Energy Systems Environmental Restoration Program
ORNL Environmental Restoration Program

Health and Safety Plan for the Environmental Restoration Program at
Oak Ridge National Laboratory

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MASTER

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Health and Safety Plan for the Environmental Restoration Program at Oak Ridge National Laboratory ORNL/ER-226

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ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	as low as reasonably achievable
anti-C	anti-contamination
API	American Petroleum Institute
BCS	boundary control stations
BP	boiling point
CG	Coast Guard
CGI	combustible gas indicator
CFR	consolidated fuel reprocessing
CNS	central nervous system
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
CSL	ORNL ER Close Support Laboratory
CVS	central vascular system
CYWP	current year work plan
C-zone	contamination zone
DAC	derived air concentration
D&D	decontamination and decommissioning
dBA	decibels on the A-weighted scale
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EC	ORNL Office of Environmental Compliance and Documentation
ECC	Emergency Communications Center
EDT	explosive detonation trench
EMS	emergency medical services
Energy Systems	Martin Marietta Energy Systems, Inc.
ER	Environmental Restoration
ES&H	environmental safety and health
eV	electron volts
EWB	emergency waste basin
EZ	exclusion zone
FID	flame ionization detector
FP	flash point
FTO	for training use only
GC	gas chromatograph
GET	General Employee Training
GI	gastrointestinal tract
Gy/h	gray per hour

ACRONYMS AND ABBREVIATIONS (continued)

H&R	hoisting and rigging
HASP	site health and safety plan
HAZCOM	communication of potential hazards
HAZMAT	hazardous materials
HAZWOPER	hazardous waste operations and emergency response
HEPA	high efficiency particle absorber
HP	health physics or health physics technician
H&S	health and safety
HSA	hollow-stem auger
HT	tritiated hydrogen
HTO	tritiated water
IDLH	immediately dangerous to life and health
IH	industrial hygiene or ORNL IH Section
IP	ionization potential
IS	Industrial Safety Section
LEL	lower explosive limit
LLI	lower large intestine
LLLW	low-level liquid waste
LLW	low-level waste
LSS	Laboratory Shift Superintendent
MCL	maximum contaminant level
MP	melting point
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
MW	molecular weight
NE	not established
NHF	New Hydrofracture Facility
NIOSH	National Institute of Occupational Safety and Health
OVA	organic vapor analyzer
OHF	Old Hydrofracture Facility
ORNL	Oak Ridge National Laboratory
ORP	ORNL Office of Radiation Protection
ORR	Oak Ridge Reservation
ORS	Occurrence reporting system
OVM	organic vapor meter
PEL	permissible exposure limit
PHASP	Programmatic Health and Safety Plan
PID	photoionization detector

ACRONYMS AND ABBREVIATIONS (continued)

PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
RBA	Radiological Buffer Area
RCRA	Resource Conservation and Recovery Act
REAC/TS	Radiation Emergency Assistance Center/Training Site
REL	recommended exposure limit
RI	remedial investigation
RMSA	Radioactive Materials Storage Area
SCBA	self-contained breathing apparatus
SCFP	Surplus Contaminated Facilities Program
SHEST	Safety and Health Evaluation and Support Team
SOP	Standard Operating Procedure
SPM	ORNL ER Site Project Manager or person responsible for managing and coordinating field activities
SSC	Service Subcontract Coordinator
SSHASP	Site-Specific Health and Safety Plan
SSHO	Site Safety and Health Officer
STEL	short-term exposure limit
SWMU	Solid Waste Management Unit
WSA	Solid Waste Storage Area
TDEC	Tennessee Department of Environment and Conservation
TDHE	Tennessee Department of Health and Environment
TLD	thermoluminescent dosimeter
TLV	threshold limit value
TMIS	Training Management Information System
TRE	trivalent rare earths
TRU	transuranics
TSCA	Toxic Substance Control Act
TSD	treatment, storage, and disposal
UEL	upper explosive limit
UL	Underwriters' Laboratory
UST	underground storage tank
WAG	Waste Area Grouping
WBGT	wet bulb globe thermometer

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EXECUTIVE SUMMARY

The Martin Marietta Energy Systems, Inc. (Energy Systems), policy is to provide a safe and healthful workplace for all employees, subcontractors, U.S. Department of Energy (DOE) prime contractors, and visitors and to protect the environment. The accomplishment of this policy at Oak Ridge National Laboratory is guided by this overall plan and a consistent proactive approach to health and safety (H&S) issues.

The policies and procedures in this plan apply to all Environmental Restoration sites and activities including employees of Energy Systems, subcontractors, and prime contractors performing work for the DOE ORNL ER Program. The provisions of this plan are to be carried out whenever activities are initiated that could be a threat to human health or the environment. This plan implements a policy and establishes criteria for the development of procedures for day-to-day operations to prevent or minimize any adverse impact to the environment and personnel safety and health and to meet standards that define acceptable management of hazardous and radioactive materials and wastes. The plan is written to utilize past experience and best management practices to minimize hazards to human health and safety and to the environment from events such as fires, explosions, falls, mechanical hazards, or any unplanned release of hazardous or radioactive materials to air, soil, or surface water.

This plan explains additional site-specific H&S requirements such as the Site-Specific Health and Safety Plan (SSHASP), which should be used in concert with this plan and existing established procedures. Any sections of this plan referenced in the SSHASP should be made as part of any addenda or included in the body of the SSHAP and shall be available for on-site inspection and review by all subcontractor, Energy Systems, and DOE personnel and shall be easily accessible in the field for site personnel. During site activities, all personnel, including subcontractors and visitors, are expected to comply fully with the requirements of this plan and other Energy Systems and DOE policies and procedures. Site activities shall be performed in accordance with all applicable DOE Orders, applicable Occupational Safety and Health Administration Standards 29 CFR 1910 and 1926, and applicable Environmental Protection Agency requirements and consensus standards.

1. INTRODUCTION

This Programmatic Health and Safety plan (PHASP) is prepared for the U.S. Department of Energy (DOE) Oak Ridge National Laboratory (ORNL) Environmental Restoration (ER) Program. This plan follows the format recommended by the U.S. Environmental Protection Agency (EPA) for remedial investigations and feasibility studies and that recommended by the EM-40 *Health and Safety Plan (HASP) Guidelines* (DOE February 1994). This plan complies with the Occupational Safety and Health Administration (OSHA) requirements found in 29 CFR 1910.120 and EM-40 guidelines for any activities dealing with hazardous waste operations and emergency response efforts and with OSHA requirements found in 29 CFR 1926.65.

This PHASP provides information applicable to activities sponsored by the ORNL ER Program. These activities may consist of, but are not limited to, remedial action activities; construction activities; operations, maintenance and surveillance activities; decontamination and decommissioning activities; environmental sampling; environmental radiological surveys; well installation; well plugging and abandonment; geophysical surveys and mapping; technology development and testing; underground storage tank sampling, removal, or closure; liquid transfer from process holding tanks; and off-site activities. ORNL ER activities performed under this PHASP will also adhere to guidelines stated in the DOE *Radiological Control Manual* (DOE April 1994) unless a waiver is granted by DOE for specific sections of the manual and the Martin Marietta Energy Systems, Inc. (Energy Systems) *Radiological Control Manual* (Energy Systems 1992).

Site-Specific Health and Safety Plans (SSHASPs) will be prepared on a project-specific basis to address in greater detail the hazards and controls associated with particular tasks. Each SSHASP will be reviewed and approved by appropriate individuals (see Sect. 2.1) to assure that the plan complies with ORNL, Energy Systems, and DOE procedures and guidelines.

1.1 PURPOSE OF THE ENVIRONMENTAL RESTORATION PROGRAM

The mission of the ER Program is to remediate contaminated waste sites and to contain known releases of hazardous materials, in order to reduce current and future risks to human health and the environment. Early activities are focused on reducing potential or current off-site risks and are conducted in conjunction with efforts to select, execute, and validate final remedies for contaminated sites. Remedial efforts are prioritized and innovative approaches are developed to support cost-effective risk reduction. All efforts are conducted with an emphasis on employee health and safety and environmental safety, along with the intent to comply with regulatory requirements and public expectations.

1.2 OAK RIDGE NATIONAL LABORATORY SITE DESCRIPTION

The Oak Ridge Reservation (ORR) consists of 35,300 acres of federally owned land located in a valley between the Cumberland and southern Appalachian mountain ranges within the corporate limits of the city of Oak Ridge in eastern Tennessee (Kornegay et al. 1991). The reservation was established in response to the World War II Manhattan Engineer District atomic weapons project in 1942. The ORR consists of three separate plant facilities, originally designated as K-25, Y-12, and X-10. Over the years, plant names were changed to the Oak Ridge K-25 Site, the Oak Ridge Y-12 Plant, and ORNL. Originally, all three plant facilities were under the authority of the U.S. Defense Department (U.S. Army). The facilities on the ORR are now under the ownership of DOE and are managed by Energy Systems. Numerous research and development projects have been conducted on the ORR, and these efforts continue as of this writing.

ORNL facilities are required to be in full compliance with all federal and state environmental regulations. To accomplish this, a listing of all known active and inactive waste management areas, contaminated facilities, and potential sources of continuing releases to the environment was prepared. Because of the large number of sites on the list (around 250), ORNL combined the sites into 20 Waste Area Groupings (WAGs), each of which contained sites within geographically contiguous and/or hydrologically defined units. Thus, many of the original sites were called Solid Waste Management Unit(s) (SWMUs) and grouped together into WAGs. The WAG concept was developed to subdivide the remedial action sites into manageable units that could be handled separately (ORNL 1987a). Diagrams showing locations of the various WAGs and some of the non-SWMU areas are presented in Attachment A (Figs. A.1 through A.26).

The following sections present brief summaries of pertinent information concerning the location, site resources, and suspected contaminants for each of the 20 WAGs. Except where otherwise noted, the primary source for this information was *RCRA Facilities Assessment (RFA)—Oak Ridge National Laboratory*, ORNL/RAP-12/V1 (ORNL 1987a) and contaminated site summary sheets (updates for the data summary sheets found in RAP-12). Information presented here should only serve as a preliminary introduction to these areas and should not serve as the sole source of information for preparing a SSHASP or site-specific sampling and analysis plan. An exhaustive search of all sources should be conducted before preparation of these documents. This search should include the primary source (ORNL/RAP/12/V1), other available reports, historical data, site usage information, site maps, and interviews with personnel (current and retired) knowledgeable about the site and/or its history. **In all cases, the contaminants listed in the following sections are not to be interpreted as conclusive lists of all contaminants at these facilities.** Field personnel should consult the SSHASP for information on site-specific resources pertaining to their project.

1.3 WAG 1—MAIN PLANT AREA

1.3.1 Location and Description

WAG 1 is situated in Bethel Valley between Bethel Valley Road to the north, the White Oak Creek flood plain to the south, and First Creek to the west. The eastern side of the facility is bounded by Buildings 4501 and 4508 and a former waste burial area Solid Waste Storage Area (SWSA) 2.

WAG 1 encompasses an area of approximately 150 acres and contains roughly 170 SWMUs. The WAG contains most of the original plant area of ORNL, including numerous types of storage facilities for holding low-level liquid radioactive waste (LLLW). These facilities consist of ponds and impoundments, waste treatment facilities, shallow land burials, SWSAs, and miscellaneous chemical and sewage facilities. Various waste management and disposal methods have been used within WAG 1, and some of these processes have resulted in releases to the environment.

1.3.2 Suspected Contaminants at WAG 1

Contaminated areas (both radiological and chemical) have been documented throughout WAG 1. Stream-gravel surveys conducted at seven sites (Morrison and Cerling 1987) within WAG 1 showed that most of the sites contained measurable levels of various metallic compounds including Cr, Cu, Mo, and Zn. These contaminants are believed to be the results of releases occurring from sources located along First Creek and the Northwest Tributary, cooling towers, or other unknown sources.

Of the seven sampling locations used by Morrison and Cerling, only one indicated organic contaminants. However, the preliminary survey results listed below can be considered representative of organics that might be encountered at ORNL.

Di- <i>n</i> -butylphthalate	1089	μg/kg
Phenanthrene	3300	μg/kg
Anthracene	1386	μg/kg
Fluoranthene	2376	μg/kg
Pyrene	1848	μg/kg
Benzp(a)anthracene	1716	μg/kg
Chrysene	1815	μg/kg
Benzp(b)fluoranthene	165	μg/kg
Benzo(a)pyrene	2673	μg/kg
Indeneo(1,2,3-cd)pyrene	2541	μg/kg

Other organic compounds isolated as groundwater contaminants at WAG 1 include trichloroethylene, 1,2-dichloroethene, and vinyl chloride. The source of these contaminants is not clearly identified.

Previous soil sampling data collected at WAG 1 have identified soil contamination from naturally occurring, as well as man-made alpha-emitters. The man-made alpha emitters have been characterized as ^{241}Am , ^{238}Pu , and $^{239,240}\text{Pu}$. Most of the contamination detected from these radionuclides has been found near Building 3019, the North Tank Farm, the South Tank Farm, isotope area, surface impoundments 3513/3524, the Building 3503/3504 storage pad, floodplain soils, SWSA 1, and the thorium tank farm. Beta-emitters found at the site include ^{137}Cs , ^{90}Sr , and ^{60}Co . Man-made radionuclides such as ^{99}Tc , $^{152,154,155}\text{Eu}$, ^{63}Ni , ^{45}Ca , and ^3H have not been widely found as site contaminants.

Radionuclides identified in the 1987 Morrison and Cerling study include ^{137}Cs , ^{90}Sr , and ^{60}Co . The Process Waste Treatment Plant is believed to be the primary source of these radiological contaminants with the exception of ^{90}Sr . Active discharges of ^{90}Sr have been documented in First Creek from two discharge pipes located on the east side of the creek. Strontium-90 contamination has also been isolated in the Northwest Tributary, with First Creek and SWSA 3 believed to be the contributing source.

Gravel radionuclides identified at WAG 1 by Morrison and Cerling (Site 12, 1986 data) included ^{60}Co , $816 \pm 132 \text{ Bq/kg}$; ^{90}Sr , $183 \pm 197 \text{ Bq/kg}$; and ^{137}Cs , $57,333 \pm 15,502 \text{ Bq/kg}$. Background concentrations are <2 , <10 , and 3 Bq/kg , respectively. These are the major radionuclides of concern in WAG 1 (ORNL 1987a).

1.3.3 WAG 1 Site Resources

Because WAG 1 incorporates a major portion of the main plant area, numerous site resources are available. Telephones, potable water supplies, employee break areas, lavatory facilities, fire alarm pull-boxes, and fire extinguishers are located throughout the main plant area.

1.4 WAG 2—WHITE OAK CREEK AND WHITE OAK LAKE

1.4.1 Location and Description

WAG 2 is located in Melton and Bethel valleys and includes the main surface water drainage system for the ORNL installation. WAG 2 is composed of two SWMUs: (1) the stream channels of White Oak Creek and Melton Branch and (2) White Oak Lake, White Oak Dam, and the surrounding embayment. White Oak Creek originates from surface water runoff and underground springs northeast of WAG 1, flows through the main plant area, exits Bethel Valley through a gap in Haw Ridge, and empties into White Oak Lake. Just upstream of White Oak Lake, Melton Branch enters White Oak Creek from the east. Melton Branch collects the drainage from many of the reactor facilities in Melton Valley. White Oak Creek enters the Clinch River 0.6 miles downstream from White Oak Dam.

1.4.2 Suspected Contaminants at WAG 2

Historical data indicate that White Oak Creek and White Oak Lake have received treated and untreated discharges from ORNL operations since 1943. These effluents include

reactor cooling water discharges, process waste water from holding ponds, and groundwater seepage. Extensive sediment and water sampling activities have been conducted throughout WAG 2 over the years.

Contaminants ranging from organic and inorganic chemicals to radionuclides have been isolated and characterized. Polychlorinated biphenyls (PCBs), Hg, As, ^{60}Co , ^{137}Cs , and ^{90}Sr are some of the more common contaminants. Sediment samples from White Oak Lake (collected by Oakes et al. 1982) contained ^{60}Co , ^{90}Sr , and ^{137}Cs . Streambed gravel surveys for ^{60}Co , ^{90}Sr , and ^{137}Cs (conducted by Cerling and Spalding 1981) indicate continual contamination of White Oak Creek and White Oak Lake from sources within the watershed. The most significant source of ^{60}Co contamination appears to be the High Flux Isotope Reactor (HFIR), which is located on a tributary of Melton Branch. Small concentrations of ^{60}Co have also been documented in the two tributaries adjacent to the east side of SWSA 6. Streambed ^{90}Sr contamination has been isolated from processes carried out at WAG 1, SWSA 4 in WAG 4, SWSA 5 in WAG 5, and the Homogeneous Reactor Experiment (HRE) area in WAG 9 on the Melton Branch tributary east of SWSA 5.

Main radioactive contaminants associated with White Oak Lake and embayment are ^{90}Sr , ^{137}Cs , Th, U, and transuranics (TRU). Preliminary scoping surveys have shown contamination by Cd and Cr in stream gravels. Main contaminants of White Oak Creek and tributaries are ^{90}Sr , ^{60}Co , ^{137}Cs , ^3H , and metals (Hg, Zn, and Cr). Hazardous chemicals, including PCBs, may also be present.

For further information regarding suspected contaminants at WAG 2, it is recommended that one consult the study conducted by Blaylock et al., *Screening of Contaminants in Waste Area Grouping 2 at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (Blaylock et al. 1992).

1.4.3 WAG 2 Site Resources

WAG 2 is an undeveloped area; therefore, fire-alarm pull boxes, telephones, potable water supplies, lavatories, etc. will not be available throughout the facility.

1.5 WAG 3—SWSA 3

1.5.1 Location and Description

WAG 3 is located in Bethel Valley, approximately 0.6 mile west of the west entrance to the laboratory complex. WAG 3 is composed of three SWMUs: the Closed Scrap Metal Area, SWSA 3, and the Contractors' Landfill. Historical data indicate that the Closed Scrap Metal Area was operated as a contractors' landfill between the early 1950s and the mid-1960s. After reaching its capacity, the fill area was used for storage of scrap metal, the nature and origin of which are undocumented (ORNL 1988). SWSA 3 was opened in 1946 for the disposal of radioactively contaminated waste. The area was closed in 1951 but was used for the aboveground storage of slightly contaminated equipment until 1979. The Contractors' Landfill

was opened in 1975 for the disposal of construction debris and fly ash from the ORNL steam plant. This facility is still in operation.

1.5.2 Suspected Contaminants at WAG 3

The quantities of radiological and chemical contaminants in WAG 3 SWMUs are unknown. SWSA 3 consists of buried wastes containing trash, scrap, carcasses, soil, rubble, filters, oils, asbestos, lumber, equipment, shielding, and containerized waste. The major radiological contaminants include ^{90}Sr , ^{137}Cs , ^3H , trivalent rare earths (TRE), and TRU isotopes (Bates 1983). A 1978 soil survey indicated the presence of ^{137}Cs , ^{90}Sr , ^{238}Pu , ^{239}Pu , ^{241}Am , and ^{244}Cm . A subsequent radiological survey in 1988 confirmed the continuing presence of radioactive contamination on the surface of SWSA 3. Drawings of SWSA 3 indicate that alpha waste and beta-gamma waste were buried in separate trenches. Initially, alpha wastes were contained in drums and then placed in concrete-lined trenches; later operations processed the drums in unlined trenches. Beta-gamma wastes were placed in separate, unlined trenches.

Hazardous chemical wastes are also thought to be buried at SWSA 3. Supporting data regarding this issue are vague. Records relating to burials at SWSAs 3, 4, and portions of 5, were destroyed by a fire in 1961 (Coobs and Gissel 1986.) Prior to the enactment of the Resource Conservation and Recovery Act (RCRA), one cannot rule out the possibility that hazardous chemical wastes were buried at the Contractors' Landfill. Current ORNL disposal procedures comply with RCRA requirements, and it is, therefore, assumed that only non-RCRA, nonradioactive solid wastes are contained in this SWMU.

Morrison and Cerling (1987) conducted sampling activities at WAG 3 in the fall of 1986. Two sites were sampled on the Northwest Tributary east of WAG 3 and two sites on the Raccoon Creek drainage west of WAG 3. Strontium-90 appeared to be the dominant radionuclide of concern in the Raccoon drainage area with average concentrations of 2.9 and 6.8 Ci at the two sites, respectively. The source of the ^{90}Sr contamination appears to be SWSA 3. The migration pattern of the contaminant occurs along a strike to the east and the west of the WAG 3 boundary. Sampling for organic compounds was not conducted.

1.5.3 WAG 3 Site Resources

As of this writing, site resources do not exist at WAG 3. The nearest telephone and rest room facilities are located in Building 1505, almost 0.5 mile away.

1.6 WAG 4—SWSA 4

1.6.1 Location and Description

WAG 4 lies within Melton Valley about 0.5 miles southwest of the main ORNL complex. The area is accessible from Lagoon Road. Three SWMUs comprise WAG 4: SWSA 4, Pilot Pits 1 and 2, and an LLLW line located north of Lagoon Road. Of the three SWMUs located

within the facility, SWSA 4 represents the most significant potential for hazardous waste releases.

The closure of SWSA 3 prompted the opening of SWSA 4 as a routine solid waste burial site in February 1951. Burial operations at SWSA 4 were the first to require that the waste be buried in Conasauga Shale. The total area of SWSA 4 (23 acres) was approximately twice that of the three previous burial sites (11 acres). Wastes were placed in shallow auger holes, trenches, and in piles on the ground surface (to be covered at a later date.). Historical records supporting the total amount of waste disposed of in SWSA 4 were destroyed by a fire. However, ORNL Waste Operations Division estimated that the total waste volume was ~2 million ft³, containing approximately 90,000 to 120,000 Ci of radioactivity including ⁹⁰Sr, ¹³⁷Cs, ⁶⁰Co, ²¹⁰Po, ³H, ¹²⁵Sb, and ²³⁹Pu. Routine burial operations ceased at the site in July 1959; however, the site accepted uncontaminated fill until July 1973.

From 1955 to 1963, Oak Ridge was designated by the Atomic Energy Commission (AEC) as the Southern Regional Burial Ground. Under this directive, SWSA 4 received a vast array of poorly characterized wastes from approximately 50 different sources. The waste consisted of paper, clothing, filters, equipment, animal carcasses, and related laboratory waste; however exact amounts of each are unknown. The waste from outside sources accounted for ~50% of the total volume of waste buried at SWSA 4.

The Pilot Pit Area (Building 7811) was constructed in 1955 for use in pilot-scale radioactive waste disposal studies (Morgan et.al 1956). The experimental area consisted of an asphalt pad surrounded by a chain-link fence, which ran adjacent to the southern boundary of SWSA 4. Two experiments were conducted in 1956 and 1957 (Pilot Pit 1 and Pilot Pit 2), only one of which utilized radioactive materials. The ceramic end product manufactured in Pilot Pit 2 contained trace levels of radioactivity and was removed from the facility following its formation. Following the experiments at Pilot Pit 2, the test program was terminated by the AEC.

Presently, three large concrete cylinders containing unused experimental equipment are all that remain at the facility. The remaining control building is now used to store laboratory and field equipment. The asphalt pads that were initially constructed have since been converted to a storage areas for drill rigs, coal drums, and coal waste products.

From 1954 to 1975, liquid radioactive wastes were transferred from the gunite storage tanks at the main ORNL complex through an underground pipeline system to the waste pits and trenches at WAG 7. The transfer line was located on the north side of Lagoon Road. While in operation, the transfer lines carried liquid waste containing activity levels on the order of 1.5 million Ci of mixed fission products (Walls et al., 1983). The line was decommissioned under the auspices of the DOE Surplus Facilities Management Program over a 2-year period beginning in 1981.

1.6.2 Suspected Contaminants at WAG 4

Since its inception, SWSA 4 has experienced a continual problem with contaminated groundwater. Radioactivity has been documented in the site monitoring wells at the facility,

and four distinct seeps were located. Duguid (1975) has done extensive work on documenting radionuclide movement in SWSA 4. A number of existing wells and surface seeps were determined to contain ^{90}Sr , ^{60}Co , ^{137}Cs , ^{125}Sb , and ^3H . In his research, Duguid (1975) divided SWSA 4 into eastern and western regions and reported concentrations of ^{90}Sr on randomly selected sampling dates. The west side of SWSA 4 was determined to contain the most contamination, with ^{90}Sr being the most prominent contaminant. Strontium-90 discharge levels were estimated to be between 1.2 and 4.8 Ci per year between 1963 and 1973. The SWSA 4 releases are estimated to contribute about one-third of the total ^{90}Sr discharged into the Clinch River (measured at White Oak Dam). Later studies by Stueber et al. (1981), confirmed the work performed by Duguid that showed that SWSA 4 was a major contributor of ^{90}Sr to White Oak Creek and that surface seeps do in fact appear along the southern boundary of the site during the rainy season.

In 1984, Spalding and Munro conducted a survey of ^{90}Sr in SWSA 4 groundwater by sampling 129 locations along a 720-m perimeter transect to the south and east of SWSA 4. They concluded that groundwater on the eastern side of SWSA 4 contained much less ^{90}Sr than groundwater on the southern side and recommended that future remedial actions be directed to the southern areas of SWSA 4.

Two major remedial actions have been conducted at the site since routine burial operations ceased 28 years ago. The scope of the effort was to isolate burial trenches from upstream groundwater recharges. The first action was conducted in 1975 and consisted of building a concrete drainage ditch along the northern boundary of the site to catch surface runoff from Haw Ridge. The runoff was then directed under Lagoon Road to three lined trenches that crossed SWSA 4 and discharged into a tributary to the south. Upon completion of the project, no reduction in ^{90}Sr contamination was observed (Tamura et al. 1980). It has been hypothesized that lined trenches running across SWSA 4 may terminate in an area where earlier migration of ^{90}Sr occurred. The second action took place in 1983 and consisted of a water diversion that routed drainage from Haw Ridge around SWSA 4. Flow measurements and stream sampling of the SWSA 4 tributary indicate reductions in the watershed area of SWSA 4 by 56%, the flow of SWSA 4 tributary by 56%, and the ^{90}Sr levels by 46% (Melroy and Huff 1985).

1.6.3 WAG 4 Site Resources

WAG 4 is an undeveloped area and contains of only one building (Building 7811). There are no telephones, lavatories, or potable water supplies located at the site. The main source of communications must be by plant two-way radio; however, a telephone is located adjacent to the site (at the main entrance gate).

1.7 WAG 5—SWSA 5

1.7.1 Location and Description

WAG 5 is located in Melton Valley ~1.2 miles south of the ORNL main plant area. The WAG contains ~37 SWMUs categorized as follows: low level waste (LLW) leak and spill

sites, support facilities for ORNL's hydrofracture operations, a sludge basin, waste storage tanks, a SWSA, a TRU waste storage area, septic tanks, and an old landfill. The largest land area in WAG 5 is devoted to SWSA 5 and the TRU waste storage area.

Historically, SWSA 5 was used to dispose of solid LLW generated at ORNL from 1959 to 1973. From 1959 to 1963, the burial ground served as the Southeastern Regional Burial Ground for AEC. When burial operations were initiated, ~10 acres of the site were set aside at its inception to allow for the retrievable storage of TRU wastes. (Wastes containing over 100 nCi/g of TRU cannot be disposed of but rather must be stored in a fashion allowing them to be retrieved at a later date, if required.) SWSA 5 waste disposal records also fell victim to a fire, but some existing records provide estimates of the type and amount of waste that is stored at the facility. The ORNL Waste Management and Remedial Action Division estimates that 3 million ft³ of waste containing ~200,000 Ci of radioactivity is buried in SWSA 5.

The WAG 5 boundary also incorporates the surface facilities for both the old and new hydrofracture facilities. Because Melton Branch (part of WAG 2) flows between the old and new hydrofracture installations, the part of WAG 5 south of Melton Branch (New Hydrofracture Facility) has a separate WAG boundary. The Old Hydrofracture Facility and the New Hydrofracture Facility both consist of buildings containing control rooms, pumping equipment, mixing equipment, and solid storage and handling equipment.

Presently, LLW tanks W-24 through W-31 are storing evaporator concentrates pending a decision for long term storage or disposal. Major constituents are ⁹⁰Sr, ¹³⁷Cs, ⁶⁰Co, and TRU. These tanks are constructed of stainless steel, and their integrity is assured by secondary containment. The Old Hydrofracture Facility tanks have been removed from active use.

WAG 5 also includes two LLW leak sites; one is related to the hydrofracture operations and the second is a leak in the LLW transfer line that once serviced the Old Hydrofracture Facility (OHF). These LLW transfer lines have since been removed from active status.

1.7.2 Suspected Contaminants at WAG 5

Various sources of water quality data exist for SWSA 5: groundwater monitoring results from the OHF pond (Stansfield and Francis 1986), the ORNL containment survey (Doyle and Taylor 1986), and areal distribution studies of ⁹⁰Sr conducted by Spalding and Munro (1984).

Stansfield and Francis (1986) installed four monitoring wells at the Old Hydrofracture Facility pond. Sampling efforts conducted over a one-year period indicated that groundwater near the pond was contaminated with ³H and ⁹⁰Sr. The ³H upgradient concentration proved to be higher than the downgradient concentrations, indicating that the pond may be diluting releases of ³H from SWSA 5. Groundwater testing for contamination conducted by Stansfield and Francis, under the auspices of Title 40, CFR (Subpart F, *Groundwater Protection*), indicated statistically significant contamination at the Old Hydrofracture Facility pond.

Surveys performed by Doyle and Taylor in 1986 consisted of sampling one seep and six wells located in SWSA 5. Their results indicated that all six wells were contaminated with ⁹⁰Sr

and ^{137}Cs . (Tritium was not screened). RCRA-regulated contaminants were also thought to be present, specifically lead.

Spalding and Munro (1984) investigated the areal distribution of ^{90}Sr in shallow groundwater along the southern boundary of SWSA 5. Their findings indicated that there were seven distinct areas of ^{90}Sr contamination.

Sampling at two sites by Morrison and Cerling (1987) indicated that groundwater seepage from SWSA 5 was contributing to the ^{90}Sr contamination found in Melton Branch. Cr, Zn, and Ni may also be released. This study also indicated that releases of other radionuclides and metals are low when compared with background levels along this specific portion of Melton Branch. Organics could not be detected in mud samples collected at one of the sites; organic analyses were not conducted on samples from the second site. Morrison and Cerling concluded that WAG 5 does not appear to be a source of organic contamination.

1.7.3 WAG 5 Site Resources

The WAG 5 facility is a remote area with little development. A plant telephone is located at the main entrance gate. One permanent building (Building 7831), which is located at the WAG 5 facility, contains the following resources: telephones, lavatories, a break room, potable water supplies, and a fire alarm pull box. The ORNL Office of Radiation Protection (ORP) maintains a few support trailers on-site; however, they contain limited resources. Remote field activities conducted at WAG 5 must rely on portable communication systems and lavatory facilities.

1.8 WAG 6—SWSA 6

1.8.1 Location and Description

WAG 6 is located ~1.2 miles south of the ORNL main plant area in Melton Valley. Lagoon Road provides access to the facility from the main plant. SWSA 6 is designated as a shallow land burial site for non-RCRA low-level radioactive or nonradioactive wastes. The site began waste storage operations in 1969 and continued operations until May 1986, when DOE mandated closure of the facility because it was discovered that RCRA-regulated waste was being deposited there. The site was reopened in July 1986, following numerous changes in operating procedures. WAG 6 is currently the only active disposal area for low-level radioactive waste at the ORNL plant. Due to the disposal of RCRA-regulated wastes at SWSA 6 prior to May 1986, the facility is currently undergoing closure operations under the auspices of Tennessee Department of Environment and Conservation (TDEC) Regulations 1200-1-11-.05(7) and (14) and EPA RCRA Regulations 40 CFR, Part 265, Subpart G.

Three SWMUs make up WAG 6: the 68-acre SWSA 6, the Emergency Waste Basin (EWB) constructed as an emergency holding basin for liquid waste from the ORNL main plant area, and the Explosives Detonation Trench (EDT) for the disposal of explosives and shock-sensitive chemicals by detonation. The EDT was located in the southeastern corner of SWSA 6. The area has since been back-filled, and its exact location is no longer known. The

EWB has a surface area of 2 acres and a storage capacity of 15 million gallons. The EWB has never been used for its intended purpose; it now contains water from surface run-off and groundwater discharge from SWSA 6.

Various methods of waste storage have been used at SWSA 6, depending upon the levels of radioactivity present. Typically, waste has been managed at the site by burial in trenches and auger holes following segregation. At the close of 1984, it was estimated that 1 million ft³ of waste containing approximately 250,000 Ci of radioactivity was buried in SWSA 6 (Boegly et al. 1985). Waste ranging from laboratory glassware to contaminated earth is currently being stored there; the waste is packaged in various forms ranging from stainless steel drums to plastic bags.

1.8.2 Suspected Contaminants at WAG 6

The most significant potential for a release of radioactive and hazardous contaminants at the WAG 6 facility lies within SWSA 6.

Streambed sampling efforts conducted in the drainage basin of White Oak Creek by Cerling and Spalding (1981) demonstrated that an ephemeral stream channel passing through the center of SWSA 6 contained concentrations of ⁹⁰Sr in excess of background levels. Follow-up studies in 1986 indicated that the ⁹⁰Sr contamination in the stream channel was decreasing but had not stopped.

Sources of ¹³⁷Cs and ⁶⁰Co were detected in the eastern section of WAG 6 between 1978 and 1985. Sampling activities conducted in the drainage area arising from the EWB showed no radionuclide contamination. In 1986, a limited sampling of stream gravels, mud, and surface water was conducted at WAG 6 to determine if further remedial actions were necessary at any of the SWMUs contained in the facility. One of four sites indicated ⁹⁰Sr contamination; however, the concentrations were considerably lower than in the studies conducted from 1978 to 1986. Two of the four sites indicated that these sites were still contaminated with ⁶⁰Co and ¹³⁷Cs.

Sampling conducted for the isolation of metals was considered to be within normal limits, except for a single sample containing Cu, Zn, and Mo. No organic contaminants were found in three samples analyzed from one site.

1.8.3 WAG 6 Site Resources

The area surrounding WAG 6 is currently undeveloped. A plant telephone is located at the main entrance to the facility. The area contains approximately four support trailers that are used as temporary offices, break rooms, and clothes-change areas for field operations conducted at the site. The support trailers contain telephones, fire extinguishers, and portable lavatory facilities but lack a permanent potable water supply. The southern boundary of SWSA 6 contains a tumulus holding area with a telephone and fire alarm pull box. Remote field activities conducted at WAG 6 must rely on portable communication systems and lavatory facilities.

1.9 WAG 7—LLLW PITS AND TRENCHES

1.9.1 Location and Description

WAG 7 is situated in Melton Valley about 1 mile south of the ORNL main plant area. Located within WAG 7 are ~23 SWMUs, including 7 pits and trenches used for the disposal of LLW, 7 fuel wells that contain acid solutions enriched primarily with uranium from the HRE, experimental hydrofracture injection sites, leak sites, shielded transfer tanks, and a decontamination facility.

In terms of radioactivity, the seven pits and trenches are the major SWMUs in WAG 7. Over the course of their operation, an estimated 42 million gallons of LLW containing ~1.2 million Ci of (beta) radioactivity were transferred to these disposal units. With decay correction, it is estimated that ~200,000 Ci of ^{90}Sr , 600,000 Ci of ^{137}Cs , and considerably smaller amounts of U and TRU isotopes remain at the facility.

1.9.2 Suspected Contaminants at WAG 7

Spalding's *Environmental Data Package for the ORNL Seepage Pits and Trenches Waste Area Grouping*, ORNL/RAP-10, is a complete compilation of the information available on WAG 7, including historical data, past releases, references, engineering drawings, and photographs. In the past, surface seepage has been observed from six of the seven pits and trenches that were previously used for disposal operations. Poor site selection may have been a key factor in causing the pit discharges. Ruthenium-106 was the main radionuclide of concern during operation of the pits and trenches, although ^{90}Sr and ^{60}Co have been the primary releases since the pits were taken out of service (Cerling and Spalding 1981). Sampling studies conducted in the area of Trench 7 (Olsen et al. 1983) indicated the presence of ^3H , ^{233}U , and ^{99}Tc .

Cerling (1986) conducted a streambed contaminant survey at two sites to measure releases originating from WAG 7. Evidence of ^{90}Sr and ^{60}Co was reported, although it was surmised that the contaminants might be the result of redistribution processes occurring within the streambed, rather than active discharges. This survey also indicated that most contaminant levels had declined by a factor of 3 to 4 in the surrounding area of the pits and trenches. Cerling attributed this phenomenon to the installation of asphalt caps over the pits in 1980.

1.9.3 WAG 7 Site Resources

A telephone is maintained at the entrance to the WAG 7 site. The site is a remote area, and no permanent resources are located there. Remote field activities conducted at WAG 7 must rely on portable communication systems and lavatory facilities.

1.10 WAG 8—MELTON VALLEY AREA

1.10.1 Location and Description

WAG 8 is located in Melton Valley and includes the reactor facilities located outside the main plant area: the Molten Salt Reactor Experiment (MSRE) and the High Flux Isotope Reactor (HFIR). Waste products from these facilities are collected on-site in LLW tanks and then transferred to WAG 1 (via a network of transfer lines) for treatment and storage. Presently, the MSRE is no longer in operation; however, HFIR continues to operate. Approximately 40 SWMUs are contained in WAG 8, including holding ponds, the experimental hydrofracture site, hazardous waste storage facilities, a waste transfer line with corresponding collection tanks, and other support facilities for the reactors.

1.10.2 Suspected Contaminants at WAG 8

The initial stream gravel surveys conducted by Cerling and Spalding (1981) recognized WAG 8 as a major source of ^{60}Co , with measurable releases of ^{137}Cs also being detected. The source of contamination appeared to be the cooling water effluent from HFIR. Strontium-90 was not detected above background levels. A 1985 survey resulted in very similar radionuclide findings; in addition, there was evidence that WAG 8 was also a potential source of Zn and Cr releases.

In 1987, Morrison and Cerling conducted further sampling efforts at the WAG 8 facility. Four sampling locations were analyzed, with two of the sites located above the HFIR discharge areas. These sites were specifically selected to indicate background measurements for the site. No evidence of contamination (radioactive or metals) was found at either site. A site located below the HFIR cooling towers was contaminated, mainly with ^{60}Co and a lesser amount of ^{137}Cs and ^{90}Sr contaminants. The ^{137}Cs and ^{90}Sr concentrations were reported to have dropped considerably since the previous (Cerling and Spalding 1981) screening. Based upon these findings, Morrison and Cerling concluded that the cooling water effluent from HFIR was the dominant discharge source of ^{60}Co from ORNL facilities. Sampling on Melton Branch indicated that ^{60}Co and ^{137}Cs were present in stream gravels, but ^{90}Sr was at background level.

Stream gravel samples collected at two sites downstream from WAG 8 confirmed that contamination from Cr, Cu, P, and Zn also exists at the site. The presence of these metals can also be attributed to the discharge of HFIR cooling water effluents. Water samples were not collected at any of the WAG 8 sampling locations, and organic analyses have not been conducted.

1.10.3 WAG 8 Site Resources

Some areas of WAG 8 are well developed, with a variety of permanent resources available in area buildings: potable water, plant telephones, lavatories, break areas, fire extinguishers, and fire alarm pull boxes. The support buildings for MSRE and HFIR contain well-maintained resources. Site resources decrease and disappear as one ventures out to the more remote SWMUs within the WAG.

1.11 WAG 9—HRE AREA

1.11.1 Location and Description

WAG 9 is located in Melton Valley approximately 0.6 miles southeast of the ORNL main plant area. The area is composed of 13 units: the HRE Pond, two inactive LLLW collection and storage tanks, a septic tank, a designated trash area, the Waste Evaporator, the Waste Evaporator Loading Pit, the HRE cooling tower, the HRE Reactor building, an absorber pit, valve pits, and a soil decontamination shed. The HRE surface impoundment is an unlined 316,000-gal earthen structure (pond) that was constructed in 1955. The impoundment was used from 1957 to 1961 as a waste storage impoundment for contaminated condensate from the HRE waste evaporator. Later, the pond was used to hold low-level shield water disposed of during cell maintenance. While in operation, chemical flocculation was used to promote waste settling in the pond. The impoundment was filled with soil and capped with asphalt in 1970.

The LLLW collection and storage tanks (7560 and 7562) are located south of the Waste Evaporator and north of the Waste Holding Pond, respectively. The 7560 tank was designated to hold condensed clean vapor from the evaporator cell until the liquid could be sampled. The 7562 tank, designed to hold high-level radioactive wastes, has been empty since 1961. Also located in the area is a 1400-gal septic tank installed to manage domestic sewage from the HRE facility. The tank supports lavatories located at the site and is not expected to contain any radioactive or hazardous wastes.

The designated trash area located east of the HRE parking lot lies north of Melton Valley Drive and directly across from Building 7500. The unit once contained an old farm house that was used by HRE-1 and HRE-2 as a storage facility. All stored material (some contaminated with radioactivity) was removed from the premises in the mid-1960s. Some construction debris is still located at the site and lies at the east end of the complex.

The waste evaporator facility is located at Building 7502 on Melton Valley Road. The Waste Evaporator Loading Pit is located immediately to the east of Building 7502. The pit was used to load carriers with LLLW from the Waste Evaporator Facility. The HRE facility was proposed for three separate phases of experimentation during the 1950s, but due to corrosion problems encountered during the first experiment, no further efforts were conducted.

1.11.2 Suspected Contaminants at WAG 9

WAG 9 appears to be a source of continual release of ^{90}Sr and ^{137}Cs from both the HRE facility and the HRE settling basin. Strontium-90 and ^{137}Cs releases are received by WAG 9 from the MSRE area in WAG 8. Indicators also point to Cr and Zn contamination within the facility, although a comparison of stream gravel data taken from 1978 and 1986 indicates that the releases are diminishing.

Stream gravel surveys were conducted by Cerling and Spalding in 1981 on the unnamed tributary that drains WAG 9 to Melton Branch and the tributary leading to the MSRE. The

analyses indicated the presence of ^{90}Sr and ^{137}Cs , with the HRE area being the most probable source of the contamination. The HRE pond was thought to be the major contributor of the ^{137}Cs , as well as additional ^{90}Sr contamination. Cerling (1986) conducted a similar study that supports the 1981 findings.

The HRE pond was characterized by Stansfield and Francis in 1986. Contamination was found, with ^{137}Cs and ^{90}Sr being the primary contaminants. Trace amounts of ^{238}Pu , ^{239}Pu , ^{241}Am , and ^{244}Cm were also isolated. Characterization efforts conducted at the Waste Evaporator Loading Pit isolated ^{90}Sr , ^{137}Cs , and ^{60}Co .

1.11.3 WAG 9 Site Resources

The support buildings in WAG 9 contain permanent potable water supplies, lavatories, change houses, fire extinguishers, and fire alarm pull boxes. Site resources decrease as one ventures out to some of the more remote SWMUs within the WAG.

1.12 WAG 10—HYDROFRACTURE INJECTION WELLS AND GROUT SHEETS

1.12.1 Location and Description

WAG 10, located in Melton Valley, includes injection wells and grout sheets from four SWMUs, two of which were used in the development of the hydrofracture process at ORNL. The remaining two SWMUs are facilities (now inactive) that were used to dispose of LLW. WAG 10 is significantly different from the other WAGs, because the grout sheets are located at depths of 300 to 1000 ft below the ground surface. WAG 10 does not include the surface facilities used for hydrofracture injections. The facilities themselves are associated with WAGs 5, 7, and 8.

The hydrofracture process was an innovative waste disposal method that was used in the disposal of over 12 million liters of low-level radioactive waste from 1959 to 1984. Waste materials processed by the hydrofracture method were mixed with grout and additives and injected (forced under high pressure) into the shale formations at depths of 200 to 300 meters. The injected slurry spread throughout the fractures and bedding planes of the shale hundreds of meters from the injection site, thereby forming grout sheets. Hydrofracture injections were carried out at two experimental sites (HF1 and HF2), as well as at the Old Hydrofracture Facility (HF3). A fourth site known as the New Hydrofracture Facility (HF4) conducted operational injections on a routine basis and eventually replaced HF3. Operational injections were carried out at HF4 as recently as 1984. Hydrofracture injections were discontinued in 1986 upon the discovery of a contaminated well located in the vicinity of a grout sheet. Since this occurrence, the validity of the hydrofracture process has been criticized, and the closure of the facility has been mandated. The hydrofracture process area contains a total of 155 injection wells as of this writing.

1.12.2 Suspected Contaminants at WAG 10

Two occurrences have been documented in which water from the grout sheets was released through wells drilled into the existing grout sheets. Radioactivity levels for two of the deep monitoring (DM) wells was reported in the range of 94,000 to 400,000 Bq/L (primarily ^{90}Sr). The third DM well indicated no contamination (ORNL 1987a). There is no information to support a theory of radionuclide migration from the grout sheets to the surface streams running through the ORR.

The survey conducted by Morrison and Cerling (1987) did not include sampling data collected at the WAG 10 facility. Radionuclide contamination reported during well drilling activities was due to the misfortune of the drill striking the grout sheets from previous LLW injections. Surface spills related to the hydrofracture method are included in other WAGS.

1.12.3 WAG 10 Site Resources

Support buildings located within WAG 10 contain limited resources. Remote field activities conducted at WAG 10 must rely on portable communication systems.

1.13 WAG 11—WHITE WING SCRAP YARD

1.13.1 Location and Description

WAG 11 is a largely wooded area of ~30 acres located in McNew Hollow ~1 mile east of the intersection of White Wing Road (Highway 95) and the Oak Ridge Turnpike. White Wing Scrap Yard is the only SWMU in WAG 11.

In the 1950s and 1960s, ~25 of the 30 acres were used for the aboveground storage of contaminated material from the K-25 Site, the Y-12 Plant, and ORNL. The material consisted largely of contaminated steel tanks; dump trucks; earth-moving equipment; large glass-lined tanks; framework from walk-in hoods; small stainless steel and mild steel support frames; mild steel, stainless steel, and aluminum of many sizes and shapes; and a reactor cell vessel. In preparation for the relocation of White Wing Road, contaminated scrap material and contaminated soil were removed during cleanup operations that lasted from 1966 to 1970.

The area is currently overgrown with weeds, trees, and other types of vegetation. Scattered scrap metal and steel drums are visible as surface and/or subsurface debris, although as of this writing various cleanup operations are underway. Recent investigative activities at the site lead to the discovery of two solution cavities underlying the facility.

1.13.2 Suspected Contaminants at WAG 11

Two important references on this site are ORNL/RAP-45, *Environmental Data Package for the White Wing Scrap Yard* (Boegly and Moore 1988) and ORNL/ER-52, *Surface Radiological Investigations at White Wing Scrap Yard, Oak Ridge Reservation, Oak Ridge, Tennessee* (Williams et al. 1991).

In the fall of 1986, water, mud, and stream sediment from two locations adjacent to WAG 11 were collected in order to determine if hazardous materials and radionuclides had been released from the scrap metal yard. One site was a moist creek bed within the scrap yard, and the second site was in a stream draining the area to the south. Stream gravels and dark mud were collected at both sites and water samples at one site. Among the extractable metals, only nickel was found in concentrations exceeding background levels in stream gravel samples. Concentrations of ^{90}Sr averaged 1 ± 1 pCi/g in stream gravel at one site and were low but detectable (0.007 pCi/mL) in one water sample from the same site. Di-*n*-butylphthalate was the only organic detected in two black mud samples. Follow-up sampling was suggested to identify the source of the contamination.

The follow-up sampling program, conducted in May 1987, included five sites: three within the WAG boundary, one site upstream, and one site downstream from the scrap yard. Cd, Cu, and Zn were found at 5 to 8 times background levels at one site within the WAG boundary; cadmium exceeded background levels in all samples. Radionuclide concentrations in stream gravels were below background levels in most samples; however, inside the WAG boundary, ^{238}U was about 3.5 times background at one site and ^{90}Sr was 2 to 3 times background at two sites. The only organic detected in the sediment was di-*n*-butylphthalate, a component of plastic materials that is common in sediments.

Aerial surveys conducted in 1974 detected gamma radiation emissions (measured at 1 m above the ground surface) on the order of 0.8 to 6 $\mu\text{R/h}$. These emissions were thought to be from ^{137}Cs . Localized hot spots up to 12 mR/h were identified during a surface radiological survey (Williams et al. 1991). Soil sample analysis confirmed the presence of ^{137}Cs , ^{238}U , and some ^{235}U and plutonium. Asbestos-like materials have also been identified at the site.

In September 1991, a ruptured capacitor discovered at the facility was inspected. The date of rupture and the release of the internal oils could not be determined by the ORNL investigative staff; however it is assumed to have occurred prior to February 1978. The capacitor was containerized, and the surrounding soil was sampled. Sample analysis confirmed that PCB concentrations of the soil were around 300,000 ppm.

1.13.3 WAG 11 Site Resources

WAG 11 is currently a mobilized work site, and there is not a permanent telephone or fire alarm pull box located on-site as of this writing. A break trailer, potable water, portable toilet facilities, and a fire extinguisher are located in the currently designated support zone. The support zone also contains a cellular phone and a two-way, hand-held plant radio. Should permanent facilities be installed on-site in the future, their location shall be documented in the SSHASP, and it shall be the responsibility of the SSHO to inform all site personnel of their location.

1.14 WAG 12—CONTRACTORS' LANDFILL

1.14.1 Location and Description

WAG 12 lies approximately 1.4 miles east southeast of the ORNL main plant area. This parcel of land was designated as a landfill primarily for the disposal of contractors' demolition and construction debris. The area is no longer operational. The Contractors' Landfill, ~2.9 acres in size, is the only SWMU located in WAG 12. The amount of material buried in WAG 12 is estimated to be between 30,000 and 50,000 m³ when taking into consideration the amount of compaction (if any) and the depth of burial. The landfill was in operation from 1950 to 1975, at which time disposal operations ceased. The area was then graded level and grass was sown. Waste-specific records were not maintained on this SWMU; therefore, no administrative controls were implemented on the character of the waste being buried. As a result, small amounts of hazardous waste may exist at the site.

1.14.2 Suspected Contaminants at WAG 12

There are no records to support releases of radioactivity or hazardous materials from WAG 12. Aerial radiation monitoring (1980) and radiation walkover surveys (3 ft above ground surface) have not detected radiation levels above background. No visible leaks or seeps have been documented at the facility.

A streambed sampling study was conducted near the WAG 12 facility by Morrison and Cerling in 1986. Two sampling locations were selected ~1000 ft from each other. Gravel and mud samples were collected at each location. No water was flowing at the time.

An Ni concentration of 7.2 µg/g was noted in one of the samples, which is twice the normal background level. This value could be attributed to lithologic variation. Other metals screened were either below detection limits or only slightly elevated. Concentrations of ⁹⁰Sr, ⁶⁰Co, and ¹³⁷Cs were close to background levels.

Organic analyses of one of the samples showed the highest concentration (1200 µg/g) of di-*n*-butylphthalate found in the entire screening of the 20 WAGs. This organic chemical is commonly found in plastic materials and is often detected in sediment samples. No other semivolatile organic compounds were detected in this screening.

