐ Variance  Date: _____

Project: _____

Site: _____

Document: _____

_____

_____

_____

Substituted Method: _____

_____

_____

Impact on Data Quality: _____

_____

_____

Justification: _____

_____

_____

Site Project Manager: _____ Date: _____

Approvals: (Field Changes Only)

Project Manager: _____ Date: _____

QA Specialist: _____ Date: _____

QA Representative: _____ Date: _____

Analytical Representative: _____ Date: _____

Other Approvals:

Name / Organization

_____ Date: _____

_____ Date: _____

_____ Date: _____

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Fig. 13.1. Field Change Request Form.

# 14. QUALITY ASSURANCE REPORTS TO MANAGEMENT

Reports, which provide evidence of the quality, cost, and schedule of the project, shall be prepared periodically for ORNL ER management. A list follows of possible reports and their content.

## 14.1 FORMAL WRITTEN REPORTS

- Audit and surveillance reports, prepared by the appropriate QAO or QAS, are submitted to the SPM, ER Program Remediation Manager, and remaining members of the QA team.
- Field observation report(s) are prepared by the SPM.
- Reports on significant quality problems, recommended solutions, and results of corrective actions are prepared by the SPM.
- Monthly reports may be prepared by the representative from the ORNL ER Project Manager and submitted to the ORNL ER Program Remediation Manager.

## 14.2 INFORMAL REPORTS

Reports shall be prepared by project personnel designated by the ORNL ER Project Manager. The reports shall identify the status of the following:

- permit approvals;
- document preparation and approvals;
- scheduled versus actual completions of waste transfer activities;
- amount, type, and location of field-generated wastes; and
- actual cost and schedule versus the expected.

Regardless of whether written or oral reports are presented to management, records of activities shall be maintained by the personnel responsible for presenting the report.

# 15. ADDITIONAL NQA-1 ELEMENTS

The *Environmental Restoration Division Quality Assurance Program Plan*[6] requires that all quality-related documents be completed in accordance with the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80[1] (hereafter referred to as QAMS). In addition to this requirement, elements must be included from *Quality Assurance Program Requirements for Nuclear Facilities*, ANSI/ASME NQA-1[2] (hereafter referred to as NQA-1), and applicable DOE orders. The NQA-1 elements that were not addressed in the body of this document (because this document follows the QAMS format) are identified and addressed below.

## 15.1 PROCUREMENT DOCUMENT CONTROL

Information dealing with procurement document control can be found in Sect. 2.4 of the *Environmental Restoration Division Quality Assurance Program Plan.*[6] The relevant section in the manual addresses the QA requirements necessary for procurement of items or services (i.e., purchase requisitions, purchase orders, and specifications). The section also describes channels for procurement requisition packages, supplier documentation, acquisition of spare and replacement parts, reporting of nonconformances, and deviations reporting and approval procedures. This activity is not required for the scope of this investigation.

## 15.2 PURCHASED ITEMS AND SERVICES CONTROL

Purchase items and services with the potential to affect health, safety, the environment, production, or schedules are controlled to ensure conformity with ER Program procurement requirements. Such control is provided through procurement planning, supplier evaluation and selection, and supplier performance evaluation and verification. If any subcontractor is required for the performance of drilling or for equipment operations, that process could be guided by Sect. 2.7 of the *Environmental Restoration Division Quality Assurance Program Plan.*[6]

## 15.3 INSPECTION

Information on inspections is located in Sect. 2.10 of the *Environmental Restoration Division Quality Assurance Program Plan.*[6] Field and laboratory work (e.g., sampling, drilling, and laboratory analysis) conducted in association with the ER Program will be inspected periodically. Inspections will be based on requirements for the given activity outlined in EPA guidance documents, the *Environmental Surveillance Procedures Quality Control Program*[5] manual, site-specific investigation plans, and other available references.

## 15.4 INSPECTION, TESTING, AND OPERATING STATUS

Information dealing with inspection, testing, and operating status of items used and wastes generated can be found in Sect. 2.14 of the *Environmental Restoration Division Quality Assurance Program Plan.*[6] To ensure that required inspections are performed and to ensure that items that have failed inspections and tests are not inadvertently installed, used, or operated, the inspection and testing status of items will be identified either on the items themselves or in documents traceable to the items. Status will be tracked through indicators such as physical location and tags, markings, stamps, inspection records, or other suitable means.

## 15.5 CONTROL OF NONCONFORMING ITEMS

Section 2.15 of the *Environmental Restoration Division Quality Assurance Program Plan*[6] defines the QA requirements for identification, segregation, control, disposition, and reporting of nonconforming items or activities. It explains how nonconforming items are tagged and controlled so that proper evaluation can be conducted without jeopardizing the data already collected. Additional information on how nonconforming items will be addressed during this investigation can be found in Sect. 13 of this document.

## 15.6 QUALITY ASSURANCE RECORDS

Requirements for establishing QA records and properly maintaining them to prevent damage or loss are discussed in Sect. 2.17 of the *Environmental Restoration Division Quality Assurance Program Plan.*[6] It also discusses retrieval of records from storage and corrected and revised records. QA records include items such as audit and surveillance reports, field logbooks, chain-of-custody forms, field change request/variance forms, field monitoring record, and daily instrument calibration/response check forms.

## 15.7 SOFTWARE

The requirements for and methods of verifying and validating computer codes or software development can be found in Sect. 2.19 of the *Environmental Restoration Division Quality Assurance Program Plan.*[6] This activity is not required for this investigation.

## 15.8 OPERATIONAL READINESS REVIEWS

An operational readiness process will be conducted to ensure that a given activity is ready to proceed to the next increment of work. Section 2.20 of the *Environmental Restoration Division Quality Assurance Program Plan*[6] describes the process of recognizing the completion of each phase of work on a project and determining whether the project is prepared to enter into the next phase of operations. A readiness review meeting may be scheduled prior to the commencement of work to establish the readiness of each phase of the investigation and detect any deficiencies. Documents to be available for review at this meeting include worker

training records, the excavation/penetration permit, and the comprehensive work plan containing the health and safety plan, waste management plan, and QAPjP.

## 15.9 RISK ASSESSMENT

Risk assessments are used to evaluate health-related issues during each phase of a project. Details on risk assessment can be found in the *EPA Guidance Document.*[7] A risk assessment is not required for this phase of the 7500 Area Contamination Site investigation.

## 15.10 DOCUMENT CONTROL

Document control is the process of assuring that documents are reviewed, distributed, and follow the prescribed ER guidelines for documentation. Documents that are under this requirement are the site-specific comprehensive work plan and health and safety plan, the field logbook, and any reports that are submitted to ER after the completion of this investigation (e.g., a field observation report).

# 16. HEALTH AND SAFETY

This health and safety section was developed by the members of the MAD Group of the Health and Safety Research Division at ORNL and will be implemented by ORNL/MAD personnel. This section was prepared to provide health and safety guidance for conducting field investigative activities at the 7500 Area Contamination Site. This investigation is necessary because surface radiological contamination has been identified at this area and the integrity of the underground waste drainage lines is suspect.

Major components of this plan include (1) assignment of key individuals to health- and safety-related positions and the delineation of their responsibilities; (2) development of a contaminant matrices table to identify contaminants that might be encountered at the site and to define their exposure limits and harmful effects on the body; (3) discussion of personnel-protective requirements and description of personnel decontamination procedures and mandatory safety requirements; and (4) provision of emergency information for contingencies that may arise during field activities.

## 16.1 PROJECT ORGANIZATION

This health and safety section will conform to 29 CFR 1910.120,[3] as defined by the final rule of March 1989 and supplement to the final rule, April 18, 1991. ORNL/MAD will designate a SHSO and alternates who will implement, monitor, and enforce the plan.

Table 2.1 is a listing of key project personnel and affiliations, including phone numbers, for individuals involved in the health and safety aspects of the environmental sampling activities at the 7500 Area Contamination Site. Backups for key project personnel are listed where appropriate. The SPM or SHSO may designate qualified alternates who are not identified in Table 2.1 to conduct their respective duties in the field, if warranted.

### 16.1.1 Site Project Manager

The SPM is responsible for oversight of the entire environmental sampling effort. He/she will be responsible for site accessibility, safety, QA, and waste management and will delegate further responsibilities to other members of the ORNL/MAD sampling team he/she determines to be qualified. Specific responsibilities of the SPM are listed below.

1. Coordinates site operations, including logistics;

2. Interfaces with plant and project personnel;

3. Assists the SHSO when necessary;

4. Participates in site characterization activities;

5. Assures that all quality-related activities are conducted in accordance with prescribed QA procedures;

6. Notifies appropriate personnel of work schedules;

7. Maintains and controls all site records;

8. Determines in-field procedural variances in response to site conditions;

9. Documents and reports unforseen site changes and corrective actions; and

10. Coordinates waste disposal following procedures established by ORNL ER and ORNL Waste Management Operations.

### 16.1.2 Site Health and Safety Officer

The SHSO, or a designated representative, with the support of the SPM, has primary responsibility for the following:

1. Prior to initiation of site activities, ensures that personnel receive this plan and are aware of its provisions; are instructed in safe work practices; are familiar with potential hazards, routes of entry, and health effects; and are familiar with planned emergency procedures.

2. Ensures that all prospective site personnel sign and date a statement in the field logbook to verify that item 1 was fulfilled.

3. Notifies the Hazardous Waste Operations and Emergency Response (HAZWOPER) Program Coordinator (see Sect. 16.1.4) of those ORNL individuals and ORNL subcontractors who may be participating in site activities. Requests that individuals volunteer any medical information that would necessitate special considerations (e.g., allergies, diabetes, pregnancy), keeping confidential the medical information provided.

4. Confirms with the Technical Resources and Training Section that personnel accessing the contamination reduction zone and exclusion zone have received the health and safety training that qualifies them to work at this site.

5. Implements health and safety requirements and reports to the SPM any deviations from anticipated conditions. If unsafe conditions or hazards arise during the investigation, orders operations to cease, safeguards personnel, and reestablishes safe working conditions upon obtaining guidance from various departments throughout ORNL. These departments may include: industrial hygiene, radiation protection, or safety.

6. Maintains on-site copies of current training records for all site personnel in order to verify compliance with 29 CFR 1910.120[3] and other required training. If task-specific training is required for site workers, verbally verifies that the training has been received by asking either the site workers or the support person responsible for securing their services.

7. Ensures that each site worker has an up-to-date respirator card, indicating proper training and quantitative fit-testing for those respirators required at this site by the SHSO.

8. Establishes site work zones and required levels of protection, and establishes personal decontamination stations and instructs personnel in their use (see Sects. 16.5 and 16.8).

9. Establishes and makes available at the site emergency response instructions and contacts, with telephone numbers and appropriate radio communication information (see Sect. 16.2).

10. Identifies key plant personnel (and alternates) who are responsible for specific safety-related areas, such as health, plant safety, radiation protection, and industrial hygiene. In addition, establishes a liaison with the Laboratory Shift Superintendent's organization to facilitate emergency response.

11. Minimizes the number of personnel and the amount of equipment in the exclusion zone in order to remain consistent with safe site operations.

12. Ensures the performance of daily response checks and/or calibration of monitoring equipment (see Sect. 6) to be used; ensures that results are recorded in the field logbook or on the Daily Instrument Calibration/Response Check Form.

13. Ensures that all monitoring equipment is operating according to the manufacturer's specifications and instructions and arranges for maintenance, if warranted (see Sect. 6).

14. Prior to commencing sampling activities, ensures that the penetration/excavation permit or any other necessary permits have been generated and approved and that signed copies of each have been provided to the SPM and are available on site.

15. Ensures that personnel comply with regulations concerning clearance distances from overhead obstructions, i.e., booms or masts of heavy equipment, and temporarily suspended equipment.

16. Ensures that personnel and equipment are frisked before egress from the contamination reduction zone.

17. Ensures that any injury or illness related to performance of work is reported to the Industrial Safety Section.

18. Assists personnel with the completion of report form(s), including those required in the event of an accident. Ensures that completed forms, either originals or copies, are returned to the ORNL/MAD SPM. Assists with ensuing investigation following an accident.

19. Ensures that continuous chemical and radiological monitoring for potential site contaminants is provided while field operations are being conducted within the exclusion zone or contamination reduction zone.

20. Ensures that site visitors stay outside the exclusion zone and the contamination reduction zone; conducts a pre-entry briefing for any qualified visitors who must access the contamination reduction zone or the exclusion zone and confirms that they meet all access requirements; ensures proper documentation of visitor's training records; ensures that visitors sign and date a statement in the field logbook stating that item 1 was fulfilled.

### 16.1.3 Field Project Personnel

Project personnel involved in site investigations and operations are responsible for:

1. Taking all reasonable precautions to prevent injury to themselves and their fellow employees; using *all of their senses* and appropriate instrumentation to alert them to potentially harmful situations.
2. Performing only those tasks that the personnel believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the SHSO and the SPM.
3. Notifying the SHSO of medical conditions (e.g., allergies, diabetes, pregnancy) that require special consideration. (Health Division approval and/or a physician's recommendation may be required before an individual with a medical condition can or may be assigned a specific field task.)
4. Avoiding unnecessary contact with any potentially contaminated substances (i.e., walking through puddles, pools, and mud) and avoiding placement of monitoring and sampling equipment on a potentially contaminated surface.
5. During the equipment decontamination process, preventing spillage of decon water whenever possible. If a spill occurs, containing the liquid if possible and notifying the SPM.
6. Avoiding splashing of contaminated materials.
7. Being familiar with the physical characteristics of the site, including:
   - wind direction in relation to ground zero;
   - accessibility to associates, equipment, and vehicles;
   - communications ( fire alarm boxes and telephones);
   - hot zones (areas of known or suspected contamination);
   - site access;
   - nearest site resources (restrooms, breakrooms);
   - possible overhead lines; and
   - buried electrical lines and underground piping systems.
8. Maintaining for proper disposal all wastes generated during site characterization and sampling activities (see Sect. 4.10).

9. Reporting all injuries, no matter how minor, to the SHSO and/or the SPM. Personnel incurring injury or illness related to performance of work are required to physically report to the ORNL Health Center.
10. Abiding by a buddy system, so that each site worker is responsible for keeping track of his/her partner in the event of an incident.
11. Reporting to the SHSO or a designated member of the investigative team for frisking prior to egress from the contamination reduction zone or exclusion zone as directed by the SHSO.
12. Becoming familiar with the required procedures in this plan and conducting all activities in accordance with this plan.

### 16.1.4 ORNL Industrial Hygiene and HAZWOPER

The ORNL Industrial Hygiene Section shall be responsible for the oversight and approval of field investigative efforts related to industrial hygiene and the requirements of 29 CFR 1910.120.[3] In addition, the industrial hygiene representative shall have stop-work authority and may be consulted regarding personal protective equipment as well as industrial hygiene monitoring and sampling. The industrial hygiene representative may be consulted to authorize a return to work after any site hazard has been resolved. If ORNL Industrial Hygiene was consulted and authorized the stop-work order, only ORNL Industrial Hygiene can restart work.

Within the Industrial Hygiene Section, located at ORNL, the HAZWOPER Program Coordinator shall approve all plans prior to mobilization and the commencement of field activities. The SHSO will provide the coordinator with a list of ORNL individuals and ORNL subcontractors who may be participating in site activities. Based on program requirements, such as specific needs, the location of the site, and potential exposure of the employee involved in the site characterization activities, the coordinator will determine which individuals must be placed on the hazardous waste worker medical monitoring program. The HAZWOPER coordinator will then provide the ORNL medical facility with a list of individuals who are approved for inclusion in the hazardous waste worker program. The ORNL Health Division will examine each individual on this list who has not been previously placed on the program. If the employee is fit to work at a hazardous waste site, he or she will be placed on the hazardous waste worker medical monitoring program.

### 16.1.5 ORNL Radiation Protection

ORNL Radiation Protection shall be responsible for the oversight and approval of personnel protection requirements related to radiation protection. Radiation protection shall approve all plans prior to mobilization and the commencement of field activities. Radiation protection may be consulted to authorize a return to work after any on-site hazard has been resolved. (Also see Sect. 6.4.1.) If ORNL Radiation Protection was consulted and authorized the stop-work order, only ORNL Radiation Protection can restart work.

### 16.1.6 ORNL Safety

The ORNL Safety Department shall be responsible for oversight and approval of field investigative efforts relating to safety. The ORNL Safety Department shall review and comment on all work plans and will sign the approval page prior to the mobilization and commencement of field activities. Safety shall also have stop-work and continuation authority and may be consulted regarding safety related issues relevant to personnel and equipment. If ORNL Safety Department was consulted and authorized the stop-work order, only ORNL Safety can restart work.

## 16.2 EMERGENCY RESPONSE PLAN

The Laboratory Shift Superintendent at ORNL coordinates 24-h emergency response coverage from the Shift Superintendent's Department of the Laboratory Protection Division. The on-duty Laboratory Shift Superintendent, assisted by a well-trained plant emergency squad, directs the response to emergencies such as fires, major equipment failure, hazardous materials releases or spills, natural disasters, and sabotage. All spills must be reported to the Office of Environmental Compliance and Documentation. Should a spill occur during operations, ORNL/MAD, as first responder, will act to contain the spill material as well as possible until plant emergency units arrive. A spill control kit will be located on site for this purpose.

### 16.2.1 Emergency Phone Numbers

- Plant Phone: **911**
- Laboratory Shift Superintendent Phone: 574-6606
- Cellular Phone: 574-6606
- Radio Number: Station 103 or 403

**Contact the Laboratory Shift Superintendent first. The Superintendent is the trained emergency response director.**

Listed below are emergency groups and their telephone numbers. A cellular phone may be present in the field and available for use when workers are not in close proximity to a plant phone.

| | |
|---|---|
| Environmental Management | 574-6670 |
| Security Control | 574-6646 |
| Radiation Protection | 574-6690 |
| Industrial Hygiene | 574-6165 |
| Medical | 574-7431 |
| Public Relations | 574-1640 |
| Safety (Industrial) | 574-6679 |
| Security Patrol | 574-6277 |

### 16.2.2 Emergency Preparedness

Parts of this section were taken from the *Consultants and Visitors Environmental, Safety, Health, and Security Handbook.*[8]

In case of emergency, the SHSO or the SPM will notify or assign someone to notify the Laboratory Shift Superintendent of the situation as soon as possible, using the following procedures.