Groundwater monitoring data from six wells in 1988 contained gross alpha, gross beta, ⁶⁰Co, and ¹³⁷Cs at concentrations found in uncontaminated groundwater in the Oak Ridge area. Mercury concentrations were far below maximum contaminant levels. Analyses for 34 volatile organics indicated bromodichloromethane at two wells at concentrations below the quantitation limit and chloroform at two wells near the quantitation limit. Results of analyses of 65 base/neutral/acid extractable organics indicated bis(2-ethylhexyl)phthalate present below the quantitation limit in 3 wells.

1.14.3 WAG 12 Site Resources

A telephone is maintained at Building 7658 within WAG 12. The site is a remote area, and few permanent resources are located at the site. Remote field activities conducted at WAG 12 must rely on portable communication systems and lavatory facilities.

1.15 WAG 13—ENVIRONMENTAL RESEARCH AREAS

1.15.1 Location and Description

WAG 13 is composed of two environmental research areas and is a part of what is known as the 0800 area. The tract was designated as a research testing site to measure the effects of nuclear fallout on the environment.

SWMU 13.1 contains ~5 acres and lies in a level floodplain along the Clinch River near Jones Island. The site included eight designated treatment plots that were used in simulated fallout experiments. Four of the plots were used as controls, and the remaining four were subjected to various amounts of ^{137}Cs exposure. During the experimentation period, soil and vegetation samples were collected, and observations of the test area were recorded. Numerous experiments with "short lived" radioisotopes were also conducted in the vicinity of the cesium test plots; however, these isotopes are no longer detectable (Taylor 1986). The site is presently inactive.

SWMU 13.2 was set up to study the effects of ^{137}Cs runoff, erosion, and infiltration on silt loam soil (Rogowski and Tamura 1965, Tamura 1967). This research effort was related to ORNL's Civil Defense Program. In this experiment, the isotope was sprayed on soil plots containing various degrees of vegetation or ground cover. A total of 15 mCi of ^{137}Cs was used, and the total area tested was less than 215 ft². The study was conducted on October 20, 1964, and it is estimated that the amount of radioactivity remaining in the test area is currently ~8.0 mCi. The site is presently inactive.

1.15.2 Suspected Contaminants at WAG 13

The sole intent of experiments conducted at WAG 13 was to simulate patterns of ^{137}Cs migration as in a nuclear weapons fallout. It, therefore, stands to reason that some of the activity used in the experiments was released outside of the test area. Aerial radiation surveys conducted in 1986 of the White Oak Creek and White Oak Lake watershed indicated the presence of ^{137}Cs in SWMU 13.1. The same study showed no detectable radioactive emissions coming from SWMU 13.2.

Stream soils were sampled at WAG 13 by Morrison and Cerling in 1987. Mud samples were not collected in this study, and organic analyses were not performed. No water was present in the streambed at the time the soils were collected; the study was limited to one sample collected from each of two sites. Data analyzed from SWMU 13.1 indicated ^{137}Cs and possibly ^{90}Sr contamination; however, SWMU 13.2 indicated levels of ^{137}Cs only slightly

higher than detectable levels. Based upon the data currently available, releases emitted from WAG 13 appear to be minimal.

During a 1988 surface radiological investigation, radiation levels were measured at 23 points on the Clinch River and 9 points along the riverbank. Gamma exposure rates on the river rarely exceeded background; a point on the riverbank closest to the contaminated field measured three times background, a value well below guidelines. Inside the fenced area, average gamma exposure rates at 1 m above the ground were ~3 to 4 mR/h, with maximum exposures exceeding 27 mR/h (Yalcintas et al. 1988). The site is currently undergoing remediation.

1.15.3 WAG 13 Site Resources

WAG 13 is a remote area with no site resources available. Any field activities conducted in this area must rely solely upon portable communications and lavatory facilities.

1.16 WAG 14—TOWER SHIELDING FACILITY

1.16.1 Location and Description

WAG 14 is situated ~2.2 miles south of the ORNL main plant area. The facility was constructed in 1954 to provide an economical means of obtaining shielding performance data free from ground scatter and structural scatter. This information was used in the development of portable reactor systems. The WAG contains 2 SWMUs and 4 large towers (~330 ft high) from which small, low-powered reactors and their associated measuring equipment were suspended. The towers were also used to check the durability of transportable shielding containers (casks) by "drop" testing.

The site also contains the Tower Shielding Facility (TSF) Scrap Yard, designated as SWMU 14.1, which contains used steel drums and tanks. The scrap yard is the storage site of approximately 300 55-gal drums containing elemental sodium. The integrity of the drums has been checked, and almost all appear to be free from leakage. Sheets of depleted uranium are also stored in this area.

A septic tank and sewage treatment system comprise the second SWMU within WAG 14. This facility was used to provide sewage treatment services for operational personnel. The unit is designated as SWMU 14.2, and it has no historical reports of leakage or discharge of hazardous materials. Sludge from the facility is pumped into a tanker truck and is transported to the ORNL waste treatment plant for processing.

1.16.2 Suspected Contaminants at WAG 14

There is no evidence to indicate any release of hazardous waste from operations conducted at the WAG 14 facility. However, scrap materials stored at the site have been found to contain various amounts of radioactivity due to previous use. Houser and Simpson (1986) performed a scoping survey of the area and indicated that there were no significant

exposure hazards caused by these materials. Presently, some cleanup efforts are being performed at the site under the auspices of the ORNL Surplus Contaminated Facilities Program (SCFP).

Morrison and Cerling performed a sampling survey of WAG 14 in the fall of 1986. Samples consisting of stream gravels, sediment, and water were taken from a creek located southeast of the facility and were analyzed for radionuclides, organics, and metals. The stream gravel results indicated that gamma and alpha emissions were at or below background levels; although ^{90}Sr concentrations were reported to be slightly higher than background. A water sample collected from the same location indicated background levels for ^{60}Co , ^{137}Cs , and ^{90}Sr . Metal concentrations were reported to be within normal limits. Concentration values for di-*n*-butylphthalate (429 $\mu\text{g/kg}$) and butylbenzylphthalate (396 $\mu\text{g/kg}$) isolated from mud samples were reported to be well above normal limits.

Based upon results from the scoping survey conducted by Houser and Simpson and the sampling analyses performed by Morrison and Cerling, it appears that WAG 14 is not a plausible source of past or present hazardous material releases. Cleanup efforts conducted under the SCFP should eliminate any further concerns regarding future releases from this facility.

1.16.3 WAG 14 Site Resources

The support buildings located within WAG 14 contain a limited number of site resources: potable water supplies, lavatories, fire extinguishers, and fire alarm pull boxes. However, remote field activities may require the use of portable communication systems and lavatories.

1.17 WAG 15—ORNL FACILITIES AT THE Y-12 PLANT

1.17.1 Location and Description

WAG 15, located in Bear Creek Valley, lies within the confines of the Y-12 Plant. Although WAG 15 falls under the jurisdiction of the ORNL ER Program, the Y-12 Plant Waste Management Division handles waste generated at the WAG. The WAG covers 17 scattered units, including the cyclotron facility, cyclotron pit, and cyclotron Z-oil storage (9201-2); former transformer storage areas (9201-2, 9204-1, 9204-3, and SY 200 scrap yard); the decontamination facility (9419-1); the contaminated attic area and east end basement (9204-1); a storage tank (9201-3); a radioisotope processing facility beta cubicle and glovebox (9204-3); a plutonium processing facility and condensate tank (9204-3); and a coolant salt technology facility and an MSRE fuel handling facility (9201-3).

1.17.2 Suspected Contaminants at WAG 15

Morrison and Cerling (1987) conducted water sampling activities in Poplar Creek, which acts as the main drainage for the southern section of the Y-12 Plant. Duplicate water samples taken from two separate locations indicated PCB concentrations below the ORNL detectable limit (0.0005 mg/L). Mud and sediment samples indicated the presence of Cd, Cu, Zn, Hg,

^{234}U , ^{235}U , ^{238}U , and several organic compounds. None of the observed contamination appeared to result from the SWMUs in WAG 15 but rather represented releases that occurred during other Y-12 Plant operations.

The Z-oil (Code AE transformer oil) was used as a coolant in the 86-in. cyclotron, which was dedicated to the production of isotopes used in medical applications and industrial operations. The cyclotron was decommissioned in 1983. The original inventory of 15,000 gal of transformer oil was drained. Residual amounts of oil contain <50 ppm PCBs. The cyclotron pit shows some signs of past spillage of oil.

All surplus PCB-contaminated transformers and capacitors were disposed of in accordance with Toxic Substance Control Act (TSCA) guidelines, and the former storage sites are now inactive. Historical records indicate that PCB-contaminated oils leaked from one transformer that was stored at the SY 200 scrap yard. Typically, oils from this type of transformer contained PCB concentrations ranging from 2 to 17 ppm, implying that this incident did not result in gross contamination.

Thorium is the primary contaminant at the decontamination facility, which was primarily a steam-cleaning facility. Transferable alpha contamination in the 9204-1 attic is largely ^{235}U and ^{238}U with some ^{137}Cs in loose dirt and debris; contamination in the basement crawl space (dirt floor) is primarily ^{226}Ra and ^{232}Th . The storage tank is slightly contaminated with alpha, which has been fixed with a coating of paint on the exterior. No transferable contamination is present at the radioisotope processing facility beta cubicle, but the interior of the curium glovebox is highly contaminated ($>500,000$ dpm/100 cm^2). The plutonium processing facility is also highly contaminated. Contamination at the coolant salt technology facility (used to inject tritium into a boron trifluoride flow) is limited to the piping and valves. The MSRE fuel handling facility (^{235}U and ^{228}Th) is generally contaminated throughout.

1.17.3 WAG 15 Site Resources

The support buildings located in WAG 15 contain a wide array of site resources. Permanent potable water supplies, lavatories, change houses, fire extinguishers, and fire alarm pull boxes may be found at various buildings throughout the complex.

1.18 WAG 16—HEALTH PHYSICS RESEARCH AREA

1.18.1 Location and Description

WAG 16, the Health Physics Research Reactor (HPRR) Area [also known as the Dosimetry Applications Research (DOSAR) Facility], is located approximately 1.8 miles from the intersection of Bethel Valley Road and Melton Valley Access Road. The HPRR consists of two buildings, one housing the unshielded reactor and the other acting as a combination laboratory/control building. The WAG contains five units: the ^{137}Cs forest research area, the HPRR process waste basin (7711), a buried scrap metal area south of Building 7710, and two septic tanks used to collect and dispose of domestic sewage from Building 7710 and the DOSAR facility.

The cesium forest is a small ecosystem that was intentionally contaminated with ^{137}Cs . The site is a 66- by 82-ft plot. Thirty yellow poplar trees ranging up to 100-ft tall were inoculated with ^{137}Cs to study the motility of the nuclide and to act as an analog to the essential element potassium. A total of 467 mCi of ^{137}Cs was injected into the tree stems over a 3-day period (May 20–23, 1962).

The process waste basin, sometimes referred to as the retention pond or retention basin, was installed to collect water draining from the concrete-lined pits in the reactor building, which houses the reactor core. According to the documentation available, the holding pond has never received any drainage from the storage pits. Every six months, fire department personnel make sure this drain system is free of obstruction by flushing water through the drain port of the storage pits to the basin. The only water entering the basin has come from these periodic checks or from precipitation.

1.18.2 Suspected Contaminants at WAG 16

There have been no reported releases (radioactive or hazardous chemicals) from any of the SWMUs located in WAG 16. Research data regarding the cesium forest (SWMU 16.1) indicates that some of the cesium injected into the trees has been transported to the leaves of the trees. Research documents indicate that some of the radioactive leaves have fallen outside the boundary. However, this is only a fraction of the original amount injected. Due to natural decay, only 230 mCi of the total injected would remain today. Water sampling activities have not been conducted in conjunction with the ecological research effort at the cesium forest.

A surface gamma scan of the retention basin in 1989 revealed gamma exposure rates ranging from 6 to 14 $\mu\text{R/h}$, which is similar to natural background. Direct alpha activity and beta-gamma dose rates measured at three locations within the basin were also typical of ORR background levels.

Morrison and Cerling (1987) collected gravel samples from three locations in WAG 16. Results indicated that ^{90}Sr and ^{137}Cs concentrations were within normal limits; however, the concentration of ^{60}Co was slightly above background at one site. Samples screened for metals showed elevated levels of cadmium, but this was probably more representative of the elevated cadmium content of the Knox Group, rather than the presence of a contaminant. A single water sample contained tritium at levels slightly higher than the analytical detection limit [30 Bq/L (8.1×10^{-10} Ci/L)]. A mud sample screened for organic contaminants was negative.

1.18.3 WAG 16 Site Resources

Although WAG 16 is situated in a remote location, the support buildings in the area contain numerous resources. Plant telephones, potable water supplies, lavatories, fire extinguishers, and fire alarm pull boxes may be found at Building 7710.

1.19 WAG 17—ORNL SERVICES AREA

1.19.1 Location and Description

WAG 17, the ORNL Services Area, is located about 1 mile east of the ORNL main plant area. WAG 17 includes the major craft and machine shop area at ORNL: shipping and receiving, the machine workshop, the carpentry workshop, the paint shop, the welding shop, the lead-burning facilities, the garage facilities, and the materials storage area required to support ORNL routine and experimental operations.

Nine SWMUs are located within the boundaries of WAG 17. These include a converted septic tank (now used as a sewage pumping station), seven waste oil storage tanks, and two photographic reproduction waste storage tanks.

1.19.2 WAG 17 Suspected Contaminants

In a recent attempt to remove an abandoned underground waste oil storage tank, all material (estimated at 148 gal) in the tank was released into the pit through existing corrosion holes on the sides of the tank. Cleanup of the site has been completed and notification of a release of PCB-contaminated material was made to the proper authorities.

There have been no other reports of releases of hazardous materials or radionuclides from WAG 17. However, because this area has been in use since ORNL operations began in 1943, some spills or leaks of waste oils and solvents have probably occurred but have not been documented.

Sampling efforts conducted in 1987 (Morrison and Cerling) included samples of bank mud, stream gravel, water, and tar-covered pebbles. Stream gravel analyzed in the survey showed concentrations of Cd, Cr, Cu, and Zn above background levels. Mud samples indicated contamination by semivolatile organic compounds. Eleven organic substances were isolated from the tar-covered stream gravels. The following concentration levels for the aforementioned contaminants are ^{60}Co <5 Bq/kg; ^{137}Cs 30.5 ± 38.5 Bq/kg; Cd 0.8 ± 0.1 $\mu\text{g/g}$; Cr 2.6 ± 0.2 $\mu\text{g/g}$; Cu 2.6 ± 1.6 $\mu\text{g/g}$; and Zn 47 ± 11 $\mu\text{g/g}$.

1.19.3 WAG 17 Site Resources

WAG 17 is a permanent facility with numerous buildings, lavatories, telephones, and fire extinguishers located throughout the area. A permanent potable water supply also serves the area.

1.20 WAG 18—CONSOLIDATED FUEL REPROCESSING AREA

1.20.1 Location and Description

The Consolidated Fuel Reprocessing (CFR) Area (WAG 18) is situated south of Bethel Valley Road, ~2.3 miles east of the main plant area. The site was initially designated as the

location for the proposed Experimental Gas Cooled Reactor (EGCR) Project; however, the project was scrapped before the facilities could be completed. The existing facilities were later converted for use by ORNL's CFR Division.

A total of 10 SWMUs are located within WAG 18: two retention basins used to accumulate storm water runoff; an underground holding tank used to store paint solvents; a septic tank system used to handle domestic waste; four acidic waste storage tanks; a retention basin used as an emergency water supply for fire protection; and a PCB waste container storage area that stores discarded fluorescent bulbs prior to pickup.

1.20.2 Suspected Contaminants at WAG 18

There have been no reported releases from the SWMUs located within WAG 18. A sampling effort conducted at the site in 1986 by Morrison and Cerling was virtually negative for contamination. Water, gravel, and mud samples were collected from a sampling location downstream from a holding pond on the west side of the paved entrance road to the CFR area.

Water samples and stream gravels contained background concentrations of ^{60}Co , ^{90}Sr , and ^{137}Cs . Zinc and copper, the only metals detected, were near background. No semivolatile organic compounds were detected in a single sample of black mud. In conclusion, Morrison and Cerling reported no contamination was observed at WAG 18, with the possible exception of zinc.

The acid waste storage tanks are included in ORNL's tank inventory program and are inspected on a regular basis.

1.20.3 WAG 18 Site Resources

The old EGCR building contains lavatories, potable water, fire extinguishers, and plant telephones. Remote activities conducted at the site must rely on 2-way radios as the main line of communications.

1.21 WAG 19—HAZARDOUS WASTE TREATMENT AND STORAGE FACILITIES

1.21.1 Location and Description

WAG 19 is located southeast of the main plant area. These SWMUs represent ORNL's hazardous waste treatment storage facilities, including a storage facility that has been permitted to store hazardous wastes.

The eight SWMUs are grouped into two separate sections: those permitted to store hazardous and mixed waste (7652, 7653, 7654, 7651) and those used to treat and/or dispose of gaseous or reactive hazardous wastes (7659A, 7659B, 7659C, and 7667). All of the SWMUs located at WAG 19 have been issued permits by the Tennessee Department of Health and Environment (TDHE) or are operated under a provisional status.

1.21.2 Suspected Contaminants at WAG 19

The WAG 19 facilities were designed to contain any spills or leaks that might arise from the containers being managed at the SWMUs. There have been no reported occurrences of spills or leaks at any of the SWMUs located in WAG 19.

Morrison and Cerling (1987) sampled three stations along the stream channel on the other side of the road next to the Hazardous Waste Storage Area and a fourth station on a small channel that enters Bearden Creek. Only sediments and stream gravels were collected, since no water was flowing in the stream channel at the time the samples were taken.

Metals were below detection limits; nickel was detectable at background concentrations. It has been theorized that these nickel concentrations represent lithologic variations in the stream gravel, as in the case reported at WAG 11. Cesium-137, ^{60}Co , and ^{90}Sr were at background levels. No organic analyses were conducted.

1.21.3 WAG 19 Site Resources

The support buildings located within WAG 19 contain a limited number of site resources. Potable water supplies, lavatories, telephones, fire extinguishers, and fire alarm pull boxes may be found at various buildings. However, remote field activities may require the use of portable communication systems and lavatories.

1.22 WAG 20—OAK RIDGE LAND FARM

1.22.1 Location and Description

WAG 20 is located ~5 miles east of the ORNL main plant area on the southeast side of Chestnut Ridge, north of Bethel Valley Road. The site is bounded on the west by Mt. Vernon Road.

The Municipal Sewage Sludge Application Site is the only unit within this WAG. The facility functions as a land disposal operation for digested sewage sludge from the city of Oak Ridge's sewage treatment plant. The site contains 65 acres, and over 6 million gal of sludge have been applied.

1.22.2 Suspected Contaminants at WAG 20

Sludge disposal operations at the WAG began in November of 1983; however, it was discovered in March of 1984 that some of the deposited sludge contained radioactive contamination, primarily ^{137}Cs and ^{60}Co . Operations at WAG 20 were discontinued for a short period until the source of contamination was eliminated. An investigative effort determined that the contamination was coming from industrial waste water, which was being discharged into the Oak Ridge sewer system. An inventory of radionuclides at the site includes 0.074 Ci from ^{60}Co , 0.013 Ci from ^{90}Cr , 0.044 Ci from ^{137}Cs , 0.010 Ci from ^{239}Pu , 397 lb of Cd, 243 lb of Ni, and 10,141 lb of Pb. Analytical results indicate that this area does

not contain RCRA contaminants in concentrations that would be classified as hazardous waste.

In 1986, Morrison and Cerling conducted a scoping survey at WAG 20. Samples of mud and water were collected from a point above the land farm and from a second point where an unnamed stream (which passes through the Land Farm) crosses Bethel Valley Road. Sampling data showed no contamination arising from WAG 20. A relatively high nickel concentration (15.5 $\mu\text{g/g}$, about three times background) was observed in one sample; however, two other samples at the same site were below detection limits. This result may be due to lithologic variation in the gravels sampled.

1.22.3 WAG 20 Site Resources

As of this writing, site resources do not exist at WAG 20. A telephone is maintained at the entrance to the WAG 20 site. The site is a remote area, and no permanent resources are located at the site. Remote field activities conducted at WAG 20 must rely on portable communication systems and lavatory facilities.

1.23 ADDITIONAL SWMU AND NON-SWMU AREAS

In addition to the WAG facilities, there are ~68 SWMU and non-SWMU areas that are under the auspices of the ORNL ER Program. During past years, a number of field studies were performed throughout the ORR related to the cycling and fate of radionuclides in terrestrial and aquatic ecosystems. Several of these studies were related to obtaining a better understanding of the fate of radionuclides resulting from fallout from nuclear detonations. Since many of these studies were conducted in the 1960s and the radionuclides selected had relatively short half-lives, no traces of the study currently remain at the site. An effort is underway to remove such sites from the list of sites identified at ORNL that could be considered sources of releases or potential releases. A SSHASP or an equivalent document will be required for activities at sites that may be potentially dangerous to personnel or the environment.

Many of the areas are a considerable distance from the ORNL main plant area. Also, the exact location of some of the sites is only vaguely reported. Approximate locations of some of these areas relative to ORNL are illustrated in Fig A.22 through A.26 of Attachment A (ORNL 1987b). A partial listing of these areas follows.

SWMUs:

Abandoned Burn Pit

Septic Tank 0907

^{137}Cs , ^{60}Co Contaminated Forest Area

^{137}Cs Contaminated Forest Floor

^{137}Cs Contaminated Forest Understory

^{137}Cs Contaminated Meadow

Tritium Target Fabrication Facility (7025)

Tritium LLLW Tank

Thorium Handling Facility (7019)
Thorium Storage Wells

Non-SWMU Environmental Research Areas:

⁴⁵Ca Tagged Trees
⁴⁵Ca Tagged Soil and Vegetation
²²Na Contaminated Soil
¹³⁷Cs Bagged Leaves Study
¹⁹⁷Hg Tagged Stream
¹³⁴Cs Tagged Tree
⁴⁵Ca Tagged Forest
¹³⁷Cs, ⁵⁹Fe Contaminated Animal Pens (McNew Hollow)
²⁰³Hg Tagged Stream
³H Contaminated Trees
¹³⁴Cs Contaminated Oak Trees
⁶⁵Zn Tagged Red Oak Seedlings
¹³⁴Cs Contaminated Soybean and Sorghum
¹³⁴Cs Contaminated Grasses
^{95m}Tc Uptake Studies
^{95m}Tc and ¹³¹I Contaminated Pasture
¹³⁴Cs Contaminated Lichens and Mosses
^{95m}Tc Contaminated Soil and Plants
⁵¹Cr Contaminated Grass Plots
⁹⁹Tc and ²³⁷Np Contaminated Soil Lysimeters
¹³⁴Cs Contaminated Persimmon Tree
⁶⁰Co and ⁵⁴Mn Animal Study
¹⁴C Maintenance-Respiration Study
¹⁴C Sucrose Inoculation of Oak and Pine Trees
¹⁴C Allocation in White Oak Trees
¹⁴C Allocation in White Pine Trees
¹⁴C Efflux in Yellow Poplar Stand
¹⁴C Allocation in Woody Biomass Plantation Species
¹³⁴Cs Contaminated Pine and Oak Seedlings
⁸⁶Rb Contaminated Plants

2. ASSOCIATED DOCUMENTS

2.1 SITE-SPECIFIC HEALTH AND SAFETY PLAN

A SSHASP shall be developed for ORNL ER projects involving activities on sites that fall under the Hazardous Waste Operations and Emergency Response (HAZWOPER) Program. A SSHASP or an equivalent document shall also be required for other activities that do not fall under the auspices of the HAZWOPER Program but may present hazardous or unsafe conditions for workers or the environment. The SSHASP will be used in concert with the PHASP and existing established procedures. SSHASPs shall meet the requirements set forth in DOE EM-40 guidelines, 29 CFR 1910.120, 29 CFR 1926.65, and the PHASP. The SSHASP shall address all site-specific information including, but not limited to, the following: work site location, description of each task, work plan for accomplishing each task, anticipated hazards to health and safety, prescribed methods for controlling hazards, monitoring requirements, PPE requirements, sanitation, decontamination, training and medical requirements, and emergency information.

Each SSHASP shall be identified by a unique number assigned by the ORNL ER Document Management Center. The SSHASP shall be a field working document that does not require clearance and publication. A signed copy of each SSHASP and any revisions or addenda shall be filed in the ORNL ER Document Management Center.

2.1.1 SSHASP Development and Approval

SSHASP development shall be a cooperative effort among site personnel: the ORNL ER Site Project Manager (SPM), the ER ES&H Manager, the Site Safety and Health Officer (SSHO), a representative of the ORNL Office of Radiation Protection (ORP), and the HAZWOPER Program Coordinator. (See Sect. 4.3 for a description of site roles.) Each SSHASP will be reviewed and approved by

- the ORNL ER SPM;
- the ORNL HAZWOPER Program Coordinator (required for HAZWOPER sites);
- a member of the Safety and Health Evaluation and Support Team (SHEST), which includes representatives from ORNL Industrial Hygiene and ORNL Industrial Safety (required at non-HAZWOPER sites);
- the SSHO or environmental safety and health (ES&H) technician who will also serve as the SSHO;
- the ORNL ER Program ES&H Manager or designee;
- the ORNL Office of Radiation Protection representative;
- normal, routine types of operation are those activities such as surface water sampling, sediment sampling, radiological surface walkover, surface geophysical surveys, civil surveys, etc.
- the DOE Project Representative (for projects not considered by the ORNL ER Program ES&H Managed to be normal, routine types of operation);

The following offices or individuals may be asked to provide review and comment, if warranted:

- DOE Project Representative;
- the Facility Manager;
- the ORNL Hazardous Waste Operations Group;
- ORNL Office of Environmental Compliance and Documentation;
- the ORNL Construction Engineering Manager;
- the ORNL Laboratory Shift Superintendent (LSS).

All site personnel, visitors, and guests shall be required to attend a pre-entry health and safety briefing (conducted by the SSHO or team leader) that explains information contained in the SSHASP and PHASP (or equivalent). All site personnel, visitors, and guests shall also be required to sign and date a section within the site logbook [or the SSHASP Briefing Log (see Attachment B)] stating that the pre-entry briefing was conducted and that items specified within the SSHASP are understood.

2.1.2 SSHASP Format

The format of the SSHASP is described in Attachment B. Elements that shall be included or addressed in the SSHASP include, but are not limited to, the following:

Site Organization (see Sect. 4)

- The chain of command for reporting health and safety issues or concerns.
- The key personnel for health and safety shall be identified in each SSHASP.
- The names, telephone numbers, and radio numbers of personnel in all site roles during each work project shall be specified in the project SSHASP.
- In the event that responsible parties change during the progress of the project, the changes will be noted in the site logbook, distributed or posted listings will be updated, and those involved in the SSHASP approval process will be notified accordingly.

Risk and Hazard Analysis (see Sects. 5 and 6)

- A task description and an assessment of the health risk to workers for each anticipated site operation shall be developed and included in SSHASPs.
- A detailed evaluation of the physical hazards associated with the project, the radiological and chemical contamination present at the site, and anticipated control measures will be included in the SSHASP.
- The SSHO or SPM shall obtain Material Safety Data Sheets (MSDSs) for any chemicals that are transported onto the site for site operations. These MSDSs may be obtained from the ORNL MSDS Database System or requested from the manufacturer or distributor. MSDSs from the manufacturer or distributor must be reviewed by the ORNL Industrial Hygiene (IH) Section. All MSDSs shall be attached to the project SSHASPs or be available on-site for review.

Site Access Requirements (see Sect. 7)

- The requirements for personal protective equipment (PPE) and respiratory protection (as determined by site hazard and operations) shall be specified for each activity in the SSHASPs.
- General procedures for donning and doffing PPE are included in Sects. 7.3.5 and Attachment I. Variations in the general procedure, based upon requirements or recommendations from other health and safety disciplines or site conditions, shall be included in the SSHASPs.
- The requirements for medical monitoring of worker exposures shall be specified in each SSHASP and shall be dictated by the requirements of 29 CFR 1910 and the procedures and exposure control programs of ORNL IH, ORNL Internal Dosimetry Program, and the ORNL Health Division. For further details on this subject, see Sect. 7.4.

Frequency and Types of Monitoring (see Sect. 8)

- Environmental monitoring and personal monitoring requirements for site activities shall be specified in the SSHASP.
- Each type of monitoring instrument to be used in the field operations must be specified in the SSHASP.
- Standard operating procedures (SOPs) for the operation and daily field calibration of all environmental and personal monitoring instruments used to detect ambient site conditions and potential personnel exposures shall be attached to the SSHASP or referenced in a document available on-site.
- Monitoring response guidelines shall be established for real-time site assessments in each SSHASP.

Site Zones (see Sect. 9)

- A site-specific map shall be included for the areas covered in each SSHASP.
- The anticipated placement of the site-specific work zones shall be included in the SSHASP and detailed on the site map.

Decontamination Procedures (see Sect. 10)

- General personnel decontamination procedures required for site activities are listed in Sect. 10.1 of this PHASP. Additional requirements based upon site conditions and specific contaminants encountered will be listed in the SSHASPs.
- All personnel and equipment decontamination procedures shall be conducted in accordance with established ORNL ORP, ORNL IH, ORNL Industrial Safety (IS) and Waste Management procedures. General equipment decontamination procedures are listed in Sect. 10.2 of this document. Applicable SOPs for equipment decontamination at a specific work site will be maintained on-site for reference. Additional requirements based upon site conditions or recommendations from other disciplines shall be included in the SSHASP.

Standard Operating Procedures (see Sect. 11)

- SOPs related to health and safety shall be developed and reviewed by ORNL ES&H disciplines and attached to the SSHASP or maintained on-site for reference.

Emergency Preparedness and Contingency Plans (see Sect. 12)

- A listing of emergency contacts and their respective telephone numbers and/or radio numbers shall be provided in each SSHASP.
- The location(s) of communication equipment at the site shall be specified in the SSHASP and explained to all site workers during the pre-entry briefing.
- The exact location of spill control kits and fire extinguishers shall be given in the SSHASP, as a part of the site emergency action plan. All heavy equipment is required to have a fire extinguisher on board.
- The location of primary and secondary site assembly points, if applicable, shall be included in the SSHASP and explained to all site workers during the pre-entry briefing.

For further information on emergency preparedness or contingency plans, refer to Sect. 12 of this document.

2.1.3 Prior Approved Tasks and Hazards

As a best management practice and meeting the intent of 29 CFR 1910.120, ORNL ER will implement a variance process for similar tasks performed at sites or facilities that pose the same hazards and warrant the same controls as tasks performed at other sites that have an approved SSHASP. The variance process involves the following:

- An addendum to the SSHASP is prepared by the SPM. The addendum should contain names and responsibilities of site personnel (if different from the previously approved SSHASP), a site map with evacuation routes, and any other important information not presented in the previously approved SSHASP.
- The addendum is attached to the previously approved SSHASP with a letter to DOE informing them of the variance from preparing a new SSHASP.
- The ER ES&H Manager and the HAZWOPER Program Coordinator or Director of the Office of Safety and Health Protection shall give prior approval before the letter is sent to DOE.

2.2 PROJECT DOCUMENTATION

2.2.1 Site Logbook

A site logbook shall be dedicated to each project for the purpose of documenting all health and safety decisions, pertinent site activities, work efforts, and events. Information to

be recorded in the site logbook shall include, but is not limited to, the following: site conditions including contamination and exposure levels, site operations, instrumentation monitoring and calibration information, site entrants, site visitors, accidents or injuries, conversations with project management and health and safety representatives, attendance at pre-entry and periodic health and safety briefings, information covered in pre-entry and periodic health and safety briefings, HAZCOM information, and detailed descriptions if personnel or equipment become contaminated. Site personnel may view the contents of the site logbook or document their account of any event in the logbook. The SSHO is responsible for maintaining the site logbook as a record of activities and events. Additional permits and forms (see Sect. 2.2.2), which may be required as documentation of project activities, must also be maintained with the site documents.

2.2.2 Required Project Documentation

Required project documentation may include, but is not limited to, the following:

- This PHASP (not required on site; however, if specific sections are referenced, they should be made as part of SSHASP addendum.)
- SSHASPs.
- SSHASP acceptance signatures for each site worker, either on the SSHASP Briefing Log (Attachment B) or in the project logbook.
- Project logbook.
- Site instrumentation monitoring and calibration logs, if separate from the logbook.
- Safety Work Permits, or equivalent.
- Radiation Work Permits, or equivalent.
- Excavation/Penetration Permits.
- Hot Work Permit/Burning Permit, or equivalent.
- Quality Assurance (QA) audits and/or surveillance reports.
- Environmental, health, and safety self assessment/surveillance plan.
- Accident and occupational illness reports.
- Inspection reports.
- Medical statements. Subcontractors must have a physician's statement certifying that they are physically qualified to perform the work. Energy Systems employees must have a medical statement from the Health Division certifying that they are qualified to perform the required work.
- Worker training records.
- Occurrence report(s), if required during the course of the project.
- Field Change/Variance Form, if required during the course of the project.

These items shall be considered a part of the project documentation and shall be maintained by the SSHO for the duration of the project. Upon completion of the project, original copies of all documentation will be maintained with the project logbook as historical

records in the ORNL ER Document Management Center. The SPM may wish, but is not required, to retain a copy of this documentation.

2.3 DOCUMENTATION INVOLVING SUBCONTRACTORS

When subcontractors are involved in an ER activity, additional documentation may be required.

2.3.1 PC-164: Service Subcontract Safety and Health

PC-164 is a checklist and questionnaire that may be issued to contractors or subcontractors that perform activities for the ORNL ER Program not covered under a HASP or SSHASP. This form will be generated by the person(s) requesting the contracted services with assistance from the Service Subcontract Coordinator. The Service Subcontract Coordinator will review the upcoming project with the health and safety representative(s) to determine hazards that might be encountered and preventive measures required to successfully complete the project. These measures and requirements, which might include training requirements for employees or equipment specifications, may influence the decision of a contractor to bid on the project. All specifications will be listed in the bid package that is sent out to contractors. The bid package will be signed by the appropriate approval authorities within Energy Systems. With the bid package the prospective contractor or subcontractor can adequately evaluate the environmental health and safety requirements of the project.

Certain ES&H specifications relating to prospective contractors must be reviewed and evaluated by members of the ORNL Safety and Health Evaluation and Support Team (SHEST) prior to awarding a contract. These specifications include the company's health and safety history (a listing of accidents or loss-of-time mishaps that involved company employees), the employee training program, and the service and equipment inspection certificates.

It is the responsibility of the SPM to assure that applicable items in Appendix A of PC-164 have been addressed in the SSHASP. Appendix A of PC-164 is shown in Table C.1, Attachment C, of this document. A cross-reference chart comparing items in Appendix A of PC-164 with the SSHASP is given in Table C.2, Attachment C. When completed by the SPM, Table C.2 shows where the required elements of Appendix A, PC-164, are addressed in the SSHASP.

2.3.2 Subcontractor Access Qualification Record

The ORNL ER Subcontractor Access Qualification Record (Attachment D, Fig. D.1) must be completed by the SPM for each subcontract person who will be involved in ER activities. The completed form(s) should be submitted with UCN-1127 and UCN-9489. A copy of the completed form(s) shall be sent to the ORNL ER Document Management Center by the SPM.

3. QUALITY ASSURANCE

The ER Quality Program Plan (Energy Systems 1993) applies to organizations directly responsible for implementing ER Program activities and to Energy Systems organizations supporting the ER Program at the five sites operated by Energy Systems and at other off-site locations, including all contractors and subcontractors under the auspices of the ER Program. Quality procedures and guidelines that are to be followed with any environmental investigation, cleanup, or other activity that is conducted by or for the ORNL ER Program must adhere to the ORNL ER Quality Program Plan and applicable DOE, EPA, and Energy Systems QA requirements.

There are two types of QA plans that may be developed: those that follow requirements specified in QAMS-005/80 (Stanley and Verner 1983) and those that follow requirements specified in ASME NQA-1. Energy Systems organizations, contractors, or subcontractors that are performing work for the ER Program that involves "measuring and monitoring" activity must develop a Quality Assurance Project Plan (QAPjP) that meets requirements contained in QAMS-005/80. Measuring and monitoring activities are usually associated with a RCRA Facility Investigation (FI) or a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS). With projects such as these, a sampling and analysis plan is usually written that will incorporate items needed for the QAPjP. For projects that do not involve "measuring or monitoring," the QAPjP does not follow requirements specified in QAMS-005/80, but rather complies with elements of the American Society of Mechanical Engineers document *Quality Assurance Program Requirements for Nuclear Facilities*, ASME NQA-1 (ASME 1989).

Additional quality requirements are provided in ESP-QA-2.6, *Quality Assurance Plans*, which defines the minimum QA planning criteria, establishes effort, identifies control requirements, and describes how conformance is to be ensured for a project, program, operation, or activity (Kimbrough et al. 1990).

3.1 AUDITS AND SURVEILLANCES

The ORNL ER QA Specialist or designee, the ORNL ES&H disciplines, and the DOE ER Safety Department are responsible for conducting periodic scheduled or unscheduled QA inspections. These inquiries are either (1) audits or (2) surveillances.

Audits are a planned, scheduled activity to determine (a) the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents and (b) 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 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 by the site-specific QAPjP.

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.

The SSHO is responsible for performing daily ES&H self-assessment/surveillance activities during site operations. These surveillance activities must be documented in the site-specific logbook. A biweekly summary of these surveillance activities and any associated corrective actions must be submitted to the ER Program ES&H Manager.

3.2 CORRECTIVE ACTIONS

Corrective actions are those measures taken to rectify any site deficiency that was observed from self assessments and surveillance. Corrective action may be initiated by any person performing work or involved in support of the project at any time. Deficiencies or problems and their corrective action must be detailed in the site logbook.

The majority of corrective actions will be of short duration. Examples include documentation errors or failure to date and sign a field monitoring form. Corrective action will be initiated by bringing the discrepancy to the attention of the appropriate personnel. Corrections will be accomplished at the time of the disclosure under supervision of the SPM. Any actions that violate safety and health protocol, such as the use of ineffective PPE, entering the support zone from the contamination reduction zone (CRZ) without frisking, or failure to calibrate instruments prior to use, will also be considered short-term events. Work activities shall be altered until the corrective action is performed under the supervision of the SSHO.

3.3 FIELD CHANGES AND VARIANCES

Deviations from the SSHASP or any change in established work procedures, must be reported to the appropriate manager(s) and the specific ES&H discipline(s). All deviations and variances shall be recorded in a specific section of the project logbook. A Field Change Request/Variance Form (provided as Attachment E) should be completed and signed by the appropriate persons in the event of any deviation from the SSHASP or the sampling plan that may effect health and safety or data quality.

A variance is a routine change in any aspect of the written procedure that would not affect the quality of the data or analytical results. If a variance from the plan occurs, the box marked "Variance" is checked on the Field Change Request/Variance Form, and the SPM is required to sign the form. A copy of the form is distributed to the project QA representatives, and the original is maintained by the SPM. All personnel involved with the work process shall be informed of these changes.

A field change is a deviation from the written procedure that could adversely affect field personnel, the environment, or the quality of the data being collected. Once approved, the "Field Change" box on the form is checked and the department representative making the field change signs the form to authorize the change (see Attachment E). For example, should an upgrade in PPE for field personnel be required based upon an unanticipated radiation hazard, the ORP representative shall initiate and authorize the field change. A justification for the change shall be stated on the form, and all key project representatives shall receive a copy of the form. This change must also be noted in the logbook. All site personnel working under the auspices of the field change shall be informed of the change prior to its enactment.

In the following conditions and/or situations, a Field Change Request/Variance Form or an addendum or revision to the SSHASP and/or sampling plan will be required, in conjunction with review and approval by the appropriate ORNL ES&H disciplines, SPM, ORNL HAZWOPER Program Coordinator, SSHO, ER Program ES&H Manager or designee, and DOE representative.

- Change in task (or previously unidentified tasks) that would impact employee health and safety, or is immediately dangerous to life, health, or the environment;
- Changes in hazards (unknown or not previously addressed) that require a significant change in, or addition to, respiratory protection. Changes in physical/barrier protection features (e.g., ballistics protection in explosive environments, sandbags, etc) or other engineering controls that have not been addressed in the SSHASP. These conditions should be of such a nature that they are immediately dangerous to life, health, or the environment.
- Upgrades that include respiratory protection (including air purifying and supplied air respirators) for previously unidentified hazards.
- Downgrades in PPE or respiratory protection not supported by monitoring data.

The following modifications would be allowed without completing a Field Change Request/Variance Form and without review by ORNL ES&H disciplines, SPM, ORNL HAZWOPER Program Coordinator, SSHO, DOE representative, or the ER ES&H Project Manager.

- Under the direction of the field health physics (HP) technician, with guidance from ORNL ORP, the level of PPE may be upgraded, including the use of air-purifying respirators, for radiological issues. These changes must be documented in the field logbook.
- Under the direction of the field HP technician, the level of PPE may be downgraded from the use of respiratory protection (for radiological hazards) if site specific monitoring data supports such a change. The change and reason for the change must also be documented in the project logbook. Any downgrades from supplied air respiratory protection will require documentation of monitoring data that support the fact that the environmental atmosphere is clear of the specific hazard that mandated the use of supplied air respiratory protection.
- The SSHO/ES&H technician with guidance from ORNL IH, may upgrade PPE for nonradiological issues and contaminants. For upgrades to include respiratory protection

(including air-purifying and supplied air) for nonradiological issues or contaminants, the appropriate health and safety disciplines must be contacted. These changes must be documented in the field logbook. The reason or evidence for the change must also be documented.

Note: Upgrades to respiratory protection will require the SSHO to ensure workers have 40-hour SARA/OSHA training and to assess any additional medical surveillance requirements. Additionally, the SSHO covering the site must meet the qualification as a Level 2 SSHO in order to supervise such activities.

3.4 OCCURRENCE REPORTING

DOE Order 5000.3B, *Occurrence Reporting and Processing of Operations Information*, became effective on February 22, 1993. The occurrence reporting system (ORS) may be initiated any time an employee, contractor, or subcontractor reports problems, concerns, conditions, or events that could adversely affect safety, the environment, health, quality, security, or site operations. All occurrences are to be reported by the SSHO to the SPM or Facility Manager and the ER Program ES&H Manager or designee. If the event involves a real-time occurrence that requires assistance from plant emergency services, on-site personnel should contact the LSS and take actions to mitigate the occurrence. Initial reporting of the situation should follow the format described in Sects. 4.2 and 12 of this PHASP. Other ORNL procedures for occurrence reporting should also be followed. The Facility Manager is responsible for filing the occurrence report with the LSS and for completing any additional paper work related to the occurrence.

3.5 ORNL ER INCIDENT REPORT

An ORNL ER Incident Report is required to be completed by the SSHO or team leader for any incident that involves the following:

- contamination of personnel;
- personal injury;
- fatality;
- unplanned environmental release or spill;
- property damage;
- unplanned personnel exposure (rad, chem, etc.);
- zone access infraction;
- contamination control infraction (frisking, using plastic, etc.);
- violation in adhering to the SSHASP or the SSHO instructions; and/or
- other incident.

For those activities that do not have an assigned SSHO, it will be the responsibility of the team leader to complete and file this report. The SPM and the Facility Manager shall be

contacted immediately in order to determine if an occurrence report should be completed. If no one from the ER Program office can be reached, the LSS should be contacted for guidance.

The ORNL Incident Report is shown in Attachment F and included in the SSHASP. Copies of the Incident Report shall be distributed by the SSHO or the team leader to the ORNL ER Program Manager, the ER Program ES&H Manager, the ER QA Manager, the SPM, and the Facility Manager. A file copy shall be sent to the ORNL ER Document Management Center.

4. SITE ORGANIZATION

4.1 KEY PERSONNEL

Table 1 includes a minimal listing of project roles that must be specified in each SSHASP. Additional roles may be required as dictated by anticipated project operations. The identity of the person or organization fulfilling the role and a phone number for each person or organization must also be specified and posted on-site.

Table 1. Key personnel

Responsibility	Name	Telephone No.	Radio No./ Beeper No.
Program Management			
DOE Project Representative			
DOE H&S Representative			
ORNL ER Program Manager			
ORNL ER Program ES&H Manager			
Project Site Organization			
ORNL ER Site Project Manager			
Facility Manager			
ORNL Construction Engineer			
Site Safety and Health Officer			
Field Team Leader			
Decontamination Officer			
Security Officer			
Industrial Hygiene/Health Physics Technician (ES&H Technician)			
Office of Radiation Protection representative			
Industrial Hygiene representative			
Office of Industrial Safety representative			
HAZWOPER Program Coordinator			
Office Environmental Compliance and Documentation			
Hazardous Waste Group			
Laboratory Shift Superintendent			

4.2 CHAIN OF COMMAND

The SSHO is responsible for informing the SPM and the ORNL ER Program ES&H Manager (or designee) of any ES&H issues. A 3-way consultation will be initiated involving the SSHO, the ORNL ER Program ES&H Manager or designee (or the SPM if the ER ES&H Manager is not available), and the appropriate ORNL discipline(s): HAZWOPER Program Coordinator, Office of Radiation Protection, Industrial Hygiene, Industrial Safety, Waste Management, or Environmental Compliance. For issues that cannot be resolved at the field-office level, the ES&H Manager or designee will contact division managers of the appropriate disciplines (ES&H, Waste Management, or Environmental Compliance) for assistance. In all cases, resolutions should be agreeable to all involved parties. When neither the SPM nor the ER ES&H Manager (or designee) can be contacted, the SSHO should contact the appropriate discipline(s) or the LSS for assistance. In a situation where there is immediate danger to life, health, or the environment, the SSHO is to contact the LSS and inform the ORNL ER Program Office as soon as possible. The SSHASP should reflect this chain of command, and all site participants should understand exactly who should be contacted before site activities are initiated. This chain of command is illustrated in Fig. 1.

4.3 SITE ROLES AND RESPONSIBILITIES

The sections that immediately follow contain descriptions of anticipated site roles and responsibilities. Site roles and responsibilities are not limited to those listed in these sections. Additional site roles and responsibilities or changes in key personnel shall be added as an addendum to this plan, if the roles are permanent for all site activities. Key personnel shall be identified in each work project SSHASP. If roles and responsibilities differ from those listed here, they also should be specified in the SSHASP.

In addition to the responsibilities listed below, all site personnel are required to follow Energy Systems' facility-wide rules and regulations and employee conduct rules detailed in General Employee Training and in *You and Martin Marietta Energy Systems, Inc.* (Energy Systems 1988). In accordance with these regulations, the use or possession of intoxicants on the premises or reporting to work under the influence of such is strictly prohibited.

4.3.1 ORNL ER Site Project Manager

In this document, SPM is the term used to denote the person primarily responsible for managing and coordinating all budget and field activities related to the project. Responsibilities of the SPM may include, but are not limited to, the following:

- Coordinating all field activities with the ER Program ES&H Manager and the Waste Management Manager.
- Coordinating support personnel required for field operations, including both Energy Systems, subcontractor personnel, and DOE prime contractors.
- Notifying the LSS of planned activities, as required.

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Fig. 1. ORNL ER chain-of-command for reporting health and safety issues. The SSHO first contacts the ORNL ER ES&H Manager and the ORNL ER Site Project Manager (SPM). Then, a 3-way conference is initiated involving the SSHO, the ORNL ER ES&H Manager (of the SPM if the ER ES&H Manager is not available), and the appropriate discipline(s): HAZWOPER Program Coordinator, Office of Radiation Protection, Industrial Hygiene, Industrial Safety, Waste Management, or Environmental Compliance. In an emergency, the SSHO should contact the LSS.

- Notifying the Facility Manager of planned activities.
- Coordinating with ORNL the distribution and control of security access badges required for Melton Valley and/or WAG access, if needed.
- Obtaining all required documentation and permits.
- Providing programmatic oversight of field activities.
- Determining and communicating site project objectives to all personnel involved in site activities.
- Participating in weekly health and safety briefings to summarize planned activities, to identify new hazards, or to clarify any task or project-related issues.
- Coordinating the completion of the state of Tennessee workers' compensation forms with injured personnel, the supervisor, and the SSHO, in the event of employee injuries.
- Assuring that all site personnel have proper training and experience and medical certification for their job.
- Assuring that all personnel adhere to all ES&H, QA, Waste Management, and any other procedures appropriate to the project.
- Assuring that all heavy/specialty equipment has been certified as being safe to operate and that personnel operating these items have the appropriate training or experience to operate the heavy/specialty equipment.
- Designating and approving SSHOs.

4.3.2 Site Safety and Health Officer

After approval from the ORNL ER SPM and the ORNL HAZWOPER Program Coordinator with concurrence from the ORNL ER Program ES&H Manager (or designee), the SSHO (or the ES&H technician acting as the SSHO) is designated to perform on-site health and safety tasks for all site activities. An ES&H technician is trained in one or two of the ES&H disciplines (IH, HP, and IS) and is familiar with procedures for recognizing and reporting hazards to the specific ORNL ES&H disciplines.

There are a number of activities and/or projects conducted under the auspices of the ORNL ER Program that do not require an SSHO or ES&H technician to be present because of the location and the absence of hazards. Projects or activities that may be considered for such a variance include surface water and sediment sampling activities, well sampling and measurement activities, operational activities on inactive LLLW tank sites, surface sampling activities, etc. The designated site must have the approval of the ORNL ER SPM and the ORNL HAZWOPER Program Coordinator with concurrence from the ORNL ER Program ES&H Manager (or designee), and all site-specific hazards must be deemed to be minimum from a radiological, chemical, and safety prospective. Upon meeting these criteria, a sample technician or researcher who is proficient in the use of radiological survey and dose-rate instrumentation and possesses current Radiological Worker II Training certification may serve as the team leader in lieu of an SSHO. The team leader shall ensure that all field personnel perform frisking prior to leaving the work site. In keeping with the ORNL HP protocol, all samples and/or equipment returning to ORNL facilities or laboratories must be cleared by an approved ES&H technician or an ORNL HP technician. Any other activity conducted on the

ORR that is not given a variance must comply with the requirements mandating health and safety coverage by an approved SSHO. The form for requesting approval of a team leader indicating that no SSHO is needed for the described task at the described site is shown in Attachment G and incorporated in the SSHASP.

4.3.2.1 Responsibilities of SSHOs

The general responsibilities of the SSHO shall include, but are not limited to, the following:

- Following the prescribed chain of command when reporting ES&H issues (see Sect. 4.2).
- Ensuring that all immediately dangerous to life and health (IDLH) and environmental impact issues are reported to the LSS.
- Conducting pre-entry and daily health and safety briefings that include, but are not limited to, subjects such as site hazard communications; information concerning the site emergency action plan and emergency response actions and responsibilities; the locations of fire alarms, extinguishers, telephones, and sanitation facilities; and discussion of any unexpected site hazards that may have recently evolved.
- Conducting H&S briefings if site conditions change.
- Ensuring that workers have been briefed or trained in recognizing unexpected hazards.
- Ensuring that information covered in the daily safety briefing is recorded in the project logbook.
- Ensuring that all prospective site personnel sign and date the field logbook (or appropriate document) to verify that the requirements for informing personnel of site-specific potential health hazards and other health and safety information covered in the PHASP and applicable SSHASP have been fulfilled.
- Overseeing the selection, inspection, storage, and maintenance of personal protective clothing and equipment to be used on-site, in conjunction with the ORP representative and IH, IS representatives as applicable.
- Establishing and maintaining work zones to prevent the potential spread of contamination during work and decontamination activities, after consultation with the ORP representative and other applicable H&S disciplines.
- Coordinating and minimizing the number of personnel and the amount of equipment in work zones.
- Controlling entry into and exit from the work zones of all personnel and observers.
- Ensuring that all personnel arriving or departing the site during activities are logged in and out at the appropriate place in the project logbook.
- Participating in the preparation of the SSHASPs and ensuring their implementation.
- Complying with and implementing the ORNL ER PHASP and ORNL HAZWOPER Program Manual.
- Conducting periodic inspections (self assessments) to ensure the compliance of all site entrants with environmental, health, and safety measures outlined in the PHASP, the SSHASP, and other appropriate documents.

- Confirming each worker's suitability for hazardous waste site work based on a physician's recommendation or participation in the ORNL HAZWOPER medical surveillance program (as required) (see Sect. 7.4). Maintaining written records on-site, including documentation of worker participation in the necessary medical surveillance programs and respiratory protection programs.
- Ensuring that any injury, illness, or exposure related to work performance is reported to the SPM, the Health Division, ORNL ER ES&H Manager (or designee), the IS Section, and the Office of Radiation Protection, as appropriate.
- Ensuring that training requirements for site access by individual workers have been met.
- Maintaining and updating each on-site worker's training record in accordance with 29 CFR 1910.120. (Note: ORNL Special Access training badges will be used to verify training for ORNL employees, subcontractors, and DOE prime contractors, if applicable).
- Monitoring of ambient site conditions for potential chemical and radiological exposures, as approved.
- Observing the workers for symptoms of exposure or for conditions related to other on-site hazards, including physical stresses such as temperature extremes.
- Observing the work parties for signs of stress.
- Assuring that appropriate ES&H instrumentation is available on-site for monitoring personnel, equipment, and the environment.
- Performing or ensuring performance of daily field calibrations of environmental monitoring equipment used to detect ambient site conditions and potential personnel exposures as outlined in the PHASP and SSHASP, as well as maintaining documentation of such instrument calibration in the project logbook or on an instrument calibration form. All calibration shall be performed in accordance with the manufacturer's guidelines and/or approved SOPs.
- Ensuring that all monitoring equipment is operating correctly according to the manufacturer's guidelines and providing maintenance or ensuring that maintenance is provided, if required or authorized.
- Performing daily ES&H self-assessment/surveillance activities and submitting biweekly written summaries of these surveillance activities and any associated corrective actions to the ER Program ES&H Manager (or designee).
- Establishing and posting (if appropriate) at the site an emergency action plan, telephone numbers, and radio communication information.
- Confirming that the emergency action plan, telephone numbers, beeper numbers, and radio numbers are current and correct.
- Advising emergency response personnel in an emergency.
- Ensuring that needed work permits are obtained and available on-site.
- Ensuring that the appropriate ES&H disciplines are contacted prior to beginning field activities and requesting oversight or monitoring support, as appropriate.
- Ensuring that all personnel are frisked before leaving a potentially contaminated work area such as a controlled access area, CRZ, or EZ.

- Ensuring that all equipment leaving any potentially contaminated work area has been surveyed and/or smeared for contamination.
- Ensuring that all sample containers are properly bagged, labeled, scanned, and/or smeared before leaving the work area.
- Ensuring that appropriate fall protection measures are in place, as warranted.
- Ensuring that an approved ORNL hoisting and rigging plan, or equivalent, is available on-site, as appropriate.
- Ensuring that appropriate measures are taken to prevent and control spills with the materials on hand.
- Ensuring that good housekeeping practices are being followed on-site.
- Ensuring that all personnel are following proper donning and doffing procedures.
- Ensuring that all waste is properly containerized and labeled.
- Verifying the buddy system is being implemented, if warranted.
- Ensuring that all workers are aware that their recommendations concerning how a task may be performed safely will be noted and taken into consideration.
- Assisting the Facility Manager in completing any occurrence report.
- Completing the ORNL ER Incident Report.

The SSHO has the authority to order a cessation of any site activities that the SSHO or any site member perceives to be dangerous to life, to the health of site personnel or the community, or to the environment. The SSHO is also authorized to order the commencement of work activities once the subject of concern has been resolved to the satisfaction of all health and safety disciplines that were consulted.

4.3.2.2 Qualifications for SSHOs

The form for requesting approval of SSHOs is shown in Attachment G and incorporated in the SSHASP. Each SSHO must be approved by the ORNL ER SPM and the ORNL HAZWOPER Program Coordinator with concurrence from the ORNL ER Program ES&H Manager (or designee). The approval or disapproval will be determined by a review of each individual's qualifications. SSHOs are required to have fulfilled site training and medical monitoring and to meet the requirements listed below regarding educational background and experience in order to qualify as a Level 1, 2, or 3 SSHO.

Level 1

A Level 1 SSHO may cover sites that require Level D or D+ personal protective equipment. The atmospheric conditions of the site must be deemed chemically and radiologically safe (i.e., no airborne radiological or chemical contaminants present), and the environment must contain safe oxygen concentrations between 19.3 and 23%. A Level 1 SSHO may also cover those sites that have been approved for coverage by a researcher or sampling technician acting as a field team leader. All potential candidates for Level 1 SSHO classification shall be approved by the ORNL HAZWOPER Program Coordinator and the

ORNL ER SPM with concurrence from the ORNL ER Program ES&H Manager (or designee).

A Level 1 SSHO may not provide coverage for the following types of sites or activities:

- Intrusive activities in radiological or chemical contamination areas that involve drilling operations or hand augering to depths greater than 6 in.
- Activities that require field workers to don respiratory protective equipment.
- Sites that require coverage by a Level 2 or 3 SSHO.

Level 1 SSHO qualification requirements include:

1. High school diploma or GED equivalent.
2. Completion of an approved ORNL SSHO orientation program or an equivalent program that has been reviewed and approved by the ORNL Training Department. A waiver to this requirement may be granted at the joint discretion of both the ER ES&H Manager (or designee) and the ORNL HAZWOPER Program Coordinator depending upon the candidate's experience.
3. One year prior experience as an SSHO on projects of similar size and nature.
4. Successful completion of Radiological Worker II Training.
5. Demonstrated knowledge and proficiency in the use of HP instrumentation for the detection of alpha, beta, gamma, and, as warranted, neutron emissions.
6. Completion of 40-hour SARA/OSHA Training.
7. Completion of 8-hour SARA/OSHA Supervisor's Training.
8. Completion of 8-hour SARA/OSHA Refresher as appropriate.
9. Successful completion of an approved basic first aid and CPR training course. This requirement shall maintain compliance with the Collateral Duty Provision, 29 CFR 1910.1030, Bloodborne Pathogens.

Level 2

A Level 2 SSHO or ES&H technician may cover sites that require Level D, Level D+, or Level C personal protective equipment. Level 2 SSHOs may oversee activities in potentially explosive or flammable environments; supervise and participate in tasks conducted in very high radiation areas; and supervise and participate in tasks conducted in areas where high concentrations of airborne radiological or chemical contaminants exceed acceptable limits. A Level 2 SSHO may function as the SSHO for construction, drilling, sampling, decontamination and decommissioning, or remediation activities. A Level 2 SSHO may also cover other tasks and projects with the approval of both the ER ES&H Manager (or designee) and the ORNL HAZWOPER Program Coordinator.

Level 2 SSHO or ES&H technician qualification requirements include:

1. Associates degree (or higher) from an accredited college or university in an ES&H discipline such as safety, HP, IH, etc. Degree criteria may be waived by joint agreement from both the ER Program ES&H Manager (or designee) and the ORNL HAZWOPER Program Coordinator in lieu of **two or more** years of applicable work experience including the ability to implement health & safety plans.
2. Demonstrated knowledge and proficiency in the operation of chemical monitoring instrumentation required in the SSHASP or access to personnel who can perform the necessary IH monitoring.
3. Demonstrated knowledge and proficiency in the use of HP instrumentation for the detection of alpha, beta, gamma, and, as warranted, neutron emissions.
4. Successful completion of Radiological Worker II Training.
5. If warranted, successful completion of specialized hazardous worker training such as asbestos, lead abatement, or confined space training, etc.
6. Completion of 40-hour SARA/OSHA Training.
7. Completion of 8-hour SARA/OSHA Supervisor's Training.
8. Completion of 8-hour SARA/OSHA Refresher, as appropriate.
9. Successful completion of an approved basic first aid and CPR training course. This requirement shall maintain compliance with the Collateral Duty Provision, 29 CFR 1910.1030, Bloodborne Pathogens.
10. Successful completion of specified training requirements in the DOE *Radiological Control Manual* by December 31, 1994, if serving in the capacity of a site HP technician unless waived by the ORNL ORP.

Level 3

A Level 3 SSHO or ES&H technician may cover sites that pose a significant health hazard to personnel, visitors, or the environment. Situations that may warrant the need for a Level 3 SSHO include, but are not limited to, the following.

- Site hazards require the use of Level A or B PPE in order to protect site workers.
- Activities will be conducted in a potentially explosive or flammable environment.
- High concentrations of airborne radiological or chemical contaminants exceeds acceptable limits.
- Activities will be conducted in a very high radiation area.
- Poisonous gases are present.
- Sampling activities will be performed on potentially explosive or flammable containers or containers of unknown substances.

Level 3 SSHO qualification requirements include:

1. A four-year degree from an accredited college or university in an ES&H discipline such as safety, HP, IH, or a related scientific discipline. Professional certification in one of the ES&H disciplines is preferred.
2. Work experience and/or certain certifications may be used in lieu of a four year college degree with joint agreement of both the ER ES&H Manager (or designee) and the ORNL HAZWOPER Program Coordinator.
3. Two years of field experience which includes working at hazardous waste sites or sites similar to those found at ORNL. Field experience should also include the ability to respond to various types of situations.
4. Demonstrated knowledge and proficiency in the use of various types of ES&H instrumentation as listed in the SSHASP.
5. Demonstrated knowledge and proficiency in donning and doffing of Levels A & B PPE.
6. Successful completion of Radiological Worker II Training.
7. If warranted, successful completion of specialized hazardous worker training such as asbestos, lead abatement, or confined space training, etc.
8. Completion of 40-hour HAZWOPER Training.
9. Completion of 8-hour HAZWOPER Supervisor's Training.
10. Completion of 8-hour HAZWOPER Refresher, as appropriate.
11. Successful completion of an approved basic first aid and CPR training course. This requirement shall maintain compliance with the Collateral Duty Provision, 29 CFR 1910.1030, Bloodborne Pathogens.
12. Successful completion of the specified training requirements in the DOE *Radiological Control Manual* by December 31, 1994, if serving in the capacity of a site HP technician unless waived by the ORNL ORP.

All Level 3 SSHOs shall be approved by the ORNL ER SPM and the ORNL HAZWOPER Program Coordinator with concurrence from the ER Program ES&H Manager.

4.3.3 Field Team Leader

The Field Team Leader is a designated individual who is responsible for field team operations and routine safety issues for all field personnel. In some cases, the Field Team Leader may be the SPM or another individual who is acting in a supervisory capacity on the project. The Field Team Leader shall be considered a "site essential" person. The project-specific responsibilities of the Field Team Leader shall include, but are not limited to, the following:

- Managing field operations.
- Executing the work plan and work schedule.
- Enforcing safety procedures.

- Coordinating with specific ORNL ES&H disciplines on all safety & health issues (including protection levels).
- Enforcing site control.
- Documenting field activities, including sampling collection.
- Assuring that the PHASP and SSHASP are followed.
- Conducting site H&S pre-entry briefings, as warranted.

4.3.4 Decontamination Officer

The Decontamination Officer is responsible for decontamination procedures, equipment, and supplies. In some cases, the Decontamination Officer may also serve as the Field Team Leader or another key site position. This individual should be considered a "site essential" person if decontamination activities are associated with the project. The responsibilities of the Decontamination Officer shall include, but are not limited to, the following:

- Establishment of site decontamination lines and the selection of decontamination solutions appropriate for the site contaminants to be encountered.
- Controlling the decontamination of all equipment and personnel, if warranted.
- Assisting in the disposal of contaminated clothing, materials, and solutions.
- Ensuring all required decontamination equipment is available and in working order.
- Providing for the collection, storage, and disposal of waste, as appropriate.

4.3.5 Security Officer

The security officer is responsible for managing site security. This individual is not required for all projects but is anticipated to play an important role at ER remedial action sites. When necessary and/or requested, an individual from the ORNL Security Department shall fill the role of Security Officer. In other situations, the SSHO or an appointed individual may fill this role. The Security Officer should be considered a "site essential" person, should the project necessitate such a role. The main responsibility of the Security Officer shall be maintaining site control. Other duties should include, but are not limited to, the following:

- Conducting routine area site patrols.
- Controlling facility access and egress.
- Assisting with communication during an emergency.
- Securing accident/incident scenes.
- Maintaining a log of site access and egress, as warranted, in the SSHASP.

4.3.6 Radiation Protection and the Office of Radiation Protection Representative

ORNL ORP shall provide oversight for all ER project sites. ORP will also provide monitoring and on-site coverage as dictated by the SSHASP. All ER HP technicians shall

meet the same standards required of ORNL HP technicians, which includes testing to ensure compliance with the *Radiological Control Manual* (DOE April 1994) by December 31, 1994.

HP technicians or ES&H technicians providing on-site support to ER operations will be provided by, subcontracted through, or approved by the ORP. The ER ES&H Manager (or designee), in consultation with the ORP, may in some cases approve the SSHO to fulfill some obligations of the ORP representative. The HP technician may also serve as the on-site SSHO. The responsibilities of the ORP representative shall include, but are not limited to, the following:

- Reviewing, commenting on, and approving all SSHASPs prior to mobilization of personnel and equipment and the commencement of project activities, based on compliance with 29 CFR 1910.120 and the adequate address of HP concerns.
- Attending pre-entry and daily health and safety briefings and presenting radiation protection information and recommendations to all site workers during the briefings.
- Being present during ongoing site operations.
- Assuring that personnel and equipment are surveyed for contamination before leaving the CRZ, sampling area, or work zone.
- Assuring that equipment and other items leaving the work area have been properly surveyed for contamination, bagged if necessary, and tagged appropriately.
- Monitoring and documenting all radiological hazards at the site.
- Overseeing all site operations to ensure that work is conducted in accordance with all ORNL Radiation Protection procedures and practices.
- Assisting in the selection of the appropriate PPE for radiological hazards, including respiratory protective equipment.
- Assisting the SSHOs in establishing zones for work project activities.
- When serving as the SSHO, fulfilling the responsibilities of the SSHO listed in Sect. 4.3.2.1.

The ORP representative has the authority to order a cessation of site activities for any concern that is perceived to be dangerous to the life, to the health of site personnel or the community, or to the environment. The ORP representative is also authorized to permit the commencement of work activities after the subject of concern has been resolved to the satisfaction of line management responsible for the work and the Radiological Control Manager in ORNL ORP (DOE April 1994).

4.3.7 Hazardous Waste Operations and Emergency Response Program Coordinator

The HAZWOPER Program Coordinator is responsible for the review written approval of all SSHASPs and the oversight of all field activities with respect to compliance with the requirements of 29 CFR 1910.120. The HAZWOPER Program Coordinator or a representative of that group shall have the authority to perform on-site inspections of site

operations at his or her discretion and shall have the authority to order the cessation of work activities. Responsibilities of the HAZWOPER Program Coordinator shall include, but are not limited to, the following:

- Reviewing all SSHASPs prior to mobilization of personnel and equipment and the commencement of project activities and granting written approval by signature or disapproval of the plan(s) on the basis of compliance with 29 CFR 1910.120.
- Authorizing the commencement of work activities once the subject of concern has been resolved to the satisfaction of all health and safety personnel consulted.
- Assisting the SSHOs and the ORP representative in the selection of PPE and respiratory protection, as needed.
- Determining in special circumstances whether equivalent training status as allowed by 29 CFR 1910.120 can be granted or waived and documenting the same in writing, as detailed in Sect. 7.1.12 of this PHASP. This determination is made in conjunction with the Technical Resources Training Section.
- Review and approval of all SSHOs.

4.3.8 Industrial Hygiene

The IH Section of the Office of Safety and Health Protection at ORNL or the ORNL SHEST shall be responsible for the review of field operations with respect to industrial hygiene concerns. For some work project activities (e.g., confined space entry), IH may be called upon to perform site assessments, perform personnel monitoring of ORNL employees, or serve as the SSHO or ES&H technician. In addition, IH may be required to assist the SSHOs and the ORP representative in the selection of appropriate PPE and respiratory protection for IH concerns. IH shall review and comment on all SSHASPs prior to the mobilization of personnel and equipment and the commencement of field activities.

IH has oversight responsibilities for all ER project sites. The IH representative has the authority to order a cessation of any site activities that IH perceives to be dangerous to life, to the health of site personnel or the community, or to the environment. The IH representative is also authorized to order the commencement of work activities after the subject of concern has been resolved to the satisfaction of all health and safety personnel consulted.

4.3.9 Industrial Safety

The IS Section of the Office of Safety and Health Protection at ORNL or the ORNL SHEST shall be responsible for the oversight and approval of field operations with respect to industrial safety concerns. IS shall review and comment on all SSHASPs prior to the mobilization of personnel and equipment and the commencement of field activities. IS has the authority to order a cessation of any site activities that it perceives to be dangerous to life, to the health of site personnel or the community, or to the environment. IS is also authorized to order the commencement of work activities after the subject of concern has been resolved to the satisfaction of all health and safety personnel consulted.

4.3.10 Field Personnel

The responsibilities of all field personnel involved in site operations include, but are not limited to, the following:

- Following the prescribed chain of command when reporting ES&H issues (see Sect. 4.2).
- Taking all reasonable precautions to prevent injury to themselves and their fellow employees; using *all of their senses* and information collected from field instrumentation to alert them of potentially harmful situations.
- Performing only those tasks that personnel believe they can do safely, and immediately reporting any accidents and unsafe conditions to the SSHOs.
- Notifying the SSHOs of any existing medical conditions (e.g., allergies, diabetes) that require special consideration. ORNL Health Division approval and/or a physician's recommendation is required before an individual with a medical condition may be assigned specific field tasks.
- Avoiding unnecessary or deliberate contact with any potentially contaminated substances (i.e., walking through puddles, pools, and mud) and avoiding placement of monitoring and sampling equipment on potentially contaminated surfaces.
- During the equipment decontamination process, preventing spillage of decontamination water, whenever possible. If a spill occurs, containing the liquid with the materials provided in the spill-control kit. If a spill-control kit is not available, the spill should be contained with materials at hand. If this cannot be done safely or with available materials, the area must be evacuated. The SSHOs should be notified immediately.
- Avoiding splashing contaminated materials.
- Being familiar with the physical characteristics of the site, including
 - wind direction;
 - accessibility to site authorities, equipment, and vehicles;
 - operation of available fire alarm boxes, telephones, and radios;
 - areas of known or suspected contaminations or "hot zones";
 - site access;
 - nearest site resources (e.g., rest rooms and break rooms);
 - overhead power lines;
 - buried electrical lines and underground piping systems (when relevant); and
 - primary and secondary assembly points.
- Maintaining for proper disposal all wastes generated during site operations.
- Reporting all injuries, regardless of how minor, to the SSHOs.
- Reporting in person to the ORNL Health Division when any injury or illness related to work activities is incurred. (The SSHO must be notified first.)
- Abiding by a buddy system, with each site worker being responsible for keeping track of his or her partner in the event of an incident or emergency situation.
- Reporting to the ORP representative, SSHOs, or approved alternates for frisking prior to egress from the CRZ, EZ, or controlled access area (CAA) as directed by the SSHOs.
- Being familiar with the procedures required within the PHASP and SSHASPs.

- Conducting all tasks in accordance with the PHASP and SSHASPs for each project.
- Reporting to the SSHO, the ORP representative, or their direct supervisor any information regarding site operations or conditions that may have an impact on the health and safety of the operation.

4.3.11 Facility Manager

The Facility Manager is a designated Energy Systems employee who is primarily responsible for the oversight and coordination of all operations and activities at their facility. The responsibilities of the Facility Manager include, but are not limited to, the following:

- Maintaining an awareness of the status of the assigned facility, including a general knowledge of current and planned research, experimental activities, and operations and maintenance.
- Ensuring that operations and maintenance involving radioactive, hazardous material, and energy sources are conducted safely and in compliance with applicable ES&H standards. Knowing and understanding the requirements for Radiation Work Permits, Safety Work Permits, and lockout/tagout. Ensuring that appropriate facility Radiation Work Permits, Safety Work Permits, and lockout/tagouts are initiated, approved, and issued.
- Directing the termination or restriction of operations in the assigned facility when judgement dictates that such action is necessary to protect the H&S of workers or the public or to protect property.
- Ensuring that notification and occurrence reporting is carried out in accordance with applicable orders and procedures and that remedial action is included when required.
- Conducting periodic walk-through inspections of the assigned facility to ascertain proper facility maintenance, to ensure that ES&H requirements are being met, and to promote good housekeeping within the facility and its surrounding area. Identifying improvements or needed repairs and recommending and/or initiating action to correct deficiencies.
- Ensuring that the division's Self-Assessment and Conduct of Operations Implementation Plans are being carried out appropriately at assigned facilities.
- Ensuring that the facility and surrounding grounds are maintained in a clean, uncluttered fashion in keeping with professional standards.
- Ensuring that appropriately reviewed and approved procedures for experimental activities, operations, and maintenance are in place that are commensurate with the hazard involved.
- Monitoring to resolution the status of ES&H noncompliances at the assigned facilities. Ensuring that noncompliances are properly reported to the applicable ES&H representative as necessary.
- Monitoring to resolution the status of corrective actions from internal and external appraisals and audits applicable to the facility.
- Maintaining the status of, and ensuring documented compliance with, facility safety documentation (i.e., safety analysis reports, safety studies, safety assessments, hazard screening, preliminary hazard screening) including technical specifications and operational safety requirements. Ensuring that action is initiated to review and to revise safety documentation as necessary.

- Ensuring that facility access training requirements are adequate. Ensuring that facility visitors without access training are properly escorted, as appropriate. Ensuring that changes are made as described in configuration control documentation.
- Ensuring that any facility configuration changes have been reviewed, approved, and documented in accordance with division and ORNL procedures before changes are implemented. Ensuring that changes are made as described in configuration control documentation.
- Ensuring that facility maintenance is planned, tracked, and coordinated. Coordinating with the applicable field or building engineer and craft foremen to maintain the facility's material status.
- Ensuring that quantities of radioactive and hazardous materials maintained within the facility are known, documented, and within applicable limits.
- Ensuring that current boundaries of controlled and other hazardous areas (e.g., contamination zones and RCRA storage areas), discharge streams, and air and water permits are well marked and maintained as appropriate.
- Ensuring that emergency plans are in place, up-to-date, and accurate. Providing resources and oversight for the local emergency squad, as applicable.
- Interfacing with the DOE facility representative, as appropriate.
- Notifying the Waste Management and Remedial Action Division Facility Manager Program Coordinator of any changes within the facility to ensure that the ORNL facility data base remains current.

4.3.12 ORNL ER Program ES&H Manager or Designee

The ORNL ER Program ES&H Manager is a designated Energy Systems employee who is responsible for the oversight of all ES&H issues affiliated with ORNL ER Program activities. The responsibilities of the ORNL ER Program ES&H Manager (or designee) include but are not limited to, the following:

- Promoting safety as the highest priority for all ER activities.
- Reviewing and approving the PHASP and all SSHASPs or equivalent documentation.
- Reviewing all ES&H self assessment and surveillance reports.
- Interfacing between ER projects and the HAZWOPER Program Coordinator.
- Reviewing qualifications of SSHOs.
- Approving all SSHOs who are to perform tasks on ER sites.
- Acting as a designated alternate SSHO for all ER projects, as appropriate.
- Serving as a focal point of contact between ER and ORNL ES&H disciplines and Waste Management.

When the ORNL ER ES&H Manager is not available to carry out the duties and responsibilities of the position, a person will be designated (the designee) to perform such obligations so that affected activities can go forward with no delays.

4.3.13 Construction Engineer

The Construction Engineer is responsible for overall site activities of specific projects; for safety; for meeting time tables and completing tasks on schedule; and for interfacing with various ORNL disciplines such as Plant and Equipment, ES&H, engineering, etc.

4.3.14 ORNL ER Program Manager

The ORNL ER Program Manager is responsible for budgeting; for interfacing with regulators, DOE officials, and state officials; and for the overall safety of activities occurring on ER sites under their jurisdiction.

4.3.15 Hazardous Waste Group

The Hazardous Waste Group is responsible for assisting in the evaluation of hazardous conditions related to hazardous chemicals, for responding to emergency spills, and for picking up and transporting hazardous waste to the appropriate ORNL waste management storage facility after waste has been properly characterized and packaged.

4.3.16 ORNL Office of Environmental Compliance and Documentation

The ORNL Office of Environmental Compliance and Documentation provides support to ORNL by interacting with Energy Systems, Central Environmental Compliance, and ORNL Environmental Restoration and Waste Management organizations in the interpretation of DOE, federal, and state regulations regarding environmental standards. The ORNL Office of Environmental Compliance and Documentation provides assessment and oversight at waste generation areas and permitted areas, verifying compliance with regulatory requirements. They also provide oversight and monitoring for ER sites to verify compliance under existing regulations and standards, and they provide site data to the HAZWOPER Program Coordinator and ES&H disciplines.

4.3.17 Laboratory Shift Superintendent

The LSS is the authorized individual, who shall direct, control, and evaluate all site emergency response/emergency activities. The ORNL LSS shall be notified immediately of all site emergencies and/or occurrences. The ORNL LSS may be contacted by telephone at 4-6606 or by 2-way plant radio at Station 103. The LSS shall direct a team response effort for all site emergencies. The emergency functions and responsibilities of the LSS shall include, but are not limited to, the following:

- Emergency response for fire, hazardous materials, radiological emergencies, security issues, energy and/or utility interruptions, medical assistance, site rescues, environmental monitoring, and damage control.
- Assuring the evacuation, emergency treatment, and emergency transport of site personnel, and notifying emergency response units and the appropriate management staff.

- Requesting assistance from local authorities, if applicable.
- Acting as a liaison to off-site organizations as necessary (i.e., local police, fire departments, hospitals, etc.).

5. ENVIRONMENTAL RESTORATION ACTIVITIES

ORNL ER activities may involve either intrusive or nonintrusive activities. Intrusive activities involve trenching, excavation, drilling, or sampling below a depth of 6 in. The demolition of buildings or structures (part of D&D activities) may also be considered intrusive activities. Nonintrusive activities are conducted at the ground surface and do not exceed a depth of 6 in. Examples of nonintrusive activities include scoping surveys and surface and stream water sampling.

5.1 SURFACE AND GROUNDWATER SAMPLING

This section addresses "grab sampling" techniques and safety concerns regarding the collection of surface and groundwater samples. This section is only intended to serve as a guide for proposed surface water sampling activities that are to be conducted at ER sites or under the authority of the ER Program. Site-specific information regarding the proposed sampling effort shall be addressed in a site-specific sampling and analysis plan and the SSHASP.

One of the simplest methods of collecting "grab" water samples is to use a dipper. By using a dipper, the sampler is able to collect water and transfer it to a collection bottle without contaminating the outside of the bottle and/or physically contacting the water. The method can be used in the collection of samples for physical, radiological, and/or chemical analysis. The method should not be used when attempting to sample a viscous material (such as heavy oil on the water surface) because the viscous material may remain on the dipper after dispensing the sample into the collection bottle. In such cases, decontamination procedures must be performed after each effort. The sampling team will always adhere to the procedures detailed in the sampling and analysis plan and/or work plan prior to commencing any sampling activities.

Groundwater sampling is normally performed by using bailers or peristaltic pumps. Care must be taken to avoid contamination from the water and to avoid personnel exposure from radiologicals and/or chemicals that may have generated hazardous conditions on or within the well column. The SSHO, or ES&H technician, is to monitor all wells at the time of opening for hazardous conditions before sampling activities begin. If no prior ES&H data are available on the well, the ES&H technician shall monitor all sampling activities on a continuous basis. Once baseline ES&H data have been gathered on the well, only intermittent monitoring may be necessary.

Before attempting to collect water samples, one should become familiar with the suspected contaminants and hazards associated with the site. Slips, falls, and contamination of personnel and/or equipment pose the greatest danger to the sample collection team during sampling activities. Extra care and safety precautions must be taken to avoid such occurrences. The following key points should be addressed prior to commencing water sampling activities:

- Historical information and process knowledge regarding the site should be reviewed by the SPM to obtain insight into the type of hazards that may be encountered at the site.
- The sampling team should review the site-specific sampling and analysis plan and the SSHASP prior to commencing any field operations. Specific requirements regarding collection method, preservatives, container specifications, labelling, etc. should be noted.
- A pre-entry briefing must be given to the sampling team to detail the work effort and the site-specific hazards that may be encountered in the field. All sampling team members should become familiar with the suspected contaminants contained in the water and take the necessary precautions to avoid potential hazards and/or health risks.
- Some basic equipment necessary for sampling operations will probably include PPE, sampling device(s), sample container(s), sample label(s), sample preservative(s) (if required), custody form(s) and seal(s), Blue Ice[®], and insulated coolers.
- To reduce the possibility of splashes and self-contamination, minimum allowable PPE for the sampling team should include Level D field clothes, eye protection with side shields, face shields, and disposable rubber gloves. Site-specific PPE will be detailed in the SSHASP or referenced in the PHASP.
- Additional measures, such as wearing layered gloves, Tyvek, or special suits, may be required when working in areas with tritium-contaminated water to protect personnel from tritium contamination.
- Hip waders, personal flotation devices, and life-lines will be considered by the SSHO for the sampling team, should they find it necessary to wade the stream or impoundment.
- The sampling team should pay close attention to the weather forecast and the current weather conditions prior to departure into the field. Extra safety precautions should be taken to avoid sampling during severe weather conditions, such as heavy rain and lightning storms. Sampling efforts may be suspended if there is snow or ice on the ground.
- The establishment of HAZWOPER zones (EZ, CRZ, Support zone) or HAZWOPER signs may or may not be required, depending on the site, sampling location, and level of effort required. Site-specific requirements will be detailed in the SSHASP.
- There should be no smoking, eating, drinking, chewing, and no application of cosmetics or lotions during sampling activities or at any time while on the sampling site.
- The SSHO should consult the site ORP representative concerning "green tag" requirements prior to the transport of the samples to an off-site laboratory.
- All generated waste from the project should be placed in the proper receptacles and disposed of according to procedures specified in the waste management plan.
- Personnel and equipment are to be frisked before leaving the sampling area.

Where applicable, field efforts and sampling activities shall comply with regulations set forth by the EPA, DOE's HAZWOPER Program, 29 CFR 1910.120, the Construction Standards specified in 40 CFR 1926, site-specific QA requirements, and the sampling guidelines specified in SW-846 (EPA 1986).

5.2 SAMPLING FROM WATERCRAFT

Many ER activities require the systematic sampling of lakes, ponds, and streams around the ORR. Any activity conducted in a watercraft that is on a navigable waterway must comply with all state, federal and local laws and regulations concerning the safe operation of that craft. Federal laws and standards concerning watercraft can be found in Department of Transportation Regulations 49 CFR, *Transportation*, Chapter IV, "Coast Guard" (Parts 400–499) and United States Coast Guard Regulations contained in 33 CFR Subtitle I (Parts 1–199). Items that must be addressed to ensure the safe operation of the craft include, but are not limited to, the proper number of life jackets or flotation devices, running lights, and emergency signaling equipment. Sampling on a pond can best be accomplished from a pontoon boat. Proper safety requirements for the specific sampling activity and for the safe operation of the navigable watercraft must be incorporated into the SSHASP. The watercraft, personnel, and equipment are to be frisked after completion of each field event. The watercraft is to be smeared for transferable contamination once the craft has been dried.

5.3 DRILLING AND SOIL SAMPLING ACTIVITIES

5.3.1 General

Soil sampling operations can be accomplished using a variety of methods and techniques. If future remediation decisions will be based on the sample analysis results, specific requirements regarding QA standards must be followed. The following discussion of soil sampling procedures covers some but not all inherent safety and health hazards. The discussion focuses on barrel augering and continuous split-barrel tube collection.

Prior to commencing any sampling activities, various project-specific requirements and presampling activities must be completed. The sampling location(s) must be identified. A grid system may be needed to assure proper confidence in sample collection. Heavy mechanized equipment must be scanned by the ORP representative and tagged before it can be admitted to or released from the site. All sampling implements or tools must be decontaminated following established procedures to prevent cross-contamination. The sampling and analysis plan must be reviewed prior to beginning operations to reference container requirements, preservative needs, and project and laboratory specifications for sampling.

5.3.2 Surface Soil Sampling Using a Barrel Auger

5.3.2.1 Discussion

This procedure describes the method used for collecting shallow surface soil samples (usually in 6-in. increments) using a manually operated barrel auger. This method is best employed in soils with little or no gravel. A barrel auger, used to penetrate the soil to the desired depth, consists of a barrel attached to an orchard bit. The bit cuts the soil, and the cuttings are forced into the barrel. The barrel holds the sample and prevents contact between the sample and the sidewalls of the borehole, thus preventing cross-contamination of the soil sample from other parts of the borehole.

The following procedure is an adaption of ESP-303-2, found in *Environmental Surveillance Procedures Quality Control Program*, ESH/Sub/87-21706/1 (Kimbrough et al. 1990). This procedure is an example of the process that is involved with this sampling technique. Precise procedures must be developed and reviewed by the contracted organization prior to beginning operations.

5.3.2.2 Procedure

1. Plastic sheeting or equivalent should be used as necessary to prevent equipment from coming into contact with potentially contaminated surfaces.
2. The precleaned auger should be advanced into the soil to the desired depth.
3. The auger should be carefully removed from the sampling borehole.
4. The material should be carefully transferred from the auger into a stainless steel pan lined with aluminum foil. The auger bucket should be replaced with a clean bucket prior to the collection of the next sample.
5. The sample recovered should be homogenized with a stainless steel trowel or sampling tool and transferred to the appropriate sample container. Documentation, packaging, and preparation for shipment will follow procedures specified in the site-specific sampling and analysis plan.
6. Any excess or unusable soil should be returned to the borehole.

5.3.2.3 Hazards

Hazards associated with this sampling technique depend upon the environment under investigation. The technique itself has no associated innate hazards. The contaminants within the matrix determine the level of PPE required for this procedure. Also, the sampling terrain and sampling location must be considered when selecting PPE needed to perform the work. Some examples of contingencies that need to be considered when determining the level of PPE for this operation might include a sampling location that is under or adjacent to a high voltage line; a sampling location under overhanging tree limbs; or a sampling location close to buried process lines. Routinely, the minimum PPE needed for any barrel augering activity includes

- anti-C clothing (if in radiological contaminated area);
- safety glasses with side shields;
- gloves (leather for augering, others as specified in the sampling and analysis plan for sample collection);
- hard-toed safety footwear;
- rubber boots, if applicable; and
- Energy Systems-issued clothing (as specified in the SSHASP).

5.3.3. Subsurface Soil Sampling (Continuous Split-Barrel Sample Tube System)

5.3.3.1 Discussion

This procedure describes the collection of samples using a Central Mine Equipment Company (CME) continuous split-barrel sample tube system.* This procedure was modeled after the *Environmental Surveillance Procedures Quality Control Program* (ESH/Sub/87-21706/1), ESP-303-4 (Kimbrough et al. 1990).

A drilling rig equipped with CME-compatible hardware advances a column of hollow-stem augers with an ID of 3.25, 4.25, 6.25, or 8.25 in. The 5-ft split-barrel sample tube is advanced with the auger column an adjustable distance in front of the lead auger head. This provides for continuous, undisturbed sample collection to depth. If samples are collected for chemical analysis, the split-barrel sample tube and shoe should be made of 304/316 stainless steel. Sampling that specifies chemical analysis will require attention to cleaning and decontamination. Once a specified sample interval has been completed, the sample tube is retrieved and opened. The sample length and a description of the sample material are recorded on field sheets. An aliquot of the sample material is containerized for analysis as prescribed in the site-specific sampling and analysis plan.

5.3.3.2 Equipment

- Drilling equipment—A drilling rig equipped with the CME continuous sample tube system that is capable of advancing a borehole to the required depth. The following support/accessory hardware complements this system:
 - Hollow-stem augers (HSAs), 5-ft sections
 - HSA blade or finger bits
 - Drill rod
 - Pilot assembly with center bit
 - Rod-to-cap adapter
 - Cat head
- Adjustment rod assembly and extensions—Flush-mount steel drill rods interlocked with removable steel pins.

5.3.3.3 Procedure

1. All operators of heavy equipment or any specialty items shall provide proof of certification or training to operate that equipment to the SPM before work begins.
2. Prior to setting up the drilling rig, spread out an ample amount of plastic sheeting around each borehole location to prevent subsurface soil from coming in contact with the ground. A drill-cuttings containment pan, where appropriate, will be used at each borehole location.

*Patent pending.

3. Advance the HSA/bit assembly through the surface material that will *not* be sampled. Remove these cuttings from the borehole.
4. Position the HSA/bit assembly to start sample collection. Insert the precleaned split-barrel sampler inside the hollow-stem auger tube and advance them together to the depth specified in the sampling and analysis plan. Add adjustment rod assembly and extensions as sample collection progresses.
5. Retrieve and open the sampler at specified intervals. Avoid contact of the sample with ungloved hands and nonsampling tools.
6. Record the sample length and the soil sample lithology or description of the sample material on field data sheets.
7. Carefully transfer the remaining material from the split-barrel sampler into a stainless steel pan that may or may not be lined with aluminum foil and homogenize the sample with a stainless steel trowel or sampling tool.
8. Place samples in containers according to the analytical needs. Documentation, packaging, and preparation for shipment will follow procedures specified in the site-specific sampling and analysis plan.
9. Excess soils should be collected and deposited in a 55-gal drum or as specified in the site waste management plan. The open borehole will be grouted and/or filled to the surface with bentonite at the end of the workday or as soon as practical or as specified by the project waste management plan.

5.3.3.4 Hazards

Numerous hazards are associated with working around heavy equipment (e.g., drill rigs, drilling operations, etc.). Aside from radiological and chemical hazards inherent in sampling activities, industrial safety hazards such as lifting, noise, electrical hazards, line leaks, getting fingers cut by drilling equipment, and drill rigs not on solid or level ground are most prevalent. The terrain must also be considered when determining the required level of PPE. The minimum PPE required for site personnel working around or near a drill rig sampling location include:

- hard hat.
- safety glasses with side shields.
- hearing protection (while the rig is operating and personnel are within a radius where sound levels are greater than 85 dBA).
- hard-toed footwear.
- rubber boots, if applicable.
- gloves (leather while handling equipment around the drill rig and possibly vinyl when collecting samples). If radiological contamination is present, leather gloves should be worn over rubber radiological gloves. Refer to the sampling and analysis plan and the SSHASP for specific requirements.
- Energy Systems-issued clothing.

- possibly Tyvek or C-zone clothing.
- no loose-fitting clothing.

For details about specific hazards associated with the project and PPE requirements, refer to both the site-specific sampling and analysis plan and the SSHASP. Additional information on general hazards associated with drilling operations can be found in Sects. 5.6 and 6 of this document.

5.4 GEOPHYSICAL METHODS, SURVEYS, AND LOGGING

5.4.1 Geophysical Methods

Nonintrusive geophysical methods such as seismic refraction, seismic reflection, electrical resistivity, electromagnetic conductivity, magnetic flux, or ground-penetrating radar are by definition methods that do not require deep penetration of the earth by drilling or excavation.

5.4.2 Geophysical Surveys and Mapping

Geophysical surveys are used to detect subsurface contamination and metal debris such as drums or discarded metal parts. The materials necessary to complete the survey are minimal, including a noncontacting conductivity meter, a magnetometer, data logbook, and stakes or flags used for grid identification. The survey is conducted by a team of field personnel, consisting of an instrument operator and a data scribe for each instrument to be used. The survey is conducted by implementing the following activities:

- Cordon off the work site, and mark grids of the appropriate size with wooden stakes.
- Survey the grids in a uniform pattern with a conductivity meter and a magnetometer, and record the instrument readings.
- Ensure that the survey is nonintrusive to the environment; the only ground contact involved should result from field personnel walking over the established grids.

5.4.2.1 Hazards

The hazards that may affect the physical well being of the survey personnel include, but are not limited to, heat stress, cold stress, noise, tripping/falling, snake and insect bites, insect stings, poisonous plants, hazardous terrain, and working in areas contaminated with radionuclides and/or chemicals.

5.4.2.2 Controls

All field personnel should have the proper training credentials prior to conducting field activities. Training and medical requirements for this activity shall be specified in the SSHASP. The SSHO is responsible for ensuring that all field personnel are briefed on the possible hazards to be encountered during the survey effort and the contents of the PHASP and the SSHASP. All field personnel shall take regular breaks at the discretion of the SSHO.

or team leader to combat fatigue, heat stress, and cold stress. The SSHO shall implement work/rest regimens for the field personnel as recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) guidelines, to minimize heat stress when appropriate. The proper PPE shall be worn by all field personnel as mandated by the SSHASP. Depending upon the activity and the level of contamination, an SSHO may not be needed for full-time site surveillance at some locations. However, workers and equipment must be frisked and, in some cases, equipment must be smeared by an ES&H technician or ORP representative before leaving the site. Workers who have completed Radiological Worker II Training can frisk themselves, but an approved HP technician must be notified to frisk and/or smear equipment.

5.4.3 Geophysical Logging using Radioactive Sources

The following procedures must be followed when performing geophysical logging using radioactive sources.

1. All geophysical borehole logging source handlers are required to be equipped with the proper dosimetry device (i.e., neutron dosimeters) when working with neutron sources.
2. Proper source protocols are to be reviewed by ORNL ORP before usage of source on-site.
3. The proper dose rate instruments are to be on-site.
4. Only qualified source handlers are allowed inside the CAA area during source exposure periods.
5. Sources must be kept locked inside vehicles when left unattended.
6. To minimize the potential for losing the logging source, an inspection of the cable connection to the logging source and logging tools shall be made before placing the source into the core hole.
7. If the nuclear source tool becomes disconnected from the cable, the ORNL LSS shall be notified.
8. Documentation of completion of the Geophysical Borehole Team Employee Training must be located at the field site.
9. Source handlers must make sure that the proper radiological posting is erected at the site prior to exposing the source.
10. ORNL ORP is to be notified before geophysical borehole logging commences.

5.5 DECONTAMINATION AND DECOMMISSIONING ACTIVITIES

The ORNL Decontamination and Decommissioning (D&D) Program is a branch of the DOE ER D&D Program and functions to provide collective management of all surplus sites under ORNL control on the ORR. The program currently provides surveillance and maintenance support for 34 facilities, which are classified into 16 D&D-related projects.

Activities covered under the D&D Program consist of ensuring adequate containment of residual radioactive materials remaining at the facility, providing safety and security controls to minimize the potential hazards to site personnel and the general public, and managing the facilities in the most cost-effective manner while awaiting decommissioning. Support for these

activities has included work in three principal areas: surveillance and maintenance (S&M) planning, routine S&M, and special projects designed to correct facility deficiencies beyond the scope of routine maintenance.

All D&D activities conducted under the authority of the ER Program must comply with the policies and procedures set forth in this document, 29 CFR 1910.120, and the ORNL HAZWOPER Program. In addition, a SSHASP must be written to address the specific effort to be conducted and the potential hazards that may be encountered. Some potential hazards associated with D&D activities include radiological and chemical exposure, heat stress, air dispersion, electrical hazards, structural hazards, and industrial and construction hazards. All field personnel conducting the proposed activity shall possess the appropriate training as mandated in the SSHASP or this PHASP and shall utilize safe work practices while conducting these activities.

5.6 WELL INSTALLATION, GROUTING, AND PLUGGING AND ABANDONMENT

5.6.1 Well Projects

Subterranean wells are used for groundwater monitoring. Hazards associated with well installation, maintenance, and plugging and abandonment projects are similar to the hazards encountered when involved with the operation of heavy equipment (see Sect. 5.3.3.4), materials handling, manual lifting, construction, excavation, and performing work outdoors under variable weather conditions.

Work activities shall follow engineering procedures specified in the work plan. In addition, all established safe work practices and procedures for well-related activities shall be followed. Requirements of excavation/penetration permits and safety work permits shall be included in the planning and operation of all phases of well activities.

The minimum level of PPE required for personnel performing well-related tasks consists of Level D PPE, which may include, but are not limited to, the following:

- Energy Systems-issued work clothing (no loose-fitting clothing allowed);
- Hard hats;
- Safety glasses with side shields, goggles or face shield with hard hat attachments when working around water;
- Hard-toed safety footwear;
- Work gloves or rubber gloves (as determined to be appropriate);
- Hearing protection where noise levels equal or exceed 85 dBA; and possibly
- Upgrading to rubber boots, Tyvek suits, or C-zone clothing when working in radiological areas.

As warranted, PPE requirements including respiratory protection (Level C) shall be upgraded and/or downgraded by the SSHO, based on the chemical, physical, and/or radiological hazards present at the work site. All appropriate procedures and work practices for monitoring of personnel for exposure and equipment for contamination shall be identified and performed

if the presence of chemical and/or radiological contaminants is known or suspected at the site. Work activities, task requirements, and the ergonomics of operations and machinery shall also be taken into consideration in the selection of appropriate PPE for work personnel. Some work activities related to well projects (e.g., steam-cleaning of heavy equipment) may require the use of slip/fall protection. Potential hazards associated with splashes, construction, heavy equipment, noise, spills, and heavy lifting should be addressed in the SSHASP.

5.6.2 Well Maintenance

Monitoring wells and piezometers that are in operation are periodically evaluated for superficial problems and for needed repairs or upgrades. Maintenance activities for monitoring wells and piezometers may include, but are not limited to, tasks such as installing protective casings, guard posts, and lock; grout seal repair; repairing protective casings; installing riser caps; repairing or replacing broken hoses; extending casings; and installing pumps and redeveloping wells.

Depending on the actual maintenance activities for each well, various types of heavy equipment or machinery may be required for on-site use. This equipment may include, but is not limited to, backhoes, drill rigs, well development rigs, and grout mixing machines. Hand-held equipment such as saws, drills, cutting torches, and welding tools may also be required during maintenance activities. Depending upon the materials involved, cutting or welding operations may require the use of respiratory protection. IH shall be consulted to determine the appropriate respiratory protection prior to the commencement of any welding or cutting activities. Hot work permits will be obtained prior to the commencement of any welding or cutting work activities by the construction engineer.

5.6.3 Well Plugging

Work activities for well plugging projects will be directed by the engineering methods and procedures specified and described in this PHASP, SSHASPs, and any other applicable documents. These activities may include well splitting, grouting, and chipping. Activities are directed by established procedures written to address factors such as geological location, depth, casing type, and design of the well.

5.6.3.1 Well Casing Perforation

Well casing perforation involves the use of heavy equipment such as a drill rig or a track drill to perforate the casing of a well prior to decommissioning of the well. The equipment used in splitting may present overhead hazards, so hard hats should be worn by all site personnel. If drill rods must be attached manually, care should be taken to avoid entrapment or crushing of fingers between rod segments and other machine parts or the entanglement of personnel or clothing in the machinery. All personnel should stand clear of the rig when splitting is being performed to avoid flying debris. The rig operator should, at all times, be aware of the proximity of other personnel to the well and the perforating equipment. The rig should be operated only when personnel are a safe distance away from moving machinery.

The noise levels created when the drill rig is in operation should be monitored by the SSHO upon initial use of the equipment on-site (as with any type of machinery used on-site). Hearing protection should be distributed to and worn by all personnel within the radius of 85 dBA or greater noise levels.

5.6.3.2 Plugging

Well plugging consists of mixing coarse granular bentonite chips (e.g., Holeplug™) or bentonite pellets and water within a well, then manually tamping the mixture with a rod until the well is elevated to a specified depth. The tamping is performed continuously as the chips and water are introduced into the well in specified increments. When the well depth is raised to the specified depth, the well is ready for grouting. If dust is generated during this activity, respirators will be made available for use on-site or the material will be wet down with a fine spray of water.

All displaced well water should be properly contained for disposal according to the type of chemical and/or radiological contamination suspected in the water (refer to the site waste management plan). A HEPA filter vacuum extraction system can be used to extract and contain the well water as it rises to the ground surface. A gasoline powered generator can be used to provide electricity for the vacuum system. Splashing of well water or other well contents should be avoided if the presence of chemical or radiological contaminants is known or suspected in the well water or the surrounding soil of the site.

Well plugging also involves the consideration of ergonomic hazards due to the manual handling of materials (i.e., water, bentonite chips), the manual tamping task, and the addition and removal of sections of the tamping rod.

5.6.3.3 Grouting

Well grouting involves the addition of a grout mixture into the well in accordance with procedures in the work plan. The grout can be added by tremie pipe or can be poured directly into the well, depending on the well depth. The grout is mixed in a grout or cement mixing machine (i.e. grout plant), which may also be used to pump the grout into the well. The grout is pumped through joined tremie pipe sections that have been lowered to the bottom of the well. Pumping of the grout into the well continues until undiluted grout flows from the top of the well at the ground surface. Well water and diluted grout may be displaced to the ground surface and must be contained as described in the above section to prevent the spread of contamination.

Hazards encountered in grout mixing include the ergonomic hazards of manually lifting materials (i.e., water, cement) and skin contact exposure to both dry and wet cement. Generally, airborne cement, which may be generated during grout mixing, is dissipated by outdoor winds and is not concentrated enough to warrant the use of respiratory protection. However, respirators will be used if needed and/or water in the form of a fine spray may be needed to control excessive dust. Excessive exposures will be investigated, as warranted. Skin contact with dry or wet cement should be avoided, as the cement may cause local irritation of exposed areas.

5.7 TECHNOLOGY TRANSFER AND DEVELOPMENT

Details of the new technology, the location of the development or tests, and the conditions under which the technology will be developed or tested determine the level of effort that will be required for adequate health and safety protection. The SPM, researcher, ER ES&H Manager, and the HAZWOPER Program Coordinator will determine the inherent hazards and potential health and safety concerns involved with the project. The location of the site where the technology will be tested or developed must also be considered. A SSHASP must be written to address the environmental health and safety concerns. All personnel involved with this effort will need to be in close communication when establishing and developing the appropriate documentation required for the safe development of the technology. (An example of a "new technology" would be in-situ vitrification.)