#### 16.2.2.1 Reporting an emergency

1. Telephone

   - If a plant telephone is accessible, dial **911**. On a cellular phone, dial **574-6606**. When using a plant radio, call **Station 103 or 403.**
   - Describe the emergency.
   - Identify the location of the emergency.
   - Identify yourself.
   - ***In case of an injury, tell whether an ambulance is needed.***
   - Listen to and follow any instructions that are given.
   - Do not hang-up until the emergency response coordinator disconnects first.
   - **The closest phone and security assistance is located at portal 19B at the south end of the REDC/HFIR access road.**

2. Fire Alarm Pull Boxes

   Pulling a fire alarm box automatically transmits the location of the emergency to the Fire Department and the Emergency Control Center. Remain at the alarm box and supply any needed information to the responding emergency squad, as conditions warrant. **The closest phone and security assistance is located at portal 19B at the south end of the REDC/HFIR access road.**

3. Radio

   When Station 103 or 403 is called, the shift superintendent will be notified of the emergency. **The closest radio and security assistance is located at portal 19B at the south end of the REDC/HFIR access road.**

   - Confirm that it is an emergency.
   - Describe the emergency.
   - Identify the location of the emergency.
   - Identify yourself.
   - Listen to and follow any instructions.

### 16.2.2.2 Alarm signals

**1. Evacuation Alarms**

Evacuation alarms are denoted by a steady or continuous sounding from the plant public address (PA) system. The SHSO or SPM will designate the evacuation routes. Evacuate the site or area and proceed to the assembly point defined by the SHSO or SPM, and wait for further instructions.

**2. Radiation Alarms**

Radiation alarms are denoted by rotating red beacon lights and a steady sound from a clarion horn. Evacuate the site or area, proceed to the assembly point defined by the SHSO or SPM, and wait for further instructions.

**3. Take Cover Alarms**

Take cover alarms are denoted by an intermittent or wailing siren sound from the plant PA system. Seek immediate protective cover in a strong sheltered part of a building. Evacuate mobile structures to a permanent building.

**4. Standard Alerting Tone**

The standard alerting tone is a high-low tone from the plant PA system. Listen carefully; an emergency announcement will follow.

### 16.2.2.3 Evacuation procedures

- Familiarize yourself with the evacuation routes that are designated (verbally or posted) by the SHSO or SPM.
- In the event of an evacuation, proceed to the predetermined assembly point and w it for further instructions.
- The SHSO or SPM and crew will follow instructions given by the Emergency Response Team upon its arrival.

### 16.2.2.4 Important reminders

- Know the telephone number of the Laboratory Shift Superintendent: **574-6606, 911, or Station 103 or 403.**
- Know how to summon an ambulance: dial **911** and give the location. Wait for the arrival of first-aid personnel.
- Know the quickest way to summon the plant emergency squad: pull a fire alarm box and wait for the arrival of the Emergency Response Team.
- **Do not hang-up until the emergency response coordinator disconnects first.**
- The closest restrooms, break facilities, and water are located in Building 7503.

## 16.3 SITE ACTION PLAN

### 16.3.1 Site Preparation

Provisions of this document are mandatory for all on-site employees and visitors engaged in hazardous material management activities, including, but not limited to, initial site reconnaissance, field investigations, mobilization, project operations, and demobilization. This section covers the health and safety concerns related to radiological and chemical field screening and the subsequent environmental soil sampling.

At the pre-entry health and safety briefing, all field investigation personnel, including representatives from ORNL (industrial hygiene, radiation protection, the fire department, safety, security, and ORNL ER) shall receive a copy of this plan and shall complete work in accordance with this document. The pre-entry briefing shall be held prior to the commencement of field operations so that field personnel may become familiar with potential hazards and mandatory field procedures. Each potential field person will be required to sign and date a designated section within the field logbook, stating that he/she has received a pre-entry health and safety briefing and a copy of the work plan containing a health and safety section.

Also at the pre-entry briefing, all personnel will provide the SPM with documentation of successful completion of training requirements, in accordance with 29 CFR 1910.120.[3] The required training includes 40-h OSHA Hazardous Worker Training and 12-h Energy-Systems-approved Radiation Worker Training. Tailgate meetings may be called during field activities to inform site personnel of potential health and safety concerns that may arise due to unplanned field conditions.

### 16.3.2 Facility Description

The 7500 Area Contamination Site (Fig. 1.1) is located in Melton Valley near ORNL grid coordinates (measured in feet) N18,100 and E32,400. The site is north of REDC/HFIR adjacent to the west side of the REDC/HFIR access road. The investigation will be undertaken because of known radiological and potential chemical contamination that was discovered in the ditch along the road leading to REDC/HFIR. The investigation may involve the following activities:

- surface soil sampling to depths of 12 in. using a breaker bar or auger,
- subsurface soil sampling to depths of 2 to 6 ft utilizing split-spoon samplers and/or barrel augers, and
- a water sample at the south end of the drainage ditch.

In many instances, the sampling locations may be close to underground waste drainage lines.

Due to the immediate nature of the request to collect samples at the 7500 Area Contamination Site, ORNL/MAD will mobilize and begin sampling shortly following the approval of this and all other required plans/permits. The proposed time frame of the investigation has not been determined but is dependent upon weather, funding, analytical

services, and various Energy Systems approvals. It is estimated that a few weeks will be required for completion of field activities.

Unusual site features and requirements of the 7500 Area Contamination Site make necessary the following items:

- Section (e)(3)(i) of 29 CFR 1910.120[3] requires that all full-time workers on site that may be potentially exposed to hazardous substances and health hazards shall receive a minimum of 40 h of off-site health and safety training and a minimum of 3 days (24 h) of actual field experience under direct supervision of a trained, experienced supervisor. Supervisors are required to have completed an extra 8 h of supervisory training prior to commencement of field activities. Twenty-four hours of off-site health and safety training and a minimum of 1 day of actual field experience under the direction of a trained, experienced supervisor shall apply for workers in areas that have been monitored and characterized indicating exposures less than permissible exposure limits or published exposure limits, where respirators are not necessary and characterization indicates no health hazard.

- Current Energy-Systems-approved 12-h Radiation Worker Training will be required of those individuals conducting field activities within the contamination reduction or exclusion zones.

- Before site access will be granted, all site personnel must have attended the pre-entry health and safety briefing, and documentation of the training must be entered in the field logbook. All personnel will also participate in the Energy Systems radiological dosimetry program, which requires thermoluminescent dosimeter badges to be worn on site.

- At the discretion of the ORNL Industrial Hygiene Department, identified individuals will be placed on a hazardous waste worker medical monitoring program, in accordance with 29 CFR 1910.120.[3] The ORNL Health Center will be notified of the names of on-site participants by the ORNL HAZWOPER and will dispense the appropriate health care. Subcontractors will receive health care and monitoring from their employer's occupational physician.

### 16.3.3 Suspected Contaminants

Descriptions of the suspected types of contaminants and their compound characteristics (if known) are provided in Table 16.1. If additional potential contaminants are identified prior to the commencement of activities or during activities, an addendum containing this information will be provided. Potential contaminants are based on information from historical data and from the normal daily operations that contributed to the waste drainage lines. Chemicals used in sampling equipment decontamination activities also appear in the table.

Table 16.1. Characteristics of suspected contaminants at the ORNL 7500 Area Contamination Site

| Contaminant[a] | TLV/PEL/CEIL/REL Activity or DAC[b] | STEL/IDLH[c] | Target organs/ miscellaneous information[d] | Chemical and physical properties[e] |
|---|---|---|---|---|
| Acetone | PEL: 750 ppm<br>TLV: 750 ppm<br>REL: 250 ppm | STEL: 1000 ppm<br>STEL: 1000 ppm<br>IDLH: 20,000 ppm | Eyes, nose, throat, skin | Colorless liquid, with mint-like odor; UEL: 13%; LEL: 2.5%; IP: 9.69 eV; LFL: 2.15%; UFL: 13% FP: -140°F |
| Americium-243 | 2 x $12^{-12}$ μCi/mL | NE | Respiratory system, kidneys, GI; irritant | Variable |
| Adogen-364 · HP | PEL: NE<br>TLV: NE<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Eyes, dermatitis | Liquid at 77°F, pH 9-11, SG 0.80, insol, incompatible with strong oxidizers, FP > 200°F |
| Ammonium hydroxide (as ammonia) | PEL: NE<br>TLV: 25 ppm<br>CEIL: 50 ppm (5 min)<br>REL: NE | STEL: 35 ppm<br>STEL: 35 ppm | Respiratory system, mucous membranes, eyes, severe irritant | Colorless gas, pungent odor, LEL: 16%, SG: 0.90, sol, incompatible with: oxidizers, acids, halogens, salts of silver and zinc |
| Carbon tetrachloride | PEL: 2 ppm<br>TLV: 5 ppm<br>REL: NE | STEL: NE<br>STEL: NE<br>STEL: 2 ppm<br>IDLH: 300 ppm | Poison by ingestion, inhalation; nausea, vomiting, pupillary constriction, coma, eye, skin irritant, contact dermatitis; affects liver and kidney; carcinogen, skin | Colorless liquid, heavy ethereal odor; when heated emits toxic fumes of Cl and phosgene; not combustible; sol: 0.8%; VP: 91 mm; IP: 11.47 eV; LFL: nonflammable; UFL: nonflammable, BP: 170°F, FP: -9°F |
| Cesium-137[f] | 7 x $10^{-8}$ μCi/mL | NE | Respiratory system, total body, GI | Variable |
| Diethylbenzene (DEB) | PEL: NE<br>TLV: NE<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Irritating to respiratory mucous membranes, eyes, skin | Colorless liquid, insol, SG 0.865 LFL; 0.8%, combustion and decomposition product: CO, $CO_2$ |

**Table 16.1 (continued)**

| Contaminant[a] | TLV/PEL/CEIL/REL Activity or DAC[b] | STEL/IDLH[c] | Target organs/ miscellaneous information[d] | Chemical and physical properties[e] |
|---|---|---|---|---|
| *Di(2-ethylhexyl)* phosphoric acid | PEL: NE<br>TLV: NE<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Respiratory mucous membranes, skin, eyes | Yellow liquid with mild odor |
| Diisopropylbenzene (DIPB) | PEL: NE<br>TLV: NE<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | No toxic effect noted | Colorless liquid, SG 0.865, insol., FP: 77•C |
| Ethanol | PEL: 1000 ppm<br>TLV: 1000 ppm<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Mildly toxic by inhalation and skin contact, eye and skin irritant, rapidly oxidized in the body to carbon dioxide and water | Clear, colorless, fragrant liquid, LEL: 3.3%, miscible in water, flammable or combustible liquid, can react vigorously with oxidizers |
| 2-Ethyl-1-hexanol | PEL:<br>TLV:<br>REL: | | | |
| Hydrazine hydrate | PEL: 0.1 ppm<br>TLV: 0.1 ppm<br>NIOSH CEIL: 0.03 ppm (120 min) | STEL: NE<br>STEL: NE<br>IDLH: NE | Respiratory system, CNS, skin, eyes, carcinogen | Colorless liquid with an ammonia-like odor, IP: 8.93 eV, miscible, LEL: 2.9%, SG: 1.01 |
| Hydrofluoric acid | PEL: 3 ppm<br>ACGIH CEIL: 3 ppm<br>REL: 3 ppm (10 hr) | STEL: 6 ppm<br>STEL: NE<br>IDLH: 30 ppm | Respiratory system, eye and skin irritant | Colorless gas with an irritating odor, miscilble, SG: 1.00, IP: 15.98 eV |
| Hydrogen peroxide | PEL: 1 ppm<br>TLV: 1 ppm<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: 75 ppm | Respiratory system, eyes, skin (irritant) | Colorless liquid with a slight odor, miscible, IP: 10.54 eV, SG: 1.39, incompatible with: oxidizable materials, iron, copper, brass, chromium, zinc, lead, manganese, sliver |

**Table 16.1 (continued)**

| Contaminant[a] | TLV/PEL/CEIL/REL Activity or DAC[b] | STEL/IDLH[c] | Target organs/ miscellaneous information[d] | Chemical and physical properties[e] |
|---|---|---|---|---|
| Hydroquinone | CEIL: 2 mg/m$^3$ (15 min)<br>TLV: 2 mg/m$^3$<br>REL: 2 mg/m$^3$ | STEL: NE<br>STEL: NE<br>IDLH: NE | Eyes, respiratory, skin, CNS | White crystals, SG: 1.330, solubility 9.4%, combustion products: CO, incompatible with oxidizers |
| Lithium chloride | PEL: NE<br>TLV: NE<br>REL; NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Respiratory, skin and eye irritant, CNS, kidneys | White crystals or powder, SG: 2.07, non-flammable |
| Lithium (hydride) | PEL: 0.025 mg/m$^3$<br>TLV: 0.025 mg/m$^3$<br>REL: 0.025 mg/m$^3$ | STEL: NE<br>STEL: NE<br>IDLH: 55 mg/m$^3$ | Respiratory system, skin, eye irritant; blurred vision, mental confusion, burns to mucous membranes | Odorless, off-white, translucent solid which darkens when exposed to light, sol: reacts, BP: decomposes, LEL: NA |
| Lithium hydroxide | PEL: NE<br>TLV: NE<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Respiratory irritant, sore throat, coughing, labored breathing, kidney, mental confusion, blurred vision, CNS, chemical burns, conjunctivitis | Colorless or white crystals, pH of 1 N solution = 14, SG: 2.54, hygroscopic, sol: 12.8%, nonflammable |
| Mercuric nitrate (inorganic) | PEL: 0.01 mg/m$^3$<br>TLV: 0.1 mg/m$^3$<br>REL: 0.01 mg/m$^3$ | STEL: 0.03 mg/m$^3$<br>STEL: NE<br>IDLH: 10 mg/m$^3$ | CNS, kidney, skin, eyes, respiratory system, liver; tremors, cough, fatigue, emotional instability | White or slightly yellow powder with odor of nitric acid, SG: 4.3. soluble in water, non-flammable, incompatible with: alcohol, phosphines, aromatic hydrocarbons, combustible materials, etc. |

**Table 16.1 (continued)**

| Contaminant[a] | TLV/PEL/CEIL/REL Activity or DAC[b] | STEL/IDLH[c] | Target organs/ miscellaneous information[d] | Chemical and physical properties[e] |
|---|---|---|---|---|
| Nitric acid | PEL: 2 ppm<br>TLV: 2 ppm<br>REL: 2ppm | STEL: 4 ppm<br>STEL: 4 ppm<br>IDLH: 100 ppm | Respiratory system, eyes, skin, teeth | Colorless or yellow liquid with an acrid suffocating odor, IP: 11.95 eV, miscible, SG: 1.5, incompatible with: combustible materials, metallic powders, hydrogen sulfide, alcohol; reacts with water to produce heat |
| Paraffin | PEL: NE<br>TLV: 2 mg/m$^3$<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Skin contact may cause irritation, particles and fumes may be irritating to eyes | Colorless or white, somewhat tanslucent, greasy feel |
| Oil (mist, mineral) | PEL: 5 mg/m$^3$<br>TLV: 5 mg/m$^3$<br>REL: NE | STEL: NE<br>STEL: 10 mg/m$^3$<br>IDLH: NE | Respiratory system, skin | Sol: Insol, LEL: NA BP: 680°F FLP: 250°-500°F, UEL: ? |
| Oxalic acid | PEL: 1 mg/m$^3$<br>TLV: 1 mg/m$^3$<br>REL: 1 mg/m$^3$ | STEL: 2 mg/m$^3$<br>STEL: 2 mg/m$^3$<br>IDLH: 500 mg/m$^3$ | Respiratory system, skin, kidneys, eyes | Odorless powder or granular solid sol: 14%, SG: 1.9, corrosive, incompatible with strong oxidizers and silver compounds |
| Potassium hydroxide | CEIL: 2 mg/m$^3$<br>CEIL: 2 mg/m$^3$<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Respiratory, skin (chemical burns), corneal necrosis, all tissues | White or slightly yellow solid, odorless, hygroscopic, SG: 2.044, non-flammable, incompatible with: acids, trichloroethylene, water, some metals and alloys, etc. |
| Sodium carbonate | PEL: NE<br>TLV: NE<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Respiratory, skin (may cause chemical burns), corneal necrosis | Odorless, small crystals or crystalline powder, SG: 2.5, non-flammable, incompatible with: alumninium, acids, lithium, etc. |

Table 16.1 (continued)

| Contaminant[a] | TLV/PEL/CEIL/REL Activity or DAC[b] | STEL/IDLH[c] | Target organs/ miscellaneous information[d] | Chemical and physical properties[e] |
|---|---|---|---|---|
| Sodium hydroxide | CEIL: 2 mg/m$^3$<br>CEIL: 2 mg/m$^3$<br>CEIL: 2 mg/m$^3$ | STEL: NE<br>STEL: NE<br>IDLH: 250 mg/m$^3$ | Upper respiratory irritant, pneumonitis, skin (severe chemical burns), eyes (severe chemical burns, may cause blindness; vapor causes irritation), latent period (several minutes to several hours) between exposure and sense of irritation | Odorless, white or off-white hygroscopic solid, SG: 2.13. Incompatible with: acids, flammable liquids, organic halogens, metals such as aluminium, tin & zinc, nitromethane; corrosive to metals |
| Sodium nitrate | PEL: NE<br>TLV: NE<br>REL: NE | STEL: NE<br>STEL: NE<br>IDLH: NE | Respiratory mucous membrane irritant, may be irritating to skin and eyes, CNS, blood, GI tract, kidneys | Colorless, transparent crystals, or white granules or powder, SG: 2.26, sol. in water: 47%, non-flammable |
| Strontium-90[f] | 2 x 10$^{-9}$ μCi/mL | NE | Skeletal system, respiratory system | Variable |
| Tributylphosphate (TBP) | PEL: 0.2 ppm<br>TLV: 0.2 ppm<br>REL: 0.2 ppm | STEL: NE<br>STEL: NE<br>IDLH: 125 ppm | Respiratory system, skin, eyes | Colorless to pale yellow liquid, odorless liquid, sol: 0.6%, SG: 0.98 |
| Trichloroethene (trichloroethelyne) | PEL: 50ppm<br>TLV: 50 ppm<br>REL: 25 ppm | STEL: 200 ppm<br>STEL: 200 ppm<br>IDLH: 1000 ppm | Respiratory system, heart, kidneys, CNS, skin, carcinogen | Colorless liquid with a chloroform like odor, BP: |
| Trichloroethene (trichloroethelyne) | PEL: 50 ppm<br>TLV: 50 ppm<br>REL: 25 ppm | STEL: 200 ppm<br>STEL: 200 ppm<br>IDLH: 1000 ppm | Respiratory system, heart, liver, kidneys, CNS, skin, carcinogen | Colorless liquid with chloroform-like odor, BP: 189°F, sol: 0.1% at 77°F, FLP: 90°F, IP: 9.45 eV, FP: -99°F, UEL: 10.5% at 77°F, LEL: 8% at 77°F |

**Table 16.1 (continued)**

| Contaminant[a] | TLV/PEL/CEIL/REL Activity or DAC[b] | STEL/IDLH[c] | Target organs/ miscellaneous information[d] | Chemical and physical properties[e] |
|---|---|---|---|---|
| Uranium-235 | $2 \times 10^{-11}$ µCi/mL | NE | Respiratory system, kidneys, GI; irritant | Variable |

[a]This list of suspected contaminants was gathered from historical and operational data.