5.8 RADIOLOGICAL LAND SURVEYS

5.8.1 Radiological Scoping Surveys

Radiological scoping surveys involve measurement of surface radiation levels and may also include surface sampling of soil, water, and/or vegetation usually at places where the walkover survey has indicated radiation levels higher than background. Walkover surveys involve radiological measurements made at the ground surface using gamma and beta-gamma radiation detectors. Gamma scans are conducted by walking slowly across the area of interest with the gamma probe suspended near the surface of the ground and swinging perpendicular to the path being traversed. Gamma measurements are also made at a height of 1 m above the ground surface at selected locations. Beta-gamma scans are conducted by attaching a beta-gamma probe to an extension rod and moving the probe slowly across the area of interest. Headphones are used for some gamma scans and optional for beta-gamma scans.

5.8.2 Sampling at Radiological Scoping Survey Sites

Soil: Before collecting soil samples, radiation levels at the surface of the soil are measured and recorded. Using a hand auger, posthole digger, or trowel, soil is removed to the desired depth (usually 6 in.). If hard-packed soil, roots, etc., block excavation, a heavy iron bar (breaker bar) may be used to break up the obstruction. The soil is placed on a plastic sheet and radiation measurements are made in the hole and on the removed soil and recorded. Soil from the hole is placed in appropriate sample containers, which are labeled and checked for contamination before removal from the site. The above steps are carried out repeatedly until the depth specified in the work plan is reached or until further penetration is not possible by the means listed above. The sample depth does not usually exceed 18 in.

Water: Water samples are taken from streams, seeps, culverts, etc. The sampler collects the sample into an appropriate container by immersing the sample container into the stream, by using a dipper to fill the container, or by holding the container under falling water. The sample container is wiped with dry paper towels, labeled, and checked for contamination before removal from the site.

Vegetation: Vegetation samples are taken by using scissors or clippers to detach vegetation, avoiding the incorporation of dirt or other extraneous matter. The sample is then placed in an appropriate container, labeled, and checked for contamination before removal from the site.

5.9 CONSTRUCTION ACTIVITIES

Projects deemed as construction activities performed by MK-F do not require DOE approval, but their SSHASP or an equivalent document is to be reviewed, commented on, and approved by MMES ES&H disciplines and ORNL ER ES&H Manager.

Standards prescribed in 29 CFR 1926 and 29 CFR 1910.120 shall be used to assure the protection of personnel safety and the environment. Employers and contractors are required and advised to institute and maintain a program that provides adequate systematic policies, procedures, and practices that protect their employees from, and allow them to recognize, job-related safety and health hazards.

Although compliance with the law, including specific OSHA standards, is an important objective, an effective program looks beyond specific requirements of law to address all hazards. It will seek to prevent injuries and illness, whether or not compliance is at issue.

Where feasible, workplace hazards are prevented by effective design of the job site or job. Where it is not feasible to eliminate such hazards, they must be controlled to prevent unsafe and unhealthful exposure. Elimination or control must be accomplished in a timely manner once a hazard or potential hazard is recognized. This can be obtained by:

- Implementation of improved procedures,
- Training programs that assist employees in recognizing hazards,
- Equipment training that includes recognition of warning indicators specific to each piece of equipment,
- Management and worker involvement in the process of recognizing and controlling hazards,
- Mock-up operations before implementing actual field activity,
- Administrative controls,
- Use of engineering techniques,
- Implementation of safe work practices,
- Preventive maintenance schedules,
- A sound equipment maintenance program,
- A medical monitoring program,
- An emergency contingency plan.

When any construction activities are being planned on an ER site, a construction hazard analysis shall be performed prior to any work beginning. If any particular questions or matters

should present themselves during these activities, the specific rule can be researched in 29 CFR 1926, the Construction Standards and in 29 CFR 1910.120. Review and approval of the SSHASP by the HAZWOPER Program Coordinator is not required for construction activities on sites not regulated by the HAZWOPER Program.

5.10 REMEDIAL ACTIVITIES

Remedial actions involve efforts to stabilize or remove contaminants that have been identified during a Site Remedial Investigation. Once the contaminants have been identified and the extent of contamination is known, clean-up efforts can be directed to address the problems. Remedial actions may involve a wide range of activities involving various types of equipment from hand held tools to heavy equipment. The level of health and safety involvement and required documentation to perform the task will be determined by project management, site conditions, and the activities to be performed. The SSHASP will address all environmental, health, and safety concerns. The SSHO and PPM or construction engineer will coordinate activities so that clean-up efforts can be accomplished in a safe and timely manner.

5.11 CONTAINER MANAGEMENT AND HANDLING

5.11.1 Containerization

Most waste receptacles encountered when working in hazardous waste areas, or throughout industrial settings, are either metal drums or large metal waste bins. Extreme care should be taken when inspecting, moving, transporting, or just working around these containers. If drums or containers are to be handled or sampled on any ER project or site, a section within the SSHASP must be completed to ensure safe handling of these receptacles. Most receptacles are stacked, one on top of the other, not more than two drums high. A minimum distance of 3 ft shall be allowed between rows of stacked drums. Stability of these containers may pose a fall/crushing concern.

5.11.2 Drums

The standard Department of Transportation (DOT) 17E or 17C type 55-gal metal drum are the most prevalent containers throughout ORNL. The 17E drum is a solid topped drum with a bung plug. This drum comes with an inner coating to prevent rusting and is primarily used for liquids. The 17 C drum, an open-topped drum, has a removable lid with a band around the rim. This drum is used for the disposal of solid waste or contaminated soil.

5.11.3 Drum Safety

When a drum or area of drums is approached, the safety of the situation should be accessed by careful visual observations. Are the drums stacked? Are the drums on pallets? Are they secured thus eliminating a fall/crush hazard? If a container is encountered in the

field the same observations must be made to ascertain the safety of the situation. When encountering drums:

- look for any major concerns that could indicate an extreme hazard (e.g., swelling or bulging of the lid or side);
- notify the ORNL Hazardous Waste Operations Group if an extreme hazard is observed;
- do not touch a drum that is swollen or bulging;
- consider and treat all drums or containers as containing hazardous material until proven otherwise;
- inspect the container for labels, placards, or anything that might assist you in determining its contents;
- label all drums with contents or suspected contents and keep in an area with like contaminants or hazards;
- determine the condition of the drum and look for rust, corrosion, or leaks;
- treat drums or other containers as shock sensitive if crystal formation is noted around the container;
- inspect all storage areas for drums and B-25 boxes on a weekly basis and record inspection in logbook;

Remember that improper handling or lack of concern can result in damage or injury if these containers are not given the respect they should be afforded.

5.11.4 Receiving Drums/Boxes

If drums are going to be used on a site for containerization and future disposal, a few protocols and procedures must be followed.

- Newly received drums or containers should be staged in an area free of congestion and in a “clean” zone free of any contamination;
- All drums should be placed on pallets for ease of transporting;
- An “Empty” drum label should be affixed to each drum when it arrives on-site or the drum should be placed in a specific area reserved for empty drums or boxes;
- When placing the drum into service, if at all possible, place the drum on a pallet;
- When the drum has reached capacity, secure the bung plug or the drum’s lid and attach the appropriate label to the side of the drum. The content of the drum label should include:
 - the site,
 - the contents of the drum (e.g., drill cuttings, compactible waste),
 - the date the drum was filled,
 - the custodian of the drum,
 - the barcode (if applicable), and
 - the disposal request number (if applicable).

The drums should be placed on pallets and arranged so the labels on the side of the drums can be easily read. The pallets should be aligned so that a forklift can access the load easily and transport the pallets to the designated staging area. Drums, or other metal containers, used for containerizing wastes that will be stored outside for 6 months or more must be protected with a protective covering or protective agent to slow down the process of corrosion.

5.11.5 Drum Handling

Most injuries that result from moving or handling packed drums are a result of improper lifting and poor body mechanics. Specific precautions to minimize worker injury when handling drums include, but are not limited to, the following:

- determine appropriate engineering controls;
- determine the contents of the drum and what precautions need to be taken prior to moving the container;
- determine the level of PPE that would limit injuries;
- whenever possible use a hand truck especially designed for moving drums;
- train personnel in proper lifting and moving techniques to prevent back injuries, and periodically reinforce these points to each worker;
- adhere to specific load limits (>50 lbs for one person) for manual lifting;
- use large rods rather than personnel to give leverage when lifting containers;
- utilize a "buddy" to help maneuver the drum into position for loading;
- have overpacks ready before contaminated material is moved;

Additional hazards include exposure to toxic or hazardous vapors, drum lids becoming projectiles due to internal pressure buildup, and/or rupture of drums. Specific precautions include, but are not limited to, the following:

- Where buried drums are suspected, conduct a geophysical survey before using any construction equipment in order to minimize the possibility of rupture.
- Use a drum grappler where possible and cost-effective to minimize contact with drums. If a grappler is not available, pump or overpack drums of poor integrity before excavation.
- Ground equipment prior to transferring wastes to new drums.
- Use nonsparking hand tools and nonsparking bucket teeth on excavation equipment, and use plexiglass shields on vehicle cabs.
- Where slings, yokes, or other accessories must be used, they must meet ORNL IS standards for hoisting equipment. Workers should back away from the work area after attaching the accessory and before the drum is lifted.
- Swollen drums should not be handled until pressure can be relieved (venting) or contents determined. **NOTE:** Frequently there is no swelling and no visible sign that pressure buildup has occurred.

- Use bars that fit over the teeth of excavation buckets to prevent drum puncture.
- Where ionizing levels of radiation are detected, the SSHO or ORP representative should be contacted; generally, the drum should be overpacked and isolated promptly.
- Where pressure buildup or explosive or shock-sensitive material is suspected, every effort should be made to handle the drum remotely.
- Use direct-reading air monitoring equipment [e.g., combustible gas indicator (CGI), organic vapor analyzer (OVA), lower explosive limit (LEL) meter, photoionization detector (PID), flame ionization detector (FID), or colorimetric indicator] when in close proximity to drums or other suspect container to detect any hazardous chemical environments.

5.11.6 Sampling Drums

In some instances drums may need to be sampled to determine the contents. This could be a normal routine operation or an emergency response activity. In either case, special consideration must be taken to prevent injury and assure safety. For routine sampling refer to the site-specific sampling and analysis plan. Items that should be included in a sampling and analysis plan should include, but are not limited to, the following:

- area to be sampled (top, middle, bottom of container),
- type of sample container,
- amount of sample required,
- sample preservative.

In the event that drums or containers must be sampled and the contents of the receptacles are in question, or the drums appear to be rusted or display bulges in the tops or sides, preparations for sampling must be addressed. All conditions to accommodate any contingencies must be explained in the SSHASP. Remote sampling or spikes may be used in conjunction with a piece of machinery to pierce the drum before sampling commences. The SSHASP should explain in detail how sampling will be accomplished and how to protect the personnel involved from harm.

5.12 UNDERGROUND STORAGE TANK REMOVAL, SAMPLING, OR TRANSFER OF LIQUID CONTENTS

Numerous issues and safety considerations must be addressed when working with underground storage tanks (USTs). This section is only intended to be used as a guide for UST removal, sampling, or fluid transfer projects proposed for facilities under the auspices of ER. Any material referenced in this document should be attached to the SSHASP.

Project managers and key personnel should gather all pertinent information on the tank and the surrounding site before attempting any site activities. Knowledge of the tank's age, contents, storage capacity, and the whereabouts of underground and overhead utilities is especially important for the safe operations at USTs. Site diagrams and blueprints should be

consulted and carefully evaluated and a visual site walkover conducted before any excavation activities are initiated. One of the major hazards involved with UST removal operations is the possibility of a fire or explosion. Extra safety precautions must be taken in order to avoid such an occurrence. There are also many industrial safety hazards associated with USTs that must be evaluated.

5.12.1 Removal

The following key points must be addressed and implemented before attempting the removal of an UST:

- Notify the Fire Department in advance of the proposed project.
- Review plans and blueprints with the Project Engineer/Manager for the evaluation of underground hazards and/or obstacles.
- Contact IH representative to have tank LELs monitored and evaluated, if warranted. Results should be recorded in the site-specific project logbook.
- Obtain tank residue volume measurements and report these values to the Project Engineer/Manager. Empty tank if required.
- Report tank LEL values to the Fire Department and document their recommendations. Request that a fire extinguisher be placed on-site.
- Establish HAZWOPER work zones (EZ, CRZ, support zone) to maintain site control. Post site-specific requirements for entry into the area.
- Obtain excavation/penetration permit from the Construction Engineer and post or have available on-site.
- Based on state regulations and recommendations from the Fire Department, vent all vapors from the tank (to a minimum height of 12 ft above grade) until the tank is purged of flammable vapors. Should the UST contain flammable and/or combustible vapors, the tank may be purged using an inert gas such as carbon dioxide, nitrogen, or dry ice. (Refer to specific American Petroleum Institute (API) procedures and recommendations.) This method should not be employed if the tank is to be entered for any reason.
- Excavate to the top of the tank using nonsparking tools and equipment, if possible.
- Remove fill pipes, gauge pipes, and other tank fixtures.
- Cap and remove all nonproduct lines except for the vent line (vent line should remain in place until purging is complete).
- Monitor tank atmosphere and excavation area regularly with a combustible gas indicator until the tank is removed from both the excavation and the site.
- Plug or cap all accessible holes, allowing one 1/8-in. vent hole to offset any differential pressures caused by temperature changes.
- Excavate around the tank in order to uncover it for removal.
- Remove tank from excavation. (Consult hoisting and lifting guidelines prior to this effort. An approved Hoisting and Rigging Plan shall accompany the SSHASP.)

- Label tank appropriately prior to transport from the site (refer to API guidelines for proper labelling).
- Transport tank for final disposition as determined by the SPM.
- Should any contaminated backfill be present in the excavation pit upon removal of the tank, consult the appropriate regulatory authorities to verify if remedial actions are warranted.

All UST removal efforts and activities shall comply with regulations set forth by the API, EPA, and the Tennessee Department of Health and Environment Underground Storage Tank Program. All work shall comply with 40 CFR Parts 280 and 281 for Underground Storage Tanks, and 29 CFR 1910.120.

5.12.2 Sampling

Sampling activities for tanks include investigations that may be conducted at the ground surface (e.g., general area inspections, radiation walkover surveys, video inspections, leak test, equipment installation and monitoring, grab samples, and tank gas sampling and analysis) and a series of excavations that require ground penetration (e.g., soil samples, tank riser installation). Although the hazards may vary somewhat at the various tanks, the ES&H practices and procedures will be consistent. Because of the potential for encountering radioactive materials or chemicals during tank investigations (e.g., video inspection, leak testing, and grab sampling), constant monitoring will be carried out by an ES&H technician. All field work concerned with tanks will be controlled through the use of a SSHASP or equivalent.

Some tank operations will involve direct access to tank internals or potential exposure of individuals to the internal contents of the tanks. Based on sampling data available on current tank radionuclide contents, the potential exists for the uptake by workers of a variety of radionuclides. Exposure to these radionuclides potentially could result through the oral, dermal, or respiratory routes.

The following points should be addressed when characterizing (sampling) the internal contents of the tank:

- The ambient atmosphere around the tank should be monitored by an ES&H professional for volatile chemicals, flammable or explosive environments, and safe oxygen levels.
- All sampling activities should be performed as specified in a site-specific sampling and analysis plan.
- Air samples collected from the tank should be taken via an air sampling pump attached to a Tedlar bag, or equivalent. Sampling should be conducted at a safe working distance from the tank opening.

- Water samples may be collected from the tank via a peristaltic pump and tygon tubing. Sampling personnel should be protected from splash hazards.
- Sludge samples may be collected by using a long-handled stainless steel dipper or trowel.

For guidance regarding sampling of tanks, refer to *Environmental, Safety, and Health Plan for the Remedial Investigation of the Liquid Low-Level Waste Tanks at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (ORNL/ER/Sub/87-99053/32).

5.12.3 Fluid Transfer

Transfer of liquids from existing tanks or lines may present hazards, including, but not limited to, noise (from pumps), contamination from leaks or rupturing lines, and slips or falls from plastic on the ground. For specific hazards and controls associated with a particular project, refer to the SSHASP or equivalent. (Some tasks that require the switching of tank contents by the turning of a knob to switch lines, may not require a SSHASP or equivalent.) The ER Program ES&H Manager and/or the HAZWOPER Program Coordinator should be contacted for direction.

5.13 SURVEILLANCE AND MAINTENANCE ACTIVITIES

The ORNL Waste Management and Remedial Action Division (WMRAD) has implemented a program designed for the management of former waste management and environmental research sites contaminated with radioactive materials and/or hazardous chemicals from the end of their operating life to the final remediation of the facility. Various surveillance and maintenance activities are conducted under this program, with the main objectives being: (1) to ensure adequate containment of the residual radioactive materials remaining at the listed sites; (2) to provide safety and security controls to minimize the potential hazards to on-site personnel and the general public; (3) to monitor for releases from sites within their jurisdiction; and (4) to manage these facilities in the most cost effective manner possible.

Numerous types of surveillance and maintenance activities are conducted under this plan. These activities will include, but are not limited to,

- routine visual inspections and maintenance of storage facilities,
- radiological surveillance of inactive waste sites and storage tanks,
- structural integrity and safety inspections of inactive buildings,
- site vegetation control and maintenance,
- security/protection system inspections,
- maintenance and surveillance activities of groundwater wells and piezometers,
- trench subsidence repair,
- surveillance and maintenance activities of capped burial grounds,

- contaminated vegetation removal,
- diversion ditch repair and guardrail and fencing installation.

Surveillance and maintenance activities conducted under the auspices of the ER Program must comply with the policies and procedures set forth in this document, 29 CFR 1910.120, 29 CFR 1926, and the DOE *Radiological Control Manual*. In addition, a SSHASP must be written to address the specific effort to be conducted and the potential hazards that may be encountered and their controls. All field personnel conducting surveillance and maintenance activities shall possess the appropriate training as mandated in this PHASP and shall utilize safe work practices while conducting the activities.

5.14 CLOSE SUPPORT LABORATORY

ER is also responsible for managing the ER Close Support Laboratory (CSL), which is located within the ORNL ER Field Office Facility Complex. The CSL performs field screens on environmental samples. Operations of this laboratory are to comply with 29 CFR 1910.1450.

6. HAZARD ANALYSIS

6.1 INTRODUCTION TO HAZARD ASSESSMENT

As part of the development of the SSHASP, a site and/or task hazard analysis will be conducted utilizing information from document reviews, site usage history, interviews with personnel currently and/or formerly associated with the site, preliminary surveillance data, and any other available data. From this information inferences will be drawn as to what hazards could reasonably be expected to exist on the site during survey, construction, sampling operations, etc. All undocumented suspected hazards will be included for consideration. This analysis will be used as a basis for assessing conditions at the site and for development of the SSHASP, which will establish PPE and other safety requirements.

Following is a listing of hazards that may be encountered during ER activities. The risk from these hazards can be lessened or eliminated by proper planning of site activities and by assuring that site personnel are aware of the hazardous conditions and the controls. It is the responsibility of the SPM, SSHO, and field personnel to be vigilant for hazardous conditions and call attention to them should they be encountered. Hazards associated with specific sites and tasks will be included in the SSHASP and covered in the pre-entry briefing and daily briefings.

6.2 PHYSICAL HAZARDS

6.2.1 Noise

Hazard: The operation of large or heavy equipment, such as drill rigs, bulldozers, and backhoes, can create areas where noise levels exceed 85 decibels on the A-weighted scale (dBA). Exposure to excessive noise levels may lead to temporary or permanent hearing loss.

Controls: Hearing protection shall be worn by site personnel when noise levels are suspected or shown by noise-level monitoring equals or exceeds 85 dBA. In the event that a new noise hazard, such as a new piece of equipment, is brought on-site, the SSHO or ES&H representative will test the equipment and the work area for possible hazards. Areas where noise levels are ≥ 85 dBA will be posted as "Noise Hazard Areas—Hearing Protection Required." Work supervisors will ensure compliance with posted warnings and ensure that personnel are wearing adequate hearing protection (such as ear plugs or ear muffs) or avoiding the range of the noise hazard.

6.2.2 Hazards of Site Working Conditions

Hazards: Due to the nature of the sites and the fact that the work will take place outdoors, there will be a large number of physical hazards due primarily to terrain and site working conditions. These hazards include, but are not limited to, personnel

encounters with objects and conditions (e.g., steep slopes, camouflaged holes, water, and a variety of terrain types) that may cause slips, trips, falls, or cuts.

Controls: Personnel should be aware of site hazards and site conditions. Minimum PPE for site operations should include a hard hat, safety glasses with side shields or goggles, work clothing, gloves (as issued by the SSHO), hard-toed footwear, and rubber boots, as applicable.

6.2.3 Overhead Power Lines

Overhead electrical transmission lines may cross portions of the work site, and special attention must be given to these overhead hazards. Prior to placing cranes and/or drill rigs in the work zone, the SSHO 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 the electrical transmission lines, or the distance specified in Table 2. Whenever possible, all personnel should stay clear of overhead work and suspended equipment.

Table 2. Safe working distances from electrical transmission lines for drill rigs

Normal voltage (phase to phase) (kV)	Minimum clearance required (ft)
<i>When operating near high voltage power lines</i>	
0 to 50	10
>50 to 200	15
>200 to 350	20
>350 to 500	25
>500 to 750	35
>750 to 1000	45
<i>While in transit with the mast lowered</i>	
0 to 0.75	04
>0.75 to 50	06
>50 to 345	10
>345 to 750	16
>750 to 1000	20

Source: Department of Energy (DOE) April 1993. *Hoisting and Rigging Manual*, DOE/ID-10500, Assistant Secretary of Environment, Safety and Health, Washington, D.C.

If the appropriate clearance cannot be maintained, the power lines shall be de-energized and grounded.

6.2.4 Temperature Extremes

A. Heat Stress

Working in protective clothing can greatly increase the likelihood of heat fatigue, heat exhaustion, and heat stroke, the latter being a life-threatening condition. If employees are dressed out in protective clothing and temperatures at the site are 70°F, the wet bulb globe thermometer (WBGT) shall be monitored to assess the potential for heat stress. There are two schools of thought about performing work activities after the WBGT index exceeds the ACGIH guideline of permissible heat exposure TLVs (ACGIH 1992): (1) All work efforts should cease; or (2) Work efforts may continue in conjunction with implemented work/rest schedules as listed in ACGIH heat stress section.

Only trained SSHO's, ES&H technicians, or medical personnel who are specifically trained in performing monitoring of site workers should do so. The following parameters recommended in *Occupational Exposure to Hot Environments* (NIOSH 1986) and *Standard Operating Safety Guides* (EPA 1992) should be followed:

- Monitoring should be initiated before initial entry into the work zone and should be continued throughout the break cycle.
- *Heart Rate* - Count the radial pulse as early as possible in the rest period to ensure a more accurate reading. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period at the same length. If, at the end of the following work period, the heart rate still exceeds 110 beats per minute, shorten the work period again by one-third.
- *Oral Temperature* - The oral temperature should be taken immediately after the worker leaves the CRZ. Using a clinical thermometer, take the temperature for three minutes. Should the oral temperature exceed 99.6°F, shorten the next work cycle by one-third, without a change in rest period. If the oral temperature still exceeds 99.6°F at the end of the following work period, shorten the next work cycle by one-third. Do not permit the worker to perform duties requiring the use of a semipermeable or impermeable garment if the oral temperature exceeds 100.6°F.
- *Ear Canal Readings* - Ear canal readings are a valid method to monitor the temperature of workers who remain in the CRZ.
- *Body Water Loss* - Body weight may be measured in order to deduce if enough fluids are being consumed to prevent dehydration.

The SSHO will be responsible for briefing workers on the signs and symptoms of heat stress when weather conditions require it. This shall be addressed and re-emphasized during the daily H&S briefing. The following prevention methods should be followed (as appropriate) in order to combat the effects of heat stress:

- Sufficient cool, potable water and disposable drinking cups should be provided in the rest area, which should be located, if possible, in an area cooler than the work zone;
- Work/rest regimens should be implemented, when necessary, within the guidelines of the ACGIH WBGT TLVs;

- Work schedules may be changed in order to take advantage of the cooler parts of the day;
- Cooling vests may be worn by field workers, as appropriate.

For further guidance, the ORNL Industrial Hygiene Temperature Extremes Coordinator should be contacted.

B. Heat Cramps

Heat cramps may result from exposure to high temperatures for a relatively long time, particularly if accompanied by heavy exertion. Heavy sweating leads to a loss of vital electrolytes, which may induce muscle cramping.

Symptoms: Painful spasms of muscles used in work (arms, legs, abdominal). Onset during or after work hours.

Treatment: Salted liquids by mouth or more prompt relief by IV infusions. Heat cramps may be prevented by allowing adequate salt intake with meals.

C. Heat Exhaustion

Symptoms: Extreme fatigue, cramps, dizziness, headache, nausea, profuse sweating, pale clammy skin, core body temperature $>38^{\circ}\text{C}$. (100.4°F).

Treatment: Immediately remove victim from the work area. Allow victim to rest, cool off, and drink plenty of cool water. If the symptoms do not subside after a reasonable rest period, employees shall notify the SSHO and seek medical assistance.

D. Heat Stroke

Symptoms: This is the most severe of the heat injuries. Body temperatures often are between 107 and 110°F . The initial symptom is often dryness of the skin and mouth. The skin will be hot to touch, red, mottled, or cyanotic. The individual has lost the ability to sweat; convulsions and possible unconsciousness may follow quickly. Death is imminent if exposure continues. The attack will usually occur suddenly.

Treatment: Immediately evacuate the victim to a cool and shady area. Remove all outer clothing and lay the victim on his or her back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels to the head. Sponge off the bare skin with cool water. Contact the LSS immediately.

E. Cold Stress

The primary hazards associated with working in the cold are hypothermia and frostbite.

F. Frostbite

Symptoms: Frostbite is most likely to occur in the extremities, especially in the fingers, toes, cheeks, and ears. In very early stages of frostbite, the affected body parts may feel numb and appear white. As frostbite progresses, the individual may experience pain and a loss of flexibility in the affected body part and the affected skin may appear waxy or translucent.

Treatment: Mild frostbite can be treated by immersing the affected part in warm water. Frostbitten tissue should not be rubbed. Deep frostbite is a very serious condition that requires immediate medical treatment. Contact the LSS.

G. Hypothermia

Symptoms: The first symptoms of hypothermia are uncontrollable shivering and the sensation of cold. The heartbeat slows and sometimes becomes irregular, the pulse weakens, and the blood pressure changes.

Treatment: Move the victim to a warm place. Cover the person with warm blankets, and warm the body slowly. Contact the LSS immediately.

Controls:

Employees who must work under cold conditions should

- Eat a proper diet and avoid alcohol,
- Wear layered clothing,
- Wear proper boots and socks,
- Wear warm gloves, if possible,
- Wear a hard hat liner that covers the ears, and
- Be aware of the conditions that are likely to cause frostbite and be prepared.

6.2.5 Confined Space Entry

A confined space is defined as an enclosed area with all of the following characteristics: not designed for human occupancy; entry and exit into the area is restricted in that it requires the entrant to contort his or her body or to use his or her hands in order to enter and/or exit the area; and the area contains known or potential hazards to the safety or health of the entrant. Examples of some potential hazards that may be encountered in a confined space are as follows: hazardous atmospheres, IDLH conditions, temperature extremes, noise, ionizing radiation, engulfments, safety hazards, and hazardous energy (uncontrolled electrical energy).

In the event that the need for confined space entry arises during site operations, the requirements of 29 CFR 1910.146 shall be fulfilled during all confined space operations. The provisions and requirements of the IH and IS procedures for confined space entry shall be followed. For trenching and shoring procedures, see Sect. 6.2.6. A representative from ORNL IH shall be contacted prior to any confined space entry. An ORNL IH or a trained ES&H

technician shall conduct all required atmospheric testing in accordance with established ORNL procedures.

An enclosed space is defined as a space that meets one or two characteristics of a confined space, but not all three. A Safety Work Permit may or may not be required, depending on the evaluation and the initial testing of the space by a qualified person. Work activities to be performed are also taken into consideration. The hazards associated with a confined space may also be encountered in an enclosed space. The ORNL Confined Space Program Coordinator shall classify and define the space after a thorough site investigation is performed.

6.2.6 Oxygen-Deficient Environment

At sea level, normal atmospheric air contains 21% oxygen and 79% nitrogen and other inert gases. An air oxygen concentration of 19.5% or below is called an oxygen deficient environment. Oxygen deficiency can best be assessed with an instrument designed to continuously monitor concentrations of oxygen and other gases and alarm when levels are below or above desirable limits. The first physiological effects of oxygen deficiency are usually apparent at 18% oxygen when there is an increased rate and depth of breathing, headache, and dizziness. An individual experiencing any of these conditions while working on any site should move upwind from that spot and notify the SSHO. Oxygen deficient environments of ~16% oxygen can cause an inability to move and a semiconscious condition that could lead to death. If a site worker comes upon an individual in a low-lying area or a confined space who is unconscious and unresponsive to verbal stimuli, do not enter or try to aid the individual. Contact the LSS for assistance.

6.2.7 Oxygen-Enriched Environment

Extreme care and caution must be exercised in an environment suspected of containing enriched amounts of oxygen. According to OSHA regulations [OSHA 1910.94(d)], an environment considered to be safe for human occupancy should contain at least 19.5% oxygen by volume. Oxygen levels that are too high ($>23.5\% \text{ O}_2$) are considered to be an explosion hazard. This condition may result in a fire hazard if fresh air is allowed to dilute the oxygen level into the flammable range. Confined and/or enclosed spaces have the potential to develop oxygen enriched environments. Should one suspect an area of containing an enriched oxygen environment, the area should be secured, and entry to all personnel should be denied until the area can be monitored by a representative from the IH Department, the SSHO, or the ES&H technician.

6.2.8 Site Excavations

All excavation work shall be conducted in accordance with 29 CFR 1926.650 through 1926.652, Subpart P. Prior to beginning excavation activities, an ORNL Excavation/Penetration Permit shall be obtained from the Energy Systems Construction Engineering. The permit will detail excavation requirements and must be posted at the job site while excavation activities are being conducted. Depending upon the site and depth of excavation, a waiver of

the Excavation/Penetration Permit may be requested from Energy Systems Construction Engineering.

6.2.9 Asbestos

Hazards: Based upon historical and/or process knowledge surrounding the ORNL facilities, it is anticipated that asbestos may frequently be encountered as a site hazard on the Oak Ridge Reservation (ORR). Asbestos-containing material will likely be found in building materials used in the construction of "older" buildings and facilities maintained on the ORR. Asbestos-containing material may also be encountered as debris left over from discontinued operations that took place prior to the regulation of asbestos. Asbestos contained in buildings does not pose a threat to humans, as long as the material is not deemed "friable" and is in an undisturbed condition. The EPA officially defines friable asbestos-containing material as "any material containing more than 1% asbestos by weight, which when dry can be crumbled, crushed, pulverized or reduced to a powder under hand pressure." The health risk to humans regarding asbestos exposure involves the introduction of asbestos fibers into the body. The main routes of entry are inhalation and ingestion. A variety of diseases and physiologic symptoms may result due to asbestos exposures, with the majority of the symptoms presenting themselves after a latency period. The most common ailment is asbestosis, which is a diffuse, nonmalignant scarring of the lungs. Mesothelioma and bronchogenic carcinoma are the malignant forms of cancer that often are associated with chronic asbestos exposures. Clinical symptoms associated with asbestos exposure may include any of the following: dyspnea, rales, finger clubbing, and restricted pulmonary function.

Controls: Although it is apparent that the human health risk is less at lower asbestos concentrations than at higher concentrations, any degree of exposure is assumed to present potentially adverse health effects to a susceptible individual. Asbestos hazards will be minimized through the use of engineering and work-practice controls as specified by the SSHO. Engineering controls might include double-enclosed tenting for asbestos removal operations and/or a positive-air-pressure ventilation system with HEPA filters. Safe work practices include wearing sufficient PPE and avoiding activities that generate airborne fibers such as sweeping. A detailed description of the specific control methods and PPE to be employed during site operations shall be documented in the SSHASP. All sampling and remediation activities dealing with asbestos-containing material at ER sites shall comply with 29 CFR 1910.1001 and EPA guidelines. All personnel participating in sampling or remediation efforts shall possess the proper training credentials as specified in 29 CFR 1910.1001. The SSHO in conjunction with IH shall monitor all site activities dealing with asbestos-containing material. The ORNL Asbestos Coordinator should be contacted for guidance.

6.2.10 Bloodborne Pathogens

Hazards: Occupational bacterial infections may be initiated by neglected superficial wounds and/or abrasions of the skin. Infections of this nature are typically caused by bacteria infiltrating the wound. Staphylococci and streptococci are the most common bacterial strains to infect occupational workers. Bacterial infections may also be passed on to field workers and employees who handle medical waste or administer first aid or life support (such as CPR) in emergency situations.

Occupational exposure to parasitic agents must also be guarded against. Parasites are organisms that live in or on another organism. They depend exclusively on the host organism to provide them with the necessary elements for growth and reproduction. Parasitic agents are carried and transmitted by numerous types of vectors; common vectors encountered on the ORR include mosquitoes, ticks, fleas, chiggers, and mites. Diseases caused by these vectors range from malaria to Rocky Mountain spotted fever.

Controls: Bacterial and parasitic infections will be minimized by work-practice controls mandated by the SSHO. The donning of proper PPE, in conjunction with strict hand washing and personal hygiene (after potential exposure), is the best control method for eliminating occupational infections. Field personnel handling euthanized animals (experimental medical waste), or animals from natural habitats, shall wear protective clothing and rubber gloves as specified by the SSHO. Insect repellent (when allowed by the SSHO) may be worn in conjunction with protective clothing by field workers who are subjected to the risk of exposure to biological vectors. All employees who are trained to administer first aid and CPR in emergency situations, or who handle medical waste, shall practice universal precautions, and all such employees must be placed on the ORNL Bloodborne Biological Hazards Program. Employee education on the potential for exposure to pathogenic diseases shall be enacted by the SSHO as appropriate.

6.3 CHEMICAL HAZARDS

Many different types of chemical hazards may be present at any ORNL site. These chemical hazards have various origins or functions (e.g., site contaminants, chemicals used in site operations, process waste). Chemicals identified in the ORNL WAG descriptions as known or suspected site contaminants are listed in Table 3. This table also contains physical and chemical properties, toxicity, health effects, and symptoms of exposure. TLVs, permissible exposure limits (PELs), short-term exposure limits (STELs), and IDLHs are continually updated as new information becomes available. Therefore, the most current edition of *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* (ACGIH 1992) or other appropriate sources should be consulted before establishing action levels for site chemicals in the SSHASP. For practical purposes, trace chemicals that are known to exist at a site do not constitute a chemical hazard.

Chemical contamination will be assessed by a review of the site characterization information and anticipated work activities by the SSHO and the IH Department. The primary chemical contaminants (found in concentrations $\geq 1/2$ the PEL) present at each site will be included in the SSHASP. Chemical hazards shall be minimized through the use of engineering and work practice controls, as mandated by the SSHO. Details of control methods (e.g., work practices, PPE, respirators, etc.) to be used in site operations to reduce the potential for personnel exposure shall be included in the SSHASP.

Table 3. Characteristics of suspected chemical contaminants at ORNL

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
1,1,2,2-Tetrachloroethane	TLV: 1 ppm	IDLH: 150 ppm	Liver, kidney, CNS; nausea, vomiting, abdominal pain; tremor; fingers; jaundice, enlarged liver; dermatitis; kidney damage; possible carcinogen	Colorless to pale-yellow with a pungent, chloroform-like odor; degrades slowly when exposed to air; IP: 11.10 eV; noncombustible liquid
1,2 cis,-Dichloroethene (total)	TLV: 10 ppm; PEL: 1 ppm	STEL: 2 ppm; IDLH: 1000 ppm	Kidneys, liver, eyes, skin, CNS; CNS depression; nausea, vomiting; dermatitis; irritated eyes, corneal opacity; potential carcinogen	Colorless liquid with pleasant, chloroform-like odor; UEL: 16%; LEL: 6.2%; IP: 11.05 eV; FP 56°F
1,2-Dichloroethane	TLV: 10 ppm; PEL: 1 ppm	STEL: 2 ppm; IDLH: 1000 ppm	Kidneys, liver, eyes, skin, CNS; CNS depression; nausea; dermatitis; eye irritation; possible carcinogen	Colorless liquid with pleasant, chloroform-like odor; UEL: 16%; LEL: 6.2%; IP: 11.05 eV; FP 56°F
Di-n-butylphthalate	TLV: 5 mg/m ³	NE	Kidneys, eyes, nausea	Oily liquid, mild odor
1,4-Dioxane	TLV: 25 ppm; NOTE: TLV is higher than OSHA PEL	IDLH: 2000 ppm	Liver, kidney, skin, eyes; drowsiness, headaches; nausea, vomiting; irritation eyes, nose, throat; liver damage; kidney failure; possible carcinogen	Colorless liquid or solid (below 53°F) with a mild ether-like color; UEL: 22%; LEL: 2.0%; IP: 9.13 eV; FP: 55°F
2-Butanone (methyl ethyl ketone)	TLV: 200 ppm	STEL: 300 ppm; IDLH: 3000 ppm	CNS, lungs; irritation eyes, nose; headaches; dizziness; vomiting	Colorless liquid with a moderately sharp, fragrant, mint- or acetone-like odor; UEL(200°F): 11.4%; LEL(200°F): 1.4%; IP: 9.54 eV; FP: 16°F
Aluminum	TLV: 10 mg/m ³		Lungs; dust may cause aluminum pneumoconiosis; not definitive	Tin white, malleable, ductile metal, with somewhat bluish tint; noncombustible solid, but finely divided dust is easily ignited and may cause explosions

Table 3 (continued)

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
Anthracene (inorganic)	NE		Headache, nausea, coughing, sore throat, shortness of breath, irritation to eyes	Colorless solid, faint aromatic odor; insoluble in water; FP: 250°F; LEL: 0.6%
Antimony	TLV/PEL: 0.5 mg/m ³	IDLH: 80 mg/m ³	Respiratory sys, CVS, skin, eyes; irritation nose, throat, mouth; cough; dizziness; headache; nausea, vomiting, diarrhea; stomach cramps; insomnia; irritation skin; cardiac abnormalities in antimony trichloride exposures	Metal is silver-white, lustrous, hard, brittle solid, scale-like crystals, or dark gray, lustrous powder; noncombustible solid in bulk form, but a moderate explosion hazard in dust form when exposed to flame
Arsenic	Proposed TLV: 0.1 mg/m ³ ; PEL: 0.01 mg/m ³	IDLH: 100 mg/m ³	Liver, kidneys, skin, lungs, lymphatic sys; ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuritis, respiratory irritation, hyperpigmentation of skin, known carcinogen	Metal is silver-gray or tin-white, brittle, odorless, solid; noncombustible solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame
Barium	PEL: 0.5 mg/m ³	IDLH: 1100 mg/m ³	Heart, CNS, skin, respiratory sys, eyes; upper respiratory irritant; gastroenteritis; muscle spasms; slow pulse, extra systoles; hypokalemia; irritation eyes, skin; skin burns	Barium nitrate and barium chloride are white odorless solids, Ba(NO ₃) ₂ is a noncombustible solid, and BaCl ₂ is a combustible solid
Benzene	TLV: 10 ppm; PEL: 1 ppm	IDLH: 3000 ppm	Blood, CNS, skin, bone marrow; irritation eyes, nose, resp sys; giddiness; headache, nausea, staggered gait; fatigue, lassitude; dermatitis; bone marrow depressant; suspected carcinogen	Colorless to light-yellow liquid with an aromatic odor (solid below 42°F); UEL: 7.9%; LEL: 1.3%; IP: 9.24 eV; FP: 12°F
Benzo(a)pyrene	NE	NE	Skin contact, wash; nausea; eye irritation	Golden-orange needles; soluble in methylene chloride and other common organic solvents

Table 3 (continued)

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
Benzoic acid	NE	NE	Eye contact, respiratory system, lungs	White to tan powder with a characteristic odor and bitter taste; combustible
Benzp(a)anthracene	NE	NE		
Benzp(b)fluoranthene	NE	NE		
Beryllium	TLV/PEL: 0.002 mg/m ³	IDLH: 10 mg/m ³	Lungs, skin, eyes, mucus membranes; irritation eyes, nose; weakness, irritability, headaches, skin eruption, pulmonary edema, suspected carcinogen	Metal is hard, brittle, gray-white solid; noncombustible solid in bulk form, but a slight explosion hazard in the form of a powder or dust
Bis(2-ethylhexyl) phthalate	TLV: 5 mg/m ³	10 mg/m ³	Mild irritant to eyes and skin; affects GI tract	When heated emits acrid smoke
Butylbenzylphthalate	NE	NE	Irritant	NE
Cadmium	Proposed TLV: 0.01 mg/m ³ ; PEL 0.2 mg/m ³	NE	Respiratory sys, kidneys, prostate, blood; pulmonary edema, dyspepsia, cough, chest tightness, substernal pain; headaches; chills, muscular aches; nausea, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia; suspected carcinogen	Metal is silver-white, blue-tinged lustrous, odorless solid; noncombustible solid in bulk form but will burn in powder form
Carbon tetrachloride	TLV: 5 ppm; PEL: 2 ppm	IDLH: 300 ppm	CNS, eyes, lungs, liver, kidneys, skin; CNS depressant; nausea, vomiting; liver, kidney damage; skin irritant; suspected carcinogen	Colorless liquid with a characteristic ether-like odor; IP: 11.47 eV; noncombustible liquid
Chloroform (total trihalomethanes)	TLV: 10 ppm; PEL: 2 ppm	IDLH: 1000 ppm	Liver, kidneys, heart, eyes, skin; dizziness, mental dullness, nausea, disorientation; headache, fatigue; enlarged liver; irritation eyes, skin; suspected carcinogen	Colorless liquid with a pleasant odor; IP: 11.42 eV; noncombustible liquid

Table 3 (continued)

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
Chromium (total)	TLV: 0.5 mg/m ³ ; PEL: 1 mg/m ³	NE	Respiratory sys; histologic fibrosis of lungs	Blue-white to steel-gray, lustrous, brittle hard solid; noncombustible solid in bulk form, but finely divided dust burns rapidly if heated in a flame
Chrysene	PEL/TWA: 0.2 mg/m ³	NE	Skin contact, wash; eye contact, flush; suspected carcinogen	Colorless plates with blue fluorescence; LEL: NA; UEL: NA
Copper	TLV/PEL: 1 mg/m ³	NE	Respiratory sys, skin, liver, kidneys; irritation nasal mucous membranes, pharynx; nasal perforation; eye irritant; dermatitis	Metal is reddish lustrous malleable odorless solid; noncombustible solid in bulk form, but powdered form may ignite
Ethyl benzene	TLV/PEL: 100 ppm	STEL: 125 ppm; IDLH: 2000 ppm	Eyes, upper respiratory sys, skin, CNS; irritation eyes, mucus membranes; headaches; dermatitis; narcosis, coma	Colorless liquid with an aromatic odor; UEL: 6.7%; LEL: 1.0%; IP: 8.76 eV; FP: 55°F
Fluoranthene	NE	NE	Skin contact, wash; eye irritation; nausea	Yellow crystals, colored needles, or pale yellow plates; a tetracyclic hydrocarbon delivered from coal tar
Indeneo(1,2,3-cd)pyrene	NE	NE	Eye irritation, wash; respiratory system; skin contact	Yellow plates or needles (recrystallized from light petroleum solution) showing a greenish-yellow fluorescence; soluble in organic solvents; there is no commercial production or known use of this compound

Table 3 (continued)

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
Lead	TLV: 0.15 mg/m ³ ; PEL: 0.05 mg/m ³	IDLH: 700 mg/m ³	GI tract, CNS, kidneys, blood, gingival tissue; weakness, lassitude, insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis of wrist and ankles; encephalopathy; neuropathy; irritated eyes; hypotension	Metal is a heavy, ductile, soft gray solid; noncombustible solid in bulk form
Manganese	Proposed TLV 0.2 mg/m ³ ; PEL: 1 mg/m ³	NE	Respiratory sys, CNS, blood, kidneys; Parkinson's; asthenia, insomnia, mental confusion, metal fume fever; dry throat, cough, tight chest, dyspepsia, rales, flu-like fever; low- back pain; vomiting; malaise; fatigue	Metal is a lustrous, brittle, silvery solid; combustible solid
Mercury	TLV/PEL: 0.05 mg/m ³	IDLH: 28 mg/m ³	Skin, respiratory sys, CNS, kidneys, eyes; cough, chest pain, dyspepsia, bronchial pneumonitis; tremor, insomnia; irritability, indecision; headache, fatigue, weakness; stomatitis, salivation; GI disturbance, anorexia; proteinuria; irritation eyes, skin	Silver-white, heavy, odorless liquid; noncombustible
Methylene chloride	TLV: 50 ppm; PEL: 500 ppm	IDLH: 5000 ppm	Skin, CVS, eyes, CNS; fatigue, weakness, sleepiness, light- headedness; limb numbness, tingling; nausea; irritation eyes, skin; suspected carcinogen	Colorless liquid with a chloroform-like odor (note: a gas above 104°F) UEL: 22%; LEL: 14%; IP: 11.32 eV; FP: ukn.

Table 3 (continued)

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
Molybdenum (as molybdenum-soluble compounds)	TLV: 5 mg/m ³ PEL: 10 mg/m ³	NA	Respiratory system; kidneys and blood in animals	Variable depending on compounds
Nickel	Proposed TLV: 0.05 mg/m ³ ; PEL: 1 mg/m ³	NE	Lungs, paranasal sinus, CNS; headache, vertigo; nausea, vomiting epigastric pain; substernal pain; cough, hyperpnea; cyanosis; weakness; leucocytosis, pneumonitis; delirium, convulsions; known carcinogen	Metal is lustrous, silvery solid; noncombustible in bulk form
Osmium ^e	TLV/PEL: 0.0002 ppm	STEL: 0.0006 ppm; IDLH: 1 mg/m ³	Eyes, respiratory sys, skin; lacrimation, visual disturbance, conjunctivitis, headache; cough; dyspepsia; dermatitis	Colorless, crystalline solid or pale-yellow mass with an unpleasant, acrid chlorine-like odor; a liquid above 105°F; IP: 12.60 eV; noncombustible solid
PCBs (54% chlorine)	TLV: 0.5 mg/m ³		Skin (chloracne), liver, eyes, respiratory system; potential carcinogen	Soluble with most organic solvents; inert; insoluble in water
Phenanthrene	NE	NE	Skin, eye irritant; wash and flush if contact occurs	Colorless shining crystals: LEL: NA; UEL: NA
Phosphorus	TLV: 0.1 mg/m ³	NE	Respiratory system, liver, blood, kidney, eye irritant; nausea	White-yellow soft waxy solid, acrid fumes when burned
Pyrene	TLV: 0.02 ppm	NE	Respiratory tract, digestive tract, skin contact; nausea	Colorless to pale yellow powder with a slight blue fluorescence
Selenium	TLV: 0.2 mg/m ³ , PEL: 0.2 mg/m ³	Unknown	Upper respiratory sys, eyes, skin, liver, kidneys, blood; irritation eyes, nose, throat; visual disturbance; headaches; chills, fever; dyspepsia, bronchitis; metallic taste, garlic breath, GI disturbance; dermatitis; skin and eye burns	Amorphous or crystalline, red to gray solid; combustible

Table 3 (continued)

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
Silver	TLV: 0.1 mg/m ³	NE	Nasal septum, skin, eyes; blue-gray eyes, throat, irritated skin, ulceration; GI distress	Metal is white lustrous solid; noncombustible solid, but flammable in form of dust or powder
Tetrachloroethylene	Adopted TLV: 25 ppm; PEL: 25 ppm	STEL: 200 ppm; IDLH: 500 ppm	Liver kidneys, eyes, upper resp sys, CNS; irritation eyes, nose, throat; nausea; flushed face, neck; vertigo, dizziness, incoherence; headaches, somnolence; skin rash; liver damage; possible carcinogen	Colorless liquid with a mild, chloroform-like odor; IP: 9.32 eV; noncombustible liquid
Thallium	TEL/PEL: 0.1 mg/m ³	IDLH: 20 mg/m ³	Eyes, CNS, lungs, liver, kidneys, GI tract, body hair; nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peripheral neuritis, tremor; retrosternal tightness, chest pain, pulmonary edema; seizures, chorea, psychosis; liver, kidney damage; alopecia	Appearance and odor vary depending upon the specific soluble compound; properties vary accordingly
Titanium ^f	TLV/PEL: 10 mg/m ³	NE	Lungs; slight lung fibrosis, possible carcinogen	White odorless powder; noncombustible solid
Toluene	TLV: 50 ppm; PEL: 100 ppm	IDLH: 2000 ppm	CNS, liver, kidneys, skin; fatigue, weakness; confusion, euphoria, dizziness, headache; dilated pupils, lacrimation, nervousness, muscle fatigue, insomnia; paresthesia; dermatitis	Colorless liquid with a sweet pungent, benzene-like odor; UEL: 7.1%; LEL: 1.2%; IP: 8.82 eV; FP: 40°F

Table 3 (continued)

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
Trichloroethylene	Adopted TLV: 50 ppm; PEL: 50 ppm	Adopted STEL: 100 ppm; IDLH: 1000 ppm	Respiratory sys, heart, liver, kidneys, CNS, skin; headaches, vertigo; visual disturbance, tremors, somnolence, nausea, vomiting; irritated eyes; dermatitis; cardiac arrhythmia; possible carcinogen	Colorless liquid (unless dyed blue) with a chloroform-like odor; UEL(77°F): 10.5%; LEL(77°F): 8%; IP 9.45 eV; FP: 90°F
Vanadium ^g	TLV/PEL: 0.05 mg/m ³	IDLH: 70 mg/m ³	Respiratory sys, skin, eyes; irritated eyes; green tongue, metallic taste, eczema; cough; fine rales, wheezing, bronchitis, dyspepsia; irritated throat	Yellow-orange powder or dark gray, odorless flakes dispersed in air; noncombustible solid, but may increase intensity of fire when in contact with combustible materials
Vinyl chloride	TLV: 5 ppm; PEL: 1 ppm	NA	Liver, CNS, blood, respiratory sys, lymphatic sys; weakness, abdominal pain, GI bleeding; enlarged liver; pallor or cyanosis of extremities; known carcinogen	Colorless gas or liquid (below 56°F) with a pleasant odor at high concentrations; UEL: 33.0%; LEL: 3.6%; IP: 9.99 eV; FP: 120°F
Xylene, total	TLV/PEL: 100 ppm	STEL: 150 ppm; IDLH: 1000 ppm	CNS, eyes, GI tract, blood, liver, kidneys, skin; dizziness, excitement, drowsiness, incoherence, staggering gait; irritation eyes, nose, throat; anorexia, nausea, vomiting, abdominal pain; dermatitis	Colorless liquid with aromatic odor; UEL: 7.0%; LEL: 1.1%; IP: 8.56 eV; FP: variable
Zinc ^h	TLV/PEL: 5 mg/m ³	STEL: 10 mg/m ³ ; IDLH: NE	Respiratory sys; sweet, metallic taste; dry throat, cough; chills, fever, tight chest, dyspepsia, rales, reduced pulmonary function; headaches; blurred vision; muscle cramps; low back pain; nausea, vomiting; lassitude, malaise	Fine white, odorless particulate dispersed in air; noncombustible solid

Table 3 (continued)

Contaminant	TLV/PEL ^a	STEL/ IDLH ^b	Target organs/ miscellaneous information ^c	Chemical and physical properties ^d
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^aTLV - Threshold limit value, PEL - Permissible exposure limit, TWA - Time-weighted average, NE - not established. Values given in this column are continually updated as new information becomes available. Consult current literature before establishing site action levels.

^bSTEL - Short-term exposure limit, IDLH - Immediately dangerous to life and health, NE - not established. Values given in this column are continually updated as new information becomes available. Consult current literature before establishing site action levels.

^cCNS - Central nervous system, CVS - Central vascular system, GI - gastrointestinal tract.

^dLEL - Lower explosive limit, UEL - Upper explosive limit, IP - Ionization potential, FP - Flash point, NA - not available.

^eInformation on osmium is based on osmium tetroxide (OsO₄).

^fInformation on titanium is based on titanium dioxide (TiO₂).

^gInformation on vanadium is based on vanadium pentoxide (respirable dust as V₂O₅).

^hInformation on zinc is based on zinc oxide fume (ZnO).

MSDSs for any chemicals brought on-site for site operations will be obtained by the project supervisor prior to the start of field activities. These MSDSs shall be obtained through the ORNL MSDS Database System or approved by ORNL IH and attached to the SSHASPs. The MSDSs shall be available on-site during all operations.

6.3.1 Mercury

Due to the widespread use of mercury at the DOE's Oak Ridge facilities over the years, there remains a potential for field personnel to encounter mercury exposures during the course of routine field activities. Unexpected personal exposures to mercury may result due to previous spills and releases that have occurred on the ORR. It is therefore necessary for field personnel to be cognizant of the hazards associated with mercury exposures and the control methods that shall be used to minimize these hazards.

Hazards: Occupational exposures to mercury and its associated compounds may result through absorption, inhalation, ingestion, or by direct contact. Mercury may exist in various physical and chemical states, and the routes of exposure may be different for each.

Inhalation of mercury vapors may produce acute, corrosive bronchitis and interstitial pneumonitis and, if not fatal, may include central nervous system disorders such as tremors or increased excitability. Chronic exposure to mercury vapors will result primarily in central nervous system disorders such as: tremors, extremity spasms, personality changes, depression, and delirium.

Ingestion of mercuric mercury (inorganic mercury salts) may produce severe abdominal cramps, diarrhea, and the suppression of urine production. Corrosive ulcers, bleeding, and necrosis of the gastrointestinal tract may result in more severe cases, with renal failure usually occurring within 24 hours of the exposure.

Exposure to organic mercury (methyl mercury) is considered to be the most serious in terms of toxicity. Neurologic damage is the primary result of such exposures, with paresthesia, ataxia, and deafness afflicting the victim. Methyl mercury exposures will also lead to neuron degeneration in the cerebral cortex (particularly the occipital cortex) and most likely result in visual impairment and the degeneration of sensory ganglion cells.

Controls: Should mercury hazards be anticipated prior to commencing field operations, the SSHO and the SPM will obtain as much information about the hazard as possible. The physical and chemical states of the mercury should be documented, and the specific amount and concentration should be obtained (if possible). The ORNL IH Department shall be contacted for assistance.

If the potential for exposure exists, informative employee education on the hazards of mercury exposure shall be enacted by the SSHO prior to the commencement of field activities. All field personnel shall read and abide by the rules and guidelines set forth in this plan, as well as the SSHASP, for the specific task to be performed. All field work shall comply with the CFR 1910.120 and the ORNL HAZWOPER Program, and all workers shall exercise safe work practices. Should mercury exposure be inevitable, all field personnel shall don the proper PPE as mandated by the SSHO and the SSHASP (i.e., chemical resistant suits, boots, gloves, respirators, safety glasses, etc.). Monitoring may be required as directed by the ORNL IH Department. It is recommended that one follow the PPE guidelines as outlined in: *Guidelines for the Selection of Chemical Protective Clothing*, published by the American Conference of Governmental Industrial Hygienists, Inc. (Schwope 1987).

Incidental mercury spills should be immediately contained with materials readily on hand, while exercising due care and caution to prevent personal contamination. Once the spill is contained, all personnel should evacuate the immediate area. The SSHO shall cordon off the area with flagging/rope, and shall notify the proper authorities (ER ES&H Manager) immediately. Field personnel shall not enter the mercury contaminated area without the specific authorization of the SSHO.

6.4 RADIOLOGICAL HAZARDS

Radiological conditions at proposed work sites will be assessed by the SPM and/or the SSHO with assistance from the ORP as part of the site-specific hazards evaluation. Anticipated work activities will be considered, site characterization information will be reviewed, and, if enough information is available, a detailed evaluation of the radiological contamination present at the site will be included in the SSHASP. Detailed information on suspected or known radionuclide contaminants at ORNL is presented in Table 4.

On-site monitoring for detection of contamination levels will be performed by the ORP representative or an approved representative. In areas not requiring an ORP representative, gamma radiation levels will be monitored by the SSHO. If, at any time, the gamma exposure rate exceeds 2.5 mR/h, personnel will be withdrawn from the area and the SPM or SSHO will contact the Area HP technician for guidance. During any intrusive operations, both beta-gamma and gamma radiation levels will be monitored and personnel will be withdrawn if

Table 4. Characteristics of suspected radionuclide contaminants at ORNL

Contaminant	DAC ^a			Critical target organs ^c
	D ^b (μ Ci/mL)	W ^b (μ Ci/mL)	Y ^b (μ Ci/mL)	
MANMADE RADIONUCLIDES				
Tritium (water)	2×10^{-5}	2×10^{-5}	2×10^{-5}	Whole body
Cobalt-60		7×10^{-8}	1×10^{-8}	Whole body, lung
Europium-152		1×10^{-8}		Whole body, bone, liver
Europium-154		8×10^{-9}		Whole body, lung, liver
Europium-155		4×10^{-8}		Bone, lung, liver
Nickel-63	7×10^{-7}	3×10^{-7}		Whole body, lung
Calcium-45		3×10^{-7}		Whole body, lung, bone
Antimony-125	1×10^{-6}	2×10^{-7}		Whole body, lung, bone
Ruthenium-106	4×10^{-8}	2×10^{-8}	5×10^{-9}	Whole body, lung
Strontium-89	3×10^{-7}		6×10^{-8}	Whole body, bone, lung
Strontium-90	8×10^{-9}		2×10^{-9}	Whole body, bone, lung
Cesium-137	7×10^{-8}			Whole body
Americium-241		2×10^{-12}		Bone, lung, gonad
Plutonium-238		3×10^{-12}	7×10^{-12}	Bone, lung, gonad
Plutonium-239/240		2×10^{-12}	6×10^{-12}	Bone, lung, gonad
Curium-244		4×10^{-12}		Bone, lung, gonad
NATURALLY OCCURRING RADIONUCLIDES				
Potassium-40	2×10^{-7}			Whole body
URANIUM SERIES				
Uranium-238	6×10^{-10}	3×10^{-10}	2×10^{-11}	Whole body, bone, lung
Thorium-234		9×10^{-8}	6×10^{-8}	Whole body, lung, bone
Uranium-234	5×10^{-10}	3×10^{-10}	2×10^{-11}	Whole body, bone, lung
Thorium-230		3×10^{-12}	7×10^{-12}	Bone, lung
Radium-226		3×10^{-10}		Whole body, lung, bone
THORIUM SERIES				
Thorium-232		5×10^{-13}	1×10^{-12}	Bone, lung, whole body

Table 4 (continued)

Contaminant	DAC ^a			Critical target organs ^c
	D ^b ($\mu\text{Ci/mL}$)	W ^b ($\mu\text{Ci/mL}$)	Y ^b ($\mu\text{Ci/mL}$)	
Radium-228		5×10^{-10}		Whole body, lung, bone
Thorium-228		4×10^{-12}	7×10^{-12}	Bone, whole body, lung
Radium-224		7×10^{-10}		Whole body, lung, bone

^aDerived air concentrations (DACs) for occupational exposure are based on either a stochastic (committed effective dose equivalent) of 5 rem/year or a nonstochastic (organ specific) dose limit of 15 rem/year to the lens of the eye and 50 rem/year to any other organ, tissue, or extremity of the body, whichever is more limiting.

^bThe DACs include three lung retention classes: D - daily, W - weekly, and Y - yearly. This classification refers to the approximate length of retention in the pulmonary region. Thus, the range of half-times is less than 10 days for class D, from 10 to 100 days for class W, and greater than 100 days for class Y.

^cCritical target organs based on exposure-to-dose conversion factors for inhalation.

Source for DACs: 10 CFR 835 December 14, 1993. *Occupational Radiation Protection; Final Rule*.

Source for critical target organs: Eckerman, K. F., et al. 1988. *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, Federal Guidance Report No. 11, EPA-520/1-88-020, U.S. EPA, Office of Radiation Programs, Washington, D.C.

radiation levels in excess of ORNL guidelines (Table 5) are detected. Radiological hazards will be minimized through the use of engineering and work practice controls. Personnel will be provided with the level of PPE deemed appropriate by the SSHO and/or the ORP representative.

The DOE dose limits and administrative control levels (based on the sum of internal and external exposure) are as follows:

- The DOE radiation dose limit during routine conditions is 5 rem/year.
- The DOE administrative control level during routine conditions is 2 rem/year.
- The ORNL administrative control level during routine conditions is 1 rem/year.

In addition, ORNL has a daily and weekly administrative control limit of 20 mrem/day and 100 mrem/week. Both of these limits may be exceeded with the proper signature on a Radiation Work Permit.

Where applicable, criticality safety, pursuant to DOE Order 5480.24, will be comprehensively addressed and receive an objective review by the ORNL Criticality Safety Officer. All identifiable risks will be reduced to acceptably low levels and management authorization of the operation will be documented.

Table 5. ORNL contamination guides

	Direct reading		Transferable smear	
	α (dpm/100 cm ²)	$\beta\gamma$ (dpm/100 cm ²)	α (dpm/100 cm ²)	$\beta\gamma$ (dpm/100 cm ²)
Action level while in a radiological Contamination Area	5,000	10,000	200	2,000
Action level outside radiological Contamination Area	500	1,000	20	200
Maximum contamination limit for skin surfaces:				
General body	500	1,000 ^a	None detectable ^b	
Hands	500	1,000 ^a	None detectable ^b	
<i>Green Tag Limits:</i>				
Maximum contamination limit for clothing and other items given radiation and contamination clearance (e.g., tools and equipment for unrestricted use)	500	1,000	20	200 ^c

^aHigher limit may be used if the identity of the contaminant is known.

^bDetection limit is related to instrumentation used.

^cExcept ¹²⁵I, ¹²⁹I, and ²²⁷Ac which have a limit of 20 dpm/100 cm², and ³H and ¹⁴C which have a limit of 1000 dpm/100 cm².

6.4.1 Contamination Control

Mixed waste sites and radiological areas pose a primary concern in controlling the spread of chemical and/or radiological contamination on the ORR. It is of utmost importance that field personnel, site visitors, equipment, and the surrounding environment be protected from the spread of site contaminants. The strict use of contamination control methods should be employed on all field projects conducted on the ORR. Whenever engineering controls and safe work practices are not feasible, PPE shall be used to reduce employee exposure levels and maintain the levels as low as reasonably achievable (ALARA). All engineering controls and safe work practices must be documented in the ORNL ER SSHASP. Contamination control methods used on the ORR may include, but are not limited to, the following:

- Frisk and/or smearing of equipment and personnel.
- Proper establishment of site work zones (CAA, EZ, CRZ, rad zone, support zone, etc.).
- Maintenance of site control and safe work practices (allowing only the necessary number of personnel in the EZ, CRZ, etc.).

- Utilization of barrier protection (plastic sheeting) to safeguard personnel and equipment from contact with contamination.
- Adherence to chemical and/or radiological decontamination procedures.
- Correct selection and use of PPE.
- Adherence to sanitation and waste management practices and policies.
- Enforcement of personal hygiene requirements (hand washing, showering before leaving the ORNL reservation or work site if appropriate, etc.)

6.4.2 Guidelines for Personnel Contamination Monitoring with Hand-Held Radiological Survey Instruments

Procedures to be used by field personnel when frisking out of potentially contaminated work zones are listed below (DOE April 1994).

6.4.2.1 General requirements

1. Verify that the instrument is in service, set to the proper scale, and the audio output can be heard during frisking.
2. Hold probe less than 1/2 in. from surface being surveyed for beta and gamma contamination, approximately 1/4 in. for alpha contamination.
3. Move probe slowly over surface, approximately 2 in. per second.
4. If the count rate increases during frisking, pause for 5 to 10 seconds over the area to provide adequate time for instrument response.
5. If the count rate increases to a value greater than preestablished contamination limit or the instrument alarms, remain in the area and notify a representative from the Office of Radiological Protection.
6. The whole body frisk should take at least two to three minutes.

6.4.2.2 Performance of monitoring

1. Frisk the hands before picking up the probe.
2. Perform the frisk in the following order:
 - a. Head (pause at mouth and nose for ~5 seconds);
 - b. Neck and shoulders;
 - c. Arms (pause at each elbow);
 - d. Chest and abdomen;
 - e. Back, hips, and seat of pants;
 - f. Legs (pause at each knee);
 - g. Shoe tops;
 - h. Shoe bottoms (pause at sole and heel);
 - i. Personnel and supplemental dosimeters.
3. Return the probe to its holder, and leave the area. The probe should be placed on the side or face up to allow the next person to monitor their hands before handling the probe.

6.5 BIOLOGICAL HAZARDS

Any site may present a variety of biological hazards, and it is the responsibility of all personnel to inform the SSHO of health conditions they have that may be affected by site conditions. Hazards that may be encountered include, but are not limited to, the following:

- Poison ivy or poison sumac;
- Insect bites or stings;
- Ticks or other disease carrying vectors;
- Pollens, grasses, and other allergens; and
- Wildlife such as snakes, rodents, fowls, etc.

Reasonable care should be taken to minimize the chances of undesirable interaction with such media. This may include wearing appropriate clothing, snake leggings, and the use of insect repellents (see Sect. 7.3). Field personnel should also adhere to the sanitation guidelines addressed in Sect. 10.1.

6.5.1 Poison Plants

Poison ivy and poison oak are identified by three leaflets radiating from a stem. It may be a climbing vine or bush-like and the leaves may be rough or smooth. Poison sumac's leaves angle up like rabbit ears, resembling those of sumac or mountain ash except that they are rounded, not toothed. Each stem contains an odd number of leaflets. The plant tissues have an oleoresin that is active in live, dead, and dried parts. The oleoresin may be carried via smoke, dust, contaminated clothing, and animal hair. When walking or working in an area with poisonous plants, wear boots, long pants, long-sleeved shirts, and work gloves, if warranted.

Wash the affected areas immediately—within 5 or 10 min, if possible—with an alkaline soap, then rinse with alcohol. Signs and symptoms include redness, swelling, and intense itching. Facial areas usually break out within 5 or 6 h, other parts of the body in 24 to 48 h. Blisters form during the subsequent 24 h. Lesions may persist for 2 to 3 weeks.

6.5.2 Insects

Stings from ants, bees, wasps, and hornets are responsible for more deaths in the United States than the bites and stings from all other venomous creatures. Sensitization to the venom by the victim develops from repeated stings and can result in anaphylactic reactions. The stinger may remain in the skin and should be removed by teasing or scraping rather than pulling. Scrape in the same direction that the stinger entered the skin. An ice cube placed over the sting will reduce pain. An analgesic-corticosteroid lotion is often useful. People with known hypersensitivity to stings should carry a kit containing an antihistamine and epinephrine and notify the SSHO of this sensitivity.

6.5.3 Ticks and Tick-Borne Diseases

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

The illness typically occurs in the summer and is characterized by a slowly expanding red rash that develops in a few days to a few weeks after the bite of an infected tick. Typically the rash is characterized by a distinctive target or bulls-eye rash (blanched area between the central bite site and the rash). However, the rash may appear anywhere on the body, not necessarily where the tick bite occurred. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage, treatment by a physician is usually effective. If left alone, these early symptoms may disappear, but more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems that may occur include meningitis, neurological abnormalities, and cardiac abnormalities. It is important to note that many people do not get the characteristic rash and may have diminished progress to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

Rocky Mountain spotted fever is transmitted by the infected dog tick *Dermacentor variabilis* and is common in the eastern and southern United States. The dog tick is significantly larger than the deer tick. Nearly all cases of Rocky Mountain spotted fever occur in the spring and summer, several days after exposure to infected ticks. The onset of illness is abrupt, often with high fever, severe headache, chills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash that usually starts at the hands and feet and gradually extends to most of the body.

The various stages and symptoms of both diseases are well recognized and, if detected, can be treated with antibiotics. Early detection and treatment with antibiotics significantly reduces the severity of both Lyme disease and Rocky Mountain spotted fever.

Tick avoidance procedures: When in an area suspected of harboring ticks (grass, bushes, woodland) the following precautions can minimize the chances of being bitten by a tick:

- Wear Tyvek suits with taped cuffs and sleeves.
- Wear light colored clothing so ticks can be easily seen.
- Use tick repellents, if allowed.
- Inspect clothing frequently while in tick habitat.
- Perform a personal inspection for ticks after being in a suspected area by closely inspecting legs, groin, arms, neck, ears, and hair.

First aid for tick bites: Inspect your head and body thoroughly when you return from the field. If an attached tick is noted on the body, report to medical immediately. However, if medical personnel are not available, removal of the tick is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouth parts enter the skin and tug gently, but firmly, until the tick releases its hold on the skin. Save the tick in a jar labeled with the date, body location of the bite, and the place where it may have been acquired. Wipe the bite thoroughly with an antiseptic and seek medical attention as soon as possible.

6.5.4 Spiders

Almost all of the 30,000 species of spiders are venomous but only a relatively small number have fangs long and strong enough to penetrate the human skin. Spiders are generally found in dark protected areas such as access ways to sanitary sewers, under ledges, in protective casings of monitoring wells, pump housings, buildings, portable toilets, and manhole covers.

The black widow spider ranges in color from gray to brown to black depending on the species. The abdomen is shiny black with a red hourglass, stripes, or spots. Although both male and female are venomous, only the latter has fangs large and strong enough to penetrate the human skin. Mature females range in body length from 10 to 20 mm. The person bitten may recall receiving a sharp, pinprick-like bite, but in some cases the bite is so minor that it goes unnoticed. Rarely is there any local skin reaction. The initial pain is sometimes followed by a dull, occasionally numbing pain in the affected extremity, and by pain and cramps in one or several of the large body muscles. Sweating, weakness, headache, and dizziness are common. The lymph nodes in the region of the bite will often be tender or painful. In severe cases, there is rigidity of the abdominal muscles and pain in the lower back, thighs, or abdomen. There is no effective first aid treatment. Report to the SSHO if a bite is suspected. Treat for shock and transport to the nearest medical facility.

The brown recluse or violin spider has an abdomen that ranges in color from grayish through orange and reddish-brown to dark brown. The back shell of the "violin" is brown to blackish and distinct from the pale yellow to reddish-brown background of the head and chest. This spider has six eyes grouped in three diads. Both male and female are venomous. They average from 6 to 12 mm in body length. The bite of this spider produces about the same degree of pain as the sting of an ant, but sometimes the person is completely unaware of the bite. In most cases, a localized burning sensation develops that may last for 30 to 60 min. The area often itches, becomes red and warm, with a small blanched area around the immediate bite site. The reddened area enlarges and becomes purplish during the subsequent 1 to 8 h. A small blister forms at the bite site, increases in size, and subsequently ruptures. The whole area may become swollen and painful. Other signs and symptoms include fever, malaise, stomach cramps, nausea, and vomiting. In severe cases, there may be breakdown of the red blood cells, renal failure, or death. All first aid measures should be avoided as the natural appearance of the bite is most important in determining the diagnosis. A cube of ice may be placed on the wound. Notify the SSHO and transport the person to the nearest medical facility.

6.5.5 Poisonous Snakes

Snake avoidance procedure: The best avoidance procedure is to be familiar with snake habitat and to be observant in the field. Snakes can be found under debris, manhole covers, or overgrown vegetation. All field personnel will exercise caution and maintain alertness to this hazard when in the field.

First aid for snake bites. All reactions from snake bites are aggravated by acute fear and anxiety. The severity of local and general reaction from poisonous snake bite depends on the amount of venom injected and the speed of absorption of venom into the victim's circulation, the size of the victim, the protection from clothing including shoes and gloves, the speed at which antivenom therapy can be provided, and the location of the bite.

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

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

The most important first aid step is to get the snake bite victim to medical assistance quickly. Meanwhile:

- Keep the victim still and as calm as possible, preferably in a prone position.
- Immobilize the bitten extremity and keep it at or below heart level. Transport the victim to the hospital. If the victim can reach medical assistance before symptoms develop (usually 4 to 5 hours), no further first aid measures need be applied.

Several other factors must be considered in cases of snake bite:

- Keep the victim lying down and comfortable and maintain body temperature. Elevate feet if the bite is not in the lower extremities. Cover body with blanket.
- If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform CPR.
- Try to identify the snake.
- The bitten area may be washed with soap and water and blotted dry with sterile gauze. Dressings and bandages may be applied for a short period of time.
- Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Consult a doctor or other medical personnel for specific medications that may be used.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of snake bite.

6.5.6 Other Animals

Wildlife found on the site (e.g., raccoons, skunks, foxes) usually avoid people. Unhealthy or threatened wildlife may be aggressive. Potential hazards due to animal bites are best controlled by cautiously entering new areas and avoiding animals whenever they are seen. If bitten, the victim should be transported immediately to receive proper medical attention. The condition and behavior of the animal should be noted and reported to the physician.

6.6 OTHER HAZARDS

6.6.1 Illumination

ER activities normally will be conducted during daylight hours or under artificial lighting. A minimum of 5 footcandles 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 one candle power.) Actual field measurements of illumination may need to be taken, if conditions warrant. A conservative guideline may be that field work commence 15 min after sunrise and conclude 15 min prior to sunset. Adherence to the minimum 5 footcandles requirement will be based on the SSHO's best professional judgment. Indoor activities such as D&D activities shall necessitate the use of indoor lighting to maintain minimum illumination requirements.

6.6.2 Dusts/Mists

Some activities may be conducted during site operations which could have the potential to generate dusts or mists. These activities shall be identified in each SSHASP. A guideline for monitoring operations for potential dust or mist exposures is that the generation of a visible cloud of dust would constitute a need for investigation by the ORP representative, IH representative, and the SSHO. Work operations should cease when visible dust is being generated until the health and safety personnel can determine any risks of exposure. Control methods such as misting the area with water may be used to prevent the generation of dust.

Decontamination of equipment may involve the use of a high pressure sprayer. If the likelihood exists of contamination becoming airborne within the mist of the washer, decontamination personnel may be required to use respiratory protection, protective eyewear, or other forms of PPE.

6.6.3 Ergonomics

The interaction of personnel with their working environment at this site may also present potential hazards such as the incorrect lifting of heavy loads, equipment vibrations, improper body positioning, negotiation of physical obstacles when accessing confined spaces, and transporting supplies and equipment over treacherous terrain. All of the aforementioned conditions are potential factors in site operations. Personnel should always position themselves properly, lift from the legs when lifting equipment or heavy objects, and rely on mechanical lifting devices or the buddy system for assistance in lifting loads that are too heavy

for one person. Back strain, the most common ergonomic hazard in the work place, may be avoided if site workers ask for assistance when they need it or use other methods beside manual lifting. Field personnel should not attempt to handle heavy (>50 lbs) and unwieldy loads alone. If there is any doubt about the safety of moving or carrying items, the SSHO should be consulted.

6.6.4 Hot Work

Hazards: Hot work (welding, burning, etc.) can be hazardous as an ignition source and as a source of release for airborne contamination or products of combustion.

Controls:

- All hot work will be done within the specification of the ORNL Safety Work Permit. The SPM or construction manager is responsible for generating the Safety Work Permit.
- A 10-lb cylinder of dry chemical fire extinguishing agents will be kept in the immediate area of hot work.
- To the extent possible, combustible material will be removed from work areas.
- A dedicated fire watch will be maintained during, and for 30 min after, all hot work activities.
- The material to be burned or welded and the atmosphere in the immediate area shall be examined by the IH representative prior to the commencement of work activities to assess the possibility of hazardous fumes being created during hot work operations.
- The Safety Work Permit will be maintained on-site for inspection purposes while work is in progress.

6.6.5 Heavy Equipment

Hazards: The hazards associated with the operation of heavy equipment, such as drill rigs, are, in general, personnel injury, equipment damage, hydraulic leaks, or property damage.

Controls:

- All heavy equipment shall be used in the manner intended. Drivers will operate all equipment in accordance with the manufacturers' instructions and within the safe operating parameters defined by the manufacturer. SPM will verify operator's qualification to operate equipment by requesting and receiving documentation from the contractor.
- Equipment with booms or masts must be properly grounded when the masts or booms are in an upright position.
- Prior to coming on-site, each piece of equipment must be "green tagged" by an ORP representative. Each piece of equipment must be capable of performing its designated task with all safety alarms and operating parts functioning properly. An up-to-date fire extinguisher must be on board each piece of heavy equipment.

- Heavy equipment conducting hoisting and rigging activities shall operate within the guidelines of the approved lift plan, if applicable.
- All heavy equipment shall have current annual inspection certifications before use.
- All heavy equipment shall be inspected daily by the operators and, as required, by certified inspectors before operations begin. The SSHO will be responsible for ensuring that inspections are performed. All inspections shall be documented in the field logbook.
- All hydraulic equipment will be inspected daily for leaks or other problems.
- Applicable monthly, quarterly, and special inspections shall be completed prior to equipment operation. Completed instruction forms for operating the equipment shall be available on-site at all times.
- Where possible, heavy equipment in stationary operations should be barricaded (with hazard tape) at a sufficient distance for ground personnel to avoid moving cabs, counterweights, and booms. When ground personnel are working in the vicinity of heavy equipment, they should inform the flagman or equipment operator of their presence.
- The Drill Rig Checklist in Attachment H shall be completed prior to using drill rigs on-site.
- The SSHO shall monitor the safe use of all heavy equipment on the work site.

6.6.6 Flammable Materials

Hazards: Flammable materials pose fire/explosion hazards if ignition sources are present. Chemical contaminants at the site shall be assessed by the SSHO to ensure that hazards are identified and that the appropriate controls are in place. MSDSs for all site materials will be maintained on-site by the SSHO or ES&H technician.

Controls:

- Flammable liquids shall be stored in an Underwriters' Laboratory-approved safety container designed and labeled for that purpose.
- Flammable materials shall be stored in a common location to be determined by the SSHO and the ORNL Fire Department.
- No smoking or open flames shall be permitted within 50 ft of stored flammable materials.
- Vapors from opened monitoring wells may be flammable and will be monitored for explosive atmospheres by the ES&H technician during all activities.
- Area to be evacuated if readings of 10% of LEL are recorded.
- Confined spaces to be evacuated if readings of 5% of LEL are recorded.

6.6.7 Compressed Gases, Cylinders, and Systems

Hazards:

- Discharge of flying objects such as dust and dirt from the cylinder valve upon opening.
- Personnel being struck by a whipping compressor hose.

- Explosions or fire from system leakages.
- Damaged cylinder or valve resulting in the cylinder becoming an airborne projectile.

Controls:

- Cylinders shall be stored upright and properly secured with chains, bars, brackets, or other approved devices to prevent the cylinder from falling.
- Segments of compressor hose shall be secured so that they will not become separated.
- Safety glasses and gloves shall be worn by site personnel when handling and assembling compressed gas cylinders or systems.
- No smoking or open flames will be permitted within 50 ft of stored compressed cylinders.
- Hoses will not be located where they may be run over by vehicular traffic.
- Cylinders shall be stored at least 20 ft from highly combustible materials.
- Damaged cylinders and cylinders with unknown contents shall not be moved under any circumstances by untrained personnel. The immediate area around the cylinders shall be roped off, personnel shall be evacuated, and the ER ES&H Manager notified at once.

6.6.8 Destruction of Concrete

Hazards:

- A possibility for increased airborne concentration and inhalation of site contaminants. This is likely to occur if the ground below is heavily saturated with contaminants or contaminated water.
- A possibility for increased dust exposure when using a concrete saw. The concrete media may pose a silica dust hazard.
- Flying debris will present eye and head injury hazards.
- Noise in excess of 85 dBA may be generated.
- Vibration to the hands and body of the person operating a jackhammer or other soil-breaking device.

Controls:

- Use engineering controls, such as enclosure or wetting, as necessary, to reduce the level of exposure.
- Wear eye, face, head, and respiratory protection, as specified in the SSHASP.
- Use a sufficient supply of water to keep the operation wet and thus reduce the dust.
- Wear hearing protection as required. If ear plugs do not offer enough protection, use earmuff-type hearing protectors and plugs.
- To combat jackhammer vibration, provide good vibration-absorbing hand grips and implement work/rest regimes.

6.6.9 Adverse Weather Conditions

Hazards: During adverse weather conditions, lightning strikes to personnel or equipment may occur without warning. Lightning may be attracted to drill rigs, bulldozers, or other types of site equipment. Lightning can strike with relatively little or no warning, at any time when thunderclouds gather or when thundershowers are forecast. It is imperative that weather updates be monitored closely during field work, particularly in the summer.

Controls:

- In the event of potential thundershowers (i.e., thunderstorm warnings or lightning sightings) shutdown equipment and proceed to shelter.
- Wait a minimum of 30 min from the last lightning strike before returning to work.
- All field instrumentation should be re-evaluated and recalibrated prior to returning to work in order to verify the instruments' integrity under humid conditions.
- All drill masts and booms shall be lowered in the event of a lightning storm, if there is sufficient warning and it poses no risk to the worker.
- In the event of snow, ice, or flooding, the SSHO shall evaluate the site conditions and shall make recommendations on whether to initiate or cancel the proposed work effort.

6.6.10 Traffic

Hazards: The possibility of vehicle-related injury or accident is inherent to field work. Accidents may occur during travel to or from the site as well as during on-site activities.

Controls:

- Vehicle and equipment operators shall adhere to federal, state, and local regulations regarding the operation of their motor vehicles and equipment.
- All posted speed limits must be obeyed.
- The number of passengers in or on a vehicle or piece of equipment shall not exceed the number that can be seated with a functional seat belt.
- Seat belts shall be used at all times by persons operating and/or riding in or on vehicles or equipment.
- Personnel will not ride in/on vehicles or equipment in a manner not designed for conveyance of personnel (e.g., riding on the running boards of trucks or the fenders of front-end loaders).
- All heavy truck and equipment operators shall use a spotter or flagman (as necessary) when operating in and around general plant traffic.
- Energy Systems Defensive Driving and Nonpaved Surfaces Training shall be completed, where required.

6.6.11 Underground Hazards

Hazards: Underground hazards occur when underground installations are encountered during drilling or excavation work. These structures may include gas utilities, power lines, product lines, concrete vaults, and tanks. These present a potential for electrocution, explosion, spills or releases, or injuries to the field personnel.

Controls: A pre-excavation meeting will be held to review the Excavation/Penetration Permit and work area to ensure all underground installations have been identified. Should an underground object that causes refusal of the ground-penetrating equipment be hit during field activities, the field crew will move away from the area and the IS representative shall be notified to assess the situation.

6.6.12 Hoisting and Rigging Operations

Operations that involve the use of cranes, forklifts, hoists, powered industrial trucks, and slings are subject to certain hazards that cannot be controlled by mechanical means. The possibility of serious accidents resulting in personal injury, death, or significant property damage exists whenever hoisting and rigging activities take place. All site operations involving hoisting and rigging operations shall be conducted in accordance with the provisions and requirements of all applicable sections of 29 CFR 1910, 29 CFR 1926, and the contents of the *DOE Hoisting & Rigging Manual* (April 1993). In addition, proposed lift plans for hoisting and rigging activities shall be submitted to the ORNL Hoisting and Rigging Program Manager and the SSHO and SPM for their approval. The following elements should be included in this review:

- Ensure that the elements of ORNL Procedure for Hoisting Equipment are included in lift plans.
- Consider the DOE Hoisting and Rigging Manual requirements as mandatory.
- Conduct a special safety briefing for all employees involved in hoisting and rigging operations.
- Ensure that pre-job safety briefings are conducted prior to hoisting and rigging operations. These briefings should include general safety as well as hoisting and rigging safety.
- Ensure that all lift plans are reviewed by ORNL IS.

The SSHO and SPM must maintain adequate documentation of the review and approval process. All applicable SOPs shall be maintained on-site for quick reference.

Hoisting and rigging activities shall be conducted only by qualified personnel as specified in the ORNL Hoisting and Rigging plan, if applicable, or the DOE Hoisting and Rigging Manual. It is the SPM and SSHO's responsibility to ensure that personnel involved in hoisting and rigging operations have been adequately trained to perform these activities. Prior to conducting any hoisting and rigging operations, a pre-job safety briefing will be conducted by a hoisting and lifting supervisor or foreman to review hazards. Crew members will also be

given a general, pre-entry briefing by the SSHO about site-specific operations and hazards that could be encountered.

Possible site operations may involve, but are not limited to, rigging activities or the use of any of the following types of equipment:

- Overhead and gantry cranes.
- Mobile cranes.
- Forklift trucks.
- Hoists.
- Hooks.
- Wire rope, slings and rigging accessories.
- Below-the-hook lifting devices.

Hazards: Hazards associated with hoisting and rigging activities include life threatening injuries; crushing injuries to fingers, hands, and feet; and noise.

Controls: Hearing protection should be worn to control excess noise. Injuries to fingers, hands, and feet can be controlled by wearing hard-toed safety footwear, hard hats, and gloves while operations are in progress. These items will protect from minor blows or glances but not from heavy direct crushing injuries. Education and a constant vigilance to all aspects of these operations is needed to protect individuals from hoisting and rigging injuries. Other control measures include inspecting all straps, chokers, and rigging equipment prior to use, maintaining strict site control in order to limit the number of personnel in the work area during hoisting and rigging operations, and establishing safe working distances for field personnel while hoisting and rigging operations are being conducted. For specific controls on site operations one should refer to the SSHASP.

6.6.13 Respiratory Hazards

Respiratory hazards (aerosols, particulates, etc.) may enter the lungs causing an immediate health hazard and may go directly into the blood stream affecting other organs or systems within the body in a matter of seconds. While working at hazardous waste sites, around waste or process lines, or in confined spaces, the conditions of the respirable atmosphere can be a life or death matter. If an atmospheric condition appears as a haze, or a cloud emanating from a source, consider that environment as hazardous until it can be sampled by a representative of the IH Department or an ES&H technician. The area should be evacuated, and no one should enter the cloud; stay upwind of the potential hazard. Treat any questionable low-lying cloud or haze as hazardous until proven otherwise. After the condition has been ascertained, don the appropriate PPE and follow the recommendations of the respective health-related disciplines.

6.6.14 Electrical Hazards

Numerous electrical hazards may exist throughout the ORNL facilities, therefore field personnel should always remain cognizant of the potential for electrocution or shock when conducting field activities. Common electrical hazards include buried power lines, overhead power lines (see Sect. 6.2.3), transformers, circuit boxes, electrical generators, and lightning. Electrical hazards associated with D&D activities may include, but are not limited to: undetected live wires, circuit boxes, or electrical systems, standing water or puddles, deteriorating wiring insulation, etc.

Hazards: Electrical hazards associated with general field activities may include, but are not limited to:

- standing water or puddles in the immediate area where work operations and power sources exist;
- conducting field activities during electrical storms;
- operating booms, masts, or drill rigs within a 10-ft radius of overhead power lines (see Sect. 6.2.3);
- drilling or excavating in the immediate area of underground power lines;
- performing surveillance or maintenance activities on equipment or machinery without following proper lock-out/tag-out or ground-fault-interrupter procedures;
- improper selection of tools for a work effort located near electrical power sources (tools should be nonconductive and/or grounded).

Controls: Various controls may be implemented in order to decrease or eliminate electrical hazards to field personnel. Some control measures to consider are:

- consulting blue prints, drawings, site maps, and/or penetration permits to locate potential power sources (underground power lines, overhead power lines, conduits, etc.) and performing a site walkover prior to commencing work activities.
- conducting interviews with Building Engineers and Facility Managers;
- implementing lock-out/tag-out procedures or ground-fault-circuit interrupters prior to commencing work activities;
- assuring that all equipment that poses an electrical hazard is equipped with a ground-fault-circuit interrupter unless waived by a representative from IS;
- recognizing hazardous work conditions (puddles or standing water) prior to commencing work activities;
- properly using PPE (rubber boots, gloves, etc.) as indicated in the SSHASP;
- ceasing field activities prior to severe weather conditions (thunderstorms/lightning storms);
- utilizing nonconducting materials and tools when working in the vicinity of electrical power sources or equipment.

Further site-specific information regarding electrical hazards and controls may be found in the SSHASP.

6.6.15 Unknown Hazards

Examples of unknown hazards include, but are not limited to, gas cylinders with unknown contents, possible RCRA waste, bottles of "suspect liquid" or crystalline material, PCBs, and high levels of unknown radiological isotopes. When a suspected unknown hazard is encountered, the SSHO will hold a site safety meeting and brief workers on what precautions are to be taken. If an unknown hazard is discovered on-site, it will be controlled by the following actions:

1. Personnel will not handle or stand around the suspect hazard.
2. Personnel in the immediate area will evacuate to the assembly point, the SSHO will be notified, and field activities altered. (The procedure for an LSS Reportable Emergency will be followed if the SSHO believes there is an immediate threat to the health and welfare of the site workers, public, and/or the environment.)
3. Access to the area of concern will be restricted by flagging or barriers and, warning signs will be posted, as appropriate.
4. The appropriate health and safety disciplines (e.g. IH, ORP, and/or IS) will be notified.
5. Response personnel appropriate for the emergency situation will be notified (e.g., LSS, spill response, SPM, facility manager, fire department, etc.).
6. The SSHO, or another designated person, will wait for response personnel to arrive on-site with instructions regarding the emergency situation.
7. All recommendations and guidance from the appropriate environmental, safety, and health disciplines will be followed.
8. All information related to the hazard/emergency will be documented (i.e., what was done, who was contacted and when, what decisions were made and why).
9. The SSHASP will be revised, if warranted.

NOTE: Field activities can resume in areas adjacent to the suspected hazard under the direction of the SSHO and appropriate H&S disciplines, only if there is no immediate threat to the health and welfare of the site workers, public and/or environment.

7. SITE ACCESS REQUIREMENTS

In many remote areas, primary access to the site is controlled by means of a perimeter fence and an ORNL security badge-activated gate. The fence and gate are maintained by ORNL. Some areas may have special access requirements based on previous history or current activities. To gain access consult with the Facility Manager who will inform you of the special requirements.

The minimum requirements for ER sites are listed below. The health and safety training complies with the requirements specified in 29 CFR 1910.120. All training requirements presented in this PHASP can be fulfilled only by training courses that have been reviewed for equivalency by the Energy Systems training program.

- The Facility Manager and/or the ER Program ES&H Manager in consultation with the ORNL HAZWOPER Program Coordinator will have final control over site access.
- All personnel other than facility visitors at ORNL are required to have General Employee Training (GET).
- All personnel who will be performing work as hazardous waste site workers are required to have a minimum of 24 hours of health and safety training and Radiological Worker Training II. If respirators are required, or intrusive activities (penetration, removal, well sampling) are performed, the workers must have 40 hours of health and safety training and Radiological Worker Training II.
- Visitors who are granted site access are required to be escorted at all times by a person who meets the specific site/facility requirements to escort visitors. Additionally, visitors are to abide by all requirements of the PHASP, applicable SSHASPs, and their escort(s).
- Access to specific HAZWOPER sites* by visitors is controlled by the SSHO, HAZWOPER Program Coordinator, and ER ES&H Manager, who will determine the level of training required.
- Visitors are not required to be on the internal dosimetry program or participate in the respiratory protection program. However, visitors who may enter potential radiological exposure areas are to receive a temporary TLD badge. Visitors will be denied access to those areas that have airborne radiological or chemical hazards. They will also be denied access into the CRZ, EZ, and any radiological posted areas, if there is danger.
- Visitors are to participate in the site briefing given by the SSHO or his/her designee.

*HAZWOPER sites are those that fall under the ORNL HAZWOPER Program. The applicability of HAZWOPER to operations/activities conducted at ORNL is based on the activity, site, and potential for exposure to health and safety hazards. Specific criteria, detailed in ORNL HAZWOPER procedures, must be reviewed to determine if the ORNL HAZWOPER Program applies.

7.1 TRAINING

7.1.1 General Employee Training (GET)

All Energy Systems' employees, prime contractors, students, interns, and subcontractors are required to complete GET and to also complete a GET refresher training session every 24 months. This requirement was established by Energy Systems for all personnel. GET training describes the primary function of the various Energy Systems' sites and their responsibility to DOE. It covers the security system, emergency programs, various emergency signals, and appropriate actions that need to be taken by each individual. GET also covers general health and safety topics including the various radiation zones that can be found throughout each plant. GET explains the Hazardous Communication Program and how it affects the employee. For additional information on the GET contact ORNL Training and Development Department.

7.1.2 40-Hour SARA/OSHA HAZWOPER Training

Personnel who work at hazardous waste site or designated HAZWOPER sites must recognize and understand the potential hazards to health and safety associated with site activities. Individuals may not participate in or supervise any site activity until they have been properly trained. The HAZWOPER standards within 29 CFR 1910.120(e) reflect a tiered approach to this training. The objectives of the HAZWOPER training program are to:

- Educate workers about the potential health and safety hazards they may encounter at the site;
- Provide the knowledge and skill necessary to minimize risk to worker safety and health;
- Provide thorough training in the proper use and potential limitation of safety and PPE; and
- Ensure that workers can safely avoid or report potential emergencies.

The training program should include 40 hours of classroom instruction in a wide range of health and safety topics, demonstrations, and "hands-on" practices plus 3 days of supervised field experience at a hazardous waste site. Upon satisfactory completion of these aspects a certificate of completion will be awarded to each individual. A copy of the certificate or verification of completion must be maintained on-site to ensure compliance. In addition, a copy of the ORNL Documentation of HAZWOPER Field Experience (found in the SSHASP, Attachment B) should be maintained on-site, and a copy should be sent to the ORNL ER Project Manager before reposit in the ORNL Document Management Center.

7.1.3 24-Hour SARA/OSHA HAZWOPER Training

SARA/OSHA 24-hour training includes a minimum of 24 hours of classroom training plus 1 day of supervised field experience at a hazardous waste site. The 24-hour training is required for workers or supervisors who are on-site regularly and will only enter areas that have been fully characterized, indicating that exposures are under the PELs and published

exposure limits. If site or task requirements specify respiratory protection equipment, 24-hour SARA/OSHA training will not suffice. An additional 16 hours classroom training and 2 days of field experience will be required to upgrade to the 40-hour training. A copy of the certificate or verification of completion of this training or the ORNL Special Access Training Badge must be maintained on-site to verify compliance. In addition, a copy of the ORNL Documentation of HAZWOPER Field Experience (found in the SSHASP, Attachment B) should be maintained on-site and a copy sent to the ORNL ER ES&H Manager before reposit in the ORNL Document Management Center.

7.1.4 8-Hour SARA/OSHA HAZWOPER Supervisor Training

An additional 8 hours of HAZWOPER supervisory training will be required for those individuals that are involved in management or supervision of workers on a HAZWOPER site. This training is in addition to either the 24-hour or 40-hour training required for the specific site. The supervisor training elaborates on supervisor roles and responsibilities under the health and safety program, the PPE program, the medical surveillance program, and the emergency response plan.

7.1.5 ORNL Radiological Worker Training

Radiation worker training is designed to meet the requirements stipulated in the DOE *Radiological Training Manual* (DOE April 1994). A radiation worker is defined as an occupational worker whose job assignment involves exposure to radiation while working on, with, or in proximity to radiation-producing machines or radiative materials and is likely to be exposed above 100 mrem per year (including external and internal sources). This also includes personnel who work in or have access to Contamination Areas, regardless of their dose. The basic objectives of this training is to provide answers to the following questions:

- What is radiation and where does it originate from?
- How harmful is it to the individual?
- How can it be controlled and who is responsible for its control?
- How can an individual minimize his/her exposure?

The ORNL ER Program requires that all site workers have Radiation Worker II training. This training covers the use of PPE for protection against a radiological concern. Instruction includes the proper type of PPE and how to don and doff the protective articles. A certificate of completion is awarded upon satisfactory completion of the course, clothing demonstration, instrument laboratory, and examination. Retraining and recertification is required every two years. A copy of each workers' certificate must be available on-site to verify compliance. In specific cases where PPE is not required, Radiation Worker I training may suffice. This shall be evaluated and approved on a case-by-case basis by ORNL HAZWOPER Program Coordinator and ER Program ES&H Manager.

7.1.6 Asbestos Training

The level of effort with regard to asbestos and the condition of the suspect material will dictate what degree of training will be required when working around or handling asbestos and other man-made fibers. The 1- to 2-hour Asbestos Awareness Training includes video tapes that explain and identify hazards dealing with asbestos containing material. This training is required of personnel working around but not coming in contact with asbestos material.

The 40-hour Asbestos Worker Training explains the hazards and controls needed to remove, handle, or abate asbestos material. The course also covers:

- potential health effects related to asbestos,
- recognition of damage or deterioration of asbestos material,
- personal hygiene,
- federal, state and local laws and regulations, and
- respiratory protection and medical surveillance programs relate to asbestos and man-made fibers.

Other OSHA standards for asbestos can be found contained in:

- 29 CFR 1910.1001, *General Industry*,
- 29 CFR 1926.58, *Construction Industry*, and
- 29 CFR 1910.134, *Use of Respirators*.

Additional laws and regulations that need to be considered when dealing with asbestos include: EPA Worker Protection Rule; the National Emission Standards for Hazardous Air Pollutants (NESHAPS); the Asbestos Hazard Emergency Response Act (AHERA); and Department of Transportation regulations.

Asbestos Abatement Supervisor Training is required for any individual who is going to supervise asbestos workers participating in an abatement project. This training follows the requirements established in the EPA asbestos regulation found in 40 CFR 763. Requirements and description for this "competent person" can be found in 29 CFR 1926.32(f). Items covered in this supervisory training include:

- federal, state, and local laws and regulations;
- proper handling of asbestos material;
- recordkeeping for asbestos abatement projects;
- insurance and liability issues; and
- contract specifications.

If any suspected asbestos-containing material must be sampled or a determination made concerning amount of suspected asbestos material or the potential degree of hazard posed by this material, a qualified Asbestos Inspector and a qualified Asbestos Management Planner

must make those calls. This involves additional training for each discipline. The individual must also possess advanced educational degrees to meet the qualifications. The qualifications for these disciplines can be found in The Asbestos Hazard Emergency Response Act (AHERA) Final Rule, 40 CFR 763 Subpart E.

7.1.7 HAZWOPER Site Safety and Health Officer Training

This 1/2 day training course (or an equivalent SSHO training course approved by the ORNL Training Department) is required by ORNL to ensure that all individuals serving as SSHOs are following the same guidelines, recommendations, and orders. The training program ensures consistency among those acting as SSHOs. All personnel requesting to be SSHOs must first be approved by the ORNL ER ES&H Manager and the ORNL HAZWOPER Program Coordinator. The ORNL ER ES&H Manager and the ORNL HAZWOPER Program Coordinator shall review the applicants educational background, field experiences, types of sites worked, and types of instrumentation utilized during the course of his/her career. Based on this information the ER ES&H Manager and ORNL HAZWOPER Program Coordinator will assign the applicant a level of competence, either SSHO Level 1, 2, or 3. After approval, the individual must attend the ORNL HAZWOPER Site Safety and Health Officer Training (TMIS # 11137). Based upon experience and educational background, this requirement may be temporarily waived by the ORNL HAZWOPER Program Coordinator until a class becomes available for participation. Once this training has been acquired, all requirements to serve as a SSHO have been fulfilled. Further information on requirements and criteria for SSHOs is available from the ORNL HAZWOPER Program and Sect. 4.3.2.2.

7.1.8 Defensive Driving and Nonpaved Surfaces

A 2- to 3-hour training session discussing how to safely drive on unpaved surfaces is required for anyone driving on nonpaved surfaces. This training describes safe braking distances, safe driving speeds, driving in adverse weather conditions, safely correcting a slide or skid, and the importance of wearing seat belts and shoulder harnesses. A Special Training Access card will be issued to individuals successfully completing this training module.

7.1.9 Worker/Visitor Training Requirements

The requirements for worker training for projects conducted under this PHASP shall be determined by the anticipated role of the worker and the tasks that he or she is required to perform. Minimum training requirements for entry into a site for routine or occasional workers; CAA, CRZ, or EZ workers (Levels A, B, C, and D+ workers); on-site supervisors; and nonworkers or site visitors are listed below in Table 6. The regulatory basis for the requirements presented in Table 6 is located in 29 CFR 1910.120. The presentation of this information was adapted from the U.S. DOE document OSHA Training Requirements for Hazardous Waste Operations (DOE 1991) and updated to include additional ORNL ER training requirements.

Table 6. Site training requirements

Operation/ personnel	Site health & safety briefing	24-h	40-h	8-h supervisor	8-h refresher ^a	Rad worker II	Emergency response personnel
Routine/occasional worker	X	X ^b	X		X	X	
Routine/occasional worker (Level D)	X	X			X	X	
On-site supervisor	X	X ^c	X	X	X	X	
Nonworker/visitor ^{d,e}							
Level A or B PPE ^f	X		X		X	X ^g	
Level C PPE	X		X		X	X ^g	
Level D or No PPE	X	X					
8-h field training		X					
24-h field training			X				
Emergency response training							X

^aAnnual requirement; however, personnel not receiving refresher training within 3 years of initial training or last refresher course (at a minimum) should repeat the initial course.

^b24-h training is adequate for workers *only* for entry into areas where Level D PPE is sufficient. For routine workers, area must also have been monitored and fully characterized.

^cSupervisors of ER site on-site workers who require only the 24-h course need only take the 24-h initial and 8-h supervisor courses.

^dAll visitors should be issued and instructed on the use of required PPE, receive a site-specific safety briefing, be escorted by trained personnel, and wear a personal dosimeter.

^eNonworkers are DOE employees and DOE contractors not directly involved with hazardous waste or other ER site operations (e.g., management, audit, and oversight personnel). Visitors include those covered and not covered by OSHA. Visitors not covered by OSHA who are granted a waiver from training requirements by the Assistant Secretary for Environment, Safety and Health (EH-1) should comply with footnote *b* requirements above.

^fPPE - Personal Protective Equipment.

^gRadiation Worker II required at radiological sites.

Other worker training requirements, as stated above, will be project- and task-specific, and may include, but are not limited to, courses on the following subjects: respiratory protection, radiation worker, confined space entrant/attendant, asbestos, specific carcinogens, and operation of specific equipment. Training requirements shall be dictated by 29 CFR 1910.120(e), 29 CFR 1926, and any other regulatory standards that would be applicable to site operations. The SSHO will be responsible for verifying task specific training for workers on certain equipment.