[b]TLV – Threshold limit value (American Conference of Governmental Industrial Hygienists), PEL – Permissible exposure limit (Occupational Safety and Health Administration), CEIL – Ceiling exposure for any given length of time (American Conference of Governmental Industrial Hygienists or Occupational Safety and Health Administration), REL – Recommended exposure limit (National Institute for Occupational Safety and Health), DAC – Derived air concentration (DOE Order 5400.5), TWA – Time-weighted average, NE – Not established, NA – Not available.

[c]STEL – Short-term exposure limit (American Conference of Governmental Industrial Hygienists, Occupational Safety and Health Administration), IDLH – Immediately dangerous to life and health (National Institute for Occupational Safety and Health), NE – Not established.

[d]CNS – Central nervous system, CVS – Cardiovascular system, GI – Gastrointestinal.

[e]BP – Boiling point, FIP – Flame ionization potential, FLP – Flash point, FP – Freezing point, IP – Ionization potential, LEL – Lower explosive limit, LFL – Lower flammability limit, MP – melting point, NA – Not available, SG – Specific gravity, Sol – Soluble, UEL – Upper explosive limit, UFL – Upper flammability limit, VP – Vapor pressure.

[f]Cesium-137 and strontium-90 are believed to be the primary contaminants that pose the highest potential for a health and safety risk. There is historical and operational evidence that suggests that other radionuclides are present at this site.

*Source:* American Conference of Governmental Industrial Hygienists, *1991–1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*, ISBN:0-936712-92-9, Cincinnati, OH, 1991 and National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, DHHS(NIOSH) Publication No. 90-117, Cincinnati, OH, June 1990.

## 16.4 SITE TASK HAZARD ANALYSES

### 16.4.1 Purpose

The site task hazard analysis identifies health and safety concerns that may be encountered by site personnel and describes the personal protective equipment required for each site task. The SHSO or the SPM has the authority to raise or lower the level of personal protective equipment worn by the teams, depending on hazards encountered in the field. The site task hazard analysis is based upon scenarios; therefore, the levels of protective equipment outlined in this section are to be used only as guidelines rather than requirements. Donning and doffing procedures are outlined for various levels of protection in Sects. 16.6.5 and 16.6.6; personal decontamination requirements are outlined in Sect. 16.8; action limits are defined in Sects. 16.10.1.2 and 16.10.2.2.

### 16.4.2 Hazard Evaluation

A hazard evaluation for the 7500 Area Contamination Site is presented in Table 16.2.

**Table 16.2. Hazard evaluation for the 7500 Area Contamination Site**

| | | | | | |
|---|---|---|---|---|---|
| Waste types: | Liquid/Free | Yes | Solid | Yes | Sludge No |
| Characteristics: | Corrosive | Yes | Ignitable | No | Radioactive Yes |
| | Volatile | Yes | Toxic | Yes | Reactive Yes |
| | Unknown | Yes | | | |
| Hazards: | Chemical | Yes | Physical | Yes | Radiological Yes |

Personal protective equipment expected to be necessary for this project is discussed in Sect. 16.6. Personnel-protective equipment requirements will be adjusted as site conditions change or as the SHSO or a qualified representative from industrial hygiene or radiation protection deem necessary. Site work generally will require modified Level D+ protection. (Action limits are presented in Sect. 16.10.1.2 and 16.10.2.2.) Modified Level D protection will include the addition of hearing protection when heavy machinery is operating and the addition of chemically-resistant gloves for sampling. Due to the potential for contact with radiological contamination or caustic chemicals, all personnel shall avoid skin contact with water or soil while at the investigation site.

### 16.4.3 Decontamination Personnel

Personnel involved with the decontamination efforts at the 7500 Area Contamination Site have the potential of exposure to a variety of chemical and radiological hazards (Table 16.1) as they decontaminate equipment. Equipment decontamination generally will require Level D+ protective equipment (see Sect. 16.6). It is recommended that all personnel shower at the change house prior to departing for home.

Personnel decontamination procedures are outlined in Sect. 16.8 and equipment decontamination procedures in Sect. 16.9.

Decontamination personnel may potentially receive burns or be exposed to splash or backspray from the portable hot-water washer. Personnel operating the hot-water washer are required to wear a splash shield for the face, which should be worn in conjunction with safety glasses.

Noise levels may be elevated near the hot-water washer. Hearing protection is required for all decontamination personnel when the decontamination trough is affixed to the back of the decontamination trailer and for personnel working within a radial distance of 10 ft from the hot-water washer. Previous monitoring results have shown that hearing protection is not required when the decontamination trough and its attendant activities are moved at least 10 ft from the decontamination trailer.

Hazards associated with inhalation of exhaust from the internal combustion engine that powers the hot-water washer may also be encountered. This potential problem may be avoided by ensuring that exhaust always trails away from decontamination personnel.

### 16.4.4 Soil Sampling Team

Operational procedures for soil sampling, which involve split-spoon sampling, hand augering, and hand troweling, are described in Sect. 4. The 7500 Area Contamination Site soil sampling team normally will consist of two sampling technicians and at least one other individual to assist and collect samples. Soil samples will be collected within the designated exclusions zones at each operational site and containerized in the contamination reduction zone (see Sect. 16.5).

Extreme care and caution must be employed prior to any sampling. Personnel involved in soil sampling will require Level D+ personal protective equipment unless downgraded or upgraded by the SHSO. Engineering plans of the entire 7500 Area Contamination Site must be thoroughly reviewed with the project engineer as well as a representative from safety to ensure the absence of underground obstructions or barriers. A penetration permit will be required prior to conducting subsurface soil sampling. Each sampling location must be reviewed against the site penetration permit and agreed upon by the SPM and SHSO prior to any sampling activities.

Pushing split-spoon samplers with a piece of heavy equipment may present a serious physical hazard to the soil sampling team. A major hazard is conducting operations where heavy equipment may be operating nearby or overhead. Due to the awkwardness of the split-spoon sampling in combination with the machinery and the uneven terrain, special attention should be paid to one's surroundings. Care must be taken in the operation of the machinery. A third person at the sampling location will act as an extra set of eyes in the event of unforeseen problems or difficulties. Each individual must be aware of visible hazards posed by this site and of all verbal communications from other members of the sampling team. The hand augering team may be exposed to the contaminants and hazards identified in Table 16.1.

### 16.4.5 Site Project Manager

The SPM is responsible for oversight of the entire 7500 Area Contamination Site sampling activities. The SPM is required to access all zones (support, contamination reduction, and exclusion) and, therefore, potentially may be exposed to all hazards associated with all zones and with all duties performed within these zones. Prior to entering an area, the SPM shall don the appropriate protective equipment required by the SHSO for activities within that area of the site.

### 16.4.6 Site Health and Safety Officer

The SHSO is responsible for the safety and health of personnel involved in the 7500 Area Contamination Site sampling. A major portion of the SHSO's time is spent providing continuous monitoring for potential contaminants at the site. The SHSO shall have access to and control of all areas at the 7500 Area Contamination Site project and will be exposed to all potential hazards to which all site-specific field personnel may be exposed.

If the exclusion zone must be evacuated because of elevated readings exceeding predetermined action limits (see Sects. 16.10.1.2 and 16.10.2.2) for the monitoring instruments, or an obvious safety concern, the SHSO will reenter the exclusion zone after consultation with the appropriate departments (industrial hygiene or safety) to determine if it is safe for the sampling team to reenter the zone.

### 16.4.7 Equipment Operators

Split-spoon sampling activities may require the use of different types of operational equipment. Personnel operating heavy equipment will use Level D personal protective equipment, although changing field conditions or positioning within or out of the site boundaries may require an upgrade of personal protective equipment by the SHSO. Personnel must observe safety precautions when operating around the site. People working around heavy equipment should be aware that operators have blind spots in their field of vision.

### 16.4.8 Special Hazards

In addition to the physical, chemical, radiological, and underground hazards of the investigative site, other types of potentially harmful hazards could be present at this site. All site investigative personnel may be exposed to the hazards outlined below.

#### 16.4.8.1 Heat stress

Activities being conducted at the 7500 Area Contamination Site may be physically demanding during much of the investigative effort due to moderate to heavy work loads, ambient air temperatures, and relative humidity.

Two important factors may help personnel function in hot environments: acclimatization and consumption of fluids. Acclimatization is a physical and psychological adjustment that workers experience during the first one or two weeks of work in hot environmental

conditions. Especially during this period, workers should concentrate on maintaining a balanced diet, consuming plenty of fluids throughout the day, and remaining aware of telltale signs of heat-related stress, such as headaches, dizziness, high body temperature, and increased heart rate. It is imperative that the SHSO be informed if a worker experiences these symptoms.

All activities that take place at the investigative site require the use of a buddy system. As field activities continue, all personnel should be aware of the condition of their buddies and be familiar with the signs of heat-related stress. The SHSO will institute a work and rest regimen to combat heat-related disorders, according to his/her best professional judgment and guidelines published by the American Conference of Governmental Industrial Hygienists (ACGIH).[9] When ambient temperatures are above 70° F, ORNL Industrial Hygiene will be contacted to determine if a wet bulb globe thermometer (WBGT) reading is necessary. The decision to make a WBGT reading will be based upon a number of factors, such as level of personal protective equipment in use, time of year, wind velocity, and humidity.

#### 16.4.8.2 Cold stress

Activities being conducted at the 7500 Area Contamination Site may be physically demanding during much of the investigative effort; this difficulty will be compounded by the use of protective clothing and equipment, moderate to heavy work loads, ambient air temperatures, relative humidity, and wind speed.

Two important factors will help personnel function in cold environments: acclimatization and proper clothing. Acclimatization is a physical and psychological adjustment that workers experience during the first one or two weeks of work in cold environmental conditions. Especially during this period, workers should concentrate on maintaining a balanced diet, consuming plenty of fluids throughout the day, and remaining aware of telltale signs of cold-related stress, such as headaches, numbness in digits or extremities, dizziness, low body temperature, and decreased heart rate. It is imperative that the SHSO be informed if a worker experiences these symptoms.

All activities that take place at the investigative site require the use of a buddy system. As field activities continue, all personnel should be aware of the condition of their buddies and be familiar with the signs of cold-related stress. The SHSO will institute a work and rest regimen to combat cold-related disorders, according to his/her best professional judgment and guidelines published by the American Conference of Governmental Industrial Hygienists.[9] Due to the time frame of this investigation, cold stress should not be a factor.

#### 16.4.8.3 Biological stress

Field conditions may present a variety of biological stresses, and it is the responsibility of investigative personnel to inform the SHSO of health conditions they have that may be affected by site conditions. Examples of these stresses may be, but are not limited to, insect bites or stings, ticks, poison ivy, pollens and grasses, snakes, etc.

### 16.4.8.4 Illumination

Field activities at the 7500 Area Contamination Site normally will be conducted during daylight hours, and a minimum of 5 ft-c will be required to conduct operations. (A footcandle is a unit of illumination equal to one lumen per square foot when measured at a surface that is everywhere one foot from a source of light of one candle power.) Actual field measurements of illumination will not be collected. A conservative guideline may be that field work will commence 15 min after sunrise and conclude 15 min prior to sunset. Adherence to the minimum 5-ft-c requirement will be based on the SHSO's best professional judgment.

### 16.4.8.5 Dust

Based on previous experience with split-spoon sampling or hand augering, dust generation should not be a concern. A rule of thumb is that a visible cloud of dust will constitute an action limit. An engineering control may be employed, such as wetting the sampling area with deionized water, sprayed as a fine mist from a garden sprayer. In the unlikely event that engineering controls are unsuccessful, ORNL Industrial Hygiene will be summoned to assess the situation and provide guidance.

### 16.4.8.6 Ergonomics

The interaction of personnel with their working environment at this site also may present potential hazards such as the incorrect lifting of heavy loads, equipment vibrations, improper body positioning, and negotiation of physical obstacles when traversing ditches and brush. All of the aforementioned conditions could be factors in this investigation. Personnel should always position themselves properly and lift from the legs when lifting equipment or heavy objects and should rely on the buddy system for assistance in lifting loads that are too heavy for one person. **Back strain, the most common ergonomic hazard in the field, may be easily avoided, provided that site workers ask for assistance when they need it.**

### 16.4.8.7 Physical sampling location hazards

Hazards located at each sampling site may include, but are not limited to, mechanical equipment malfunctions and noise hazards. Prior to sampling at each location, the area will be reviewed for both above- and below-ground hazards and obstacles. This will be confirmed by the use of area engineering plans and maps and personnel communications with various representatives. A site walk-over with all involved parties will be performed prior to any excavation, and all proposed sampling locations will be agreed upon prior to starting. A signed penetration permit that identifies all potential underground/overhead hazards will be provided to the SHSO.

Overhead electrical transmission lines cross portions of the location. Prior to placing cranes at a sampling site, the SPM or his designee shall verify that the equipment will not be operated when any part of the equipment enters within a minimal radial distance of 10 ft from electrical transmission lines or as specified in Table 16.3. Whenever possible, all personnel should stay clear of overhead work and temporarily suspended or moving equipment.

**Table 16.3. Safe working distances from electrical transmission lines for heavy equipment**

| Normal voltage (phase-to-phase) (kV) | Minimum clearance required (ft) |
|---|---|
| *When operating near high voltage power lines* | |
| 0 to 50 | 10 |
| 50 to 200 | 17 |
| 200 to 350 | 22 |
| 350 to 500 | 27 |
| 500 to 750 | 35 |
| 750 to 1000 | 44 |
| *While in transit with boom lowered* | |
| All voltages | 10 |

*Source: Crawler locomotive and truck cranes* [29 CFR 1910.180j(1)].

## 16.5 DETERMINATION OF WORK AREA

The following sections will be used to determine work zones for the 7500 Area Contamination Site.

### 16.5.1 Zone 1: Exclusion Zone

The exclusion zone is the area where the greatest potential exists for exposure to contamination (see Fig. 16.1). Personnel entering the exclusion zone must meet all applicable site access requirements and wear the appropriate level of protective clothing as prescribed by the SHSO. An entry and exit checkpoint will be visually defined or communicated by the SHSO at the periphery of the exclusion zone to regulate the flow of personnel and equipment.

Prohibited personnel, items, and conduct in the exclusion zone include the following:

- beards and long sideburns (if respiratory protection is required);
- eating, smoking, or chewing anything;
- personal articles (e.g., watches and rings);
- failure to inform the SPM or SHSO of any illness that could affect safety or cause health-related complications;
- removal of respiratory protective equipment while using Level C or higher protection;
- access to the exclusion zone by any individual lacking the required health and safety training [in accordance with OSHA regulations 29 CFR 1910.120(e)1 and (e)2[3]], lacking other applicable training, or not participating in the hazardous-waste-worker medical monitoring program;
- any conduct or item thought to be potentially dangerous to the well-being of the sampling team or the drilling subcontractor; and
- application of insect spray or cosmetics, since interaction of these substances with other chemicals is possible.

### 16.5.2 Zone 2: Contamination Reduction Zone

As shown in Fig. 16.1, a contamination reduction zone is established outside the exclusion zone to provide a transition from and a buffer between the exclusion zone (potentially contaminated) and the support zone (clean). The contamination reduction zone provides additional assurance that the physical transfer of contaminating substances on personnel, equipment, or in the air, is limited through a combination of decontamination, distance

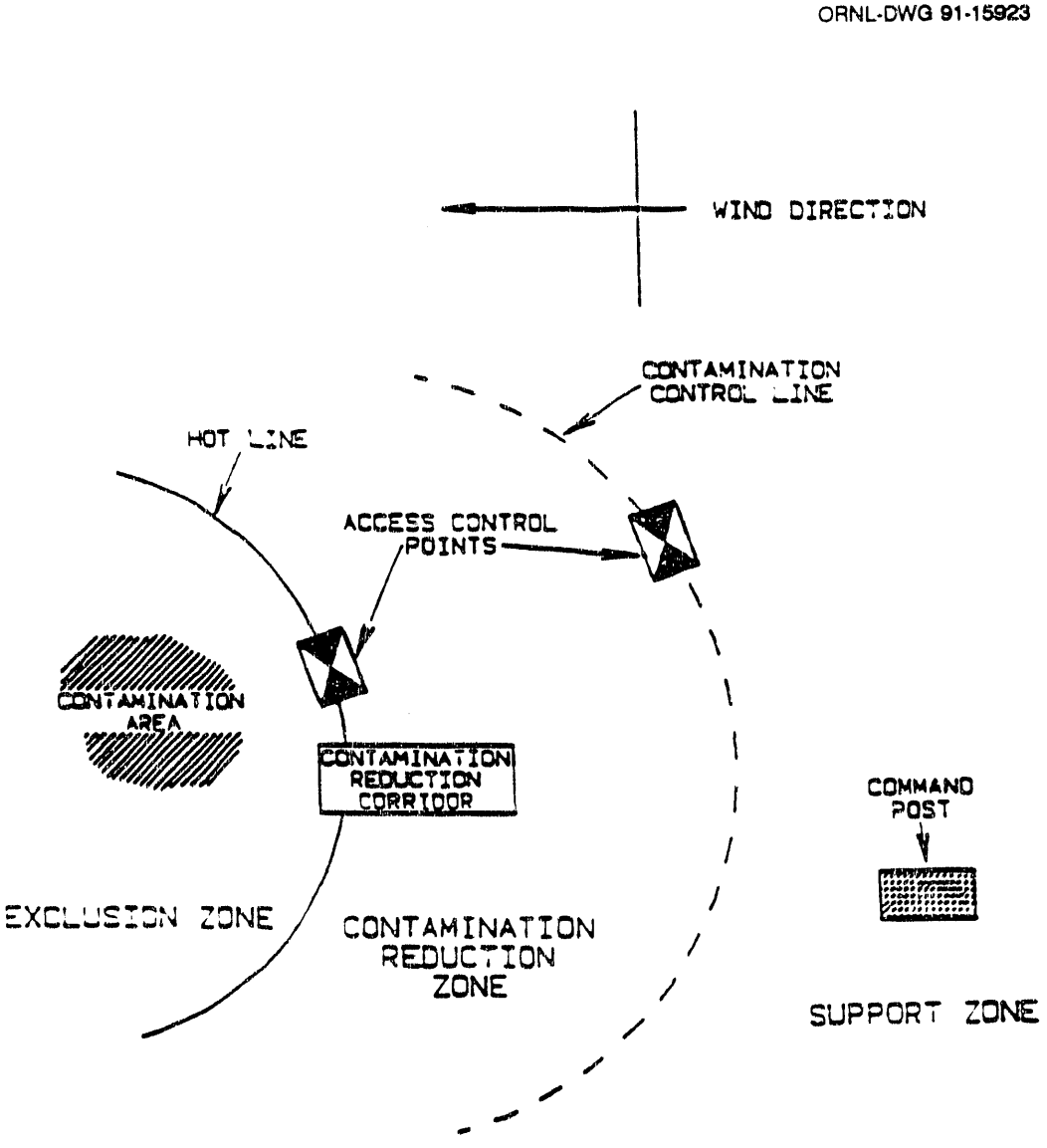


**Fig. 16.1. Diagram of site work zones showing exclusion zone, contamination reduction zone, and support zone.**

between exclusion and support zones, air dilution, zone restrictions, and work functions. Personnel entering the contamination reduction zone must meet all applicable site access requirements. The primary function of the contamination reduction zone is decontamination of personnel and equipment. Personnel decontamination stations will be established and constructed as detailed in Sect. 16.8. Equipment decontamination will be accomplished as described in Sect. 16.9 of this document.

### 16.5.3 Zone 3: Support Zone

The support zone (clean zone), shown in Fig. 16.1, will be marked and protected against contamination from the work site.

The support zone functions primarily as

- the entry area for personnel, material, and equipment;
- the exit area for decontaminated personnel, material, and equipment;
- a storage area for clean safety and work equipment; and
- an area for rest breaks, the consumption of food and beverages, and all other activities.

## 16.6 PERSONAL PROTECTIVE EQUIPMENT

The SHSO shall specify the personal protective equipment required for site activities, tasks, and work zones, based on possible site contaminants, OSHA guidelines, and the information in Table 16.4 and Sects. 16.6.1 through 16.6.3 of this document. Conservative additions to personnel protection may be made by ORNL/MAD, ORNL Industrial Hygiene, ORNL Radiation Protection, or ORNL Safety. All sampling activities will be conducted in Level D+ as stipulated in the following chart. Equipment decontamination procedures will be carried out in modified Level D+. The following explanation of protective clothing and procedures for donning and doffing of protective clothing are given strictly as guidelines and will be adhered to in the event that upgrading or downgrading is advised by the SHSO or by the SHSO in conjunction with other health related representatives.

### 16.6.1 Level C Protective Equipment

- Full-face, air-purifying cartridge respirator capable of filtering out organic vapors and radionuclides. (Other cartridges, types of respiratory protection, or personal protective equipment may be required depending upon site conditions.)
- Hooded chemical-resistant clothing (Tyvek®) with all seams and openings taped.
- Gloves (chemical-resistant).
- Cotton gloves (inner gloves).
- Hard-toed footwear (ANSI Z41.1 approved).
- Hard hats.
- Scuffs or outer boots.
- Hearing protection, as warranted.

**Table 16.4. Protective equipment for site activities**

| Activity | Level | Protective equipment[a] |
|---|---|---|
| Environmental sampling[b] | D | Hard hat (ANSI Z89.1)<br>Safety glasses (ANSI Z87.1)<br>Hard-toed footwear (ANSI Z41.1)<br>Field work clothes<br>Face shield[c]<br>Hearing protection[d]<br>Chemically-resistant work gloves[e]<br>Shoe scuffs, if warranted |
| Environmental sampling and decontamination where there is potential splash hazard | D+ | Above protection plus:<br>Chemical-resistant polyethylene-lined Tyvek® clothing<br>Chemical-resistant disposable gloves<br>Nitrile or butyl rubber outer boots |
| Environmental sampling or decontamination at action levels | C | Above protection plus:<br>Full-face respirator with organic vapor/high efficiency dust, mist, and radionuclide cartridge |

[a]Chemical-resistant gloves, outer boots, and Tyvek® clothing may be worn by personnel to reduce the danger of potential splashing and to maintain personal hygiene. All personnel entering the exclusion zone or contamination reduction zone are required to wear appropriate personal protective equipment. Site personnel and visitors must contact the SPM or SHSO to confirm actual personnel protection requirements prior to entering an investigation site.

[b]Due to the potential for contacting caustic materials, environmental sampling crews at this site will use Level D protection only when downgraded by the SHSO.

[c]Full-faced face shield mounted on hard hats with safety glasses will be worn only during the decontamination process.

[d]If the decontamination process is performed within 10 ft of the decontamination trailer, hearing protection (plugs) will be required.

[e]Leather work gloves will be worn by heavy equipment operators only during operation of the heavy equipment; leather gloves will be worn by those handling abrasive hand-operated equipment who are not involved in the collection of soil samples.

### 16.6.2 Level D+ Protective Equipment

- Chemical-resistant (polyethylene-lined) Tyvek® clothing.
- Chemical-resistant disposable gloves.
- Cotton gloves (inner gloves).
- Hard-toed footwear.
- Hard hats.
- Safety glasses.
- Scuffs or outer boots.

### 16.6.3 Level D Protective Equipment

- Coveralls or field clothes.
- Hard-toed footwear.
- Safety glasses.
- Hard hats.
- Leather work gloves allowed only for the heavy equipment operator; the sampling team will be required to wear chemical-resistant gloves.
- Scuffs or outer boots, if warranted.

The outer protective garment will be made of a chemical-resistant woven material (Tyvek® or equivalent), which forms a protective barrier against detrimental chemicals for a specific period based on the chemical in question. The resistance of the protective clothing will vary because each chemical has its own permeating ability. For some chemicals, the risk of chemical permeation increases when an outer protective garment becomes damp from soil or water contact. Therefore, a wet outer protective garment should be replaced with a dry garment as soon as possible.

### 16.6.4 Respiratory Protection

Personnel at the 7500 Area Contamination Site will be covered by a respiratory protection program that meets the legal requirements of 29 CFR 1910.134[10] by incorporating the following elements:

- a program administrator;
- standard operating procedures for selecting and using respirators (based on the ORNL Respiratory Protection Program;
- proper selection of respirators based on the hazard;
- training of personnel in use and limitations of equipment;
- regular cleaning and maintenance of equipment;
- proper storage of equipment;
- routine monthly inspection of equipment and inspection before and after use;
- constant monitoring of the work area for adverse conditions and worker stress;
- continual evaluation of the respiratory compliance program, once in operation;

- determination of the medical fitness of potential user;
- use of approved equipment that has been properly fit tested.

The fit test determines the user's ability to obtain a satisfactory fit with a negative pressure, air-purifying respirator. Results of the test dictate the specific type, make, size, and model of negative pressure, air-purifying respirator for the wearer. The following policies apply to the fitting and use of respirators.

1. An employee must have passed the fit test and the medical evaluation before using a respirator and must present a valid respirator card prior to being issued a respirator.

2. If an employee cannot obtain a good respirator-to-face seal because of facial or medical characteristics, that employee will not use a respirator and/or enter an atmosphere that requires the use of a respirator.

3. Facial hair such as beards, sideburns, or certain mustaches that may interfere with the fit test are not allowed.

4. Persons requiring corrective lenses shall be provided with specially mounted lenses inside the full-face mask. As stated in 29 CFR 1910.134(e)(5)(ii),[10] under no circumstances will contact lenses or normal glasses be worn while using full-face respirators.

5. Although fit testing for positive-pressure, self-contained breathing apparatuses is not required, a less-than-acceptable respirator-to-face seal will reduce effective breathing time through leakage. Such leaks may pose a hazard to the user if sufficient air is not available to allow him/her to reach an uncontaminated air supply.

6. A person may use only the specific make(s) and model(s) of air-purifying respirator(s) for which he/she has obtained a satisfactory fit through quantitative fit-testing procedures. Under no circumstances shall a person be allowed to use any make or model respirator for which he has not passed a fit test.

The determination of medical fitness of the potential user is generally based on evaluating the individual for physiological and psychological limitations, as given in American National Standards Institute Standard Z88.6[11] and 29 CFR 1910.134(b)(10),[10] "Medical examinations." Examples of problems that may render an employee unfit to use a respirator include

- pulmonary problems;
- cardiovascular problems;
- skin sensitivity, diabetes, perforated eardrum, deviated septum;
- claustrophobia, anxiety, and discomfort.

All respiratory equipment will be approved by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA). All personnel required to use respiratory protection shall have an up-to-date quantitative respirator fit test and shall wear only those respirators approved by the quantitative fit test, as specified on his/her respirator fitting card. In addition, site personnel will abide by a single-

use respirator policy. Once the seal of the respirator has been broken (i.e., for lunch and other breaks), a new respirator will be donned in place of the previous one.

### 16.6.5 Protective Clothing Donning Procedure

This procedure ensures that site personnel are instructed in the proper way to don protective clothing. Failure to adhere to this procedure may render the protective clothing ineffective against a potential contaminant. The following procedure is a **guide** and may be altered by the SHSO if procedural changes are warranted in the field. In addition, some articles of protective clothing and equipment detailed below may not be necessary for a particular site task; hence personnel should consult the SHSO for the appropriate protective equipment combination.

1. Inspect clothing and respiratory equipment before donning.

2. Adjust the hard hat to fit head.

3. While standing or sitting, place legs in the suit and push the safety boots through. Gather the suit at the waist and pull it up over hips. Place arms in the sleeves, pull the upper portion of the suit over shoulders, and zip the suit closed.

4. Place boot covers over the safety boots if required. Tape the boot covers to the leg of the suit to provide a seal and tab the tape to permit removal.

5. Don the respirator after performing the initial qualitative checks of the respirator's integrity. Ensure that the proper cartridges are in place. All personnel who may be required to wear respirators should familiarize themselves with Sect. 16.6.4 (respiratory protection).

6. Perform the necessary qualitative respirator fit test under the direct supervision of the SHSO.

7. If using a full-face respirator, draw the hood up around the respirator and use duct tape to seal exposed facial areas.

8. First don cotton inner gloves, then chemical-resistant gloves. Pull the sleeve of the suit over the cuff of the glove and seal it to the glove with tape. Create a tab on the tape to ease the removal of gloves during decontamination procedures.

### 16.6.6 Protective Clothing Doffing Procedure

This procedure ensures that site personnel are instructed in the removal of protective equipment. Failure to adhere to the procedure may result in unnecessary exposure to potential contaminants. The following doffing procedure is a **guide** that may be altered by the SHSO if procedural changes are warranted in the field. In addition, because some protective equipment and clothing listed below may not be required for a specific task, personnel should consult the SHSO if there is any doubt about the proper removal of protective equipment.

1. Remove any extraneous disposable clothing and equipment (e.g., outer gloves, hard hat, boot covers, tape) and dispose of it in the appropriate receptacle.

2. Unzip the protective suit.

3. Removing one arm at a time, turn the suit inside out. Inner gloves and respirator should still be worn at this time.

4. While seated, if possible, remove one leg from the suit at a time, turning the suit inside out.

5. Dispose of the suit in the appropriate receptacle.

6. Remove respiratory equipment.

7. Remove inner disposable gloves by rolling them off each hand, inside out, and dispose of them in the appropriate receptacle.

Personnel should familiarize themselves with this guidance and with the personnel decontamination procedures in Sect. 16.8 because both procedures must work in harmony.

## 16.7 STANDARD SAFE WORK PRACTICES

1. Eating, drinking, chewing gum or tobacco, smoking, or applying cosmetics are prohibited in the exclusion zone and the contamination reduction zone or wherever the possibility exists for the transfer of contamination.

2. Contact with potentially contaminated substances should be avoided. Do not walk through puddles, pools, mud, etc. Avoid, whenever possible, kneeling on the ground and leaning or sitting on equipment or the ground. Do not place monitoring equipment on a potentially contaminated surface such as the ground.

3. Spillage should be prevented to the extent possible. If a spill occurs, contain liquid, if possible, and notify the SPM. (All spills must be reported to the ORNL Office of Environmental Compliance and Documentation.)

4. Splashing of contaminated materials should be prevented.

5. Field crew members should use all of their senses and appropriate instrumentation to alert them to potentially harmful situations.

6. Practice good housekeeping. Keep everything orderly and out of potentially harmful situations.

7. Field crew members must be familiar with the physical characteristics of investigations, including

- wind direction in relation to ground zero;
- accessibility to associates, equipment, and vehicles;
- communications;
- the location of hot zones (areas of known or suspected contamination);
- site access; and
- the nearest water sources.

8. The number of people and equipment in the exclusion zone should be minimized in accordance with work space requirements for safe site operation.

9. All waste generated during the 7500 Area Contamination Site characterization and sampling activities will be disposed of in accordance with Sect. 4.10 and the appendices.

10. Report all injuries, no matter how minor, to the SHSO and the SPM.

11. All workers in the exclusion zone and contamination reduction zone will maintain verbal contact with fellow workers or maintain visual contact if site conditions make hearing difficult. A buddy system must be utilized in the exclusion zone and the contamination reduction zone.

12. Each person will make his/her presence known to the SPM daily, and changes in personnel will be noted. A list of workers on the job site will be maintained in the field logbook for accountability.

## 16.8 PERSONNEL DECONTAMINATION PROCEDURES

Personnel decontamination procedures are designed to eliminate or limit the contaminated materials workers may encounter and to limit the spread of contaminated materials from the exclusion and contamination reduction zones. Decontamination procedures for levels of protective equipment C, D+, and D, which are quite similar, are described in this section.

The SHSO is responsible for the establishment of the exclusion, contamination reduction, and support zones (see Sect. 16.5); the construction of a site decontamination station; and the instruction of personnel on its proper use. Figures 16.2, 16.3, and 16.4 depict minimum requirements for decontamination stations.

The following procedures have been provided as guides for personnel decontamination. Actual procedures depend on site conditions and may be modified by the SHSO if improvements are needed. These guides are worst-case scenarios; therefore, personnel shall check with the SHSO to determine the site requirements (see also Sect. 16.6.6 for protective clothing doffing procedures).