7.1.10 Training or Medical Requirements

Specific training or medical requirements (e.g., bioassay program, respirator fit tests) may not be required for visitors requiring access to certain zones if specific hazards (such as airborne hazards) do not exist. Variances may be enacted on a case by case basis and shall be granted and approved by both the ER ES&H Manager and the ORNL HAZWOPER Program Coordinator.

Personnel that do not meet the training or medical requirements will always be escorted by the SSHO/ES&H technician or the ER Program ES&H Manager. The safety and health of no individual will be compromised for site access. All site hazards shall be evaluated before access is granted.

7.1.11 Training Documentation

Training received outside ORNL or Energy Systems must be reviewed by the MMES Center for Continuing Education Health and Safety Institute. Acceptable forms of documentation of worker training will be up-to-date certificates of training as well as course materials for all completed courses that are required for site access and operations. An ORNL Special Access Training card and an up-to-date respiratory fit-test card will serve as acceptable forms of training documentation, as applicable. Training records will be maintained by the SSHOs.

7.1.12 Equivalent Training

In special circumstances, according to the provisions of 29 CFR 1910.120 (e)(9), equivalent training such as hazardous waste site work experience, academic training and/or other forms of certification or training may be considered acceptable for compliance with the training requirements of 29 CFR 1910.120(e)(1) through (e)(4). The determination of whether equivalent training status is granted shall be determined and documented in writing by the HAZWOPER Program Coordinator and the MMES Center for Continuing Education Health and Safety Institute.

7.2 PRE-ENTRY HEALTH AND SAFETY BRIEFING

All personnel shall be required to attend a pre-entry health and safety briefing prior to entering the site as a requirement for access to the work site. This pre-entry health and safety briefing shall be conducted jointly by the SSHO or team leader and the ORP representative or by designated representatives who have been approved by the SSHO and the ORP. The pre-entry health and safety briefing shall highlight the health and safety information presented in this PHASP and the SSHASP. This information may include, but is not limited to, the following:

- Reporting chain of command.
- Site history.

- Site access requirements.
- Site chemical hazards and symptoms of exposure (HAZCOM).
- Site physical and mechanical hazards and recognition of hazards.
- Personnel and equipment decontamination requirements.
- "Clear" areas or break areas and rest room facilities
- Location of communications equipment (nearest telephone and fire alarm pull box) and identification of site personnel who have access to two-way radios.
- Location of emergency telephone numbers.
- Evacuation routes and recommended progression.
- Location of the site primary and secondary emergency assembly point.
- Emergency and contingency procedures.
- Locations and types of emergency equipment available during site operations.
- Spill response procedures.
- Actions to take if unexpected hazards are encountered.
- Location and content of the emergency action plan (see Sect. 12).
- Location and content of the site emergency contingency plan (see Sect. 12.2).
- Other information contained in the SSHASP.

7.2.1 Documentation of Briefings

Attendance at the initial pre-entry health and safety briefings will be documented by the signature of all personnel present at the briefing and by the completion of the SSHASP Briefing Log (see Attachment B) or by signing a specific section in the site logbook.

7.2.2 Daily Safety and Health Briefings

Daily H&S briefings shall be held by the SSHO, ES&H technician, ORP representative (if required on-site), and/or the SPM to summarize planned activities, to identify new hazards, or to clarify any task- or project-related issues. All site personnel anticipated for the day's activities will be required to attend. Daily H&S briefings may include, but are not limited to, the following subjects:

- Worker safety issues;
- Task-specific PPE and respiratory requirements;
- Requirements for Radiation Work Permits and/or Safety Work Permits;
- SOPs; and/or

- Any project changes or deviations such as changes in site conditions, operations, hazards, or supervisory personnel.

7.3 PERSONAL PROTECTION REQUIREMENTS

The SSHO in consultation with the ORNL HAZWOPER Program Coordinator and the appropriate ES&H disciplines, shall specify the PPE required for site activities, tasks, and work zones. This specification shall be based on possible site contaminants, OSHA guidelines, and chemical and radiological hazards information. In most cases, the PPE required will be some combination of chemical and radiological PPE. The final decision on PPE levels and requirements will be made by the SSHO, IH, IS, and/or a representative from ORP, and shall be recorded in the SSHASP. The SSHO and/or the ORP representative shall instruct all site personnel in donning and doffing procedures prior to beginning any site activities. The donning procedures shall be posted in the support zone for reference. The doffing procedures shall be posted between the CRZ and the support zone or at the boundary of the CAA.

In all circumstances, field clothes worn while conducting ORNL ER activities must be issued by Energy Systems. Field clothes issued by companies or organizations other than Energy Systems cannot be worn at ORNL ER sites. Additionally, long-sleeved field clothes must be worn by all field personnel in the following situations:

- Work activities are to be performed in areas that require Level D+ PPE or greater.
- Work activities are to be performed in areas that pose an extreme biohazard to field personnel (poison ivy, insects, etc.).

7.3.1 General PPE Guidelines

Chemical PPE required may include, but is not limited to, the ensembles listed in Table 7.

The requirement that safety glasses be worn under Levels D and D+ of protective equipment will not apply when the requirements for protective equipment are upgraded to Level C and respiratory protection with a full-face mask is required. Where the potential for chemical contaminant absorption exists, the outer protective garment will be made of a chemical-resistant woven material (Saranex® or a more protective material) which forms a protective barrier against detrimental chemicals for a specific period of time based on the chemical in question. Each chemical has its own permeating ability, and the resistance of the protective clothing will vary with each chemical. For some chemicals, the risk of chemical permeation increases when an outer protective garment becomes damp from soil or water contact. The SSHO or ORP representative shall determine the appropriate PPE ensemble, with input from other ORNL ES&H disciplines, as appropriate. The required PPE levels shall be specified in the SSHASPs.

Table 7. Suggested protective ensembles

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
A	<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Pressure-demand, full -facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA. • Fully-encapsulating, chemical-resistant suit. • Inner chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Two-way radio communications. <p>OPTIONAL:</p> <ul style="list-style-type: none"> • Cooling unit. • Long cotton underwear • Hard hat. • Disposable gloves and boot covers. 	The highest available level of respiratory, skin, and eye protection.	<ul style="list-style-type: none"> • The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either: <ul style="list-style-type: none"> -measured (or potential for) high concentration of atmospheric vapors, gases, or particulates or -site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin. • Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible. • Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined. 	<ul style="list-style-type: none"> • Fully-encapsulating suit material must be compatible with the substances involved.

Table 7 (continued)

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
B	<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA. • Chemical-resistant clothing (coveralls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit). • Inner and outer chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Hard hat. • Two-way radio communications. <p>OPTIONAL:</p> <ul style="list-style-type: none"> • Coveralls. • Disposable boot covers. • Face shield. • Long cotton underwear. 	The same level of respiratory protection but less skin protection than Level A. Level B protection is the minimum level recommended for initial site entries until the hazards have been further identified.	<ul style="list-style-type: none"> • The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. This involves atmospheres: <ul style="list-style-type: none"> - with IDLH concentrations of specific substances that do not represent a severe skin hazard; or - that do not meet the criteria for use of air-purifying respirators. • Atmosphere contains less than 19.5% oxygen. • Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin. 	<ul style="list-style-type: none"> • Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin. • Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates or splashes of material that will affect exposed skin.

Table 7 (continued)

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
C	<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Full-facepiece, air-purifying, canister-equipped respirator. • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit). • Inner and outer chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Hard hat. • Two-way radio communications. <p>OPTIONAL:</p> <ul style="list-style-type: none"> • Coveralls. • Disposable boot covers. • Face shield. • Escape mask. • Long cotton underwear. 	The same level of skin protection as Level B, but a lower level of respiratory protection.	<ul style="list-style-type: none"> • The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin. • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant. • All criteria for the use of air-purifying respirators are met. 	<ul style="list-style-type: none"> • Atmospheric concentrations of chemicals must not exceed IDLH levels. • The atmosphere must contain at least 19.5% oxygen.
D+	<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Coveralls. • Safety boots/shoes. • Safety glasses or chemical splash goggles. • Hard hat. <p>OPTIONAL:</p> <ul style="list-style-type: none"> • Gloves. • Escape mask. • Face shield. 	No respiratory protection. Minimal skin protection.	<ul style="list-style-type: none"> • The atmosphere contains no known hazard. • Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals. 	<ul style="list-style-type: none"> • The atmosphere must contain at least 19.5% oxygen.
D	<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Energy Systems-issued field clothes. • Hard-toed safety footwear. • Safety glasses or chemical splash goggles. • Cotton work gloves. 	No respiratory protection. Minimal skin protection.	<ul style="list-style-type: none"> • The atmosphere contains no known hazards. • Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals. 	<ul style="list-style-type: none"> • Atmosphere contains at least 19.5% oxygen.

7.3.2 Radiological PPE Guidelines

Protective Clothing Guidelines for Radioactive Contamination that comply with the DOE *Radiological Control Manual* are presented in Attachment I. The ORNL ORP should be contacted for further guidance and for information on updates and revisions to these guidelines.

7.3.2.1 Personal protective equipment for radiological land surveys

PPE will be chosen to provide protection appropriate to the situation, keeping in mind that overprotection and underprotection can each create hazardous conditions. When survey/sampling work is carried out on sites that have no known contamination and are accessible to anyone on the reservation, requirements for PPE will be determined by the physical nature of the site under investigation. Minimum PPE requirements are discussed here; the SSHASP will specify additional requirements, if needed.

Walkover survey: Survey personnel will wear Energy Systems-issued work clothes and hard-toed safety footwear. At some sites higher levels of PPE may be required. This could include overboots, gloves, safety glasses, hard hat, snake leggings, brightly colored safety vest, and other items.

Soil Sampling: The minimum PPE required for soil sampling is Energy Systems-issued work clothes and hard-toed safety footwear. The sampling team (i.e., the two people collecting and packaging the sample) will also wear safety glasses and leather or vinyl gloves while collecting samples. Under dusty conditions, the soil should be misted with water or respirators should be worn.

Water Sampling: The minimum PPE required for water sampling is Energy Systems-issued work clothes, hard-toed safety footwear, rubber boots, vinyl gloves, and eye protection with a face shield, if warranted. Tyvek protective coveralls shall be worn at the discretion of the SSHO or other qualified ES&H disciplines. If tritium is expected to be contained in the water, a Tyvek suit or other PPE that is impervious to water is required.

Vegetation Sampling: The minimum PPE required for vegetation sampling is Energy Systems-issued clothing with long sleeves (to protect against skin contact with poisonous plants and insects), safety glasses, and gloves (cotton, leather, or vinyl).

7.3.3 Respiratory Protection

All respiratory equipment shall 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 annual quantitative respirator fit test and will wear only those respirators approved by the quantitative fit test. Fit testing precisely measures the respirator fit (seal) while the body makes normal and exaggerated movements and while breathing normally and hyperventilating. Fit testing must be repeated whenever there is a change in facial shape (e.g., dentures, weight loss, plastic surgery). In addition, site personnel will abide by a single-use respiratory policy. Once the

face-to-facepiece seal of the respirator has been broken (e.g., for lunch and other breaks), a new respirator will be donned in place of the previous one. (NOTE: DOE currently has a policy which allows reuse of a respirator under certain conditions. Energy Systems is reviewing this policy at the present time. If Energy Systems adopts a similar policy on respirator reuse, this information will be conveyed to the appropriate managers for incorporation into the appropriate documents.)

Unless otherwise stated in the contract for site activities, respirators shall be supplied by IH and shall be inspected by a representative from QA prior to issue for field use. Respirators will only be issued by qualified issuing personnel. No site personnel will be issued a respirator without a valid respirator card. The SSHO will verify qualification of respirator users. All site personnel that don respirators will comply with the ORNL respiratory protection program, which meets the requirements of 29 CFR 1910.134 and ORNL IH procedures. Subcontractors that are fit tested by other than the ORNL IH Department must provide documentation on their fit-test program to the SPM for approval.

7.3.4 PPE Upgrade/Downgrade Authority

There are various circumstances where it may be necessary to upgrade or downgrade PPE levels. Some instances where upgrading or downgrading may be necessary:

Reasons to upgrade:

- Known or suspected presence of dermal hazards
- Occurrence or likely occurrence of gas or vapor emission.
- Change in work task that will increase contact or potential contact with hazardous materials.
- Request of the individual performing the task.

Reasons to downgrade:

- New information indicating that the situation is less hazardous than was originally thought.
- Change in site conditions that decreases the hazard.
- Change in work task that will reduce contact with hazardous materials.

The decision to change PPE levels will be made based upon site conditions. Persons with the following site roles shall have the authority to order the upgrade or downgrade of PPE levels during ongoing site activities: the SSHO, the ES&H technician, the ORP representative, IH representative, and IS. At a minimum, the upgrade or downgrade of PPE that does not involve the use of a respirator does not require the approval of health and safety disciplines. When respirators are to be donned for unexpected hazard(s) other than dusty conditions, the appropriate parties (IH representative, ORP representative, IS) must be notified for approval. In all cases, the change and the reason or evidence for the change must be documented in the field logbook.

Specific information on upgrade and downgrade authority is detailed in Sect. 3.3.

7.3.5 Donning and Doffing Personal Protective Equipment

Procedures for donning and doffing PPE will be dependent upon the type of ensemble required to control worker exposures during anticipated site operations. General donning and doffing procedures for Level D, D+, C, B, and A are listed below. General donning and doffing procedures for radiological work are listed in Attachment I. Specific procedures shall be determined by the SSHO and ORP representative and, if different from the procedures listed here, shall be included in the SSHASP.

7.3.5.1 Inspection of PPE

A sample PPE inspection checklist is provided in Table 8. Prior to donning any piece of PPE, the item must be inspected by the individual that will be wearing it to ensure that the piece of PPE will protect the worker in the manner that it was designed to. Each item should be visually inspected for defects that could compromise the protection factor of that article. Protective clothing must be checked for tears or rips, malfunctioning closures or zippers, and for pinhole-sized defects (hold the garment up to light to see if light penetrates). Gloves also should be inspected for defects that could result in an exposure or contact with a hazardous chemical. Visually inspect the glove for noticeable tears and then pressure check by rolling the gloves toward the fingers to inflate the body of the glove. If there are any tears or leaks the glove will not remain inflated. Respirators shall be inspected prior to donning. The respirator must be clean and the seals must be intact and not cracked. The valves and cartridge seals should move slightly when touched. Additional information on what to inspect with regard to respirators can be found within 29 CFR 1910.134, *Respiratory Protection*. If any article of PPE is found to be defective or inoperable, it should be turned in to the SSHO and a replacement article should be selected.

7.3.5.2 Donning and doffing procedures for Level D PPE

Donning Procedures for Level D PPE

Strict guidelines for donning Level D and Level D+ PPE do not exist. Field workers should use their best judgement and don articles in the most convenient order. All PPE should be donned in the support area prior to entering the CCA or EZ.

Doffing Procedures for Level D PPE

There are no strict guidelines for doffing Level D PPE; however, all field personnel should use their best judgement and exercise caution when doffing potentially contaminated articles. For example, potentially contaminated field gloves should be doffed prior to removing any other articles, such as safety glasses and hard hats. All potentially contaminated articles must be disposed of in compliance with applicable waste management policies and guidelines. Once all articles are doffed, radiological frisking (Sect. 6.4.2) and stringent hand washing should be performed.

Table 8. Sample PPE Inspection Checklist

CLOTHING

Before use:

- Determine that the clothing materials are correct for the specified task at hand.
- Visually inspect for:
 - imperfect seams
 - non-uniform coatings
 - tears
 - malfunctioning closures
- Hold up to light and check for pinholes.
- Flex product:
 - observe for cracks
 - observe for other signs of shelf deterioration
- If the product has been used previously, inspect inside and out for signs of chemical attack:
 - discoloration
 - swelling
 - stiffness

During the work task, periodically inspect for:

- Evidence of chemical attack such as discoloration, swelling, stiffening, and softening. Keep in mind, however, that chemical permeation can occur without any visible effects.
- Closure failure.
- Tears.
- Punctures.
- Seam discontinuities.

GLOVES

Before use:

- Pressurize glove to check for pinholes. Either blow into glove, then roll gauntlet towards fingers or inflate glove and hold under water. In either case, no air should escape.

FULLY-ENCAPSULATING SUITS

Before use:

- Check the operation of pressure relief valves.
- Inspect the fitting of wrists, ankles, and neck.
- Check faceshield, if so equipped, for:
 - cracks
 - fogginess

RESPIRATORS*

SCBA

- Inspect SCBAs:
 - before and after each use
 - at least monthly when in storage
 - every time they are cleaned
- Check all connections for tightness.
- Check material conditions for:
 - signs of pliability
 - signs of deterioration
 - signs of distortion
- Check for proper setting and operation of regulators and valves (according to manufacturers' recommendations).
- Check operation of alarm(s).
- Check faceshields and lenses for cracks and fogginess

Air-Purifying Respirators

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

Supplied-Air Respirators

- Inspect supplied-air respirators:
 - daily when in use
 - at least monthly when in storage
 - every time they are cleaned
- Inspect air lines prior to each use for cracks, kinks, cuts, frays, and weak areas.
- Check for proper setting and operation of regulators and valves (according to manufacturers' recommendations).
- Check all connections for tightness.
- Check material conditions for:
 - signs of pliability
 - signs of deterioration
 - signs of distortion
- Check faceshields and lenses for cracks, fogginess

* Must have NIOSH/MSHA approval

7.3.5.3 Donning and doffing procedures for Level D+ PPE

Donning Procedures for Level D+ PPE

1. Visually inspect all clothing and equipment to be worn prior to donning.
2. If the ensemble includes a chemical protective suit, the suit should be worn over Energy Systems-issued clothing.
3. While standing or sitting, step into the legs of the chemical protective suit. Tape leg cuffs to top of work boots (leaving a tab on the tape for easy removal).
4. Place arms in the sleeves of the chemical protective suit, and pull the suit over the shoulders.
5. Zip suit to the neck, and place tape over zipper to ensure closure (leave a tab on the tape for easy removal).
6. Don chemical protective overboots, and tape top of boot to outside of the suit (leave a tab on the tap for easy removal).
7. Don cotton liners and chemical resistant outer gloves. Place tape around top of outer glove (leaving a tab on the tape for easy removal).
8. Don safety glasses and hard hat (if appropriate).

Doffing Procedures for Level D+ PPE

1. Remove all outer tape from the ensemble.
2. Remove chemical protective overboots while stepping to a step-off pad (if provided).
3. Remove contaminated outer gloves by pulling down on the inner cuff of the glove with the opposite hand, thereby turning the glove inside out. While still holding the partially removed glove, grasp the cuff of the glove on the other hand and pull down over the partially removed glove. One glove should be encapsulated in the other, with the contaminated side turned inward.
4. Remove tape from the top of work boots.
5. Unzip suit, and remove arms from suit. Roll suit downward to feet, turning inside out. Step out of suit, and place the suit in the appropriate waste receptacle.
6. Remove inner cotton gloves as described in step 3.
7. Remove safety glasses and hard hat.
8. Perform radiological frisking, if appropriate.
9. Wash hands before eating, drinking, or smoking.

7.3.5.4 Donning and doffing procedures for Level C PPE

Donning Procedures for Level C PPE

1. Inspect all clothing and respiratory equipment before donning.
2. Adjust hard hat to fit user's head.

3. While standing or sitting, step into the legs of the chemical protective suit. Tape leg cuffs to top of boots (leaving a tab on the tape for easy removal).
4. Put on chemical protective overboots, and tape the top of the boot to the suit (leaving a tab on the tape for easy removal).
5. Don skull cap.
6. Place arms in chemical protective suit, and pull suit over the shoulders and hood over head.
7. Don respirator and conduct positive and negative pressure tests.
8. Zip suit to neck, and place tape over zipper and around respirator and hood (leaving a tab on the tape for easy removal).
9. Don cotton inner gloves and chemical resistant outer gloves. Place tape around outer glove seam (leaving a tab on the tape for easy removal).
10. Don hard hat.

Doffing Procedures for Level C PPE

1. Remove all exterior tape closures (from overboots, gloves, zipper, etc.).
2. Remove overboots while stepping to a step-off pad.
3. Remove outer gloves, rolling over hand inside out.
4. Unzip chemical protective suit, and pull hood off of head rolling suit inside out.
5. Slip suit off shoulders, and roll suit inside-out down to ankles.
6. Step out of suit and onto a second step-off pad (if available).
7. Remove respirator and place in designated plastic bag.
8. Remove skull cap.
9. Remove cotton gloves, rolling over hand inside out.
10. Perform whole body radiological frisk.

73.5.5 Donning and doffing procedures for Level B PPE

Donning Procedures for Level B PPE

1. Inspect all clothing and respiratory equipment before donning.
2. Adjust hard hat to fit user's head.
3. While standing or sitting, step into the legs of the chemical protective suit (Saranex or higher level). Tape leg cuffs to top of boots (leaving a tab on the tape for easy removal).
4. Put on chemical protective overboots, and tape the top of the boot to the suit (leaving a tab on the tape for easy removal).
5. Don skull cap.
6. Place arms in chemical protective suit, and pull suit over the shoulders and hood over head.

7. Don pressure-demand full-face SCBA or pressure-demand full-face supplied-air respirator with escape SCBA, and conduct positive and negative pressure tests.
8. Zip suit to neck, and place tape over zipper and around respirator and hood (leaving a tab on the tape for easy removal).
9. Don cotton inner gloves and chemical resistant outer gloves. Place tape around outer glove seam (leaving a tab on the tape for easy removal).
10. Don hard hat.

DoFFing Procedures for Level B PPE

1. Remove all exterior tape closures (from overboots, gloves, zipper, etc.).
2. Remove overboots while stepping to a step-off pad.
3. Remove outer gloves, rolling over hand inside out.
4. Remove SCBA harness and tank, unzip chemical protective suit, and pull hood off of head rolling suit inside out.
5. Slip suit off shoulders, and roll suit inside-out down to ankles.
6. Step out of suit and on to a second step-off pad (if available).
7. Remove respirator and place in designated plastic bag.
8. Remove skull cap.
9. Remove cotton gloves rolling inside out.
10. Perform whole body radiological frisk.

7.3.5.6 Donning and doffing procedure for Level A PPE

Donning Procedure for Level A PPE

1. Inspect the clothing and respiratory equipment before donning.
2. Adjust hard hat or headpiece if worn, to fit user's head.
3. Open back closure used to change air tank (if suit has one) before donning suit.
4. Standing or sitting, step into the legs of the suit; ensure proper placement of the feet within the suit; then gather the suit around the waist.
5. Put on chemical-resistant safety boots over the feet of the suit. Tape the leg cuff over the tops of the boots.
 - If additional chemical-resistant boots are required, put these on now.
 - Some one-piece suits have heavy-soled protective feet. With these suits, wear short, chemical-resistant safety boots inside the suit.
6. Put on air tanks and harness assembly of the SCBA. Don the facepiece and adjust it to be secure, but comfortable. Do *not* connect the breathing hose. Open valve on air tank.
7. Perform negative and positive respirator facepiece seal test procedures.

8. Depending on type of suit:
 - Put on long sleeved inner gloves (similar to surgical gloves).
 - Secure gloves to sleeves, for suits with detachable gloves.
 - Additional overgloves, worn over attached suit gloves, may be donned later.
9. Put sleeves of suit over arms as assistant pulls suit up and over the SCBA (if used). Have assistant adjust suit around SCBA and shoulders to ensure unrestricted motion.
10. Put on hard hat, if needed.
11. Raise hood over head carefully so as not to disrupt face seal of SCBA mask. Adjust hood to give satisfactory comfort.
12. Begin to secure the suit by closing all fasteners, leaving only enough room to connect the breathing hose. Secure all belts and/or adjustable leg, head, and waistbands.
13. Connect the breathing hose while opening the main valve.
14. Have assistant first ensure that wearer is breathing properly and then make final closure of the suit.
15. Have assistant check all closures.
16. Have assistant observe the wearer for a period of time to ensure that the wearer is comfortable, stable, and that the equipment is functioning properly.

Doffing Procedure for Level A PPE

If sufficient air supply is available to allow appropriate decontamination before removal:

1. Remove any extraneous or disposable clothing, boot covers, outer gloves, and tape.
2. Have assistant loosen and remove the wearer's safety shoes or boots.
3. Have assistant open the suit completely and lift the hood over the head of the wearer and rest it on top of the SCBA tank.
4. Remove arms, one at a time, from suit. Once arms are free, have assistant lift the suit up and away from the SCBA backpack—and the wearer's body—and lay the suit out flat behind the wearer. Leave internal gloves on, if any.
5. Sitting, if possible, remove both legs from the suit.
6. Follow procedure for doffing SCBA.
7. After suit is removed, remove internal gloves by rolling them off the hand, inside out.
8. Remove internal clothing and thoroughly cleanse the body.

If the low-pressure alarm has sounded, signifying that approximately 5 min of air remain:

1. Remove disposable clothing.
2. Quickly scrub and hose off, especially around the entrance/exit zipper.
3. Open the zipper enough to allow access to the regulator and breathing hose.

4. Immediately attach an appropriate canister to the breathing hose (the type and fittings should be predetermined). Although this provides some protection against any contamination still present, it voids the certification of the unit.
5. Follow steps listed above for sufficient air supply. Take care to avoid contaminating the assistant and wearer.

These donning procedures should be performed only after decontamination of the suited worker. They require a suitably attired assistant. Throughout the procedures, both worker and assistant should avoid any direct contact with the outside surface of the suit.

7.4 MEDICAL SURVEILLANCE

7.4.1 ORNL ER Policy Concerning Physicals

All Energy Systems employees, subcontractors, prime DOE contractors, and students performing investigative activities, remedial actions, D&D activities, sampling, monitoring, or construction type activities on sites controlled by the ORNL ER Program are required to have a physical annually, or as often as recommended by a physician (not to exceed a two year interval.) This physical is to be commensurate with the HAZWOPER physical requirements for hazardous waste workers. Copies of the physician's statement (certifying that said worker is medically fit to perform field tasks) shall be provided to the SPM and the ORNL ER Document Management Center. A copy shall also be maintained at the work site in order to ensure compliance requirements.

7.4.2 HAZWOPER Physicals

The SPM must submit to the HAZWOPER Program Coordinator a description of duties and tasks as well as potential contaminants that each project worker will be involved in on the site. From this information, the HAZWOPER Program Coordinator and the ORNL Medical representative will place each project worker on the appropriate monitoring program. HAZWOPER physicals are usually conducted annually and must be conducted at least every 2 years. Physical shall be documented through a written approval by the examining physician. Copies of this Physician Statement will be forwarded to the HAZWOPER Program Coordinator, IS, the worker's supervisor, and a copy will be maintained in the worker's medical record.

7.4.3 Medical Examinations for Asbestos/Man-Made Fibers

The employer shall institute a medical surveillance program for those workers exposed, or having the potential of exposure, to airborne concentrations of fiber asbestos. Regulations pertaining to medical surveillance can be found in 29 CFR 1910.1001, Occupational Safety and Health Administration (OSHA) Asbestos Regulations for General Industry subpart (1) Medical surveillance. Prior to working in an environment with friable asbestos, an individual must have a physical examination conducted by a licensed physician. The examination must include:

1. a medical and work history,
2. a physical examination of all body systems, with special attention to respiratory, digestive, and cardiovascular systems,
3. completion of a respiratory disease form,
4. a chest roentgenogram, and
5. pulmonary function tests to include force vital capacity (FVC) and forced expiratory volume (FEV).

The individual must also be approved for wearing and working in a respirator. Individuals on the asbestos program must be re-examined annually. Upon termination for the asbestos program, or termination of employment, a termination examination shall be performed. This exam must comply with requirements stipulated in 29 CFR 1910.1001(l).

7.4.4 Respirator Fit Test Physical

Individuals should not be assigned tasks that would require them to don a respirator unless they have had a physical examination by a physician to determine their emotional and physical capabilities for wearing a respirator. Some items that the examining physician shall ascertain will be the physical appearance of the individual (e.g., abnormal facial structures or respirator obstructions that would cause difficulties in wearing a respirator) and difficulties with claustrophobia and confinement for a long period of time. A physical examination of the nostrils, upper airways, and a chest exam will be conducted. Further guidance on aspects of a physical examination for the ability to wear a respirator can be found in 29 CFR 1910.134 Respiratory protection.

7.4.5 Medical Monitoring

Minimum requirements for ORNL ER physicals are presented in Table 9. The requirements for additional medical monitoring of worker exposures shall be specified in each SSHASP and shall be dictated by the requirements of 29 CFR 1910 and the procedures and exposure control programs of ORNL IH Section. Medical monitoring for ORNL employees shall be performed through the Health Services Division of ORNL and shall be coordinated with ORNL IH Section. Subcontractors and prime contractors must provide/obtain medical services elsewhere. ER must supply the HPC/medical department with potential site contaminants to determine appropriate monitoring.

Table 9. Minimum requirements for ORNL ER physicals

Exam component	Exam type			
	Baseline	Annual	Termination	Unscheduled
<i>History and physical exam</i>				
Complete medical history	X		X	X
Physical exam by physician	X	X	X	X
Visual acuity	X	X	X	0
<i>Routine laboratory tests/procedures</i>				
Pulmonary function	X	X	X	0
Audiometry	X	X	X	0
Electrocardiogram	X	0	X	0
Chest X-ray*	X	0	X	0
Complete blood count	X	X	X	0
Routine urinalysis	X	X	X	0
Blood chemistry	X	X	X	0

X = Recommended.

0 = Not required.

* = Chest X-rays not repeated more than once a year.

Source: Environmental Protection Agency (EPA) 1990. *Occupational Medical Monitoring Program Guidelines for SARA Hazardous Waste Field Activity Personnel*, EPA Publication 9285.3-04.

7.4.5.1 Baseline screening

The baseline screening has two major functions: (1) to determine an individual's fitness for work, including the ability to work while wearing protective equipment; and (2) to provide baseline data for comparison with future medical data. To ensure that prospective employees are able to meet work requirements, the pre-placement screening should focus on the following areas:

Occupational and Medical History

- Require all personnel to fill out an occupational and medical history questionnaire, describing all prior occupational exposures to chemical and physical hazards.
- Take note of past illnesses and chronic diseases, particularly atopic diseases such as eczema and asthma, lung diseases, and cardiovascular disease.
- Review symptoms, especially shortness of breath or labored breathing upon exertion, or other chronic respiratory symptoms, chest pain, high blood pressure, heat intolerance, or sensitivity to particular substances.
- Record relevant lifestyle habits (eg., smoking, alcohol/drug use) and hobbies.

Physical Examination

- Conduct a comprehensive physical examination focusing on the pulmonary, cardiovascular, and musculoskeletal systems.
- Note conditions that could increase susceptibility to heat stroke or that could affect respirator use.

Ability to Work While Wearing PPE

- Disqualify individuals who are unable to perform based on the medical history and physical exam (e.g., those with severe lung disease, heart disease, or back or orthopedic problems).
- Note limitations concerning the worker's ability to use PPE.
- Provide additional testing for ability to wear PPE where necessary.
- Complete a written assessment of worker's capacity to perform while wearing a respirator, if respiratory protection is a job requirement. Note that the OSHA standard 29 CFR 1910.134 states that no employee should be assigned to a task that requires the use of a respirator unless that person is physically able to perform under such conditions.

7.4.5.2 Termination examination

At the termination of employment as a hazardous site worker, all personnel should have a termination medical examination. A full examination is necessary at the termination of employment if any of the following criteria are not met:

- The last full medical examination was within the last 6 months;
- No exposure occurred since the last examination; and
- No symptoms associated with exposure occurred since the last examination.

7.4.6 ORNL Internal Dosimetry Program

All ER personnel conducting intrusive activities or working in an environment with airborne contamination must participate in the ORNL Internal Dosimetry Program. The frequency for bioassay measurements set by ORNL ORP procedures for workers in radiological areas is shown in Table 10.

Table 10. Frequency of bioassay measurements

Nuclide	Urine	Lung count	WBC	Thyroid
Individuals spending >20% of time in Radiological Area				
Category I				
^3H	Biweekly			
^{14}C	Bimonthly			
^{32}P	Quarterly			
^{90}Sr	Semiannual			
^{125}I				Semiannual
^{131}I				Monthly
^{153}Gd			Semiannual	
Fission and activation products			Semiannual	
Uranium	Quarterly	Annual		
Plutonium	Quarterly	Annual		
Curium	Quarterly			
Individuals spending 5-20% of time in Radiological Area				
Category II				
^3H	Bimonthly			
^{14}C	Semiannual			
^{32}P	Semiannual			
^{90}Sr	Annual			
^{125}I				Annual
^{131}I				Quarterly
^{153}Gd			Annual	
Fission and activation products			Annual	
Uranium	Semiannual	Annual		
Plutonium	Semiannual	Annual		
Curium	Semiannual			

Table 10 (continued)

Nuclide	Urine	Lung count	WBC	Thyroid
Individuals spending <5% (but >0%) of time in Radiological Area				
Category III				
^3H	Semiannual			
^{14}C	Semiannual			
^{32}P	Annual			
^{90}Sr	Annual			
^{125}I				Annual
^{131}I				Semiannual
^{153}Gd			Annual	
Fission and activation products			Annual	
Uranium	Annual	Annual		
Plutonium	Annual	Annual		
Curium	Annual			

8. FREQUENCY AND TYPES OF MONITORING

8.1 EXPOSURE MONITORING

8.1.1 Continuous Area Monitoring

At various times throughout the project, either prior to beginning or periodically while the project is in progress, area monitoring may be employed. Area monitoring will be continuous, generally from a stationary device for a specific period of time. Area monitoring establishes environmental conditions at a specific location during a specific time frame. From this data, action levels can be readjusted and PPE re-evaluated. Samples from continuous area monitoring must be evaluated by an analytical laboratory and are not instantaneous. Examples of continuous area monitoring: high-volume air sampling for a radiologic concern or area air sampling for asbestos during an asbestos abatement project. Continuous monitoring may also be performed by the SSHO using various types of industrial hygiene and/or radiological instrumentation for monitoring site conditions.

Continuous air monitoring equipment for airborne radioactivity shall be installed in occupied areas where a person is likely to be exposed to a concentration of radioactivity in air exceeding 1 DAC, or where there is a need to alert potentially exposed personnel to unexpected increases in the airborne radioactivity levels. For further guidance, refer to the DOE Radiological Control Manual (DOE April 1994).

8.1.2 Intermittent Area Monitoring

Intermittent monitoring shall be conducted in work areas where continuous monitoring is not necessary in order to protect employee health. The ORNL ER ES&H Manager, ORNL HAZWOPER Program Coordinator, SSHO, and the appropriate representative(s) from the ORNL ES&H discipline(s) shall collectively decide on the frequency of monitoring for the site, depending upon the site hazards and the work effort being conducted. Intermittent monitoring shall be conducted in the worker's breathing zone and in the general work area. It is recommended that the work area and the breathing zone be monitored on a routine or consistent basis (i.e., 5-, 15-, or 30-min intervals) depending upon the potential site hazards. All monitoring data should be recorded in the site project logbook or on specific project monitoring data sheets.

8.1.3 Monitoring of Personnel

Personnel exposure monitoring (i.e., exposure monitoring for specific site contaminants with air sampling pumps) shall be conducted in accordance with the requirements of 29 CFR 1010 Subpart Z. Unless otherwise agreed upon in the contract or the SSHASP, monitoring of ER personnel will be conducted by a representative of IH in accordance with established ORNL IH procedures. Site personnel may also use pocket and electronic dosimeters that provide real-time indications of exposure to various contaminants or hazardous conditions. This effort shall assist in monitoring personnel exposures that are less than administrative control levels. The need for personnel exposure monitoring will be based upon site

contaminants and work hazards, and will be determined by the ORP representative, IH, and the ORNL HAZWOPER Program Coordinator. These requirements shall be detailed in the SSHASP.

8.1.4 Direct Monitoring

Real-time assessment of levels of potentially hazardous chemicals and radiologicals using direct-reading instruments will be performed by either the SSHO, ES&H technician, IH representative, or the ORP representative while operations are being conducted at sites that are deemed hazardous. Prior to commencement of any field activities, background concentrations and levels near the site will be monitored and recorded in the site logbook. Site monitoring data will be recorded either in the site logbook or on specific project monitoring data sheets. Monitoring of air concentrations for any confined space entries shall be conducted in accordance with ORNL procedures by a representative from IH or a designated, approved ES&H representative. Details of the monitoring will be contained in the SSHASP.

8.1.5 Dosimetry

All site entrants shall be regulated by the ORNL Radiation Dosimetry program and shall comply with all provisions of the requirements of ORP. The ORP representative will inform the workers of the radionuclides of concern, based on the characterization data from the site. If conditions warrant, the ORP representative will arrange for workers to be placed on the internal dosimetry program and the bioassay program and be monitored for the specific radionuclides detected during site characterization. (This requirement may not apply to visitors or occasional site workers depending on the task and duration of the specific effort.) If bioassay monitoring is required, site characterization and job description information will also be used to determine the type and frequency of bioassay monitoring program (refer to Table 10). The radionuclides of concern for each project will be listed in the SSHASP.

8.2 MONITORING EQUIPMENT/ACTION LEVELS

Various types of monitoring equipment may be required to detect the possibility of worker exposure during on-site operations. The SSHO shall ensure that adequate monitoring equipment is available prior to the start of work and that the instruments are used only by knowledgeable persons with training and experience in the care, operation, calibration, and limitations of the equipment. Work involving potential exposure to hazardous materials shall not be performed unless properly maintained and calibrated monitoring instruments are available for use.

Instrumentation such as the following may be used to identify the presence of and/or to quantify the potential health hazards in existence at the site.

- **Combustible Gas/Oxygen Meter:** To measure combustible gases and oxygen content in confined spaces, trenches, and other areas that may have limited ventilation. All instruments used should be fully automatic, self adjusting, and shall have the capability of detecting oxygen, hydrogen sulfide, and carbon monoxide concentrations. The

instrument shall be precalibrated with standard gases of known concentrations prior to field use. The prescribed action limits for the instrument shall be as follows:

LEL	$\geq 10\%$ (5% LEL for confined spaces)
O ₂	$\leq 19.5\%$ or $\geq 22\%$
H ₂ S	5.0 ppm
CO	12.5 ppm

- **High-Flow Air Sampling Pumps:** To sample and evaluate the air quality on-site. These instruments shall be calibrated before and after each use by the SSHO or qualified designee.
- **Personnel Air Sampling Pumps:** To collect personal samples if airborne contaminants are encountered. These instruments shall be calibrated before and after each use by the SSHO or qualified designee.
- **Total Organic Vapor Monitors:** PID or FID to survey the soil and air for possible organic contamination. The instrument is not chemical-specific; therefore, it can only indicate the presence of volatile organics that are detectable in the range of the instrument. Action level for this monitor measured within the breathing zone for 1 min duration is 5 ppm unless the specific chemical TLV is known. In the event the action level is reached, the area will be evacuated and the ES&H Manager shall be notified. The ER Program ES&H Manager will, in turn, notify the proper ES&H discipline (IH).
- **Colorimetric Detector Tubes:** For field identification of specific chemical contamination presence and for providing a rough estimate of the concentration level. These instruments shall be leak-checked prior to each use. Action level is 1/2 PEL.
- **Noise Monitoring Equipment:** To identify "problem" noise areas and equipment. These instruments shall be calibrated prior to, and after, use. Action level is 85 dBA. Refer to Sect. 6.2.1.
- **Wet Bulb Globe Thermometer (WBGT):** May be used to detect possible heat stress conditions. These instruments will be calibrated according to the manufacturer's specifications. The WBGT should be used at temperatures $>70^{\circ}\text{F}$. Action levels follow ACGIH guidelines.
- **Portable Gas Chromatograph (GC):** May be used to help evaluate and isolate potential volatile components measured in the breathing zone by the PID or FID. The action level for this instrument is chemical dependent.
- **Personal Thermoluminescent Detection (TLD) Badges and Direct-read Pocket Dosimeters:** Issued to each employee through ORNL Radiation Protection programs to monitor worker beta/gamma exposures. The administrative limit for worker exposure is 20 mrad/day.
- **Portable Alpha and Beta-Gamma Survey Meters:** To survey for radioactive contamination on personnel and equipment. These instruments shall be source-checked daily and calibrated at least quarterly. Action level is above Green Tag limits (see Table 5).
- **Neutron Dose Rate Instrument:** To survey for neutron radiation dose rates. These instruments shall be source-checked daily and calibrated at least quarterly.
- **Beta/Gamma Exposure Rate Instrument:** An ion chamber used to survey for beta and/or gamma radiation in order to determine exposure rates. These instruments shall be source-checked daily and calibrated at least quarterly.

- **Direct-Reading Pocket Dosimeters:** Issued to employees through ORNL Radiation Protection programs in order to monitor worker exposures to gamma radiation. Direct reading pocket dosimeters allow employees to monitor their exposure to gamma radiation throughout the work period.
- **Neutron TLD Badge:** Issued to employees through ORNL Radiation Protection programs in order to monitor worker neutron exposure.
- **Air Sampling Equipment:** To identify and quantify airborne radioactivity or specific chemical contaminants through laboratory analysis of samples.

All types of instrumentation used in field operations must be specified in each SSHASP.

Site monitoring action limits in effect at the time of publication of this document are given in Table 11. However, these action limits are continually updated as new information becomes available and new guidelines are established. It is therefore imperative that the appropriate ORNL ES&H discipline(s) be consulted to establish current action limits.

8.3 CALIBRATION REQUIREMENTS

All monitoring and detection instruments used during field operations shall be calibrated within the proper time frame and in accordance with the manufacturer's recommendations, guidelines, and specifications described in the manufacturer's SOPs. Written standard procedures for instrumentation operation and calibration shall be maintained and used on-site. All instrumentation operation and calibration shall be conducted in accordance with ORP and IH procedures, where applicable and available.

All chemical instrument calibration gas cylinders used in field calibrations must have a manufacturer's label with the lot number, the manufacturer's name, the type of gas, and the ppm or percent of gas concentration contained within the cylinder. Calibration readings, the lot number from the calibration gas cylinder, the calibration gas manufacturer, and each number of the radiological source will be recorded on the Daily Instrument Calibration Check Sheet, or within a designated section of the project field logbook dedicated to daily instrumentation calibration, maintenance and use, as well as other information pertinent to field instruments.

Table 11. Site monitoring action limits

Hazard	Monitoring interval	Limits		Action
		Area	Action limit	
Beta, gamma, or neutron radiation (measured with neutron or beta-gamma exposure rate instrument)	Prior to job, intermittently	Not posted as Radiation Area	Sharp increase or unexplained change in background	Notify field team leader or SSHO who will notify appropriate ES&H representative, if necessary
		Not posted as Radiation Area	>2.5 mrem/h for general area at 1 m above ground surface	Notify ORP representative
		Posted Radiation Area		Obtain Rad Work Permit or equivalent, if required
Personnel radiological contamination (measured with alpha survey meter or beta-gamma survey meter)	Before exiting CRZ or CAA	Not posted as Contamination Area	Detected above background levels	Notify ORP representative, monitor all personnel for contamination
		Posted Contamination Area or Airborne Radioactivity Area	>300 dpm/100 cm ² alpha or >1000 dpm/100 cm ² beta-gamma	Notify ORP representative

Table 11 (continued)

Hazard	Monitoring interval	Limits		Action
		Area	Action limit	
Surface radiological contamination (measured with alpha survey meter or beta-gamma survey meter)	Prior to job, intermittently, and upon exit from CRZ or CAA	Not posted as Contamination Area	>300 dpm/100 cm ² alpha or >1000 dpm/100 cm ² beta-gamma	Monitor personnel and equipment for contamination, Notify ORP representative.
		Posted Contamination Area	>3000 dpm/100 cm ² alpha or >10,000 dpm/100 cm ² beta-gamma	Monitor personnel for contamination, Notify ORP representative
Airborne radioactivity (measured with breathing zone samples)	Initial and intermittent	Not posted as Airborne Radioactivity Area	0.1 DAC as determined by ORP representative	Stop work, Notify ORP representative who is responsible for posting as Airborne Radioactivity Area, No reentry to EZ or CAA without ORP authorization or Radiation Work Permit or equivalent

Table 11 (continued)

Hazard	Monitoring interval	Limits		Action
		Area	Action limit	
		Posted Airborne Radioactivity Area	1.0 DAC as determined by ORP representative	Notify ORP representative, evaluate adequacy of respiratory protection (i.e., protection factors), No reentry to EZ or CAA without ORP authorization or Radiation Work Permit or equivalent
Chemical contamination	Intermittent	Breathing zone	1/2 the PEL or TLV	Variable, may include administrative, engineering, and personal protection
Chemical contaminants monitored with PID or FID	Intermittent, 30 min or less	Breathing zone 2-3 ft from borehole or 14 in. in front of employee's shoulder	5 ppm for 1 min unless the chemical's TLV indicates <5 ppm	Evacuate CAA or EZ, notify ER ES&H Program Manager, identify contaminant(s) if possible, upgrade PPE as appropriate

Table 11 (continued)

Hazard	Monitoring interval	Limits		Action
		Area	Action limit	
CGI				
LEL	Based on site hazards present and tasks being performed	Confined space	5% LEL	Evacuate confined space, notify IH
LEL	Intermittent (30 min or less if flammable materials are present)	Working environment	5% LEL	Continue work effort
			5-10% LEL	Evaluate source
			>10% LEL	Evacuate EZ or CAA
O ₂			≤19.5% or ≥22%	Evacuate EZ or CAA
CO	Constant monitoring	Surface or within 1 ft of surface of cuttings	12.5 ppm	Evacuate EZ or CAA
H ₂ S			5 ppm	Evacuate EZ
Chemical contamination associated with drill cuttings			Any indication that boring has hit an area of contamination	Stop work, secure drill rig, evacuate EZ, do not seal hole or disturb cuttings, notify ER ES&H Manager, SPM, and IH
Noise	Initially before job starts, intermittently during job, at end of job	Working environment	≥85 dBA	Hearing protection required

Table 11 (continued)

Hazard	Monitoring interval	Limits		Action
		Area	Action limit	

Acronyms:

CGI - combustible gas indicator
 CRZ - contamination reduction zone
 DAC - derived air concentration
 EZ - exclusion zone
 FID - flame ionization detector
 LEL - lower explosive limit
 PEL - permissible exposure limit
 PID - photoionization detector
 TLV - threshold limit value

8.4 MONITORING RESPONSE GUIDELINES

During site operations, the decisions to upgrade or downgrade PPE levels; to re-establish site CAAs, EZs, CRZs, and/or support zones; or to cease work activities may be made on the basis of site monitoring results. These changes can only be authorized by site authorities such as the SSHO and the specific ES&H discipline(s). These response guidelines are dependant upon the type of work being conducted, the suspected contaminants, and the health effects and toxicity of the contaminants. However, there are some general guidelines for monitoring response. If the reading on any organic monitoring device stabilizes at 5 ppm and holds steady for 1 min within the breathing zone, workers should be withdrawn from the CAA, CRZ, or EZ. ORNL IH Section should be notified and the area should be sampled and the chemical identified before work continues. This can usually be done on-site without a long delay. If a known chemical is present at a specific site, the action level should be based on the known chemical, and workers should be withdrawn when that action limit is reached. IH should be notified. If the monitoring instrument has a fluctuating reading that varies above the action limit, workers should be withdraw from the area until the cause of the instrument's erratic readings can be determined. Conditions vary from site to site, therefore, monitoring response will vary due to these site conditions. Guidelines shall be established for real-time site assessments in each SSHASP.

9. SITE ZONES AND CONTROL MEASURES

Work zones will be established to separate certain operations and to control the flow of personnel and equipment when there is the potential for exposure to hazardous chemicals or radiation, the potential for the accidental spread of hazardous substances to clean areas, and/or a potential safety hazard. The establishment of work zones will help ensure that personnel are properly protected against hazards at the work site, that work activities and contamination are confined to the appropriate area, and that personnel can be evacuated and accounted for in the event of an emergency.

In order to clarify the definitions of work zone and posting requirements defined in the DOE *Radiological Control Manual* and the ORNL HAZWOPER Program, a Radiological Area will generally equate to an Exclusion Zone, a Radiological Buffer Area will equate to a Contamination Reduction Zone, and a Controlled Area will equate to a Support Zone. This equivalency is documented in Table 12.

Table 12. General equivalency of work zones

Radiological contamination areas ^a	Hazardous substance contamination zones
Controlled Area	Support Zone
Radiological Buffer Area	Contamination Reduction Zone
Radiologically Contaminated Area ^b	Exclusion Zone

^aDepartment of Energy (DOE) April 1994. *Radiological Control Manual*, DOE/EH-0256T, DOE N 5480.6, U.S. Department of Energy, Assistant Secretary for Environment, Safety and Health, Washington, D.C.

^bIncludes Contamination Area, High Contamination Area, Fixed Contamination Area, Soil Contamination Area, and Airborne Radioactivity Area.

9.1 WORK ZONES

If appropriate, work zones will be cordoned off with HAZWOPER (orange and black) flagging and HAZWOPER signs will be placed to facilitate recognition of each zone. The following sections will be used to determine the work zones for each site. Figure 2 contains a diagram of a typical work zone divided into three segments: the EZ, the CRZ, and the support zone. The anticipated placement of these zones for each SSHASP will be detailed on the site map included in the SSHASP. The posting of work zones may be coordinated to accommodate ORNL ORP procedures. In some cases, based upon site conditions, three individual zones may not be necessary; instead, the site will be posted as a HAZWOPER site, and a CAA will be designated by HAZWOPER placards or signs. Figure 3 shows a diagram of a CAA. The CAA shall be used in lieu of an EZ in areas where limited tasks and/or activities are to take place. Such activities may include, but are not limited to well sampling,

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Fig. 2. Diagram of site work zones showing exclusion zone, contamination reduction zone, and support zone.

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Fig. 3. Diagram of a controlled access areas.

surface water sampling, drilling operations, and radiological surveys. Limited decontamination activities may also take place within a CAA.

The SSHOs and ORP representative shall establish these zones based on the amount and nature of contamination present and the specific work activities. The SSHOs will modify these zones as necessary to meet the needs of the site. The SSHOs will also control access to and from the CAA, EZ and CRZ. The SSHOs and/or ORP representative will periodically monitor the perimeter of the zones to ensure the safety of site workers and visitors.

The site control zones will be isolated from the rest of the work site by use of rope, fences, barricades, or warning signs. The HAZWOPER Program Coordinator may be contacted to provide HAZWOPER rope signs and guidance for establishing areas. No person will enter the EZ or CRZ without proof of sufficient training and appropriate medical clearance as required by this PHASP and OSHA 29 CFR 1910.120. A daily log of all persons entering and leaving the CAA, EZ, and CRZ will be maintained by the SSHO or designee in the project logbook.

9.1.1 Exclusion Zone/Controlled Access Area

The EZ or CAA is the area where contamination does or could occur and the greatest potential for exposure exists. To separate the EZ from the rest of the site, the outer boundary of the EZ (also known as the "hotline") shall be designated by the SSHO and the ORP representative and be clearly marked. Site personnel who enter the EZ or CAA will have the prescribed level of protective clothing and training, as determined by the SSHO. An entry and exit checkpoint will be visually defined at the periphery of the EZ or CAA to regulate the flow of personnel and equipment into and out of the zone.