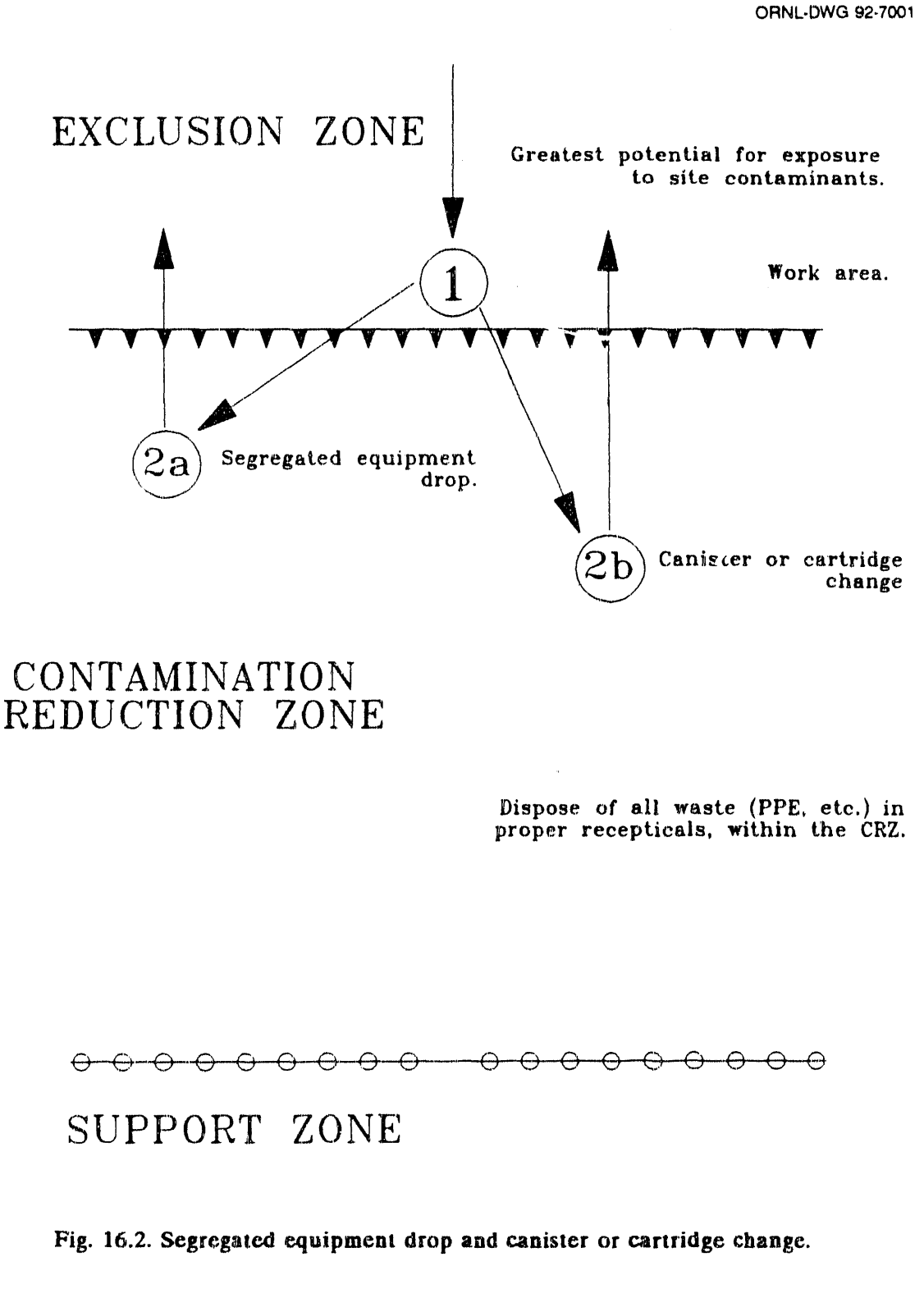


**Fig. 16.2. Segregated equipment drop and canister or cartridge change.**

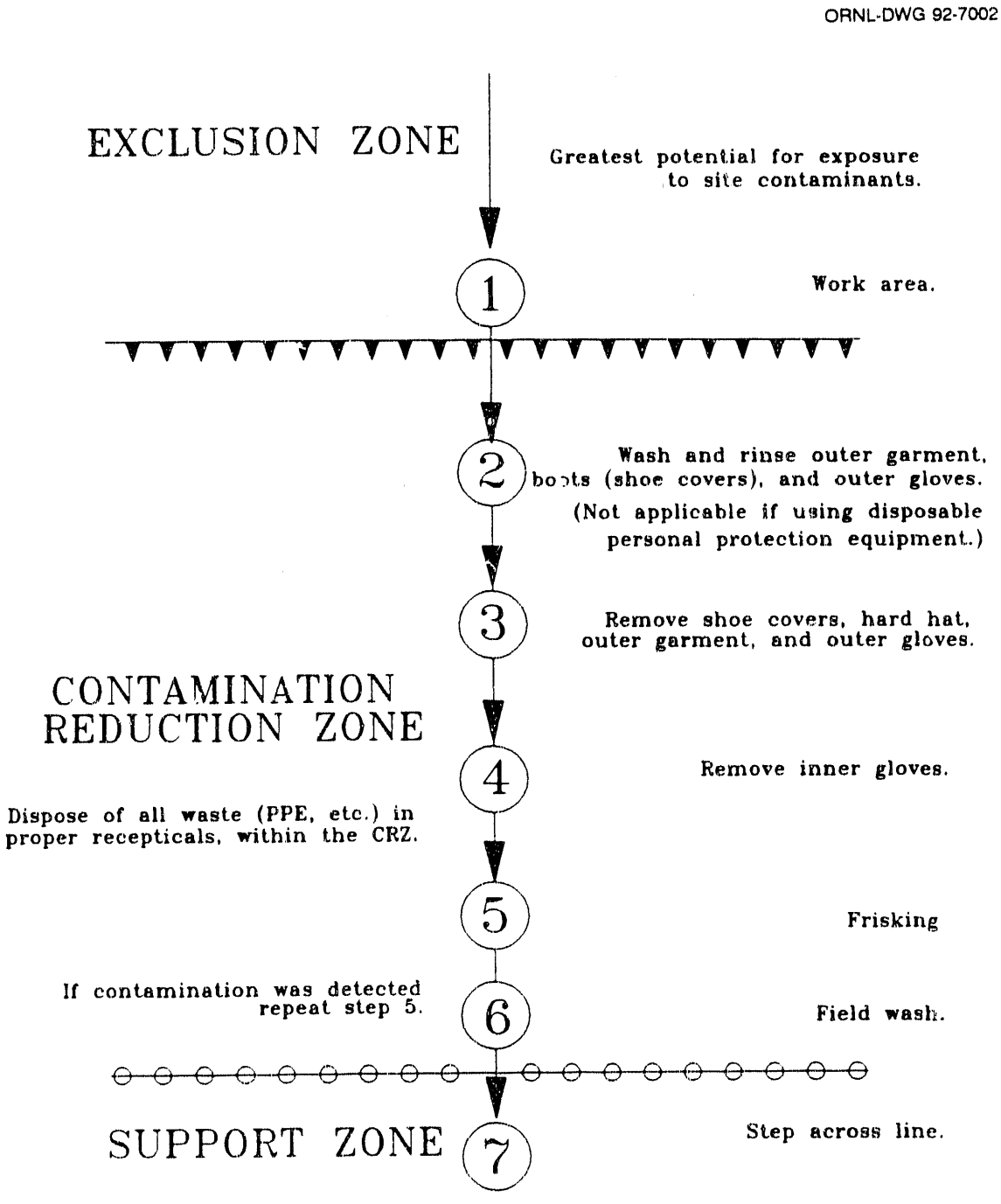


Fig. 16.3. Minimum decontamination requirements for Level D+ protection.

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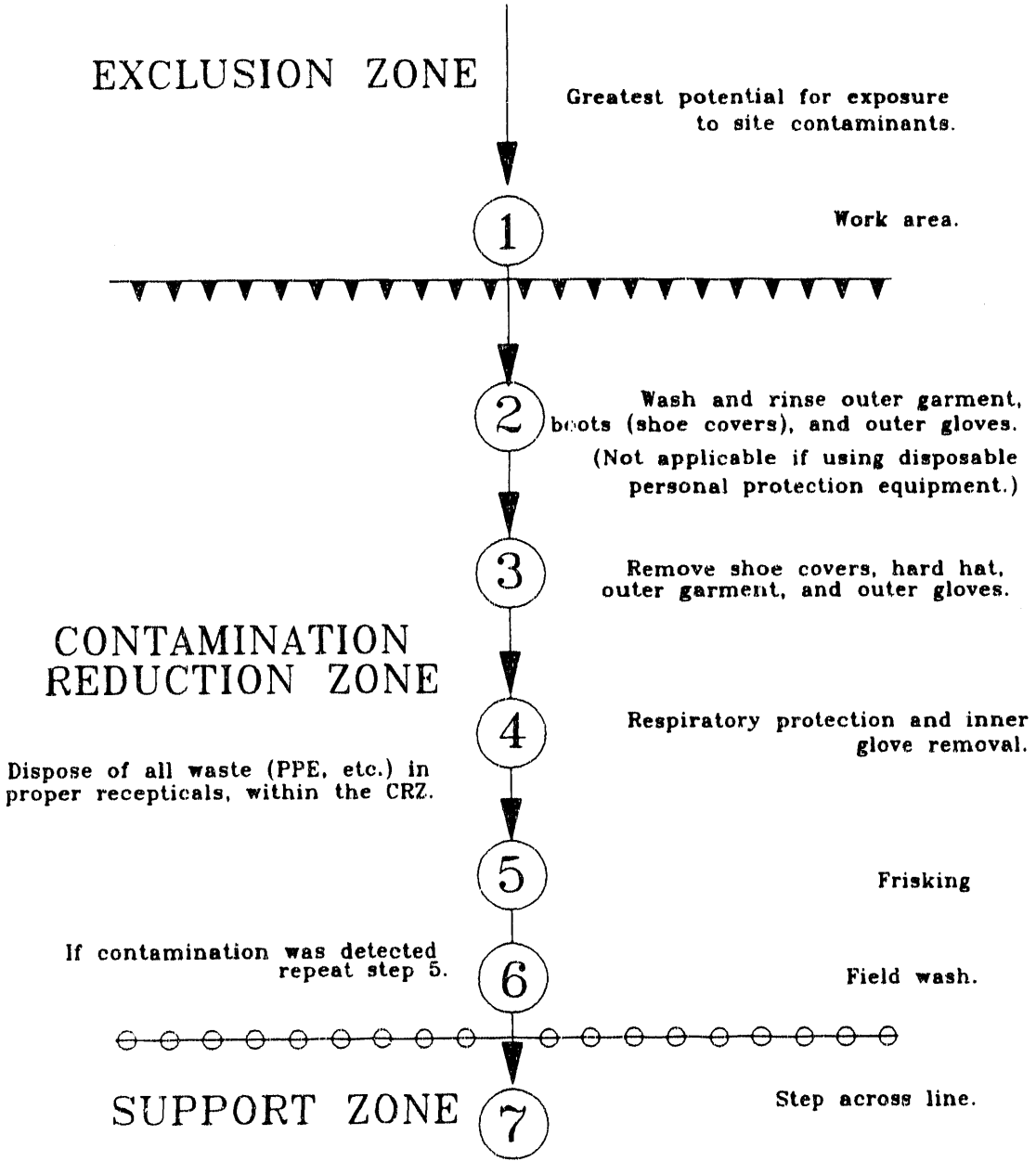


**Fig. 16.4. Minimum decontamination requirements for Level C protection.**

### 16.8.1 Segregated Equipment Drop and Canister or Cartridge Change

*Station 1: Work area.*

This is the area of greatest potential for exposure to site contaminants.

*Station 2a: Segregated equipment drop.*

Deposit equipment used on site (tools, sampling devices, containers, monitoring equipment, clipboards, etc.) on a plastic drop cloth or in a container with a plastic liner. Either return immediately to the exclusion zone or proceed to station 2 of the decontamination process described below.

Equipment necessary: containers
plastic liners
55-gal compactible waste drum

*Station 2b: Canister or cartridge change.*

When the respirator canister or cartridge has been replaced, put the used canister or cartridge in a plastic bag for disposal.

Equipment necessary: respirator cartridges or canisters
plastic trash bags

### 16.8.2 Level D Protection Decontamination

*Station 1: Work area.*

This is the area of greatest potential for exposure to site contaminants.

*Station 2: Scrubbing and rinsing tools and agents for outer garment, boots, gloves, hard hats, safety glasses.*

Scrub outer boots and gloves with a laboratory-grade detergent (Liquinox or equivalent) and rinse with potable water. Disposable boots and gloves need not be scrubbed and may be disposed of in compactible waste drums. Clean safety glasses and hard hat in same fashion. If boots must be decontaminated, all decontamination should take place while personnel are standing in large wash tubs so that decontamination solutions can be caught and drummed in accordance with this plan.

Equipment necessary: two or three washtubs
one hand-pump sprayer
water
detergent
scrub brushes
paper towels
55-gal drum with liner for paper towels
and protective clothing

*Station 3: Outer garment, boot, glove, safety glasses, and hard hat removal.*

Remove boots, gloves, safety glasses, and hard hats.

*Station 4: Inner glove removal.*

Remove inner gloves.

*Station 5: Frisking.*

To ensure that no radiological contamination is transferred to the support zone, personnel shall be frisked (screened for radiological contamination) by a member of the ORNL/MAD group after approval from the ORNL Radiation Protection department prior to leaving the contamination reduction zone for the support zone. Frisking will be performed according to standard operating procedures developed by the ORNL/MAD group or those of ORNL Radiation Protection if they perform the task.

Equipment necessary: alpha detector
beta-gamma detector

If contamination is detected, proceed to station 6, then return to station 5 and repeat the frisking procedure. If contamination is still detected after repeating station 5, the Laboratory Shift Superintendent must be notified immediately to take the worker to the health division.

*Station 6: Field wash.*

Thoroughly wash hands and face with soap and water and a soft-bristle brush, if necessary. Shower as soon as possible.

Equipment necessary: water
wash basin or bucket
soap

If contamination was detected at station 5, return there now and repeat the frisking procedure. If no contamination was detected, proceed to station 7.

*Station 7: Step across line.*

Enter the designated support zone.

### 16.8.3 Level D+ Protection Decontamination

Follow the steps for Level D decontamination; the only difference occurs at station 3. Remove the disposable chemical protective coverall and deposit it in a lined 55-gal compactible waste drum. Level D+ protective clothing is deemed necessary when sampling operations may produce excessive splashing of surface or subsurface materials, yet the action level does not require the use of a respirator and taped, protective chemical-resistant suits.

### 16.8.4 Level C Protection Decontamination

*Station 1: Work area.*

This is the area of greatest potential for exposure to site contaminants.

*Station 2: Scrubbing and rinsing of outer garment, boots, and gloves.*

Scrub outer garment, boots, and gloves with laboratory-grade detergent and water and rinse with potable water. All wash water and rinsing solutions will be disposed of in accordance with this plan. NOTE: This station is not necessary when disposable personal protective equipment is used.

Equipment necessary: washtubs
water
detergent
scrub brushes

*Station 3: Outer garment, boots, and gloves removal.*

Remove outer garment, boots, and outer gloves with accompanying tape. Tape and disposable gloves should be placed in a plastic trash bag and disposed of in accordance with procedures outlined in this document. Reusable outer garments and boots will be placed in plastic bags for screening by ORNL Radiation Protection. This equipment must be scanned and green-tagged before it may be reused. NOTE: This station is not necessary when disposable personal protective equipment is used.

Equipment necessary: plastic trash bags
bench or stool

*Station 4: Respiratory protection and disposable inner glove removal.*

The respirator is the next-to-last item for removal. Cartridges or canisters are placed in a plastic trash bag and disposed of in accordance with procedures contained within this plan. The respirator is placed in a plastic bag dedicated for used respirators. Due to the single-use respirator policy, respirators may not be reused until they have been scanned and tagged by ORNL Radiation Protection and returned to ORNL Industrial Hygiene. Finally, remove disposable inner gloves and deposit them in a plastic trash bag.

Equipment necessary: plastic trash bags

*Station 5: Frisking.*

To ensure that no radiological contamination is transferred to the support zone, personnel shall be frisked (screened for radiological contamination) prior to leaving the contamination reduction zone for the support zone.

Equipment necessary: alpha detector
beta-gamma detector

If contamination is detected, proceed to station 6, then return to station 5 and repeat the frisking procedure. If contamination is still detected after repeating station 5, the Laboratory Shift Superintendent must be notified immediately to take the worker to the health division.

*Station 6: Field wash.*

Wash hands and face thoroughly with soap and water and a soft-bristle brush, if necessary.

If contamination was detected at station 5, return there now and repeat the frisking procedure. If no contamination was detected, proceed to station 7.

*Station 7: Step across line.*

Enter the designated support zone.

## 16.9 EQUIPMENT DECONTAMINATION PROCEDURES

The decontamination of sampling equipment, reusable supplies, and heavy equipment will be performed in accordance with procedures identified in this section.

### 16.9.1 Decontamination for Chemical Sampling Equipment

Two procedures are described for the decontamination of chemical sampling equipment: one for the hot-water washer and the other for the bucket system. Decontamination of large objects and/or multiple objects is best carried out with the hot-water washer. For small sampling operations, the bucket system is less complicated and requires smaller equipment.

#### 16.9.1.1 Hot-water washer

This procedure will require the use of the larger pieces of equipment including the hot-water washer (Fig. 16.5), sawhorses with plywood tables, large garbage cans, alcohol-rinse trough, decontamination rinse water pump and hoses, etc. The placement of this equipment inside the contamination reduction zone will be determined by the SPM and the SHSO. The procedure for placement of the decontamination equipment is as follows.


Fig. 16.5. Photographs of decontamination trailer (hot-water washer).

1. To reduce exposure to noise, the hot-water washer should be placed at least 10 ft from other work stations in the zone. An even greater distance is preferable. The hot-water washer should be placed downwind from other work stations in order to eliminate exhaust fumes from the motor.

2. The ground at this station should be covered with sheet plastic. The decontamination trough (Fig. 16.6) for the hot-water washer should be placed on sawhorses away from the washer and other work stations in the contamination reduction zone. The trough should be placed so that the sun will shine into the work area. Flat wooden stakes can be used to tilt the end so that the water will drain to the collection bucket. A large (32-gal) plastic garbage can for scrubbing of equipment prior to spraying should be placed near the trough.

3. Drums for the accumulation and staging of decontamination rinse water should be placed on pallets prior to filling. These should be placed out of the way of normal operations but in a location where they are accessible for removal by a forklift after completion of the investigation. The proper labels should be affixed to these drums prior to collection of the rinse water.

4. A small portable electric (intrinsically safe) pump should be placed in the rinse water collection bucket and the hose run from the pump to the first drum to be filled.

5. The power extension cord for the pump should be connected to the generator on the hot-water washer. **Note:** the pump should ***not*** be operated continuously, but only when the collection bucket becomes almost full.

6. The alcohol rinse trough and drying table should be placed far enough away from the decontamination trough to avoid contamination from overspray. They should be placed upwind from the hot-water washer, if possible.

7. For the drying table, plywood should be placed on sawhorses and covered with clean plastic.

8. A garden sprayer with deionized water should be placed at the decontamination trough. Two garden sprayers and red squeeze bottles filled with isopropyl alcohol should be placed at the alcohol rinse trough.

9. An open-top drum (17-C) should be placed near the drying table to collect compactible waste.

10. A large, clean (32-gal) plastic garbage can should be placed near the drying table. This container should be lined with a clean plastic bag and used for the temporary storage of clean sampling pans, trowels, and screwdrivers. At the end of the day, this receptacle may be used for storing drying table supplies (plastic sleeves, wipes, tape, etc.).

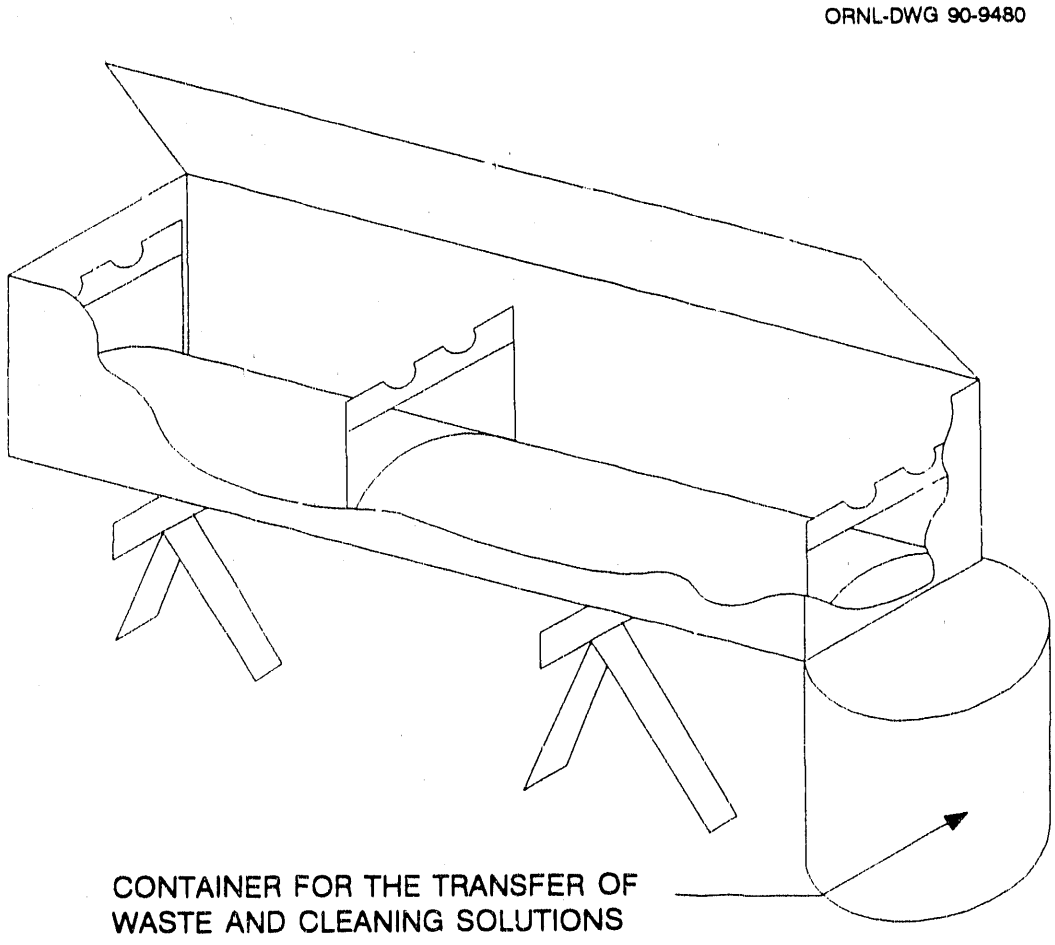


**Fig. 16.6. Decontamination trough.**

#### 16.9.1.1.1 Procedure

1. Unroll the entire length of sprayer hose from the reel on the hot-water washer.
2. Put a small amount of phosphate-free soap in the scrub bucket and fill approximately one fourth of the bucket with hot water.
3. Scrub each piece of equipment in soapy water with a long wooden-handled brush or bottle brush.
4. Place the equipment in the decontamination trough and spray it thoroughly.
5. Rinse the equipment with deionized water from the garden sprayer.
6. Place the equipment in the alcohol rinse trough and rinse it with alcohol.
7. Rinse the equipment with deionized water.
8. Place the equipment on the drying table to dry.
9. After equipment is dry, check for radiological contamination.
10. Place clean pans, trowels, screwdrivers, etc., in a plastic-lined garbage can for temporary storage. At the end of the day, this bag can be taped shut.
11. Split spoons should be placed in plastic sleeves with the ends taped shut to prevent contamination.

#### 16.9.1.1.2 Hot-water washer operations

The following guidelines should be followed in the operation of the hot-water washer.

1. Make sure that diesel and gasoline cans are filled and accompany the trailer.
2. Make sure extra motor oil is stored in the front compartment of the trailer.
3. If an adequate supply of potable water is not available, prefill the reservoir on the back of the trailer prior to use.
4. During operation, the sprayer hose should be completely unrolled.
5. Do not leave the motor running for long periods when the sprayer is not in use.
6. Before turning off the motor at the end of a work period (i.e., for lunch breaks and at the end of the day), turn off the heating unit and continue to spray until cool water has passed through the system.

7. At the end of each day's activities, when the heater stack has cooled, place a small bucket or cover over the top of the stack.

### 16.9.1.2 Bucket Decontamination Procedure

This procedure is applicable for smaller sampling operations not requiring an extended amount of time or a large amount of equipment. The bucket decontamination system is ideal for soil sampling with hand augers and other operations that do not require extensive washing. The procedure is as follows:

1. Set up small buckets in any convenient place. They should be placed on a plastic ground cover.

2. Set up site control, if necessary.

3. Partially fill one bucket with potable water. Add soap.

4. Spread a plastic sheet on the ground for drying cleaned equipment.

5. Scrub equipment pieces with a small wooden-handled brush or bottle brush and rinse with deionized water.

6. Place equipment in a second bucket and rinse with alcohol.

7. Rinse equipment again with deionized water.

8. Place equipment on the plastic sheet for drying.

9. After equipment is dry, check for radiological contamination.

10. Wrap equipment in aluminum foil or plastic, as appropriate.

11. Dispose of decon rinse water in an approved, designated container.

### 16.9.2 Decontamination for Radiological Sampling Equipment

After sampling at each location or depth, equipment will be checked for contamination with portable instrumentation. If no contamination is detected, sampling can continue at the next sampling location or depth. If contamination is detected, a dry paper towel will be used to wipe down the equipment. If contamination is still detected after wiping, the equipment will be washed with brush and water at the decontamination trough. Paper wipes and/or decon fluid will be deposited in approved containers. If the equipment cannot be decontaminated at this point, it will be bagged and ORNL Radiation Protection will be notified.

### 16.9.3 Heavy Equipment Decontamination

If a piece of heavy equipment becomes contaminated due to any investigative effort, that machine must be decontaminated before it can leave the site. ORNL Radiation Protection must scan the equipment and locate the areas of elevated contamination. The equipment will be placed in a diked area and cleaned until the contamination has been removed. This process will be supervised and guided by a representative of ORNL Radiation Protection. Limits for decontamination equipment are defined in ORNL Radiation Protection procedures and practices.

## 16.10 MONITORING

This monitoring program is designed to provide prescreening of environmental samples and to protect all site investigative personnel from potential chemical and radiological contaminants, to the best of our knowledge and within the limits of ORNL/MAD resources. The specified instruments and the monitoring frequencies were selected primarily to provide worker protection and sample screening. The contaminants of concern are identified in Table 16.1.

Continuous real-time assessment of potentially hazardous chemical concentrations and radiological contaminants will be performed while conducting operations at the 7500 Area Contamination Site. Field measurements will be recorded on the Field Monitoring Record (see Fig. 16.7) when they are collected (approximately every 15 min or when concentrations rise above average or typical background readings). The deployment of specific monitoring equipment will depend on the site, as well as the activities being conducted at that location. Radiological and chemical monitoring equipment shall be utilized for prescreening of samples; radiological instrumentation shall be used for the frisking of personnel, samples, and equipment as they egress from the contamination reduction zone into the support zone (see Sect. 16.10.2).

Personal thermoluminescent dosimeters, which measure dose from beta, gamma, or neutron radiation with a high degree of accuracy, will be worn by all on-site personnel. Personal air sampling pumps shall be used if airborne contaminants are encountered at or above the action level. ORNL Industrial Hygiene will be contacted for assistance in determining the need for personal air sampling pumps.

### 16.10.1 Chemical Monitoring Equipment

Equipment to be utilized for on-site environmental chemical monitoring shall consist of the following: a PID, such as an OVM or HNU (equipped with a 11.8 or 11.7 eV lamp) or a flame ionization detector (FID). Other equipment may be utilized if site conditions warrant.

#### 16.10.1.1 Chemical monitoring frequency

Volatile organic monitoring, utilizing the PID or the FID, will be performed while work is being conducted within the exclusion zone and while samples are being processed within the contamination reduction zone. Continuous monitoring utilizing chemical monitoring

## FIELD MONITORING RECORD

| Site | | | | | Date | | | | | Location | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| On Site Time:<br>Start: End: | | | | | Measurements Taken By: | | | | | | | | | | | | | | |
| Instrument Numbers: | OVM | HNu | FID | HAM | CGI CO | CGI $O_2$* | CGI $H_2S$ | CGI LEL* | ALPHA ($\alpha$) | BETA ($\beta$) | GAMMA ($\gamma$) | | | | | | | | |
| Background Reading: | | | | | | | | | | | | | | | | | | | |
| Action Level: | | | | | | | | | | | | | | | | | | | |
| Ambient Weather Conditions: | | | | | | | | | | | | | | | | | | | |

| Time | Depth | PID Value ppm | | | | FID Value ppm | | | | HAM Value mg/m³ | | | | CGI Value ppm | | | | RAD Value cpm | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mil | Ft | AA | BZ | BS | SS | AA | BZ | BS | SS | AA | BZ | BS | NA* | CO | $O_2$* | $H_2S$ | LEL* | $\alpha$ | $\beta$ | $\gamma$ |
| | | | | | | | | | | | | | | | | | | | | |
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AA = Ambient Air; BZ = Breathing Zone; BS = Borehole Space; SS = Soil Sample; X = Background

* $O_2$ and LEL are given as percent; NA = Not Applicable

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**Fig. 16.7. Field Monitoring Record.**

equipment will be performed to ensure, within the levels of detection of the instrumentation employed, that hazardous gas/vapor concentrations at the breathing zone remain below predetermined action limits. Soil samples will be scanned with the PID or the FID. The surrounding air, soil sample, and any cuttings will be periodically monitored as they are brought to the surface. All data for each monitoring occurrence will be recorded.

#### 16.10.1.2 Chemical monitoring equipment action limits

The PID can be preset to alarm at 1.00 ppm. If volatile organic concentrations measured on the PID or FID exceed 1.0 ppm above background concentrations at the breathing zone for more than 30 s, the SHSO should direct the evacuation of all personnel upwind to the border of the contamination reduction and the support zone. Monitoring should be performed at the point of evacuation to ensure that the contamination reduction zone or the support zone is clean. An industrial hygienist representing ORNL will be summoned to the site to assess the potential hazard of the conditions and to determine whether work should continue. It may become necessary to abandon the sampling location and proceed to the next sampling location. The action limit is necessary because of known potential health hazards as well as unknown characteristics.

### 16.10.2 Radiological Monitoring Equipment

All radiological monitoring equipment used in the field is required to have up-to-date calibration stickers. No instrument that is out of calibration will be used. Instruments are maintained on an annual calibration schedule. All instruments maintained by ORNL/MAD are calibrated by ORNL Instrumentation and Controls and are calibrated in accordance with NIST standards and procedures. It is also necessary to note that instrument and probe combinations are calibrated as a set; therefore, ratemeters and probes shall not be interchanged. If interchange becomes necessary, the ratemeter and probe combination will be returned to the ORNL/MAD instrument technician who will be responsible for calibrating the unit. Instrument response check measures performed in the field are not a substitute for calibration. Radiological equipment necessary to conduct on-site monitoring shall consist of the following portable detector systems or equivalents:

| | Meter | Probe | Purpose |
|---|---|---|---|
| (1) | Bicron Analyst | Geiger-Mueller (GM) pancake with No. 18 mesh screen | Monitor beta-gamma surface contamination levels |
| | | or GM side window | Down hole beta/gamma logging |
| (2) | Victoreen 490 | Victoreen 489-55, NaI scintillator | Gross gamma monitoring/scanning |
| (3) | Bicron Analyst | ORNL Q2101, "beer mug," ZnS scintillator | Monitor alpha surface contamination levels |

### 16.10.2.1 Radiological monitoring frequency

Radiological scanning for surface beta and gamma radiation will be performed at each sampling location prior to the commencement of sampling activities. Soil retrieved from sampling devices as well as some periodic soil borings will be screened to determine whether elevated radioactivity is present. The GM pancake instrument will be used to monitor the soil as close to the surface as possible and to monitor radiation levels around the workers. Since no airborne radiological contamination is expected to be present, the breathing zone of site investigative personnel will not be monitored. The radiological monitoring will be performed while work is being conducted within the exclusion zone and while samples are being processed within the contamination reduction zone. The soil sample and any cuttings will be periodically monitored as they are brought to the surface. All data collected for each monitoring occurrence will be recorded by the SHSO or his/her designee.

### 16.10.2.2 Radiological monitoring action and release limits

Radioactive contamination release limits for equipment, clothing, and skin are listed in Table 16.5. Action levels are: (1) a count rate of 2000 cpm above background at 1 ft above the ground surface measured with the GM pancake instrument or (2) a count rate of 800,000 cpm at 1 ft above the ground surface measured with the NaI scintillator. Should such action levels be indicated, all personnel will move from the work site to the border of the contamination reduction zone and the support zone. A health protection technician will be summoned to the site to assess the potential hazard and determine whether work should continue. ORNL Radiation Protection will be responsible for posting contaminated areas identified during the site investigation and field work.

**Table 16.5. Radioactive contamination release limits in dpm/100 cm²**

| | Alpha | | Beta-Gamma | |
|---|---|---|---|---|
| | Direct[a] | Removable[b] | Direct[a] | Removable[b] |
| Skin (general body) | 150 | None detectable | 1000 | None detectable |
| Hands | 300 | None detectable | 1000 | None detectable |
| Company shoes | 300 | 20 | 1000 | 200 |
| Company issue clothing | 150 | NA | 1000 | NA |
| C-zone clothing | 300 | NA | 15,000 | NA |
| Equipment | 300 | 20 | 1000 | 200 |

[a]Fixed plus removable.
[b]Transferable.

Each worker's hands and footwear will be frisked or scanned, and release limits must be met before an individual can leave the contamination reduction zone. ORNL Radiation Protection shall be responsible for either scanning personnel or approving ORNL/MAD to

scan personnel prior to egress from the contamination reduction zone. The alpha and beta-gamma instruments read in cpm; therefore, a conversion is required to compare field readings to contamination release limits, which are given in dpm/100 $cm^2$. Each alpha instrument has a conversion factor posted on it, which normally ranges from 7 to 12 dpm/100 $cm^2$ per cpm. The GM pancake instruments do not have conversion factors posted on them because factors vary depending on the nuclide of interest, the surface material (e.g., concrete, steel, clothing), and the probe efficiency. Based on calculations made by R.L. Coleman of ORNL/MAD, a conservative conversion factor of 40 dpm/100 $cm^2$/cpm should be used for estimating beta surface contamination levels with a Geiger-Muller pancake probe with number 18 mesh screen.

# REFERENCES

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2. *Quality Assurance Program Requirements for Nuclear Facilities,* ANSI/ASME NQA-1, American Society of Mechanical Engineers, New York, NY, 1986.

3. "Hazardous Waste Operations and Emergency Response," 29 CFR 1910.120, Occupational Safety and Health Administration, final rule, March 1989; supplement to the final rule, April 1991.

4. *Data Quality Objectives for Remedial Response Activities: Development Process,* EPA/540/G-87/003, Environmental Protection Agency, Washington, DC, March 1987.

5. C.W. Kimbrough, L.W. Long, and L.W. McMahon, *Environmental Surveillance Procedures Quality Control Program,* ESH/Sub/87-21706/1, Martin Marietta Energy Systems, Inc., September 1988.

6. *Environmental Restoration Division Quality Assurance Program Plan,* ES/ER/TM-4/R1, Martin Marietta Energy Systems, Inc., September 1991.

7. "Risk Assessment Guidance for Superfund, EPA Guidance Document, Volume I," EPA/540/1-89/002, *Human Health Evaluation Manual, Part A,* Environmental Protection Agency, December 1989.

8. *Consultants and Visitors Environmental, Safety, Health, and Security Handbook,* ORNL/M-569, Oak Ridge Natl. Lab., Martin Marietta Energy Systems, Inc., Oak Ridge, TN, June 1989.

9. American Conference of Governmental Industrial Hygienists (ACGIH), *1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices,* ISBN: 0-936712-92-9, ACGIH, Cincinnati, OH, 1991.

10. "Respiratory Protection," 29 CFR 1910.134, Occupational Safety and Health Administration, current version.

11. *Practices for Respiratory Protection—Respirator Use—Physical Qualifications for Personnel,* American National Standards Institute Standard, Z88.6, 1984.