Prohibited items and conduct in the EZ or CAA include, but are not limited to, the following:

- Beards, stubble, and long sideburns (in the event respiratory protection is required).
- Eating, drinking, tobacco products, or chewing gum.
- Failure to inform the SSHO of any personal illness that could affect safety or cause health-related complications.
- Personal clothing (with the exception of underclothing and socks) if potential contact with radiological contamination is anticipated. Only Energy Systems-supplied clothing will be allowed under PPE under these conditions. (Consult with the ORP representative.)
- Access to the EZ by any individual not having the required health and safety training or not in the medical monitoring program in accordance with OSHA regulations 29 CFR 1910.120(e)1 and (e)2.
- Any individual that does not possess the appropriate credentials to gain entrance to the site.
- Any conduct or item thought to be potentially dangerous to the well-being of the remediation personnel.

- Application of insect spray, sunscreen, or cosmetics, (because of possible chemical interactions with substances on-site). In some cases, the risk of ticks, chiggers, etc., may outweigh the risk of chemical interaction, and insect repellent may be allowed. This will be determined by the SSHO, ORP, or IH.

9.1.2 Contamination Reduction Zone

As the transition area between the contaminated area and the clean area, the CRZ is the area in which decontamination procedures take place. This zone is designed to reduce the probability that the support zone will become contaminated or affected by other site hazards. The SSHO will establish and clearly mark the contamination reduction corridor within the CRZ where decontamination procedures will take place (See Fig. 2). At a minimum, a washing station should be provided inside the CRZ to limit the possibility of contaminants being spread outside the CRZ. Each person will be monitored by the ORP representative or a designated representative properly trained to evaluate hazards upon leaving the CRZ and before entering the support zone. Access requirements for personnel entering the CRZ are the same as those described for entrance to the EZ. Prohibited activities within the CRZ are the same as for the EZ, which are listed in Sect. 9.1.1.

Equipment will be surveyed for radiological contamination by the SSHO, the ORP representative, or a designee before entering and before exiting the CRZ or CAA. The ORP representative performing the survey will log the results of these surveys in the project logbook. All vehicles will be checked for contamination before leaving the CRZ or CAA, and personnel and equipment will be frisked.

9.1.3 Support Zone

The Support zone is defined as the uncontaminated area where workers should not be exposed to hazardous conditions. The zone will be marked with flagging and appropriate signs and protected against contamination from the work site. The primary functions of the support zone are to serve as:

- An entry area for personnel, material, and equipment;
- An exit area for decontaminated personnel, materials, and equipment;
- A staging area for clean safety and work equipment;
- An area for rest breaks, the consumption of food and beverages (as approved by the Facility Manager and the ORP representative), and all other activities.

Because the support zone is free from contamination, personnel working within it may wear normal work clothes, and access to and from the area is not restricted for authorized site personnel. Such personnel, however, will receive instruction in the proper evacuation procedures in the event of an emergency.

9.2 SITE COMMUNICATIONS

Several means of communication may be available for use during site operations. The location of the means of communication shall be addressed in the pre-entry health and safety briefing, and shall be specified in the SSHASP.

9.2.1 Two-Way Radios

Some personnel, such as the SSHO, the ORP representative, the IS representative, IH representative, and the SPM, may have two-way radios for use in plant-wide communications. Radio numbers of key personnel will be listed in the SSHASP. Other site personnel who will have access to two-way radios should be identified during the pre-entry health and safety briefings. Radio checks will be performed prior to site entry.

9.2.2 Cellular Telephones

Cellular phones may be available for use during on-site operations to communicate within the plant through the plant telephone system and outside the ORNL facility. A cellular phone can be used to contact departments or persons within the plant system by dialing the digits 57X-XXXX or 24X-XXXX, where "X-XXXX" is the plant extension or the last five digits of the ORNL telephone number.

9.2.3 Plant Telephone System

The ORNL plant telephone system can be used to communicate within the plant by dialing the last five digits of the telephone number (e.g., 4-XXXX, 6-XXXX, 1-XXXX).

9.2.4 The Buddy System and Hand Signals

The buddy system as described in 29 CFR 1910.120(a)(3) shall be used during site operations and activities conducted in the CRZ and the EZ. Hand signals shall be used as the means of site communication in the support zone, CRZ, and EZ when distance or noise levels prevent verbal communications. Basic hand signals and their meanings during site operations are listed below.

• Thumbs up	"Okay" or "I understand."
• Thumbs down	"No," "Negative" or "I do not understand."
• Grasping buddy's wrist	"Evacuate!" or "Leave the site now!"
• Hands on top of the head	"I need assistance" or "Help!"
• Hand on the throat	"I am choking" or "I can't breathe!"

There may be situations depending upon the hazard(s) and the location that the buddy system may not be warranted.

9.3 SANITATION

9.3.1 Housekeeping

All sites shall be maintained in an orderly manner, free of congested construction debris and trash. All contaminated and uncontaminated wastes shall be handled according to the project waste management plan. Disposable contaminated PPE may need to be checked and bagged by the ES&H technician or ORP representative and placed in the proper containment system as directed by the waste management plan. An approved accumulation area will be designated to store these drums for removal by Energy Systems Waste Management.

9.3.2 Potable Water

- Cool drinking water may need to be made available in a designated "clean" area.
- Portable containers used to dispense drinking water shall be capable of being tightly closed and equipped with a tap.
- Containers used to distribute drinking water shall be clearly marked as to their contents and not used for any other purpose.
- When single-service cups (to be used one time) are supplied, both a sanitary container for dispensing unused cups and a receptacle for disposing of the used cups shall be provided.
- Potable water is not to be stored or used in any decontamination area or potentially contaminated area.

9.3.3 Consumption of Food and Tobacco Products

Eating, drinking, chewing gum, and use of tobacco products on any potentially contaminated site are confined to designated clean areas only. These areas will be designated by the Facility Manager and appropriately marked by the ORP representative, IH representative, and the SSHO. These designated areas shall be surveyed regularly for chemical and radioactive contamination.

Food will be handled by "clean" personnel only. As a minimum control measure, all personnel who have been in the field performing tasks must wash their hands before handling food. Suspected contamination of any of the approved areas will result in discontinuation of their use for food handling or storage.

9.3.4 Washing Facilities

Adequate washing facilities, consisting of a 50-gal tank with a faucet, will be provided for employees engaged in operations where hazardous substances are present. Facilities for washing hands and face will be available in break areas or support zones. Wash water will be collected in buckets and properly disposed in accordance with the Waste Management Program.

9.3.5 Rest Room Facilities

For extended projects in remote areas where no rest room facilities are available, rest room facilities consisting of Port-O-Lets® or, as available, facilities located in project trailers shall be provided for on-site for workers. The rest room facilities will be located in designated "clean" areas or break areas, which will be indicated during pre-entry health and safety briefings.

9.3.6 Shower Facilities

Shower facilities are required for remediation activities that will last for a minimum of 6 months. However, a waiver of this requirement can be granted by the HAZWOPER Program Coordinator for valid reasons. Emergency showers may be required for specific projects where hazards and duration of the project may cause an immediate danger to site personnel. All field workers are encouraged to take showers after field operations. Personnel working with contaminated material are required to shower at the end of the workday.

9.3.7 Emergency Eyewash Units

In areas where eyewash units are required, such as decontamination areas that may employ the use of corrosive chemicals or agents, all eyewash units shall meet or exceed the ANSI standard (ANSI Z358.1). All portable units will be refilled with potable water and shall be inspected on a weekly schedule. Prior to refilling the portable unit with potable water, a functional test of the unit is to be performed. A daily visual pressure check shall be performed when work occurs in the area. If the eyewash water has been treated with a manufacturer's chemical preservative, the water should be tested in accordance with the manufacturer's guidelines. The SSHO or ES&H technician must keep a record in the site project logbook of all maintenance and inspection activities for the eyewash units located on site.

10. DECONTAMINATION PROCEDURES

10.1 PERSONNEL DECONTAMINATION

Decontamination, the process of removing or neutralizing contaminants, is critical to safety and health at hazardous waste sites. Decontamination protects workers from hazardous substances that can eventually permeate protective clothing, respiratory equipment, tools, and vehicles. It protects site personnel by minimizing the spread of hazardous substances into clean areas on-site, prevents the mixing of incompatible wastes, and protects the community by preventing the migration of contaminants from the site. Personnel engaged in hazardous waste operations may become contaminated in a number of ways, including:

- Contacting vapors, gases, mists, or particulates in the air;
- Being splashed by materials while sampling or opening containers;
- Walking through puddles of liquids or sitting in contaminated soil; and
- Using contaminated instruments or equipment.

Protective clothing and respirators help prevent the wearer from becoming contaminated or inhaling hazardous substances, and good work practices help minimize contamination on PPE, instruments, and equipment. But even with these safeguards, contamination may occur. To prevent and minimize the severity of such incidences, the HAZWOPER regulations at 29 CFR 1910.120(k) require the development of a decontamination plan prior to site entry; the development of standard operating procedures (SOPs) to minimize contamination; full decontamination of employees and equipment; and the monitoring of decontamination procedures by the SSHO.

Cross contamination from protective clothing to the wearer, from equipment to personnel, and from one area to another can be minimized by combining decontamination, the correct methods for removing contaminated PPE, and the use of site work zones.

Personnel decontamination procedures are designed to eliminate or limit the contaminated materials that workers may encounter and to limit the spread of contamination from the EZ, CRZ, or CAA. Decontamination and doffing procedures for PPE Levels D, D+, C, B, and A are described. These procedures have been provided only as *guides* for personnel decontamination. Actual site conditions, PPE ensembles, and conditions may differ from those described below. If the decontamination procedures required for site activities differ from these guidelines, the actual decontamination procedures should be described in or attached to the SSHASPs. The ORP representative and SSHOs shall determine and instruct site personnel in the proper decontamination steps once the decontamination procedures have been approved by the IH representative, ORP representative, and SSHOs. This task and site-specific training shall be documented by an attendance sheet.

10.1.1 Level D Protection Decontamination and Doffing Guidelines

Station 1: Work area

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

Station 2: Scrubbing and rinsing tools or outer garment (if reusable), boots, gloves, hard hats, and safety glasses

Scrub outer boots and gloves with a laboratory-grade detergent (Liquinox™ or equivalent) and rinse with 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 the 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 PHASP and any project waste management plan.

Equipment necessary:

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

Station 3: Boots, gloves, safety glasses, and hard hat removal

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

Station 4: Inner glove removal

Remove inner gloves by rolling them off the hand, inside out.

Station 5: Frisking

To ensure that no radiological contamination is transferred to the support zone, personnel shall be frisked (screened for radiological contamination) by ORP representative or by a member of the SSHO group after approval from the ORP representative prior to leaving the CRZ or CAA for the support zone. Frisking will be performed according to the ORNL ORP procedures, Sect. 6.4.2, and Table 5.

Equipment necessary:

- alpha detector
- beta-gamma detector
- appropriate sources for instrument response-checks

If contamination above ORNL guidelines [500 dpm/100 cm² alpha or 1000 dpm/100 cm² beta on skin or clothing except C-zone clothing (see Table 5)] is detected on personnel, immediately notify the ORP representative and await decontamination instructions, if

warranted. After decontamination, repeat the frisking procedure. If contamination is still detected on skin after repeating station 5, the LSS must be notified immediately and the worker must be taken to the Health Division.

Station 6: Field wash

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

Equipment necessary: water
wash basin or bucket
soap
sprayer for rinsing
soft-bristle brush

Proceed to Station 7.

Station 7: Step across line

Enter the designated support zone.

10.1.2 Level D+ Protection Decontamination and Doffing Guidelines (see Fig. 4)

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 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.

10.1.3 Level C Protection Decontamination and Doffing Guidelines (see Fig. 5)

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 (if reusable), 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 PHASP. NOTE: This station is not necessary when disposable PPE is used.

Equipment necessary: washtubs
potable water
detergent
scrub brushes
sprayer for rinsing

Fig. 4. Minimum decontamination requirements for Level D+ protection.

Fig. 5. Minimum decontamination requirements for Level C protection.

Station 3: Outer garment, boots, and gloves removal

Remove outer garment, boots, and outer gloves and accompanying tape. Tape and disposable gloves should be placed in a plastic trash bag and disposed of in accordance with procedures outlined in this PHASP document. Reusable outer garments and boots will be placed in plastic bags for screening by the ORP representative. This equipment must be scanned and green-tagged before it may be reused. Refer to Table 5 for release limits. This is not necessary when disposable PPE 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 ORP representative, sent to the laundry and QA, and returned to ORNL IH Section. Finally, remove disposable inner gloves by rolling them over the hand, inside out, 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) by the ORP representative or by the SSHO prior to leaving the CRZ or CAA for the support zone. However, in some situations, personnel who are radiation worker trained may be allowed to frisk themselves.

Equipment necessary: alpha detector
beta-gamma detector
appropriate sources for instrument response-checks

If contamination above ORNL guidelines [500 dpm/100 cm² alpha or 1000 dpm/100 cm² beta on skin or clothing except C-zone clothing (see Table 5)] is detected on personnel, immediately notify the ORP representative and await decontamination instructions, if warranted. After decontamination, repeat the frisking procedure. If contamination is still detected on the skin after repeating Station 5, the LSS must be notified immediately and the worker must be taken to the health division.

Station 6: Field wash

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

Equipment necessary: water
wash basin or bucket
soap
sprayer for rinsing
soft-bristle brush

Proceed to Station 7.

Station 7: Step across line

Enter the designated support zone.

10.1.4 Segregated Equipment Drop and Canister or Cartridge Change (see Fig. 6)

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 (e.g., 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 EZ 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

10.1.5 Level B Protection Decontamination and Doffing Guidelines

Station 1: Work area

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

Station 2: Scrubbing and removal of boot covers and outer gloves.

Scrub outer boot covers and outer gloves with laboratory-grade detergent and rinse thoroughly. Remove tape around boots and place in plastic trash bag. Remove boot covers

Fig. 6. Segregated equipment drop and canister or cartridge change.

and place in trash. Remove outer gloves by rolling over hand, inside out, and place in trash. If boot covers and outer gloves are reusable, place in appropriate container.

Station 3: Scrubbing and rinsing of outer garment, SCBA, boots, and gloves.

Scrub chemical-resistant outer garment, self-contained breathing apparatus (SCBA), inner gloves, and safety boots with laboratory-grade detergent and water and a long-handled scrub brush. Rinse with potable water. Wrap SCBA regulator (if belt mounted type) with plastic to keep water out. Wash backpack assembly with sponges or cloths. All wash water and rinsing solutions will be disposed of in accordance with this PHASP.

Equipment necessary: washtubs
 potable water
 detergent
 long-handled scrub brushes
 sprayer for rinsing
 sponges and cloths

NOTE: If worker leaves EZ to change air tank, this is the last step in the decontamination procedure. Worker's air tank is exchanged, new outer gloves and boot covers donned, and joints taped. Worker returns to duty.

Station 4: Removal of outer garment, SCBA, and boots

While wearing facepiece, remove backpack and disconnect hose from regulator valve. With assistance of helper, remove outer garment, and boots. Reusable outer garments, SCBA, and boots should be placed in plastic bags for screening by the ORP representative. Reusable equipment must be scanned and green-tagged before it may be reused. (This is not necessary if equipment is disposable.) Refer to Table 5 for release limits.

Equipment necessary: plastic trash bags
 bench or stool

Station 5: Facepiece and inner glove removal

Wash inner gloves with decontamination solution and rinse with water. Remove facepiece. Deposit in a plastic bag. Avoid touching face with fingers. Finally, remove disposable inner gloves by rolling them over the hand, inside out. Deposit gloves in a plastic trash bag.

Equipment necessary: wash tubs
 potable water
 detergent
 sprayer for rinsing
 plastic trash bags

Station 6: Frisking

To ensure that no radiological contamination is transferred to the support zone, personnel shall be frisked (screened for radiological contamination) by the ORP representative or by the SSHO prior to leaving the CRZ or CAA for the support zone.

Equipment necessary: alpha detector
beta-gamma detector
appropriate sources for instrument response-checks

If contamination above ORNL guidelines [500 dpm/100 cm² alpha or 1000 dpm/100 cm² beta on skin or clothing except C-zone clothing (see Table 5)] is detected on personnel, immediately notify the ORP representative and await decontamination instructions. After decontamination, repeat the frisking procedure. If contamination is still detected on the skin after several attempts to remove it, the LSS must be notified immediately and the worker must be taken to the health division.

Station 7: Inner clothing removal

Remove inner clothing. Place in container with liner. Do not wear inner clothing off-site because of the possibility that small amounts of contaminants might have been transferred when removing the fully encapsulating suit.

Station 8: Field wash

Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. If a shower is not available, wash hands and face thoroughly with soap and water and a soft-bristle brush and shower as soon as possible after leaving the site. Put on clean clothes.

Equipment necessary: water
soap
soft-bristle brush
portable shower
or wash basin/bucket and sprayer for rinsing
clean clothes

Proceed to Station 9.

Station 9: Step across line

Enter the designated support zone.

10.1.6 Level A Protection Decontamination and Doffing Guidelines

Station 1: Work area

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

Station 2: Scrubbing and removal of boot covers and outer gloves.

Scrub outer boot covers and outer gloves with laboratory-grade detergent and rinse thoroughly. Remove tape around boots and place in plastic trash bag. Remove boot covers and place in trash. Remove outer gloves by rolling over hand, inside out, and place in trash. If boot covers and outer gloves are reusable, place in appropriate container.

Station 3: Scrubbing and rinsing of encapsulating suit and boots.

Scrub encapsulating suit and boots with laboratory-grade detergent and water and a long-handled scrub brush. Rinse with potable water. Repeat as many times as necessary. All wash water and rinsing solutions will be disposed of in accordance with this PHASP.

Equipment necessary: washtubs
potable water
detergent
long-handled scrub brushes
sprayer for rinsing

NOTE: If worker leaves EZ to change air tank, this is the last step in the decontamination procedure. Worker's air tank is exchanged, new outer gloves and boot covers donned, and joints taped. Worker returns to duty.

Station 4: Removal of boots, encapsulating suit, and hardhat

Remove boots and deposit in plastic bag. With assistance from helper, the fully encapsulating suit is removed and laid out on a drop cloth or hung up. Hardhat is removed. Reusable equipment must be scanned and green-tagged before it may be reused. (This is not necessary if equipment is disposable.) Refer to Table 5 for release limits.

Equipment necessary: plastic trash bags
bench or stool

NOTE: A hot weather rest station may be set up within this area for personnel returning to the site.

Station 5: Backpack, facepiece, and inner glove removal

While still wearing facepiece, remove backpack. Disconnect hose from regulator valve. Wash inner gloves with decontamination solution and rinse with water. Repeat, if necessary. Remove facepiece. Deposit in a plastic bag. Avoid touching face with fingers. Finally, remove

disposable inner gloves by rolling them over the hand, inside out. Deposit gloves in a plastic trash bag.

Equipment necessary: wash tubs
potable water
detergent
sprayer for rinsing
plastic trash bags

Station 6: Frisking

To ensure that no radiological contamination is transferred to the support zone, personnel shall be frisked (screened for radiological contamination) by the ORP representative or by the SSHO prior to leaving the CRZ or CAA for the support zone. However, in some situations, personnel who are radiation worker trained may be allowed to frisk themselves.

Equipment necessary: alpha detector
beta-gamma detector
appropriate sources for instrument response-checks

If contamination above ORNL guidelines [500 dpm/100 cm² alpha or 1000 dpm/100 cm² beta on skin or clothing except C-zone clothing (see Table 5)] is detected on personnel, immediately notify the ORP representative and await decontamination instructions. After decontamination, repeat the frisking procedure. If contamination is still detected on the skin after several attempts to remove it, the LSS must be notified immediately and the worker must be taken to the health division.

Station 7: Inner clothing removal

Remove inner clothing. Place in container with liner. Do not wear inner clothing off-site because of the possibility that small amounts of contaminants might have been transferred when removing the fully encapsulating suit.

Station 8: Field wash

Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. If a shower is not available, wash hands and face thoroughly with soap and water and a soft-bristle brush and shower as soon as possible after leaving the site. Put on clean clothes.

Equipment necessary: water
 soap
 soft-bristle brush
 portable shower
 or wash basin/bucket and sprayer for rinsing
 clean clothes

Proceed to Station 9.

Station 9: Step across line

Enter the designated support zone.

10.1.7 Emergency Decontamination

In the event that the emergency decontamination of site personnel is required due to site conditions, exposure to site contaminants or other hazards, personnel injury or illness, the worker(s) will be removed from the EZ to the CRZ by site rescue personnel or the SSHO. Site operations will be shut down. Site conditions must be monitored and rescue personnel must be properly protected by PPE and respiratory protection prior to initiating rescue efforts, if applicable under site conditions. First aid will be administered, if applicable, to the site worker(s) by the SSHO and site emergency decontamination will be overseen or administered by the ORP representative. The LSS will be contacted and, if necessary, emergency transportation to the ORNL Health Division or Radiation Emergency Assistance Center/Training Site (REAC/TS) will be coordinated by the LSS.

10.2 EQUIPMENT DECONTAMINATION

Equipment decontamination procedures will be available on the site for reference. General decontamination procedures are listed below:

Instrument and hand tool decontamination

- In decontamination area, hand tools will be cleaned with soap and water using a brush and rinsed in potable water. Cleaning of instruments must be accomplished without damaging the instrument. All instruments can be wiped with a damp cloth and some can be scrubbed with a brush. Many instruments are not water tight. Check with the technician in charge of the particular instrument, or, if necessary, the manufacturer before attempting a questionable cleaning procedure.
- Tools will be placed in a specified area lined with plastic, to air dry.
- After drying, the tools will be frisked by the ORP representative for contamination. Contamination levels must meet release limits listed in Table 5.
- If contamination remains, repeat this procedure using a diluted cleaner such as 409™.

Heavy equipment decontamination (steam cleaning)

- The work area will be roped off with magenta rope and appropriate signs, as directed by the SSHO.
 - Storage area for contaminated material
 - Steam cleaning area
 - Drying area
 - Storage area for full 55-gal drums
 - CRZ for workers and equipment storage facilities
- The ORP representative, SSHO, or ES&H technician, with assistance from the heavy equipment operator, will check items to be cleaned and indicate locations and types of contamination (general, spots, low or high).
- The heavy equipment operator(s) will place the item/items inside the diked area.
- The operator of the steam cleaner will start the steam cleaner and check the equipment.
- The operator of the steam cleaner will dress out as follows:
 - Energy Systems-issued clothes and shoes.
 - Energy Systems-issued C-zone clothing and tape.
 - Full rain suit and tape.
 - Four-buckle overshoes or equivalent, rain pants outside overshoes.
 - Cotton gloves and magenta rubber gloves.
 - Hard hat, safety glasses, and full-face shield.
- The operator of the steam cleaner will proceed to clean the items.
 - A pattern of back and forth or up and down should be followed based on the size and shape of item to be cleaned.
 - Pressure adjustments and nozzle adjustments should be made as needed.
 - The cleaning person should try to spray the items downward or position himself above the items to keep from spreading any contamination outside the diked area.
 - All surface areas of the items should be washed. Any spots or high contaminated areas should be cleaned twice.
- After the items have been steam cleaned, the ORP representative, SSHO, or ES&H technician will check for contamination and mark or indicate any contamination found.
- If any contamination is found:
 - 409™ will be mixed in the waste bucket with water.
 - The contaminated area will be scrubbed with a tire brush and 409™.
 - It may be necessary to use full strength 409™ and a stainless steel wire brush to clean the contaminated area.
 - The area will then be steam cleaned again.
 - The ORP representative, SSHO, or ES&H technician will then check for contamination.
- If the items are decontaminated, the heavy equipment operator will place the items outside the diked area on plastic to air dry.
- After the items have air dried, the ORP representative, SSHO, or ES&H technician will check again.
- If no contamination is found, the items will be green tagged and placed in a clean area.

- If contamination is found, the step with 409™ will be repeated
- If after a second cleaning, the items are still contaminated, the ORP representative will notify the appropriate persons.
- If performing chemical decontamination (on sampling equipment, etc.), 409™ will not be used. Alconox™ or some other phosphate-free detergent will be used.
- Any and all wash water will be pumped into 55-gal drums, using a small gasoline pump. The drums will be adequately labeled and stored.
- As necessary, the drum contents will be sampled to determine proper disposal methods.

11. STANDARD OPERATING PROCEDURES

All site SOPs shall be in accordance with established procedures that are applicable to site operations. Work project SOPs shall be developed and included the SSHASPs as necessary. Specific ORNL SOPs that are applicable to work project operations should be referenced in a document available on-site or incorporated in the work project SSHASPs.

12. EMERGENCY ACTION PLAN

This section applies to any type of emergency, such as a fire or explosion, radiation, or chemical exposure, personal injury, or other types of emergencies that may be encountered by site personnel during work efforts being conducted at ORNL ER sites.

12.1 EMERGENCY CONTACTS AND NOTIFICATIONS

A listing of emergency contacts' telephone numbers and radio numbers shall be provided in each SSHASP and shall be posted during all site operations in a designated location that is easily accessible to all site personnel. Primary emergency telephone numbers shall include, but are not limited to, the following:

<u>Emergency Personnel</u>	<u>Phone</u>	<u>Radio No.</u>
ORNL Emergency Response	911	
Laboratory Shift Superintendent	574-6606	Station 103
Fire Department	574-5678	
Medical Center	574-7431	
Security	574-7196	401
Industrial Hygiene	576-5064	69
Industrial Safety	576-5974	
Radiation Protection	574-6701	334
Environmental Compliance	574-8870	650
ER Program ES&H Manager	574-8268	686
HAZWOPER Program Coordinator	576-5064/576-6445	69

NOTE: These phone and radio numbers are subject to change and **must be verified** before posting or including in the SSHASP.

Additional emergency phone numbers may include appropriate key personnel from Table 1.

The LSS has responsibility for overall site shift operations and acts as Site Emergency Director in the event of an emergency at Energy Systems' facilities. The LSS evaluates or determines how to evaluate an emergency situation and directs remedial actions, taking into consideration risks versus benefits of emergency response actions, potential for exposure, possible biological consequences, and the anticipated number of persons potentially affected. The ECC is the ORNL site control center to which emergency situations can be reported and from which emergency response activities are coordinated and dispatched.

12.1.1 Site Personnel Responsibilities

The minimum requirements of an individual during an emergency situation are to know the following about his or her work area:

- The location of site emergency exit routes.
- The location of the nearest fire alarm pull box and fire extinguisher. Fire extinguishers should only be used by personnel who know how to operate them safely, in addition to knowing the type of fire (e.g., Class A—combustible materials such as wood and paper, Class B—flammable petroleum products, Class C—electrical, or Class D—combustible metals) and the appropriate type of fire extinguisher to be used under the existing conditions.
- The location of other emergency equipment such as first aid kits, stretchers, emergency self-contained breathing apparatus, eyewash stations, emergency showers, and spill kits or other spill containment supplies and equipment.
- The location of the nearest telephone or other means of communication such as radio or cellular telephone.

12.1.2 Reporting An Emergency

Upon discovering an emergency situation, an individual must immediately take action to initiate emergency response activities. This involves the individual first removing themselves from immediate danger, then notifying the LSS and/or the laboratory Emergency Communications Center (ECC) of the emergency situation so that the emergency response system can be activated.

12.1.2.1 Summoning assistance by telephone

1. The plant telephone system can be used to initiate emergency response actions by dialing the numbers listed below.

<u>SITE</u>	<u>OFFICE</u>	<u>NUMBER</u>	<u>RADIO</u>
ORNL	LSS	4-6606	KIN 294/295 or Station 103
	ECC	4-6646	KIN 294/295

2. The Emergency Medical Services (EMS) network on the plant telephone system serves as a direct method to contact the ECC and is monitored during all shifts by the LSS and by the ORNL Health Services offices during day shift. The EMS network can be used as a method of communication and to summon emergency service units during emergencies at each facility by dialing 911.
3. Once the LSS office or the ECC has been contacted, the following information should be given over the telephone before the caller hangs up:
 - a. A description of the type of emergency.
 - b. The location of the emergency.
 - c. The identity and location of the caller reporting the emergency.
 - d. When personnel have been injured, tell whether an ambulance may be needed.
4. Before ending the conversation, the caller should listen for any instructions and answer any questions the LSS office may have. The LSS office should be the party that ends the communication.

12.1.2.2 Summoning assistance by fire alarm pull boxes

In addition, help can also be summoned immediately by pulling a fire alarm. Fire alarm pull boxes are generally located in every building, as well as in other posted areas. The exact location of fire alarm pull boxes should be given in the SSHASP as a part of the site emergency action plan.

Pulling a fire alarm results in the automatic transmission of the location from which the alarm was sounded to the ORNL Fire Department and to the site ECC, whose dispatcher immediately notifies the LSS and dispatches other emergency service units such as security, ambulance, and radiation protection. If conditions are not life-threatening, the person who sounded the alarm should remain at the location where the alarm was sounded in order to direct emergency personnel to the location of the emergency and to provide additional information as necessary.

12.1.2.3 Summoning assistance by radio

The LSS office can also be notified of emergency situations by radio. The LSS office monitors facility radio networks and can be contacted by announcing over the air on any network "(Self-identification) to the LSS, emergency, emergency! Over." The information listed in Sect. 12.1.2.1, item 3, should be conveyed to the LSS office.

12.1.3 Emergency Coordinator

In the event of an emergency situation, the SSHO will assure that all personnel are evacuated from the area and that proper ORNL emergency response personnel are notified. Upon the arrival of ORNL emergency support staff (e.g., the Fire Department, the Health Division, or Spill Response), the SSHO will relinquish authority to the incident commander of the ORNL support staff.

12.1.4 Emergency Actions for Site Personnel

The immediate and appropriate actions required of an individual during an emergency situation are the following:

1. Summon help immediately by reporting the emergency to the LSS, SSHO, SPM, or other authority.
2. Bring the emergency under control with the materials on site, if this can be done safely.
3. Contact the local area or building emergency supervisor, warden, or searcher.
4. Sound the area, building, or facility evacuation alarm, as warranted.
5. Meet and brief emergency response units about the site emergency.

12.2 SITE EMERGENCY CONTINGENCY PLAN

The site emergency contingency plan is used when a hazard(s) that is extreme in nature is encountered during routine site activities. The site emergency contingency plan applies to hazards of the type or degree that would cause serious injury or even death to site workers. Some examples of such hazards include possible explosive materials or chemicals (picric acid) or unmarked compressed gas cylinders.

12.2.1 Emergency Coordinators

During any emergency situation the SSHO will be the on-site emergency coordinator until members from the ORNL Emergency Response Team arrive on-site and take control. The ORNL Emergency Response Team members will work with the SSHO to remediate the problem. Members of this team must meet all requirements for site entry and operations.

12.2.2 Responsibilities of Field Personnel

It is most important that the individual(s) discovering the emergency situation responds immediately and in the proper fashion. The person discovering the emergency or suspected hazard should:

- immediately notify the SSHO who will coordinate the on-site response,
- listen to and respond to the emergency as directed by the SSHO,
- know the location and use of on-site emergency equipment,
- know the location of the on-site and off-site assembly points,
- know the site emergency signals as well as the laboratory wide alarms and signals, and
- know who is the on-site emergency response coordinator.

12.2.3 Responsibilities of SSHO

The responsibility of day-to-day health and safety issues lies with the acting SSHO. An on-site emergency situation should be reported directly to the SSHO by field personnel. The SSHO (or designee) shall notify the LSS of the emergency immediately. All field personnel shall have access to a hand-held plant radio and shall work according to the buddy system unless otherwise instructed by the HAZWOPER Committee or the ER ES&H Manager. During an actual emergency-response situation, the SSHO shall serve as the emergency first responder until the LSS or an emergency response team arrives on site. At that point, the SSHO shall relinquish the responsibilities of Emergency Coordinator to the LSS. The LSS shall provide emergency response personnel and coordinate the emergency assistance.

In the event of an on-site emergency that requires the evacuation of on-site personnel, the SSHO will issue verbal instructions to evacuate the area. The SSHO will immediately notify the LSS. All personnel will evacuate to a predesignated assembly point located upwind from the hazard. At this time, the SSHO shall account for all personnel, ascertain as much information about the emergency as possible, and give further instructions to on-site

personnel. In all situations that require the evacuation of the work area, site personnel shall not re-enter the work area until the following items have been addressed: conditions causing the evacuation have been evaluated and corrected, the hazard has been reassessed, the SSHASP has been revised and reviewed with on-site personnel (if necessary), and the directive for safe reentry into the work area has been issued by the SSHO or the LSS.

The SSHO is responsible for implementing the site emergency contingency plan and communicating the contents of the plan contained in the PHASP and SSHASP to all field personnel. The plan should be explained during the pre-entry briefing and the fact that this instruction was given should be documented in the site-specific log book. The SSHO shall be responsible for assuring that the site contingency plan is at all times consistent with the overall ORNL site emergency plan throughout the duration of the project. Other responsibilities of the SSHO include:

- taking immediate action to confront an emergency or any unknown hazard;
- directing field personnel in the event of an apparent emergency or the discovery of an unknown hazard;
- making sure personnel are evacuated from the area in question and altering field activities as required to safeguard site workers and the environment;
- isolating and restricting the area with flags and/or warning tape and posting warning signs as directed by the appropriate health and safety disciplines;
- assuring that appropriate health and safety organization are notified (i.e., IH representative, ORP representative, and/or IS);
- meeting the response personnel, briefing them on the situation, and directing them to the scene;
- complying with instructions given by the response personnel or the appropriate health and safety organizations;
- shutting down equipment and processes as necessary;
- determining and communicating to site workers the location of on-site and off-site assembly points;
- overseeing the remediation of the hazard, if remediation falls within the scope of the project; and
- restarting work in the affected area after the hazard has been eliminated and the various health and safety disciplines concur that work can be restarted.

12.2.4 Responsibilities of the Facility Manager

The facility manager will be responsible for assisting the SPM in ensuring the hazard is properly addressed.

12.2.5 Implementation of the Site Emergency Contingency Plan

The site emergency contingency plan will be implemented any time conditions present a potential threat to the health and welfare of employees, the public, or the environment.

Conditions under which the plan would be implemented include, but are not limited to, the following:

- an unknown hazard not previously addressed arises;
- a potential for human injury not previously covered in any site-specific documents arises;
- toxic fumes or vapors can be generated;
- there exists a potential for fire or explosion, which may result in human injury or could spread to other facilities;
- there is a release or spill of harmful or hazardous materials.

The SSHO will be the on-scene coordinator for emergency procedures until the response personnel arrive at the site.

12.2.5.1 LSS Reportable Emergency

In the event of an emergency situation that requires the notification of the LSS (e.g., fire; explosion; release and/or spill of waste that causes an immediate threat to the health and welfare of site workers, public, and/or environment) the following actions shall be taken:

1. The immediate area will be evacuated to the off-site assembly point.
2. The LSS will be notified and provided the following information:
 - number of persons injured and type(s) of injuries;
 - location of the emergency and any other information available about the situation;
 - whether a fire or potential for a fire is involved;
 - if there is a spill, the amount and source of the spill and, if known, the type(s) of material involved.
3. Instructions given by the LSS or other emergency response personnel will be followed.
4. Access to the immediate area will be restricted and field activities altered.
5. Appropriate health and safety disciplines will be notified.
6. Prearranged emergency plans will be implemented, if applicable.

12.2.5.2 Evacuation Plan

In the event of an on-site occurrence (which necessitates an evacuation of the site), all project personnel shall comply with standardized ORNL evacuation procedures. All field personnel shall be advised of evacuation procedures and emergency routes during the documented pre-entry briefing and/or "tailgate" safety meetings by the SSHO. Should an evacuation be necessary, it shall be the responsibility of the SSHO to provide all personnel at the site with the specific evacuation route.

NOTE: For a medical emergency notify the LSS who will direct the medical team to the site and/or injured individual(s). The medical team can reach the site and/or injured individual(s) faster and safer than field personnel can transport the individual(s) to the medical department.

12.3 EMERGENCY ACTION PLANS

12.3.1 Emergency Alarm Systems at ORNL

It is the responsibility of any site personnel during an emergency situation to activate appropriate emergency alarm systems when applicable during an emergency, such as building evacuation and fire alarms, or when necessary, plant-wide alarms.

Personnel should be familiar with the correct actions to be taken in response to any plant, facility, or area alarm. To hear an audio tape of the alarms described below, dial the following number from the plant system telephone:

<u>SITE</u>	<u>NUMBER</u>
ORNL	4-4462

12.3.1.1 Standard alerting tone

The standard alerting tone is an alternating high-low tone that is followed by a Public Address (PA) system announcement and/or instructions.

12.3.1.2 Laboratory evacuation alarm

The laboratory evacuation alarm is a continuous 30-second warbling wail that is followed by PA instructions for the safest exit routes from the laboratory.

12.3.1.3 Edwards horn fire alarm

The Edwards horn alarm is a loud, continuous buzzer that functions as a fire alarm or local building evacuation alarm. Building or area occupants should immediately exit to the local assembly point through the designated evacuation routes.

12.3.1.4 Radiation emergency alarm

The local radiation emergency alarm is a clarion siren which is similar to the sound of an air raid siren or a locomotive whistle. This alarm is the signal for immediate evacuation of an area or building. This alarm is often accompanied by flashing, rotating red or magenta beacon lights. Building occupants should exit by the shortest route and proceed to the local assembly point for further instructions. Site occupants should progress to the local assembly point through the designated evacuation route. Personnel should not re-enter the building or area under any circumstances.

In the event of an emergency that would affect workers in remote areas of the ORR, the ORNL Public Warning System is used to alert anyone who may be outdoors within the 2-mile Immediate Notification Zone of an event that may affect public health and safety. The system consists of 11 outdoor warning sirens/loudspeakers.

12.3.1.5 All clear signal

The all clear signal is an announcement given over the PA system that indicates that it is safe for personnel to return to work areas and resume normal activities.

12.3.2 Emergency Assembly Points

An emergency assembly point shall be designated for each project. The location of the assembly point shall be included in the SSHASP and shall be addressed in the pre-entry health and safety briefing or in a periodic health and safety briefing in the event that the location of the assembly point must be changed due to site activities.

12.3.3 Evacuation Routes

Evacuation routes shall be established for all site operations. EZ evacuation routes shall be through the contamination reduction corridor, if possible. The ORP representative shall designate the safest site operations evacuation route with the assistance of the SSHO. The location of the route and the recommended progression shall be discussed in the pre-entry health and safety briefing. In the event of an evacuation, personnel responsibilities are as follows:

1. Personnel should be familiar with the safest and shortest evacuation route from each site and area in which they perform work.
2. When an evacuation alarm is sounded, personnel should quickly but calmly proceed to the area exit and to the designated assembly point to await further instructions from the LSS, the SSHO, or the incident commander.
3. If possible and practical, equipment should be shut down prior to exit from the area. If undue risk of exposure is present, personnel will not attempt to shut down equipment.
4. Personnel should follow the instructions given over the ORNL PA System, by the SSHO, or by the emergency response team incident commander upon his or her arrival.
5. Personnel should remain at the assembly point until otherwise instructed.

12.3.4 Fire or Explosion

Fire suppression and response services shall be provided for field activities by the ORNL Fire Department. The ORNL Fire Department can be summoned through the LSS or ECC offices as described in Section 12.1.2.1.

12.3.5 Emergency Equipment

The locations and types of emergency equipment available during site operations shall be given in the SSHASP and addressed in the pre-entry health and safety briefing.

12.4 EMERGENCY MEDICAL SERVICES

12.4.1 Personnel Injuries

All injuries to site personnel, regardless of how minor, must be reported to the SSHO. First-aid will be rendered by the designated SSHO, as necessary, and transportation to EMS will be made at the discretion of the SSHO, or at the injured person's request. All site injuries and the circumstances involved will be recorded in the project logbook by the SSHO. The completion of state worker compensation forms will be coordinated with the injured person, the person's supervisor, the SSHO, and the SPM.

12.4.2 First-Aid and CPR

At least one person shall be designated to perform first aid and CPR in the event of emergency conditions during site operations. The designated person shall be a person trained in CPR and first-aid procedures and shall be informed of ORNL procedures for bloodborne pathogens. The designated person shall remain on-site at all times during operations.

Some symptoms that might indicate the onset of respiratory or cardiac distress:

- clutching or grabbing of the chest or throat.
- cyanosis or blue tint to lips or nail beds.
- anxiety.
- unconsciousness or unresponsiveness.

12.4.3 Bloodborne Pathogens

All site activities will be conducted in accordance with established ORNL procedures for the control of bloodborne pathogens and with the requirements of 29 CFR 1910.1030. Personnel designated to perform first-aid shall be enrolled in the ORNL Bloodborne Biological Hazards Program as a collateral duty.

12.4.4 Emergency Medical Services

First-aid treatment and emergency cardiopulmonary resuscitation will be performed by designated site personnel. All work-related injuries will be treated by ORNL Health Division. Personnel with serious injuries requiring treatment beyond the capacity of ORNL Health Division services will be transported to the Methodist Medical Center of Oak Ridge, Tennessee, for further treatment and evaluation. Emergency radioactive decontamination or treatment of personnel exposure to radiation will be performed by REAC/TS.

12.4.5 Transportation

Emergency transportation of site personnel to receive medical attention or emergency decontamination (whether to the ORNL Health Division or to outside facilities) will be provided through the LSS office.

12.5 EMERGENCY RESPONSE

All emergency response activities shall be performed by personnel trained according to the requirements of 29 CFR 1910.120 and ORNL procedures. The ORNL Emergency Response Team can be contacted through the LSS or ECC offices as described in Section 12.1.2.

12.6 SPILL CONTAINMENT

A spill control kit shall be available on-site for use in the event of the uncontrolled release of materials considered potentially hazardous to site personnel, the community, or the environment. The spill control kit is considered a temporary provision to be used by site personnel to control the spread of contamination. The spill kit should be used by personnel only if they are properly protected from exposure to the spill constituents. If spill conditions exceed the control of the spill kit, the ORNL Spill Response Team should be summoned immediately to provide emergency services by contacting the LSS or ECC offices as described in Section 12.1.2.

At a minimum, the spill containment response kit should contain the following items:

- Liquid absorbent pads and pillows;
- Heavy-duty plastic bags;
- Plastic 55-gal drum liners;
- Spare 55-gal drum(s);
- Nonsparking scoop or shovel;
- Bulk absorbent materials such as clay or soda ash;
- Heavy-duty sheet plastic;
- Warning signs and flagging;
- Duct tape and cutter;
- Chemical resistant coveralls and shoe covers;
- Chemical resistant inner & outer gloves;

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Attachment A

**DIAGRAMS SHOWING LOCATIONS OF THE ORNL
WAGS AND SELECTED non-SWMU
AREAS**

Fig. A.1. Diagram showing general location the K-25 Site, the Y-12 Plant, ORNL (X-10), and the Oak Ridge Reservation ORR).

Fig. A.2. WAG 1-ORNL M

NOTES

1. ALL COORDINATES ARE BASED ON THE ORNL GRID SYSTEM. THE ANGLE OF DECLINATION OF THE ORNL GRID TO TRUE NORTH IS TAKEN FROM THE APPROXIMATE CENTER OF THE WAG.
2. SOURCES FOR WAG 1 SURFACE FEATURES INFORMATION INCLUDE:
 - A. AERIAL SURVEY BY CONTINENTAL AERIAL, INC.
 - B. SITE WALKOVER INVESTIGATIONS.
 - C. ORNL MAIN ATLAS DRAWINGS.
 - D. GEOLOGY - STOCKDALE, 1951.