# Appendix A

# WASTE MANAGEMENT PLANNING CHECKLIST

# Waste Management Planning Checklist

ORNL Environmental Restoration Program
Martin Marietta Energy Systems, Inc.
P.O. Box 2008
Oak Ridge, Tennessee 37831-6402

Date Issued—March 1992

Prepared by
ORNL Environmental Restoration Program
Charles Clark, Jr.
Building 7078-A
MS-6402
Oak Ridge, Tennessee

# Waste Management Planning Checklist
## ORNL Environmental Restoration Program
## (Page 1 of 11)

**PLEASE TYPE THIS FORM**

1. **Project Name:** 7500 AREA CONTAMINATION SITE SAMPLING **Date:** April 14, 1992

   **Location of Project:** ORNL grid coordinates N18,100; E32,400 (general area)

   **Responsible Organization:** ORNL Remedial Action

   **Charge Number for Waste Management/ P&E Activities:** A2529PAA

   **DOE Site Reference Number:** WAG 8

   **ORNL ER Work Breakdown Structure No. (Level 6)** 1.1.1.3.3.1.1.1

2. **Responsible Project Manager:** H. R. Gaddis

   **Phone:** 576-0224

   **Address:** Bldg. 3001, MS-6029

   **Responsible ER WAG/Task Manager:** P. F. Tiner/ R. D. Foley

   **Phone:** 574-5379/574-1777

   **Address:** Bldg. 7503, MS-6382

   **Responsible Construction Engineer:** NA

   **Phone:**

   **Address:**

   **Responsible Site ES&H Manager:** Glen Cofer/Paul Abston

   **Phone:** 576-7362

   **Address:** Bldg. 7503, MS-6383

# Waste Management Planning Checklist
**ORNL Environmental Restoration Program**
**(Page 2 of 11)**

Please attach a copy of your ES&H and Waste Management Plans to this document.

Please attach a drawing or sketch of the proposed location(s) of the waste-generating activities.

If there is no place to store or dispose of this waste, you must inform the ER Site Remediation Manager or Program Manager before any waste is generated.

---

3. Expected Start/Completion Dates: April 23, 1992/May 23, 1992

---

4. Project Description: Hole logging and soil sampling in vicinity of line leak site using split spoon pushed by backhoe, truck-mounted drill rig with hollow stem auger and hammer, and/or hand-operated auger. Samples will be analyzed by ORNL Analytical Chemistry.

---

5. Completion and Signatures of Waste Management Forms

A. Request for Storage or Disposal of Radioactive Waste

Form UCN-2822

| D. A. Rose | R. L. Davis |
|---|---|
| Requester's Name | Health Physics Technician's Name |

**Waste Management Planning Checklist**
**ORNL Environmental Restoration Program**
**(Page 3 of 11)**

B. Log in Data Sheet

Form UCN-16114

R. D. Foley
Column 9 Name

D. A. Rose
Column 10 Name

D. A. Rose
Notes 1, 2, and 3 Name(s)

C. Request for Disposal of Hazardous Waste Material

Forms UCN-13698 and UCN-13698A

NA
Subcontractor/Prime Contractor
Waste Generator Name

R. L. Davis
Health Physics Technician's Name

D. A. Rose
MMES Waste Generator Name

D. Request for Disposal of Asbestos or Material Containing Asbestos NA

Form UCN-11386

Requester's Name

E. Request for Disposal of Sanitary/Industrial Waste and Spoil Material NA

(No UCN form available. Obtain form from waste management operations manager.)

Authorized Name

Individuals who have not taken the proper training authorizing them to sign off on Waste

**Waste Management Planning Checklist**
**ORNL Environmental Restoration Program**
**(Page 4 of 11)**

Disposal forms UCN-2822 and UCN-16114 should contact Kory Gabrielsen at 576-4374.

Specific Training Requirements: Solid Low-Level and Transuranic Waste

6. Person or organization responsible for completing the ORNL ER Weekly Waste Generation Report: P. F. Tiner

7. Organization or person responsible for providing prime or subcontractor with characterization data for waste disposal: NA

8. Organization or person responsible for obtaining samples from waste containers and transporting those samples to the analytical laboratory for characterization purposes:
   ORNL/MAD

9. Organization or person responsible for performing analysis on waste samples for characterization purposes: ORNL Analytical Chemistry

10. What analysis will be requested to characterize the waste? gross alpha, gross beta, gamma spec., strontium; TCLP organics, TCLP metals

11. List the process knowledge available to characterize the waste:
    See attachment (Tables A.1 through A.4)

12. Is the available process knowledge enough to properly characterize the waste? Y/N/NA N

## Waste Management Planning Checklist
**ORNL Environmental Restoration Program**
**(Page 5 of 11)**

13. What organization or persons will be assigned the responsibility of properly containerizing the waste, labeling the waste containers, and labeling and bagging contaminated material?

ORNL/MAD

---

14. What person or organization will be responsible for transporting the waste from the generation area to the temporary waste storage area to await final pickup by Martin Marietta Energy Systems (MMES)?

NA

Describe the route that will be used to transport waste to the storage area, treatment facility, or disposal facility:

---

15. Will MMES Waste Management Operations be responsible for transporting waste from site generation to an MMES storage or disposal facility (before waste is characterized)? Y/N/NA
After waste is characterized, it will be transported to disposal facility by MMES Waste Management Operations.

| MMES Person Contacted | Phone |
|---|---|
| Brad McClellan | 4-4126 |

---

16. A. Will waste require transporting over public roads? Y/N/NA N

B. Will waste require transporting over DOE roads before 9 a.m. and after 4 p.m.? Y/N/NA N

C. List the Department of Transportation issues that address transporting this waste:

D. List the resolutions to those issues:

**Waste Management Planning Checklist**
**ORNL Environmental Restoration Program**
**(Page 6 of 11)**

E. Have you communicated the issues of transporting the waste and associated resolutions to ORNL Transportation Operation Management Department and received their concurrence of how the waste may be transported? Y/N/NA

Person Contacted _____ Phone _____

17.

| | Waste Stream/Source | Type[a] | Category[b] | Volume (cubic feet) | Contaminants |
|---|---|---|---|---|---|
| (1). | Solid | soil | rad | approximately 7 $ft^3$ | rad |
| (2). | Compactible | paper, plastic | rad | approximately 7 $ft^3$ | rad |
| (3). | Liquid | decon. fluid | rad | approximately 14 $ft^3$ | rad |
| (4). | | | | | |

[a]Liquid, metal, plastic, sediment, sludge, soil, etc.
[b]Classified, clean, construction, hazardous, mercury, mixed, nonhazardous, radiological, TRU, TSCA, etc.

18. Will a spill control kit be on-site during waste generation activities? Y/N/NA Y

What will the spill control kit consist of? Absorbent materials, oil absorbing materials, drum, shovel.

19. Which of the following areas will be required to temporarily store the project waste until the waste can be transferred to ORNL Waste Management Operations?

The drums will remain at the roped-off Contamination Reduction Zone at the sampling site until transferred

A. Radiological Waste Storage Area: Y/N/NA N

Location:

Responsible organization or person that will manage area:

**Waste Management Planning Checklist**
**ORNL Environmental Restoration Program**
**(Page 7 of 11)**

B. 90-Day Storage Facility for hazardous or mix waste: Y/N/NA N

Location:

Responsible organization or person that will manage area:

C. Satellite Accumulation Area: Y/N/NA N

Location:

Responsible organization or person that will manage area:

D. MMES Permitted/Interim Storage: Y/N/NA N

Location:

Available capacity:

Type of waste:

Responsible organization or person that will manage area:

Have training requirements (e.g., Satellite Accumulation Area and 90-Day Accumulation Area) been fulfilled to manage the storage area? Y/N/NA NA

**Waste Management Planning Checklist**
**ORNL Environmental Restoration Program**
**(Page 8 of 11)**

20. MMES Intended Destination of Waste NA

| Solid Waste | | Volume of Waste (cubic feet) | |
|---|---|---|---|
| 1. Clean Dumpster | Y/N | | |
| 2. Radiological Dumpster | Y/N | | |
| 3. Silo | Y/N | Y | 7 |
| 4. Tumulus | Y/N | Y | 7 |
| 5. Wells | Y/N | | |
| 6. TRU Aboveground Storage | Y/N | | |
| 7. Y-12/K-25 | Y/N | | |

List the specific site or facility for final waste disposal, treatment, or storage:

| Liquid Waste | | Volume of Waste (cubic feet) | |
|---|---|---|---|
| 1. Process Waste Treatment Plant | Y/N | Y | 14 |
| 2. Nonradiological Waste Treatment | Y/N | | |

Other:

Specific training requirement for managing bottled waste includes Liquid Low-Level Waste training. Contact John R. Parrott at 574-6595.

21. Have you spoken to compliance pertaining to your requirements for temporary satellite, 90-day, or radiological waste storage area? Y/N/NA Y

Nancy Dailey — Person Contacted

4-8774 — Phone

List the specific requirements: None. Waste will be handled as rad waste unless laboratory results indicate otherwise.

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22.

A. Can the ORNL Hazardous Waste group take charge of the hazardous or mixed waste generated? Y/N/NA Y

If not now, when?

List any specific requirements:

Volume of Waste (cubic feet): 7

L. C. Wesley — Person Contacted

4-7467 — Phone

B. Can the Solid Radioactive Waste group accept the volume of radiological waste that will be generated? Y/N/NA Y

If not now, when?

List any specific requirements:

Volume of Waste (cubic feet): 7

Brad McClellan — Person Contacted

4-4126 — Phone

C. Can the Liquid Gaseous Waste group accept the Liquid waste that will be generated? Y/N/NA Y

If not now, when?

List any specific requirements:

**Waste Management Planning Checklist**
**ORNL Environmental Restoration Program**
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Volume of Waste (cubic feet): approximately 14

| Chris Scott | 4-7057 |
|---|---|
| Person Contacted | Phone |

For waste that cannot be managed by any of the above ORNL Waste Operation groups, what is your alternative for managing the waste? NA

25. Waste Minimization and Reduction Techniques to be Implemented:

| | |
|---|---|
| ☒ Segregation | ☐ In-Field Pretreatment |
| ☐ Decontamination | ☐ Waste Handling (Spill Control) |
| ☐ Compaction | ☐ Material Recycle (Solvents, Containers) |
| ☐ Solvent Substitution | ☐ Material Reuse (Solvents, Wash Waters) |
| ☐ Sludge Dewatering | ☐ Cutting Fluids Recovery |
| ☒ Selection of PPE | ☒ Selection Of Equipment |
| ☐ Other | |

Description of Special Techniques and Expected Effectiveness:

26. Attach any additional information that will give further clarification of your waste management plan.

# Waste Management Planning Checklist
## ORNL Environmental Restoration Program
## (Page 11 of 11)

P. F. Tiner

Prepared by

P. F. Tiner

Signature

April 14, 1992

Date

Approvals:

ORNL Waste Management Organization

5/8/92

Date

ORNL Environmental Restoration Organization

5/8/92

Date

**Table A.1. Principal constituents of a typical irradiated REDC-HFIR target measured in the outlet solutions from the dissolution**

| Nuclide | Content[a] per target (Ci) | Distribution to exit streams | | |
|---|---|---|---|---|
| | | Dejacketing solution (%) | Off-gas (%) | Nitric acid solution (%) |
| $^{244}Cm$ | 40 (0.5 g) | 0.1 | | 99.9 |
| Cm (total) | 41 (4 g) | 0.1 | | 99.9 |
| $^{249}Bk$ | 8 (5 mg) | | | >95 |
| $^{252}Cf$ | 21 (40 mg) | 0.1 | | 99.9 |
| $^{253}Es$ | 5 (200 $\mu$g) | 0.1 | | 99.9 |
| Gross alpha | 90[b] | 0.1 | | 99.9 |
| $^{65}Zn$ | 5 | 100 | | 0 |
| $^{95}Zr$ | 60 | 2 | | 98 |
| $^{95}Nb$ | 10[b] | 1 | | 99 |
| $^{103}Ru$ | 210 | 1 | | 99 |
| $^{106}Ru$ | 160 | 1 | | 99 |
| $^{110m}Ag$ | 3 | 0 | | 100 |
| $^{131}I$ | 110 | 43 | ~56 | 1.3 |
| $^{134}Cs$ | 8 | 50 | | 50 |
| $^{136}Cs$ | 120 | 48 | | 52 |
| $^{137}Cs$ | 13 | 44 | | 56 |
| $^{140}Ba$ | 160 | 0 | | 100 |
| $^{140}La$ | 50[b] | 0 | | 100 |
| $^{141}Ca$ | 160 | 0 | | 100 |
| $^{144}Ce$ | 130 | 0 | | 100 |
| $^{156}Eu$ | 310 | 0 | | 100 |

[a]At discharge.
[b]At target dissolution, approximately 3 weeks after discharge.

Table A.2. Inorganic chemicals used regularly in REDC

| Chemical | On hazardous materials list 7017 | Approximate annual usage |
|---|---|---|
| Activated alumina | | m |
| Aluminum (powder) | | m |
| Aluminum chloride | | m |
| Ammonium hydroxide | | 100 L |
| Ammonium persulfate | | m |
| Ferric chloride | | m |
| Ferrous sulfamate | | m |
| Hydrazine hydrate | X | m |
| Hydrochloric acid | | 1,000 L |
| Hydrofluoric acid | X | m |
| Hydrogen peroxide | | 40 L |
| Hydroxylamine hydrochloride | | m |
| Hydroxylamine nitrate | | 300 L |
| Lithium chloride | | 200 L |
| Lithium hydroxide | X | m |
| Lithium hypochlorite | | m |
| Lithium nitrate | | m |
| Mercuric nitrate | X | m |
| Nitric acid | | 500 L |
| Nitric oxide | | m |
| Nitrogen trioxide | | m |
| Potassium bromate | | m |
| Potassium carbonate | | m |
| Potassium hydroxide | | 15,000 L |
| Potassium nitrite | | m |
| Silica gel | | m |

Table A.2 (continued)

| Chemical | On hazardous materials list 7017 | Approximate annual usage |
|---|---|---|
| Sodium carbonate | | 40 kg |
| Sodium hydroxide | | 1,000 L |
| Sodium nitrate | | 20 kg |
| Sodium thiosulfate | | m |
| Zinc bromide | | m |

m = minimal usage: <10 kg/year or <10 L/year.

**Table A.3. Organic chemicals used regularly in REDC**

| Chemical | On hazardous materials list 7017 | Approximate annual usage |
|---|---|---|
| Acetic acid | | m |
| Acetone | | 100 L |
| Adogen-364·HP | | 50 L |
| Ascorbic acid | | m |
| Carbon tetrachloride | X | m |
| Citric acid | | m |
| Deodorized mineral spirits (Amsco) | | 1000 L |
| 2,5-di-*tert*-butylhydroquinone (DBHQ) | | m |
| Diethylbenzene (DEB) | | 800 L |
| Diethylenetriaminepentaacetic acid (DTPA) | | m |
| Di(2-ethylhexyl) phosphoric acid (HDEHP) | | 200 L |
| Diisopropylbenzene (DIPB) | | 100 L |
| Dowex 1-X8 and -X10 | | m |
| Dowex 50W-X4 and -X8 | | m |
| Ethanol | | 100 L |
| Ether | X | m |
| Ethylenediaminetetraacetic acid (EDTA) | | m |
| 2-ethyl-1-hexanol | | 100 L |
| Hydroquinone | X | m |
| $\alpha$-hydroxyisobutyric acid (AHIB) | | m |
| Ionac A-580 | | m |
| Methanol | | m |
| *n*-dodecane | | m |
| *n*-paraffin (NPH) | | 1000 L |

**Table A.3 (continued)**

| Chemical | On hazardous materials list 7017 | Approximate annual usage |
|---|---|---|
| Oxalic acid | X | m |
| Stearic acid | | m |
| Tributylphosphate (TBP) | | 400 L |
| Trichloroethylene (TCE) | X | 100 L |
| Xylene | X | m |

m = minimal usage: <10 kg/year or <10 L/year.

**Table A.4. Approximate composition of typical REDC campaign feed: 13 HFIR targets plus rework material**

| Component | Source | Weight (g) |
|---|---|---|
| Al | Target cladding, spacers, pellet matrix | 1600 |
| Cm[a] | Target residual, plus rework | 85 |
| Si | Activation of aluminum | 30 |
| Mo, Ru, Pd, Cs, Ba | Fission products | 30[b] |
| Rare-earth elements | Fission products | 20[b] |
| Ni | Impurity in aluminum | 13 |
| Zn | Impurity in aluminum | 9 |
| Fe | Impurity in aluminum | 9 |
| Mn, Cu, Mg, Cr, Ti | Impurity in aluminum | 6[b] |

[a]Other transplutonium elements in the feed include 1 g of Am, 30 mg of Bk, 300 mg of Cf, 1 mg of Es, and 1 mg of Fm.

[b]Total amount for the group.

Project Name _____
Project Engineer _____
Phone _____
Week Ending _____
Work Breakdown Structure No. _____
DOE Site Reference No. _____

INSTRUCTIONS
1. For all waste, indicate volume (cubic feet) and classification method. (e.g., 25F indicates 25 ft³, determined by field screening.)
2. For mixed waste, also indicate hazardous constituents. (e.g., 25AT indicates 25 ft³, determined by Lab analysis, with radiological/TSCA hazardous constituents.)
3. Mail to: Charles Clark, 7078-B, MS-6402

CLASSIFICATION METHOD
F - Field screening
A - Lab analysis
P - Process knowledge

HAZARDOUS CONSTITUENTS OF MIXED WASTE
R - Radiological/RCRA
T - Radiological/TSCA
X - Radiological/RCRA/TSCA

## ORNL ER Program Weekly Waste Generation Summary Report

| | Soil | | | | | | Liquid | | | | | | Compactible | | | | | | Non-Compactible | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Clean | Radioactive | Hazardous | Mixed | TSCA | Asbestos | Clean | Radioactive | Hazardous | Mixed | TSCA | Asbestos | Clean | Radioactive | Hazardous | Mixed | TSCA | Asbestos | Clean | Radioactive | Hazardous | Mixed | TSCA | Asbestos |
| | | | | | | | | | | | | | | | | | | | | | | | | |
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| *Weekly Total* | | | | | | | | | | | | | | | | | | | | | | | | |

| | Sludge | | | | | | Sediment | | | | | | Other | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Clean | Radioactive | Hazardous | Mixed | TSCA | Asbestos | Clean | Radioactive | Hazardous | Mixed | TSCA | Asbestos | Clean | Radioactive | Hazardous | Mixed | TSCA | Asbestos |
| | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | |
| *Weekly Total* | | | | | | | | | | | | | | | | | | |

Person or organization that completed form _____

Revised 2 April 1992, 12:12



Fig. A.1. ORNL ER Program Weekly Waste Generation Summary Report.

# Appendix B

# ENVIRONMENTAL RESTORATION TASK/PROJECT SPECIFIC WASTE MANAGEMENT PLAN PREPARATION

**This draft procedure is to become ER/C-P2101, "Preparation of ER Task/Project Specific Waste Management Plans."**

MARTIN MARIETTA ENERGY SYSTEMS, INC.
Environmental Restoration Division
Number ER/
Page 1 of 9
Issue Date 11/1/91

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Subject: Environmental Restoration Task/Project Specific Waste Management Plan Preparation

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## I. PURPOSE

The purpose of this procedure and the applicable referenced policies and procedures is to define the activities associated with the preparation of Environmental Restoration (ER) task/project specific waste management plans. This procedure supports the Martin Marietta Energy Systems Environmental Restoration Waste Management policy to safely handle and store waste materials generated by ER activities in compliance with applicable Federal and state regulations, DOE Orders, and Energy Systems' policies.

## II. REFERENCES

A. Source Documents

"DOE Field Office, Oak Ridge Environmental Restoration Program Waste Management Plan," DOE/ORO 976 Revision 0, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, September 1991.

"Environmental Restoration Program Waste Minimization And Pollution Prevention Awareness Program Plan," Draft, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, July 15, 1991.

"Martin Marietta Energy Systems, Quality Procedures Manual," December 8, 1989.

Department of Transportation (DOT) Regulations, 49 CFR Parts 171 through 179.

U.S. EPA Regulations for Hazardous Waste Transporters, 40 CFR Part 263.

B. Other References

"Waste Disposal Management," Standard Practice Procedure, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, December 1989.

U.S. EPA Regulations and Standards, 40 CFR Parts 260 through 270.

## III. SCOPE AND LIMITATIONS

This procedure applies to ER task/project specific activities at all Oak Ridge Reservation (ORR) sites and ER projects at Paducah, Kentucky and Portsmouth, Ohio.



This draft procedure is to become ER/C-P2101, "Preparation of ER Task/Project Specific Waste Management Plans."

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Subject: Environmental Restoration Task/Project Specific Waste Management Plan Preparation

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## IV. DEFINITIONS

*Oak Ridge Reservation Sites*: Plant locations K-25, Y-12, X-10, and ER offsite locations.

*Public Access Road*: A road used by members of the general public without their having to gain access through a controlled access point.

*Reportable Quantity*: Quantities that may be harmful, as set forth in 40 CFR 117.3 and 49 CFR 172.101. Transportation or discharges of designated hazardous substances in quantities equal to or greater than the reportable quantities requires compliance with certain DOT or EPA regulations.

*Staging Area*: The location, usually near the point of waste generation, where the containerized waste materials are staged before transporting to a Waste Storage Area.

*Waste Acceptance Criteria*: Criteria established to ensure the receipt of acceptable waste materials at a treatment, storage, or disposal site.

*Waste Analysis and Characterization*: Characterization of waste materials based on historical information or analytical testing. Formalized waste analysis plans are required by Resource Conservation and Recovery Act (RCRA) regulations for hazardous waste treatment, storage, and disposal facilities.

*Waste Category*: A specific category that characterizes waste (i.e., sanitary, hazardous, mixed, low level waste [LLW], transuranic [TRU], or high-level radioactive).

*Waste Generator*: The individual or organization responsible for generation of waste materials.

*Waste Handler*: The individual or organization responsible for waste handling (i.e., packaging, labeling) during staging of the waste materials.

*Waste Management Plan*: An approved and agreed upon documented plan for handling, transporting, staging, and storing generated waste materials.

*Waste Type*: A specific waste type: solid, liquid, sludge, or gas.

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*Waste Transporter*: The individual or organization responsible for transportation of waste materials.

*Waste Storage Area*: The location used for storage of waste materials that includes: an approved Field Staging Area; 90-Day Storage Area; or a permitted or interim status storage area.

## V. REQUIREMENTS

As specified in the DOE ERP Waste Management Plan (DOE ORO 976), all ER Program participants are required to develop project-specific waste management plans to identify all waste generating activities and define the steps to be taken to manage those wastes properly. These plans must be reviewed and approved by the appropriate program and plant management staff prior to initiation of project waste generating activities.

## VI. RESPONSIBILITIES

This section describes the organizational responsibilities for implementation of this procedure.

A. Project Manager:

The Project Manager is responsible for the following activities:

- preparing of the Waste Management Plan and
- assuring implementation of the approved Waste Management Plan.

B. Central Waste Management Division:

The Central Waste Management Division (CWMD) is responsible for providing overall guidance and policies for conducting waste management activities at the ORR sites and providing a review and approval of waste management plans for these sites. CWMD serves only in an advisory role for waste activities at Paducah and Portsmouth and is not a required approver for ER activities at those sites.

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## VI. RESPONSIBILITIES (continued)

C. Central ER Waste Management:

The Central ER Waste Management organization is responsible for providing overall guidance and policies for ER waste management activities and providing a review of the waste management plan.

D. Plant ER Waste Management Organization:

The waste management coordinator within the Plant ER organization is responsible for implementation of ER waste management policies and procedures for all ER projects. They provide initial review and approval of the waste management plan.

E. Plant Waste Management Organization:

The Waste Management Organization at each site is responsible for picking up the waste material from the waste location and transporting the waste to an approved storage or treatment location, operating the storage and/or treatment facility in accordance with regulatory requirements and Energy Systems' policies and procedures, and providing review and approval of waste management plans.

F. ER Waste Minimization Coordinator:

The ER Waste Minimization Coordinator is responsible for providing overall guidance and policies for ER waste minimization techniques and guidance at all sites.

G. Plant Environmental Compliance Organization:

The Plant Environmental Compliance Organization is responsible for oversight of all ER activities, including review of the waste management plans.

H. ER Information Systems Procedure Coordinator:

The ER Information Systems Procedure Coordinator is responsible for facilitating the revision of procedures, coordinating the issue of ER procedures with the Document Management Center, and coordinating controlled procedures updates.

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**Subject:** Environmental Restoration Task/Project Specific Waste Management Plan Preparation

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## VII. ACTION STEPS

This section describes action steps that must be taken for preparing the Waste Management Plan for all ER proposed or in-progress projects/tasks. The waste management plan checklist shall be completed for all ER projects/tasks that generate waste materials. Appendix A is the checklist to be completed in the preparation of this plan.

The Project Manager or designated representative should complete the checklist as soon as practical and issue the plan to the applicable organizations for approval.

A. Step 1: General Project/Task Information

Sections 1-5 should be completed as follows:
*Project Name:* Plant ER project/task designation.
*Revision Number:* Sequential number identifying revisions to the original plan.
*Plant:* ER project/task plant location.
*Date:* Date checklist prepared.
*Organization:* Organization responsible for initiating checklist.
*Responsible Project Manager:* Name of Project Manager.
*Expected Start/Completion Date:* The expected or scheduled start and completion dates for the generation of waste materials.
*Project Description:* A brief description of the project; include key words such as D&D, soils/sludge excavation, treatment technologies.
*Project Participants:* Identify the organization's responsible for generation, handling (staging area), transportation, storage (interim and permanent), treatment or disposal of the waste materials; include responsible organization, the responsible manager within the organization, and telephone number.

B. Step 2: Project/Task Waste Generation

Complete sections 6 and 7 as follows:
*Waste Generation:* Define the waste materials type (solid, liquid, sludge, or gas) and category (hazardous, LLW, mixed or transuranic). Also include the projected volume of waste materials ($ft^3$ or gal) by type, category, and expected contaminants of concern, if known. Identify whether this preliminary characterization is based on process knowledge or sampling and analysis results. Provide reference to analysis results, if available.

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Subject: Environmental Restoration Task/Project Specific Waste Management Plan Preparation

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VII. ACTION STEPS (continued)

*Waste Analysis and Characterization:* Identify and briefly describe the plans and schedules for development and implementation of waste characterization activities. Include references to published waste analysis plans, if applicable.

C. Step 3: Waste Transportation, Storage, and Handling

Contact the plant Waste Management Division to determine the best approach for transfer and subsequent storage or treatment of the waste materials. Once defined, complete Sections 8, 9, and 10 as follows:

*Waste Staging Area:* Define the physical location of the staging area to be used upon generation of the waste materials. Include reference to any special requirements for the staging area including, as a minimum: container type (55-gallon drum, B-25 box, wooden box); signs; container labeling; and containment measures.

*Waste Transportation Requirements:* Describe the expected routes to be used to transport waste materials from the site to storage, treatment, or disposal facilities. If public access roads are involved, DOT regulations must be considered and will affect material packaging, labeling, and shipping. Computation of reportable quantities of regulated hazardous substances may be necessary to determine whether DOT regulations apply.

*Waste Storage Requirements:* Define the location and responsible organization for transfer of the waste materials to a Field Staging Area, a 90-Day Storage Area, and/or a permitted or interim storage facility. Include reference to any special storage area Waste Acceptance Criteria.

D. Step 4: Waste Treatment and Disposal

Contact the plant Waste Management Division to determine the potential for treatment and disposal of the waste materials. Once defined, complete Sections 11 and 12 as follows:

*Identification of Potential Treatment Options:* Define the location, capacity, responsible organization, and any special waste acceptance criteria (WAC) for the treatment facility, if applicable.

*Identification of Potential Disposal Options:* Define the location, capacity, responsible organization, and any special WAC for the disposal facility, if applicable.

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Subject: Environmental Restoration Task/Project Specific Waste Management Plan Preparation

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## VII. ACTION STEPS (continued)

E. Step 5: Waste Minimization and Reduction Techniques

Evaluate the potential for waste minimization techniques for the project/task using the checklist provided in Section 13. Contact the ER Waste Management organization's Waste Minimization Coordinator for information on potential methods of waste minimization.

*Waste Minimization Techniques To Be Implemented:* Describe the waste minimization techniques to be implemented to minimize waste materials generation during the project/task. Potential techniques to be considered include segregation, decontamination, substitution, compaction (volume reduction), and recycle/reuse. Proper selection of personal protective equipment (PPE), investigation equipment, or remediation equipment will minimize the generation of unnecessary waste materials.

F. Step 6: Additional Information

Section 14 is provided for additional information or space for completing this checklist.

G. Step 7: Plan Review and Approval

Plan is reviewed and approved as follows:

*Project Manager:* Project Manager or appointed representative signs the checklist, retains a copy, and forwards the checklist to the plant ER Waste Management Organization.

*ER Waste Management Organization:* Plant ER Waste Management Organization distributes the checklist to the plant Waste Management Organization, the Central ER Division Waste Management organization, the Central Waste Management Division, the ER Waste Minimization Coordinator, and the Plant Environmental Compliance Organization for review. Comments are coordinated by the Project Manager for disposition. Approval signatures are required by the Plant ER Waste Management Organization, the Plant Waste Management Organization, and the Central Waste Management Division. This approval signifies agreement with the scope, schedule, and planned TSD activities outlined in the plan. However, the signatures do not guarantee the availability of TSD capacity, and the project

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Subject: Environmental Restoration Task/Project Specific Waste Management Plan Preparation

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## VII. ACTION STEPS (continued)

manager should make contact with the Plant Waste Management Organizations prior to generation of waste. The approved plan is distributed to all involved organizations.

## VIII. REQUIRED RECORDS AND CHANGE CONTROL PROCEDURES

The preparation of a ER task/project specific waste management plan shall include the completion of the ER waste management planning checklist provided in Appendix A. However, larger projects may require a more detailed description of waste management activities. A documented Project Waste Management Plan shall meet this requirement if the plan includes all the informational needs defined on the waste management planning checklist.

Significant changes in the project scope, schedule or waste volumes defined in the approved waste management plan must be documented in a revised plan. The project manager must revise and reissue the project waste management plan for review and approval prior to project initiation. The same review and approval procedures apply for revision of the plan as applied for the original development and issuance (see Section VII).

The ER Division Waste Management Organization shall retain the original of the waste management plan for a minimum of 3 years after completion of the project. At that time, the approved plan original is submitted to Central Records.

## IX. ADMINISTRATION

The ER Waste Management Manager is responsible for the interpretation of this procedure, and the ER Information Systems procedure coordinator is responsible for maintenance of this procedure. The implementation of this procedure is the responsibility of the managers or supervisors of staff members who perform the activities described in this procedure.

The ER Waste Management Quality Assurance Plan (DOE/ORO 916) documents the quality assurance program requirements for all sites on which ER activities are planned or underway. Preparation of the project-specific Waste Management Plans must be done in accordance with this QA Plan.

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Subject: Environmental Restoration Task/Project Specific Waste Management Plan Preparation

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## X. APPROVAL

All procedures and instructions generated by the ER Division and Program must receive the signed approval of the ER Division director.

Approved by _____

Approval date _____

Effective date _____

## XI. APPENDICES

Appendix A: ER Waste Management Planning Checklist.

**Environmental Restoration**
**Waste Management Planning Checklist**
**(Page 1 of 3)**

1) **Project Name:** 7500 AREA CONTAMINATION SITE SAMPLING **Revision No.** 0
**Plant:** ORNL **Date:** 4/14/92
**Organization:** ORNL Remedial Action

2) **Responsible Project Manager:** H. R. Gaddis

3) **Expected Start/Completion Dates:** April 23, 1992/May 23, 1992

4) **Project Description (Brief):** Hole logging and soil sampling in vicinity of line leak site using split spoon, truck-mounted drill rig, and/or hand-operated auger.

5) **Project Participants:(for waste management interface only)**
**Waste Generator:** D. A. Rose/ D. E. Rice
**Waste Handler:** D. A. Rose/ D. E. Rice
**Waste Transporter:** NA
**Interim Waste Storage:** At sample site in Contamination Reduction Zone
**Permanent Waste Storage:** NA
**Waste Treatment:** NA
**Waste Disposal:** ORNL Waste Operations

6) Waste Generation:

| | Type | Category | Volume ($ft^3$ or gal) | Contaminants | Characterization Based on: Process Knowledge | Characterization Based on: Sampling and Analysis |
|---|---|---|---|---|---|---|
| Waste Stream 1 | solid | rad | 7 $ft^3$ | rad | X | X |
| Waste Stream 2 | compactible | rad | 7 $ft^3$ | rad | X | X |
| Waste Stream 3 | liquid | rad | 100 gal | rad | X | X |
| Waste Stream 4 | | | | | | |

**NOTE: Use Page 3 of 3 for Additional Waste Streams.**

7) **Waste Analysis and Characterization:** Rad: gross alpha and beta; gamma spec.
Chem: TCLP metals and organics, as required

8) **Waste Staging Area: Y/N** N
**Location:**
**Special requirements:**

**Environmental Restoration**
**Waste Management Planning Checklist**
**(Page 2 of 3)**

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9) Transport Across Public Access Roads Required: Y/N N
Roads Involved:
DOT Regulations to be applied : Y/N
Reportable Quantities of Anticipated DOT Regulated Hazardous Materials (if required):

---

10) Waste Storage Requirements:

Field Staging Area: Y/N/NA Y
Location: 7500 Area Contamination Site
Responsible Organization: ORNL Remedial Action

90-Day Storage Area: Y/N/NA N
Location:
Capacity:
Waste Acceptance Criteria Requirements:
Responsible Organization:

Permitted (or Interim Status) Storage: Y/N/NA N
Location:
Capacity:
Waste Acceptance Criteria Requirements:
Responsible Organization:

---

11) Identification of Potential Treatment Options: NA
Location:
Capacity:
Responsible Organization:
Special Waste Acceptance Criteria Requirements:

---

12) Identification of Potential Disposal Options:
Location: Bldg. 7823
Capacity:
Responsible Organization: ORNL Waste Operations
Special Waste Acceptance Criteria Requirements:

---

**Environmental Restoration**
**Waste Management Planning Checklist**
**(Page 3 of 3)**

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13) Waste Minimization and Reduction Techniques to be Implemented:

| | |
|---|---|
| Segregation __ | In-Field Pretreatment __ |
| Decontamination x | Waste Handling (Spill Control): x |
| Compaction __ | Material Recycle (Solvents, Containers) __ |
| Solvent Substitution __ | Material Reuse (Solvents, Wash Waters) __ |
| Sludge Dewatering __ | Cutting Fluids Recovery __ |
| Selection of PPE x | Selection of Equipment __ |
| Other __ | |

Description of Special Techniques and Expected Effectiveness:

---

14) Additional Information:

---

Prepared by: P. F. Tiner Date: 4/14/92

Review:

Plant Environmental Compliance Organization:

Central ER Waste Management:

ER Waste Minimization Coordinator:

Approvals:

Plant ER Waste Management Organization: _____ Date: _____

Plant Waste Management Organization: [signature] Date: 5/8/92

Central Waste Management Division: _____ Date: _____

91-079P/1191

# DISTRIBUTION

1. L. D. Bates
2. K. J. Brown
3–5. S. N. Burman
6–7. T. W. Burwinkle
8. C. Clark, Jr.
9. M. F. P. DeLozier
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