LEGEND

- WAG 1 BOUNDARY
- == PAVED ROAD
- - - FENCE
- - - PERENNIAL STREAM
- ~~~~ WATER BODY
- 2525 BUILDING WITH NUMBER
- - - ELEVATION CONTOUR (10' INTERVAL FT MSL)
- == GRAVEL ROAD
- - - SIDEWALK
- NTF NORTH TANK FARM
- STF SOUTH TANK FARM

ORNL-DWG 96 16375

Fig. A.3. WAG 2—White Oak Creek and White Oak Lake.

Fig A.4. WAG 3—Solid Waste Disposal Area 3.

ORNL-DWG 86-16937

Fig. A.5. WAG 4—Solid Waste Disposal Area 4.

ORNL-DWG 84-16834

Fig. A.6. WAG 5—Solid Waste Disposal Area A.

Fig. A.7. WAG 6—Solid Waste Disposal Area 6.

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Fig. A.9. WAG 8—Melton Valley Area.

Fig. A.10. WAG 9-Homogeneous Reactor Experiment Area.

Fig. A.11. WAG 10—Hydrofracture Injection Wells and Grout Sheets.

Fig. A.12. WAG 11—White Wing Scrap Yard.

- DRAINAGE
- WAG BOUNDARY
- LOCATION OF SWMU
- SAMPLING SITES

Fig. A.13. WAG 12-Closed Contractors' Landfill.

Fig. A.14. WAG 13—Environmental Research Areas.

Fig. A.15. WAG 14—Tower Shielding Facility.

ORNL-DWG 87-8369B

— WAG BOUNDARY
 ● LOCATION OF SWMU
 ■ SAMPLING SITE

ORNL DWG 87 8369C

— WAG BOUNDARY
 ■ SAMPLING SITE

Fig. A16. WAG 15—ORNL Facility at the Y-12 Plant.

Fig. A.17. WAG 16—Health Physics Research Reactor Area.

ORNL-DWG 87-8372

Fig. A.19. WAG 18—Consolidated Fuel Reprocessing Area.

ORNL DWG 87 8373

Fig. A.20. WAG 19—Hazardous Waste Treatment and Storage Facility.

Fig. A.21. WAG 20—Oak Ridge Land Farm.

Fig. A.22. Abandoned Burn Pit.

Fig. A.23. Locations of Environmental Research Areas.

Fig. A.24. Locations of Environmental Research Areas.

ORNL-DWG 86-12054A

Fig. A.25. Locations of Environmental Research Areas.

Fig. A.26. 2Locations of Environmental Research Areas.

Attachment B

ORNL ER SITE-SPECIFIC HEALTH AND SAFETY PLAN

Project Name

Project SSHASP #

The project SSHASP number will be assigned by the Oak Ridge National Laboratory Environmental Restoration Document Management Center.

ORNL ER SITE-SPECIFIC HEALTH AND SAFETY PLAN APPROVAL

WORK PROJECT TITLE: _____

TASK: _____ SSHASP No. ☐☐☐ ☐☐☐☐ ☐☐☐☐
WAG Report Year

Brief description of purpose of project and specific task(s) entailed: _____

SSHO Training Level _____ Other _____

Date _____
 ORNL ER Site Project Manager*

Date _____
 ORNL HAZWOPER Program
 Coordinator or SHEST†

Date _____
 SSHO or ES&H technician

Date _____
 ORNL ER Program ES&H Manager or
 designee

Date _____
 Office of Radiation Protection
 representative

Date _____
 DOE Project Representative‡

The following offices or individuals may be asked to provide review and comment, if warranted:

Facility Manager
 ORNL Hazardous Waste Operations Group
 ORNL Office of Environmental Compliance and Documentation
 ORNL Construction Engineering Manager
 ORNL Laboratory Shift Superintendent
 ORNL Fire Department
 Team Leader

*It is the responsibility of the Site Project Manager to assure that all reviewer comments are addressed.

†At HAZWOPER sites, review and approval for MMES to issue to DOE for approval will be required by the ORNL HAZWOPER Program Coordinator; at non-HAZWOPER sites, review and approval will be required by a member of the Safety and Health Evaluation and Support Team (SHEST).

‡Approval by the DOE Project Representative will be required for activities not considered (by the ORNL ER Program ES&H manager) to be normal, routine types of operations.

**ORNL ER SITE-SPECIFIC HEALTH AND SAFETY PLAN
(SSHASP)**

WORK PROJECT TITLE: _____

ISSUED DATE: _____ SSHASP No. ☐☐☐ ☐☐☐/☐☐☐☐ ☐☐☐☐

Addendum issued date (if applicable): _____ Date: _____

Six month compliance review: By _____ Date: _____

- This SSHASP is to be used in conjunction with the ORNL ER Programmatic Health and Safety Plan (PHASP); all referenced sections of the PHASP must be available on-site.
- In order to be valid, this SSHASP must undergo review and approval and have a signed approval page attached to it documenting such approval.
- This SSHASP is to be reviewed and updated (as necessary) every 6 months if the duration of the project is projected to be 6 months or greater.
- Changes in this SSHASP may require the completion of a Field Change Request/Variance Form. (Refer to Sect. 3.3 of the PHASP.)

SECTION I: Work Plan

Provide a detailed description of project objectives and how the work will be accomplished. Include all procedures or reference procedures in documents that will be available on-site. Attach additional sheets, if necessary.

SECTION II: Key Personnel:

Complete Table B.1. If site roles and/or responsibilities differ from those presented in the PHASP, attach a sheet describing the differences.

Table B.1. Key personnel

Responsibility	Name	Telephone No.	Radio No./ Beeper No.
Program Management			
DOE Project Representative			
DOE H&S Representative			
ORNL ER Program Manager			
ORNL ER Program ES&H Manager			
Project Site Organization			
ORNL ER Site Project Manager			
Facility Manager			
ORNL Construction Engineer			
Site Safety and Health Officer			
Alternate Site Safety and Health Officer			
Field Team Leader			
Decontamination Officer			
Security Officer			
Industrial Hygiene/Health Physics Technician (ES&H Technician)			
Office of Radiation Protection representative			
Industrial Hygiene representative			
Office of Industrial Safety representative			
HAZWOPER Program Coordinator			
Office of Environmental Compliance and Documentation			
Hazardous Waste Operations Group			
Laboratory Shift Superintendent			

SECTION III: Emergency Contacts and Site Map

Emergency Personnel	Phone	Radio No.
ORNL Emergency Response	911	
Laboratory Shift Superintendent	574-6606	Station 103
Fire Department	574-5678	
Medical Center	574-7431	
Security	574-7196	401
Industrial Hygiene	576-5064	69
Industrial Safety	576-5974	
Radiation Protection	574-6701	334
Environmental Compliance	574-8870	650
Facility Manager		
ORNL ER Site Project Manager		
ER Program ES&H Manager	574-8268	686
HAZWOPER Program Coordinator	576-5064/576-6445	69

NOTE: These phone and radio numbers are subject to change and **must be verified** before posting or including in the SSHASP.

The chain-of-command for reporting health and safety issues is shown in Fig. B.1.

ORNL-DWG 94-9245

Fig. B.1. ORNL ER chain-of command for reporting health and safety issues. The SSHO first contacts the ORNL ER ES&H Manager and the ORNL ER Site Project Manager (SPM). Then, a 3-way conference is initiated involving the SSHO, the ORNL ER ES&H Manager (or the SPM if the ER ES&H Manager is not available), and the appropriate discipline(s): HAZWOPER Program Coordinator, Office of Radiation Protection, Industrial Hygiene, Industrial Safety, Waste Management, or Environmental Compliance. In an emergency, or when neither the ORNL ER ES&H Manager (or designee) nor the SPM is available, the SSHO should contact the appropriate discipline(s) directly.

Site-Specific Health and Safety Plan
SITE MAP

NOTE: Include location(s) of work zones, communications equipment, primary and secondary assembly points, evacuation routes, fire alarm pull boxes, and fire extinguishers.

Note: If there are several tasks, duplicate and complete Sects. IV through VIII for each task. Sects. VI and VIII may not need to be duplicated (see NOTE in each section).

SECTION IV: Project Hazard Evaluation

Place an X in each ☐ to indicate existing conditions or those that may be a result of site operations.

Task: (provide description of task)

Intrusive Activity? ☐ Yes ☐ No

Safety Work Permit or equivalent required? ☐ Yes ☐ No

Excavation/Penetration Permit or equivalent required? ☐ Yes ☐ No

Hot Work Permit/Burning Permit or equivalent required? ☐ Yes ☐ No

Radiation Work Permit required? ☐ Yes ☐ No

List other permit requirements. _____

Waste Management Plan checklist required? ☐ Yes ☐ No

If no, give reason _____

Physical hazards: Industrial Safety, Industrial Hygiene, and/or the Fire Department may be contacted for assistance in completing this section.

☐ Heat stress	☐ Cold stress	☐ Noise
☐ Confined space	☐ Enclosed space	☐ Manual lifting
☐ Tripping/falling	☐ Ergonomic	☐ Vibration
☐ Oxygen deficient atmosphere	☐ Explosive/fire hazards	☐ Dusts/mists
☐ Oxygen enriched atmosphere	☐ Water	☐ Compressed gasses and/or cylinders

Safety/Construction Hazards: Industrial Safety, Industrial Hygiene, and/or the Fire Department may be contacted for assistance in completing this section.

☐ Trenching	☐ Drum handling	☐ Work in water/boat
☐ Demolition	☐ Elevated work heights	☐ Welding/cutting/burning
☐ Hoisting/rigging	☐ Underground hazards	☐ Overhead hazards
☐ Personnel decon	☐ Equipment decon	☐ New technology
☐ Drilling/hand augering	☐ Underground storage tanks	☐ Heavy equipment op.
☐ Environmental sampling		☐ Well installation
- Specify _____

Chemical Hazards: Industrial Hygiene may be contacted for assistance in completing this section.

☐ Volatile organics	☐ Inorganics	☐ Carcinogen
☐ Corrosive	☐ Reproductive toxicant	☐ Metals
☐ Mutagen	☐ Flammable/explosive	☐ PCBs
☐ Mercury	☐ Asbestos	

List known primary chemicals on-site that pose a major health and safety concern. Also list exposure limits for each chemical (refer to Table 3, Sect. 6.3 of PHASP for target organs and toxic effects).

Chemical	TLV/PEL/STEL

Attach Material Safety Data Sheets (MSDSs) or have available on-site.

Ionizing Radiation Hazards: An Office of Radiation Protection representative may be contacted to assist in completion of this section.

Any known contamination present

(from prior scanning or history) ☐ Yes ☐ No

List primary contaminating isotope(s)	Range of concentration (pCi/g, pCi/L, μ Ci/mL)	Media (soil, water, air, etc.)

(DACs given in Table 4, Sect. 6.4 of PHASP.)

Ionizing Radiation Hazards (continued)**Radiography source**

Type of source _____

HP Source ID _____

Activity (Ci) _____

Radiation type☐ Alpha☐ Beta☐ Gamma☐ Neutron**Location on site**

Exposure rate measured on-site:

Ground surface

1 meter above ground surface

maximum

_____ $\mu\text{R/h}$ _____ $\mu\text{R/h}$

average

_____ $\mu\text{R/h}$ _____ $\mu\text{R/h}$

unknown

_____ $\mu\text{R/h}$ _____ $\mu\text{R/h}$

Maximum exposure rate expected _____

Surface contamination☐ Yes☐ No☐ Not known

fixed

_____ dpm/100 cm²

removable

_____ dpm/100 cm²**Airborne contamination**☐ Yes☐ No☐ No prior history_____ $\mu\text{Ci/mL}$ **Will operations generate a hazardous atmosphere?**☐ Yes☐ No☐ Not known

If yes, list type _____

Water contamination potential (such as tritium)☐ Yes☐ No☐ Not known

If yes, list type _____

ES&H coverage required☐ Yes☐ No

Type

☐ Continuous☐ Intermittent

If no, explain why not _____

Ionizing Radiation Hazards (continued)**Nonionizing Radiation Hazard**

☐ UV	☐ Radiofrequency	☐ Microwave
☐ Laser	☐ High voltage	

Biological/Vector Hazards

☐ Wildlife (snakes, rodents)	☐ Plants (poison ivy)	☐ Medical waste
☐ Bacteria	☐ Parasites	☐ Animal research waste
☐ Insects/ticks stings/bites		☐ Allergens (grasses, pollens)

Controls

Specify the hazard and list controls for each hazard identified in the previous sections (Physical Hazards, Safety/Construction Hazards, Chemical Hazards, Ionizing Radiation Hazards, Nonionizing Radiation Hazards, and Biological/Vector Hazards). Do the same for any additional hazards not previously mentioned. (Attach sheet if necessary.)

SECTION V: Monitoring Requirements: The IH and/or ORP representative may be consulted to assist in preparing this section.

ES&H Coverage ☐ Continuous ☐ Intermittent ☐ Not required
 Type of Coverage ☐ HP ☐ IH ☐ Safety ☐ Cross trained ES&H discipline

Direct Reading Instruments	<u>Task(s)</u>	<u>Monitoring Frequency</u>	<u>Action Levels^a</u>	<u>Action^a</u>
Combustible Gas Indicator			5% (confined space) >10%	
LEL	_____	_____		_____
O ₂	_____	_____	≤19.5% or ≥22%	_____
CO	_____	_____	12.5 ppm	_____
H ₂ S	_____	_____	5 ppm	_____
Photoionization Detector (PID)	_____	_____	5 ppm for 1 min unless the chemical indicates <5 ppm	_____
Flame Ionization Detector (FID)	_____	_____	5 ppm for 1 min unless the chemical indicates <5 ppm	_____
Alpha Meter	_____	_____	>300 dpm/100 cm ²	_____
Beta/Gamma Meter	_____	_____	>1000 dpm/100 cm ²	_____
Neutron Meter	_____	_____	_____	_____
Ion Chamber	_____	_____	_____	_____
Noise Meter	_____	_____	85 dBA	_____
Other (Specify)	_____	_____	_____	_____
Personal Monitoring				
Visual pocket/Electronic dosimeter	_____	_____	_____	_____
Whole-body dosimetry	_____	_____	_____	_____
Extremity dosimetry	_____	_____	_____	_____
Whole-body count	_____	_____	_____	_____
Urinalysis/bioassay	_____	_____	_____	_____
Area Monitoring				
Chemical area monitoring	_____	_____	_____	_____
Radiation area monitoring	_____	_____	_____	_____
Personal Sampling Pumps				
Chemical	_____	_____	_____	_____
Radiological	_____	_____	_____	_____

^aSee Table 11, Site monitoring action limits, in Sect. 8.2 of the PHASP.

Instruments used by ORNL IH Section will be calibrated and maintained in accordance with IH SOP. Instruments used by the ORP are calibrated and source checked in accordance with established health physics procedures. Source-check procedures for all radiological field instruments used with this SSHASP must be attached or referenced.

Site monitoring requirements may change based upon site conditions. All changes must be reported to the SPM, the ER Program ES&H Manager (or designee), the HAZWOPER Program Coordinator, and the appropriate ORNL ES&H discipline(s).

SECTION VI: Initial Level of Personal Protective Equipment

NOTE: If all tasks require the same PPE, Sect. VI can be completed only once. If project tasks require differing combinations of PPE, Sect. VI must be completed for each different PPE ensemble.

Task(s) _____

Level of Protection: ☐ A ☐ C ☐ Modified
 ☐ B ☐ D Specify _____
 ☐ Anti-radiological contamination PPE

Respirator: ☐ SCBA ☐ Full face ☐ Half-face Resp.
 ☐ Escape SCBA ☐ PAPR* ☐ Other

Cartridge: _____

Protective Clothing:** ☐ Tyvek ☐ Encapsulating suit
 ☐ Saranex ☐ Splash suit
 ☐ Other ☐ Energy Systems clothing
 ☐ Energy Systems under apparel

Head/eye/ear: ☐ Hard hat ☐ Safety glasses ☐ Goggles
 ☐ Splash shield ☐ Ear plugs ☐ Ear muffs
 ☐ Other

Gloves: ☐ Nitrile ☐ Neoprene ☐ PVC
 ☐ Latex ☐ Vinyl ☐ Leather
 ☐ Cotton ☐ Other

Footwear: ☐ Hard-toed leather ☐ Other
 ☐ Hard-toed rubber ☐ Rubber boots
 ☐ Chemical overboots

Other: Fall protection ☐ Yes ☐ No
 List item(s): _____

Welding goggles/
apron/gloves ☐ Yes ☐ No List type _____

Rescue equipment ☐ Yes ☐ No List type _____

Nonsparking tools ☐ Yes ☐ No List type _____

Fire extinguisher(s) ☐ Yes ☐ No List type _____

Describe the donning/doffing steps if different from those in Sect. 7.3.5 or Attachment I of the PHASP:

*Powered air-purifying respirator.

**Subcontractors are to wear MMES supplied clothing or disposable clothing for working in CRZ, EZ, CAA or any areas deemed to be contaminated with radiological or chemical hazards. All workers should shower at the end of the workday if their activities occurred within a CRZ, EZ, CAA, or contaminated area.

SECTION VII: Decontamination

If decontamination is required during the course of this project:

- 1. List materials/equipment needed for decontamination or reference in PHASP (see Sect. 10.1).**
- 2. Provide a description of the decontamination steps/stations or reference in the PHASP (see Sect. 10.1).**
- 3. Describe equipment decontamination procedures (for instruments, hand tools, heavy equipment, etc.) or reference in the PHASP (see Sect. 10.2).**
- 4. List health and safety controls to protect the workers.**

SECTION VIII: Sanitation

NOTE: If the same sanitation facilities will be used for all tasks, Sect. VIII need only be completed once. If some tasks have differing or additional sanitation requirements, Sect. VIII must be completed for each task.

Task(s): _____

Potable water available? ☐ Yes ☐ No

If yes, location _____

If no, how will it be supplied? _____

Eating, drinking, chewing, use of tobacco products permitted on site?

☐ Yes ☐ No

If yes, location _____

Toilet facilities available: ☐ Yes ☐ No

If yes, location _____

If no, how will this be addressed? _____

Washing facilities available: ☐ Yes ☐ No

If yes, location _____

If no, how will this be addressed? _____

Change rooms required? ☐ Yes ☐ No

If yes, specify _____

If no, how will this be addressed? _____

SECTION IX: Training/Medical Requirements (see Sects. 7.1 and 7.4 of the PHASP).

This form should be completed by the ORNL ER Site Project Manager or designee before initiation of any field activities.

List applicable training/medical requirements for this project. Routine site workers requiring access to the work zones (contamination reduction zone and exclusion zone) must meet access requirements. Upon agreement of the ER Program ES&H Manager and the HAZWOPER Program Coordinator, the SSHO may waive specific access requirements for occasional visitors and emergency personnel.

_____ Medical examination (Note: All persons performing field activities as part of this SSHASP must have a medical examination verifying that he/she is physically capable of performing the assigned tasks.)

_____ Whole body count (in vivo)

_____ Bioassay (in vitro)

_____ List specific radionuclides assayed as part of the bioassay program

_____ 24-hour HAZWOPER (SARA/OSHA) training

_____ 40-hour HAZWOPER (SARA/OSHA) training

_____ HAZWOPER 8-hour Annual Refresher

_____ HAZWOPER 8-hour Supervisor Training

_____ ORNL General Employee Training (GET)

_____ ORNL photo ID badge required

_____ TLD badge required

_____ Respirator fit test/training

_____ Radiological Worker Training I

_____ Radiological Worker Training II

_____ HAZWOPER SSHO Training

_____ Asbestos Worker Training

_____ Defensive Driving and Nonpaved Surfaces

_____ Hazardous Waste Characterization/Waste Generator Training for Satellite

Accumulation Areas

_____ Confined Space Entrant Training

_____ Confined Space Attendant Training

_____ Specialized Equipment Training

_____ Additional site-access requirements

_____ Specify _____

_____ First aid/CPR

_____ Additional training or medical requirements

_____ Specify _____

HAZWOPER Medical Surveillance (see Sect. 7.4)

_____ ORNL Hazardous Waste Worker Medical Surveillance Program (only for individual meeting criteria specified in the ORNL HAZWOPER Program and Sect. 7.4.2 of the PHASP).

Note: If site conditions change, or other hazards are detected, the training and access requirements will be revised accordingly.

Site Personnel Qualifications: Copy this page and complete for each site worker.

Employee: _____ Badge No. _____		
Assigned task(s):		
	Yes	Date
Medical examination	☐	
Whole body count (in vivo)	☐	
Bioassay (in vitro)	☐	
List specific radionuclides to be assayed as part of the bioassay program (if applicable)		
OSHA 24-hour Training	☐	
OSHA 40-hour Training	☐	
OSHA Refresher 8-hour Training	☐	
HAZWOPER 8-hour Supervisor Training	☐	
ORNL General Employee Training	☐	
ORNL photo badge required	☐	
TLD badge required	☐	
Respirator fit test/training	☐	
Radiological Worker Training I	☐	
Radiological Worker Training II	☐	
HAZWOPER SSHO Training	☐	
Asbestos Worker Training	☐	
Defensive Driving and Nonpaved Surfaces Training	☐	
Hazardous Waste Characterization/Waste Generator Training for Satellite Accumulation Areas	☐	
Confined Space Entrant Training	☐	
Confined Space Attendant Training	☐	
Specialized Equipment Training	☐	
Additional site access requirement Specify:	☐	
Additional training or medical requirements Specify:	☐	
First aid/CPR	☐	

ORNL ER Documentation of HAZWOPER Field Experience: Copy this page and complete for each site worker. **NOTE:** A copy of this form should be available on-site and a copy should be sent to the ORNL ER ES&H Manager before reposit in the ORNL ER Document Management Center. This form is to be completed by supervisor that observed the field experience.

Name:	Badge:					
Company:	Work Date(s): —					
Completed OSHA 24-Hour Training ☐ Yes ☐ No						
Completed OSHA 40-Hour Training ☐ Yes ☐ No						
Description of hazards anticipated or encountered:	Hours					
Description of duties performed:						
Tools, equipment, or instruments used:						
Level of PPE:						
Description of site briefing to personnel:						
Person appropriately performed donning/doffing of PPE:						
Person appropriately entered/exited zones and followed proper decontamination and frisking procedures:						
Total hours of field experience						
I certify that the above information accurately represents the field experience that occurred during the period noted: <table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: bottom;"> Trainee Signature _____ </td> <td style="width: 50%; vertical-align: bottom;"> Date _____ </td> </tr> <tr> <td style="vertical-align: bottom;"> Supervisor Signature (SSHO) (person who observed the field experience) _____ </td> <td style="vertical-align: bottom;"> Date _____ </td> </tr> </table>			Trainee Signature _____	Date _____	Supervisor Signature (SSHO) (person who observed the field experience) _____	Date _____
Trainee Signature _____	Date _____					
Supervisor Signature (SSHO) (person who observed the field experience) _____	Date _____					

ORNL ER SSHO Request Form

In order to be valid, this form must be signed by the ORNL ER Site Project Manager and the ORNL HAZWOPER Program Coordinator, with concurrence from the ORNL ER Program ES&H Manager. Qualifications for SSHOs and conditions or situations for which a waiver will be granted are listed in the ORNL ER Programmatic Health and Safety Plan (ORNL/ER-226), Sect. 4.3.2.

Requestor	Title of Requestor	Date
	<div style="display: flex; justify-content: space-around; font-size: small;"> 123 </div> <div style="display: flex; justify-content: space-around;"> <input style="width: 30px; height: 20px;" type="checkbox"/> <input style="width: 30px; height: 20px;" type="checkbox"/> <input style="width: 30px; height: 20px;" type="checkbox"/> </div>	<div style="font-size: small;">Team leader</div> <input style="width: 30px; height: 20px;" type="checkbox"/>
Name of Personnel	SSHO Level Requested	

List the educational background and experience of the above named person for whom you are requesting approval as SSHO or a waiver. List any special training (e.g., ORNL Radiological Worker Training II, ORNL SSHO Training, OSHA 40- or 24-hour Training, HAZWOPER 8-hour Supervisor Training) and experience operating Health Physics or Industrial Hygiene equipment. You may attach any additional information that will assist in the approval or waiver process.

Describe in detail the task(s) that will be performed for which approval or wavier of an SSHO is requested. Also list location and potential hazards that may be encountered.

	<div style="display: flex; justify-content: space-around; font-size: small;"> 123 </div> <div style="display: flex; justify-content: space-around;"> <input style="width: 30px; height: 20px;" type="checkbox"/> <input style="width: 30px; height: 20px;" type="checkbox"/> <input style="width: 30px; height: 20px;" type="checkbox"/> </div>	<div style="font-size: small;">Team Leader</div> <input style="width: 30px; height: 20px;" type="checkbox"/>	<div style="font-size: small;">Denied</div> <input style="width: 30px; height: 20px;" type="checkbox"/>
ORNL ER Site Project Manager	SSHO Level Granted		

Denied request due to the following:

	1	2	3	Team Leader	Denied
<hr/>	☐	☐	☐	☐	☐
ORNL HAZWOPER Program Coordinator	SSHO Level Granted				

Denied request due to the following:

A signed copy of this form is to be maintained at the work site; copies should also be mailed by the ORNL ER Site Project Manager to the ORNL ER Document Management Center and the ORNL ER Program ES&H Manager (Bldg. 7078A, MS-6402).

	Yes	No
<hr/>	☐	☐
ORNL ER Program ES&H Manager	Concurrence	

ORNL ER INCIDENT REPORT

INCIDENT REPORT NO. - - -
 (SSHASP#) WAG # - Report # - Year - Frequency Rate

The Incident Report Number is the number assigned to the SSHASP that the task was being performed under. The frequency rate will be assigned by the ER ES&H Manager. A copy of the signed form must be sent by the SSHO or Team Leader to the ORNL ER Document Management Center.

TO: ER PROGRAM MANAGER, ER ES&H MANAGER, ER QA MANAGER, ER SITE PROJECT MANAGER, FACILITY MANAGER, and ORNL ER DOCUMENT MANAGEMENT CENTER

DATE OF INCIDENT _____ TIME OF INCIDENT _____ AM/PM

I. INCIDENT (Check As Applicable)

- ☐ PERSONAL INJURY
☐ FATALITY
☐ UNPLANNED ENVIRONMENTAL RELEASE OR SPILL
☐ PROPERTY DAMAGE
☐ UNPLANNED PERSONNEL EXPOSURE (Rad, Chem, etc.)
☐ ZONE ACCESS INFRACTION
☐ CONTAMINATION CONTROL INFRACTION (Frisking, Using Plastic, etc.)
☐ VIOLATION IN ADHERING TO THE PHAWP OR THE SSHO INSTRUCTIONS
☐ OTHER _____

II. NAME(S) OF INDIVIDUALS INVOLVED, BADGE NO., AND SITE LOCATION

III. DESCRIPTION OF INCIDENT (Attach additional information if needed)

IV. CORRECTIVE ACTION

V. PERSON OR DEPT. RESPONSIBLE FOR ACTION _____
 DATE ACTION REQUIRED OR COMPLETED _____

☐ CHECK IF ADDITIONAL INFORMATION IS ATTACHED. NUMBER OF PAGES _____

 INVOLVED INDIVIDUAL(S) DATE
 SIGNATURE

 ER PROJECT MANAGER DATE
 SIGNATURE

 SSHO/TEAM LEADER DATE
 SIGNATURE

 ER ES&H MANAGER DATE
 SIGNATURE

SECTION X: Briefing Log

[illegible]

Attachment C

PC-164: SERVICE SUBCONTRACT SAFETY AND HEALTH

Table C.1. PC-164 checklist

NOTE: Factors that must be considered when determining the presence of hazards include the type of work, time, methods, location, materials, and tools and equipment.

Key: EC = Environmental Compliance FA = Facility Authority FP = Fire Protection
 IH = Industrial Hygiene IS = Industrial Safety RP = Radiation Protection WM = Waste Management

1. Project/Activity Title and Number:				
2. Description:				
3. Organization Performing Activity: ☐ Service Subcontractor ☐ Other _____ Name of Organization _____				
4. Site:		5. Building/Area:		
6. Requisitioner (Name and Phone #):			7. Date:	
Would the work activities involve any of the following:	(Y) Yes	(N) No	(U) Uncertain	If Y or U, review required by:
A. RADIATION PROTECTION (RP)				
1. Radiological Area				RP
2. Potential for/adjacent to radiation				RP
B. INDUSTRIAL HYGIENE (IH)				
1. Asbestos				IH
2. Biohazards				IH
3. Chemicals (including any carcinogens)				IH
4. Confined Space Entry				IH, IS
5. Generation of Gases, Fumes, Dusts or Mists				IH
6. Hazardous Waste Operations				IH, RP
7. Hearing Conservation Concerns				IH
8. Lasers				IH
9. Man-made Mineral Fibers				IH
10. Respiratory Protection				IH
11. Roofing, Coating, Painting				IH, IS

Table C.1 (continued)

1. Project/Activity Title and Number (cont.):				
B. Industrial Hygiene (cont.)				IH
12. Temperature Extremes				
13. Ventilation				IH
14. Work Above/Over Operation Areas (Ceilings, Attics, etc.)				IS, IH, RP
15. Other (Specify)				
C. INDUSTRIAL SAFETY (IS)				IS, FP
1. Compressed Gas Cylinders				IS, FP
2. Corrosive or Flammable Chemical Storage Compatibility				IS
3. Crane Operations				IS
4. Decontamination or Demolition				IS, IH, RP
5. Electrical Hazards				IS
6. Elevated Work				IS
7. Environmental Sampling				IS, IH, RP
8. Excavation/Trenching/ Earthmoving				IS, IH, RP
9. Explosives				IS
10. Forklift/Material Handling Equipment				IS
11. High Operating Pressures				IS
12. Hoisting or Rigging Operations				IS
13. Lockout/Tagout of Hazardous Energy (electrical, hydraulic, pneumatic, mechanical, radiological, chemical)				IS
14. Tree Cutting or Clearing				IS, RP
15. Well Drilling				IS, RP, IH
16. Other (specify)				

Table C.1 (continued)

1. Project/Activity Title and Number (cont.):				
D. FIRE PROTECTION (FP)				IH, IS, FP
1. Burning, Welding, & Hotwork				
2. Explosive Atmosphere				FP
3. Fire Protection System Outage				FP
4. Flammable Liquids				FP
5. Other (specify)				
E. OTHER				
1. Off-Shift				IH, IS, FP, RP
2. Penetrations Into Walls, Floors etc.				IH, IS, FP
3. Criticality Safety Constraints				FS
4. Safety Class Items or Systems				FS
5. Temporary Services				IS, IH, RP
6. Affects Facility Occupant Safety				FA
7. Generation of Waste				WM
F. RECOMMENDED CONTROL MECHANISMS (Keyed to above):				

**Table C.2. Cross-reference chart showing where PC-164
checklist items are addressed in the SSHASP**

PC-164 checklist items Would the work activities involve any of the following:	Location within PC-164 (Sect.No.)	Applies to this SSHASP (Yes or No) ^a	Location within SSHASP (page number)
A. RADIATION PROTECTION			
1. Radiological Area	A.1.		
2. Potential for contamination	A.2.		
B. INDUSTRIAL HYGIENE			
1. Asbestos/Man-Made Fibers	B.1.		
2. Biohazards	B.2.		
3. Chemical Hazards	B.3.		
4. Confined Space Entry	B.4.		
5. Fumes/Dusts/Mists	B.5.		
6. Hazardous Waste Operations	B.6.		
7. Hearing Conservation	B.7.		
8. Lasers	B.8.		
9. Man-made Mineral Fibers	B.9.		
10. Respiratory Protection	B.10.		
11. Roofing, Coating, Painting	B.11.		
12. Temperature Extremes	B.12.		
13. Ventilation	B.13.		
14. Elevated Work	B.14.		
15. Other (Specify)	B.15.		
C. INDUSTRIAL SAFETY			
1. Compressed Gas Cylinders	C.1.		
2. Chemical Storage Compatibility	C.2.		
3. Heavy Equipment Operation	C.3.		
4. Decontamination/Demolition	C.4.		
5. Electrical Hazards	C.5.		

**Table C.2. Cross-reference chart showing where PC-164
checklist items are addressed in the SSHASP**

PC-164 checklist items Would the work activities involve any of the following:	Location within PC-164 (Sect.No.)	Applies to this SSHASP (Yes or No)^a	Location within SSHASP (page number)
6. Elevated Work	C.6.		
7. Environmental Sampling	C.7.		
8. Excavation/Trenching	C.8.		
9. Explosives	C.9.		
10. Forklift/Material Handling	C.10.		
11. High Operating Pressures	C.11.		
12. Hoisting or Rigging	C.12.		
13. Lockout/Tagout	C.13.		
14. Tree Cutting/Clearing	C.14.		
15. Well Drilling	C.15.		
16. Other (Specify)	C.16		
D. FIRE PROTECTION			
1. Burning/Welding and Hotwork	D.1.		
2. Fire Protection System Outage	D.2.		
3. Flammable Liquids	D.3.		
E. OTHER HAZARDS			
1. Off-shift Work	E.1.		
2. Penetration into Walls, Floors, etc.	E.2.		
3. Critical Safety Constraints	E.3.		
4. Safety Class Items or Systems	E.4.		
5. Temporary Services	E.5.		
6. Affects Facility Occupant Safety	E.6.		
7. Generation of Waste	E.7		

^aIf "Yes," the item must be addressed in the SSHASP and the last column must be completed.

Attachment D

**EMPLOYEE AND SUBCONTRACTOR ACCESS
QUALIFICATION RECORD**

ORNL Environmental Restoration Employee and Subcontractor Access Qualification Record

(Attach this record to all UCN-1127 and UCN-9489 forms. Send copy of this form to ORNL ER Document Management Center.)

Employee: _____			
ORNL Badge No. _____			
Subcontractor Company: _____			
Job task description and areas where tasks will be performed: _____			
<div style="display: flex; justify-content: space-between;"> Office activity ☐ Field activity ☐ </div>			
Item	Required		Date Completed or Scheduled ^a
Medical examination	Yes	No	/ /
Whole body count (in vivo)	Yes	No	/ /
Bioassay (in vitro)	Yes	No	/ /
List specific radionuclides to be assayed as part of the bioassay program (if applicable)			
OSHA 24-hour Training	Yes	No	/ /
OSHA 40-hour Training	Yes	No	/ /
OSHA Refresher 8-hour Training	Yes	No	/ /
HAZWOPER 8-hour Supervisor Training	Yes	No	/ /
ORNL General Employee Training	Yes	No	/ /
ORNL photo badge required	Yes	No	/ /
TLD badge required	Yes	No	/ /
Respirator fit test/training	Yes	No	/ /
Radiological Worker Training I	Yes	No	/ /
Radiological Worker Training II	Yes	No	/ /
HAZWOPER SSHO Training	Yes	No	/ /
Asbestos Worker Training	Yes	No	/ /
Defensive Driving and Nonpaved Surfaces Training	Yes	No	/ /
^b SLLW Generator Training or equivalent	Yes	No	/ /
Confined Space Entrant Training	Yes	No	/ /
Confined Space Attendant Training	Yes	No	/ /
Specialized Equipment Training	Yes	No	/ /
^c Melton Valley access required	Yes	No	/ /
ORNL ER Project Manager		ORNL ER ES&H Manager	

^aVerification of medical and training records must be submitted to the project manager.

^bRenamed Hazardous Waste Characterization/Waste Generator Training for Satellite Accumulation Areas.

^cWorker must read and sign Melton Valley Access request form TX-5350.

UCN-20115 (3 7-94)

Fig. D.1. Employee and Subcontractor Access Qualification Record.

Attachment E

FIELD CHANGE REQUEST/VARIANCE FORM

FIELD CHANGE REQUEST / VARIANCE FORM

☐ Field Change

Change Number: _____

☐ Variance

Date: _____

Project: _____

Site: _____

Document: _____

Substituted Method: _____

Impact on Data Quality or Health and Safety: _____

Justification: _____

* † SSHO or Team Leader: _____ Date: _____

Approvals: (Field Changes Only)

* † Site Project Manager: _____ Date: _____

† QA Specialist/Officer: _____ Date: _____

† Analytical Representative: _____ Date: _____

* Other Approvals [ES&H Representative(s)]:

Name / Organization

_____ Date: _____

_____ Date: _____

_____ Date: _____

• Signatures required for a health and safety issue or concern.

† Signatures required for a data quality issue or concern.

UCN 18330 (3 6-94)

Fig E.1. Field Change Request Form.

Attachment F

ORNL ER INCIDENT REPORT

ORNL ER INCIDENT REPORT

INCIDENT REPORT NO. - - -
 (SSHASP#) WAG # - Report # - Year - Frequency Rate

The Incident Report Number is the number assigned to the SSHASP that the task was being performed under. The frequency rate will be assigned by the ER ES&H Manager. A copy of the signed form must be sent by the SSHO or Team Leader to the ORNL ER Document Management Center.

TO: ER PROGRAM MANAGER, ER ES&H MANAGER, ER QA MANAGER, ER SITE PROJECT MANAGER, FACILITY MANAGER, and ORNL ER DOCUMENT MANAGEMENT CENTER			
DATE OF INCIDENT _____		TIME OF INCIDENT _____ AM/PM	
I. INCIDENT (Check As Applicable) ☐ PERSONAL INJURY ☐ FATALITY ☐ UNPLANNED ENVIRONMENTAL RELEASE OR SPILL ☐ PROPERTY DAMAGE ☐ UNPLANNED PERSONNEL EXPOSURE (Rad, Chem, etc.) ☐ ZONE ACCESS INFRACTION ☐ CONTAMINATION CONTROL INFRACTION (Frisking, Using Plastic, etc.) ☐ VIOLATION IN ADHERING TO THE PHAWP OR THE SSHO INSTRUCTIONS ☐ OTHER _____			
II. NAME(S) OF INDIVIDUALS INVOLVED, BADGE NO., AND SITE LOCATION _____ _____			
III. DESCRIPTION OF INCIDENT (Attach additional information if needed) _____ _____ _____			
IV. CORRECTIVE ACTION _____ _____ _____			
V. PERSON OR DEPT. RESPONSIBLE FOR ACTION _____ DATE ACTION REQUIRED OR COMPLETED _____ ☐ CHECK IF ADDITIONAL INFORMATION IS ATTACHED. NUMBER OF PAGES ____			
_____ INVOLVED INDIVIDUAL(S) DATE SIGNATURE		_____ ER PROJECT MANAGER DATE SIGNATURE	
_____ SSHO/TEAM LEADER DATE SIGNATURE		_____ ER ES&H MANAGER DATE SIGNATURE	

Attachment G

**SITE SAFETY AND HEALTH OFFICER
APPROVAL FORM**

ORNL ER SSHO Request Form

In order to be valid, this form must be signed by the ORNL ER Site Project Manager and the ORNL HAZWOPER Program Coordinator, with concurrence from the ORNL ER Program ES&H Manager. Qualifications for SSHOs and conditions or situations for which a waiver will be granted are listed in the ORNL ER Programmatic Health and Safety Plan (ORNL/ER-226), Sect, 4.3.2.

Requestor	Title of Requestor	Date
	<div style="display: flex; justify-content: space-around; font-size: 0.8em;"> 123 </div> <div style="display: flex; justify-content: space-around;"> <input style="width: 20px; height: 20px;" type="checkbox"/> <input style="width: 20px; height: 20px;" type="checkbox"/> <input style="width: 20px; height: 20px;" type="checkbox"/> </div>	<div style="display: flex; justify-content: space-around; font-size: 0.8em;"> Team leader </div> <div style="display: flex; justify-content: space-around;"> <input style="width: 20px; height: 20px;" type="checkbox"/> </div>
Name of Personnel	SSHO Level Requested	

List the educational background and experience of the above named person for whom you are requesting approval as SSHO or a waiver. List any special training (e.g., ORNL Radiological Worker Training II, ORNL SSHO Training, OSHA 40- or 24-hour Training, HAZWOPER 8-hour Supervisor Training) and experience operating Health Physics or Industrial Hygiene equipment. You may attach any additional information that will assist in the approval or waiver process.

Describe in detail the task(s) that will be performed for which approval or wavier of an SSHO is requested. Also list location and potential hazards that may be encountered.

	<div style="display: flex; justify-content: space-around; font-size: 0.8em;"> 123 </div> <div style="display: flex; justify-content: space-around;"> <input style="width: 20px; height: 20px;" type="checkbox"/> <input style="width: 20px; height: 20px;" type="checkbox"/> <input style="width: 20px; height: 20px;" type="checkbox"/> </div>	<div style="display: flex; justify-content: space-around; font-size: 0.8em;"> Team LeaderDenied </div> <div style="display: flex; justify-content: space-around;"> <input style="width: 20px; height: 20px;" type="checkbox"/> <input style="width: 20px; height: 20px;" type="checkbox"/> </div>
ORNL ER Site Project Manager	SSHO Level Granted	

Denied request due to the following:

	1	2	3	Team Leader	Denied
	☐	☐	☐	☐	☐
ORNL HAZWOPER Program Coordinator	SSHO Level Granted				

Denied request due to the following:

A signed copy of this form is to be maintained at the work site; copies should also be mailed by the ORNL ER Site Project Manager to the ORNL ER Document Management Center and the ORNL ER Program ES&H Manager (Bldg. 7078A, MS-6402).

	Yes	No
	☐	☐
ORNL ER Program ES&H Manager	Concurrence	

Attachment H
DRILL RIG CHECKLIST

DRILL RIG CHECKLIST

Name: _____

Date: _____

Type of Drill Rig: _____

	<u>YES</u>	<u>NO</u>	<u>NA</u>
1. Drill rig cleaned?	☐	☐	☐
2. Auger flights present?	☐	☐	☐
3. Extra auger heads?	☐	☐	☐
4. Auger Bolts?	☐	☐	☐
5. Subs?	☐	☐	☐
6. Timbers?	☐	☐	☐
7. Drill rods?	☐	☐	☐
8. Air filters present?	☐	☐	☐
9. Fire extinguisher present and properly charged?	☐	☐	☐
10. Mud pan?	☐	☐	☐
11. Oil levels checked?	☐	☐	☐
12. Hydraulic and air compressor hoses checked?	☐	☐	☐
13. Chicago fittings and water hoses inspected?	☐	☐	☐
14. Tires?	☐	☐	☐
15. Jacks (Outriggers)?	☐	☐	☐
16. Leaks (Inspect hydraulic lines, hydraulic cylinder and ground plastic)?	☐	☐	☐
17. Cables and ropes?			

Are cables free from any of following conditions:

Randomly distributed broken wire (excess of six) in one strand in one lay?	☐	☐	☐
--	--------------------------	--------------------------	--------------------------

Wear of one-third of original diameter of the outside individual wires?	☐	☐	☐
---	--------------------------	--------------------------	--------------------------

DRILL RIG CHECKLIST (continued)

	<u>YES</u>	<u>NO</u>	<u>NA</u>
Kinking, crushing, bird caging, or other damage resulting in distortion of the cable structure?	☐	☐	☐
Are end fittings free of three broken wires in one strand, rust, or corrosion?	☐	☐	☐
Do end fittings use three clamps, properly placed, securing the eye?	☐	☐	☐
Are drums and pulleys free of cracked hubs, spokes, flanges, or other damages?	☐	☐	☐
Are cables the correct size for drums and pulleys, as recommended by the manufacturer?	☐	☐	☐
Do cable hooks have safety latches?	☐	☐	☐
Are fiber ropes free of excess wear, fraying, or cuts?	☐	☐	☐
18. Emergency operator switch installed and working properly?	☐	☐	☐
19. Fuel tanks free of leaks or spills?	☐	☐	☐
20. Machine guards in place for moving or rotating parts?	☐	☐	☐
21. Muffler working properly and damage free?	☐	☐	☐
22. Tower connector/stabilizing bolts present and installed properly?	☐	☐	☐
23. Spill control kit/materials present?	☐	☐	☐
24. Drill rig properly grounded?	☐	☐	☐

Comments:

Inspector(s)

Attachment I

**PROTECTIVE CLOTHING GUIDELINES FOR
RADIOACTIVE CONTAMINATION
AND
DONNING AND DOFFING PROCEDURES
FOR RADIOLOGICAL WORK**

PROTECTIVE CLOTHING GUIDELINES FOR RADIOACTIVE CONTAMINATION

LIMITATIONS

The removable contamination levels, potential for airborne contamination, and anticipated increases in removable contamination will determine the required protective clothing, using this document for guidance. The ORNL Radiological Control Manager or his/her designee is authorized to change these guidelines to facilitate implementation of radiological controls to accommodate other hazards present in hazardous waste sites or construction and environmental restoration projects.

DEFINITIONS

Anti-C Coveralls - Yellow anti-contamination (anti-C) coveralls. Disposable coveralls (including yellow tyvek, saranex or splashproof coveralls) may be used in remote areas at the discretion of Site HP personnel. Disposable coveralls will be required to be yellow in color for all work in Contaminated Areas. Other coveralls will be evaluated on a case-by-case basis by the ORNL Radiological Control Manager or his/her designee. Disposable coveralls may be used in those areas requiring disposable clothing. These include PCB and asbestos contaminated areas, etc.

Anti-C Gloves - Yellow rubber ~15 in. gloves labeled as "anti-C" with the radiation symbol on the cuff, will be designated as "Anti-C Rubber Gloves." Yellow canvas impregnated work gloves labeled as "anti-C" with the radiation symbol on the cuff, will be designated as "Anti-C Work Gloves."

Anti-C Lab Coat - Yellow anti-C lab coat.

Anti-C Jackets - Yellow DOE jackets with the radiation symbol on the front or back shall be designated as "Anti-C Jackets" and be used only in contaminated areas.

Anti-C Raincoats - Yellow DOE raincoats with the radiation symbol on the front or back shall be designated as "Anti-C Raincoats" and be used only in contaminated areas.

Anti-C Shoe Covers - Yellow launderable, low-top rubber overshoe, e.g., "Totes," or yellow disposable PVC shoe covers. The low-top shoe cover shall be used wherever practical, in order to assist in waste minimization. The disposable PVC shoe covers shall be used in those areas wherever laundering the clothing is not an option. These include PCB-contaminated areas or areas with loose classified material that may become attached to the shoe covers, etc.

Anti-C Boots - Yellow launderable boots to be worn in contaminated areas or during wet work where low-top shoe covers do not offer adequate protection in standing water.

Clean Bag - A white nylon bag with the following wording "New or laundered anti-C clothing potentially contaminated - DO NOT LEAVE UNATTENDED in a nonradiological

area," which is used for transporting laundered or new anti-C clothing from a Radiological Buffer Area (RBA) or the site laundry to remote Contaminated Areas or RBAs.

Contaminated Area – Any area designated as a radiological area based on contamination or potential contamination levels. These include: Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas.

Tours and Inspections – Work that does not involve touching or handling contaminated items. The installation radiological control organization (Health Physics or Office of Radiation Protection) reserves the right to make the distinction between Tours and Inspections and "routine work."

Radiological Buffer Area – The "grey" areas located at boundary control stations, which are maintained within nonradiological limits (less than Table L1 limits). Personnel will don protective clothing and perform personnel monitoring (frisking) in RBA.

NOTE: Laundered protective clothing does not have to meet nonradiological limits.

MINIMUM REQUIREMENTS

Low General Area Removable Contamination Levels (1 to 10 times Table L1)

Routine Work: Anti-C coveralls with hood or skull cap; one pair of booties taped to the anti-C coverall; one pair of anti-C shoe covers; single anti-C gloves taped to coveralls over surgeons gloves. If snaps are utilized to close the coverall front, the closure area will be taped closed.

Heavy Work: Same as Routine Work.

Pressurized and Large Volume Liquid Systems: Splashproof anti-C coveralls with attached feet and hood; one pair of anti-C boots; single anti-C rubber gloves over surgeons gloves. Gloves and boots to be taped to the splashproof anti-C coveralls with waterproof tape.

Tours and Inspections: Anti-C lab coat or Tyvek suit; one pair of anti-C shoe covers; and single anti-C gloves; if appropriate, rubber boots.

Moderate General Area Removable Contamination Levels (10 to 100 times Table L1)

Routine Work and Tours and Inspections: Anti-C coveralls with hood; one pair of booties taped to the anti-C coverall; one pair of anti-C shoe covers; single anti-C gloves taped to coveralls over surgeons gloves. If snaps are utilized to close the coverall front, the closure area will be taped closed.

Heavy Work: Two pair of anti-C coveralls with hoods (inner pair taped to inner pair of booties); two pair of anti-C shoe covers; two pair of anti-C gloves (inner pair taped to inner coveralls over surgeons gloves). If snaps are utilized to close the outer coverall front, the closure areas will be taped closed.

Table I.1. Summary of contamination values

Nuclide ^a	Removable ^b (dpm/100 cm ²)	Total (fixed+removable) ^c (dpm/100 cm ²)
U-natural, ²³⁵ U, ²³⁸ U, and associated decay products	1,000 alpha	5,000 alpha
Transuranics, ²²⁶ Ra, ²²⁸ Ra, ²³⁰ Th, ²²⁸ Th, ²³¹ Pa, ²²⁷ Ac, ¹²⁹ I	20	500
Th-natural, ²³² Th, ⁹⁰ Sr, ²²³ Ra, ²²⁴ Ra, ²³² U, ¹²⁵ I, ¹²⁶ I, ¹³¹ I, ¹³³ I	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except ⁹⁰ Sr and others noted above. Includes mixed fission products containing ⁹⁰ Sr.	1,000 beta-gamma	5,000 beta-gamma
Tritium organic compounds, surface contaminated by HT, HTO, and metal tritide aerosols	10,000	10,000

^aThe values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently.

^bThe amount of removable radioactive material per 100 cm² of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. For objects with a surface area less than 100 cm², the entire surface should be swiped, and the activity per unit area should be based on the actual surface area. Except for transuranics, ²²⁸Ra, ²²⁷Ac, ²²⁸Th, ²³⁰Th, ²³¹Pa, and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination.

^cThe levels may be averaged over 1 m² provided the maximum activity in any area of 100 cm² is less than three times the values in Table G.1.

Source: U.S. Department of Energy (DOE) April 1994, *Radiological Control Manual*, DOE/EH-0256T, Revision 1, U.S. Department of Energy, Assistant Secretary for Environment, Safety and Health, Washington, D.C.

Pressurized and Large Volume Liquid Systems: Splashproof anti-C coveralls with attached feet and hood over one pair of anti-C coveralls with hood and one pair of anti-C shoe covers; one pair of booties taped to anti-C coverall; one pair of anti-C boots; and single anti-C rubber gloves over surgeons gloves. Gloves and boots to be taped to the splashproof anti-C coveralls with waterproof tape.

High General Area Removable Contamination Levels (Greater than 100 times Table I.1)

Routine Work and Tours and Inspections: Anti-C coveralls with hood; one pair of booties taped to the anti-C coverall; two pair of anti-C shoe covers; two pair of anti-C gloves (inner pair taped to inner coveralls over surgeons gloves). If snaps are utilized to close the coverall front, the closure area will be taped closed.

Heavy Work: Two pair of anti-C coveralls with hoods (inner pair taped to inner pair of booties); two pair of anti-C shoe covers; two pair of anti-C gloves (inner pair taped to inner coveralls over surgeons gloves). If snaps are utilized to close the outer coverall front, the closure areas will be taped closed.

Pressurized and Large Volume Liquid Systems: Splashproof anti-C coveralls with attached feet and hood over one pair of anti-C coveralls with hood and one pair of anti-C shoe covers; one pair of anti-C boots; one pair of booties taped to anti-C coverall; two pair of anti-C rubber gloves (inner pair taped to anti-C coverall over surgeons gloves, other pair taped to splashproof coverall). Outer gloves and boots to be taped to the splashproof anti-C coveralls with waterproof tape.

Airborne Radioactivity Area

All Work: Clothing applicable to existing or anticipated conditions, e.g., Contamination Area, High Contamination Area, etc., with the addition of a skull cap and specified respiratory protection, if required. Hood taped to respiratory protection, where practical.

Pressurized and Large Volume Liquid Systems: Splashproof anti-C coveralls with attached feet and hood over one pair of anti-C coveralls with hood and one pair of anti-C shoe covers; one pair of booties taped to anti-C coverall; one pair of anti-C boots; single anti-C rubber gloves over surgeons gloves. Outer gloves and boots to be taped to the splashproof anti-C coveralls with waterproof tape. Hood taped to respiratory protection with waterproof tape, where practical.

Fixed Contamination Areas

Protective clothing is not normally required in this area.

Radioactive Material Storage Area (Radioactive Material Areas) and Radiological Buffer Areas

Protective clothing is not normally required in these areas.

Radiation Areas

Protective clothing is not normally required in these areas, unless also designated as a Contaminated Area.

Soil Contamination Areas

Protective clothing is not normally required in these areas, unless also designated as a Contaminated Area.

Underground Radioactive Material Areas

Protective clothing is not normally required in these areas, unless also designated as a Contaminated Area.

GENERAL PROHIBITIONS

Cotton Glove Liners

Cotton glove liners are not to be worn for contamination control purposes, but MAY be worn under the anti-C gloves or surgeons gloves for comfort.

Damaged Protective Clothing

Protective clothing that is damaged should be placed in the damaged anti-C containers at the Boundary Control Stations (BCS), so that it may be returned to the laundry for repair rather than disposed of. Clothing that is considered nonrepairable at the site laundry shall be disposed of as radioactive waste.

DOE Jackets

Blue DOE jackets are prohibited from being worn on the outside of protective clothing. Blue DOE jackets and other company-purchased winter clothing, such as hard hat liners, may only be worn under protective clothing.

Donning Protective Clothing

At Boundary Control Stations (BCS): Protective clothing shall be completely donned at the BCS, prior to entering the Contaminated Area.

At Remote Locations (no BCS): Protective clothing should be completely donned at the radiological area boundary, then the personnel are to immediately enter the radiological area.

NOTE: Protective clothing shall not be donned in a Contaminated Area with the following exception, donning respiratory protection and hood at the job site under the supervision of radiological control personnel. Outer gloves may be changed as necessary within the contaminated area, but the inner taped gloves must stay intact.

Hard Hats

Hard hats, other than yellow hard hats, are prohibited from being worn in all contaminated areas. Anti-C hoods or skull caps shall be worn under hard hats. Hard hats, in general, will not be individualized. Yellow hard hats are prohibited from use in noncontaminated areas.

Hats

Hats are prohibited from being worn in all contaminated areas. Skull caps and/or hoods are to be worn in contaminated areas, as specified in the clothing requirements.

High Heels

High heels are prohibited from all radiological buffer areas and contaminated areas.

Legs

Skin of the legs should not be exposed, but rather must be covered with full-length pant legs under lab coats in all areas with removable contamination above Table I.1 limits.

Nonradiological Areas

Yellow-toed shoes, yellow shoes, yellow anti-C gloves, yellow surgeons gloves, yellow anti-C shoe covers, yellow anti-C skull caps, yellow hoods, yellow booties, yellow lab coats, yellow hard hats, yellow raincoats, yellow anti-C jackets, and ANY other clothing designated as anti-C clothing are prohibited in nonradiological areas unless properly packaged and surveyed, as appropriate.

NOTE: This specifically does not apply to those items used and identified "For Training Use Only."

Protective clothing that is properly packaged and surveyed, as appropriate, may be left unattended in red-stickered vehicles only. This includes Clean Bags.

Personal Clothing

Outer personal clothing should not be worn under protective clothing for entry into High Contamination Areas or during work conditions requiring a double set of protective clothing.

Protective Clothing Modification

Protecting clothing SHALL NOT be modified without written approval of the ORNL Radiological Control Manager or his/her designee. Altering the intent of the use for protective clothing would be considered a modification, such as rolling up coverall or lab coat sleeves, etc.

Reuse of Protective Clothing

Protective clothing is NOT to be reused without being laundered OR surveyed. It is to be disposed of or placed in a Used Protective Clothing Container, as appropriate. Lab coats may be surveyed by radiological control personnel from the Contaminated Area to the RBA for reuse without being laundered.

NOTE: Only the following protective clothing should be disposed of as radioactive waste: disposable booties, disposable shoe covers, surgeon's gloves, disposable coveralls, and anti-C clothing that is either contaminated in excess of laundry limits or damaged beyond repair.

Yellow hard hats, yellow anti-C raincoats, and yellow anti-C jackets may be stored at BCSs for reuse. These items may be reused since the protective clothing required under them will protect the employee from becoming contaminated by the raincoat, jacket, or hard hat. Suitable racks for these items shall be supplied immediately inside the contaminated area, for storage of these items. Laundry personnel should pick-up the anti-C jackets at least every other week to be laundered.

GENERAL REQUIREMENTS

Long Hair

Long hair shall be worn tucked into or under the lab coat or coverall collar, or worn in a bun.

Proper Storage of Protective Clothing

Used protective clothing must be stored in a Contaminated Area. If used protective clothing is properly contained (i.e., sealed in a bag) and the exterior of the container is surveyed and not found to be contaminated, then it may be stored in a Radioactive Materials Storage Area (RMSA) or a RBA. Laundered protective clothing must also be stored in a RMSA or RBA, but MAY NOT be stored in Contaminated Areas. If protective clothing is properly packaged, and surveyed, as appropriate, it may be left unattended in red-stickered vehicles. This includes Clean Bags.

Proper Wearing of Protective Clothing

Protective clothing shall be worn completely snapped, sipped up, or closed, as appropriate, and shall not be opened in a Contaminated Area, unless it is to be removed and not replaced at that point.

Security Badge/TLD With Protective Clothing

Employees performing work with lab coats should wear their badge/TLD outside the coat. Due to the higher contamination potential where anti-C coveralls are worn, the badge/TLD should be worn inside the protective clothing or within zip-lock plastic bags if local security requirements are such that the badge must be worn outside of the coverall. This type of activity typically includes any breaching of a process system, decontamination, etc. During a

security event, work must cease and security requirements will take precedent. The badge/TLD should be worn between the shoulders and waist, with the picture facing outward.

Stocking of Protective Clothing

It is the responsibility of the BCS owner to assure that sufficient protective clothing is available at each BCS. It is each worker's responsibility to assure that the protective clothing is undamaged and suitable for use. Laundry hampers or buggies are not approved storage containers for laundered protective clothing, other than in those with separated ingress and egress areas.

Training Clothing

Protective clothing to be used for training purposes shall be approved by the ORNL Radiological Control Manager or his designee. Only new protective clothing that has NEVER been in a Contaminated Area shall be used and shall be marked "For Training Use Only " or "FTO." The training clothing shall only be laundered in the nonradiological side of the laundry facility and shall be statistically monitored prior to reuse after laundering. Training clothing shall be disposed of, after a satisfactory 100% release survey and removal of any designator, such as a trefoil radiation symbol, by being sealed in a non-see-through box and a green tag attached.

Transport of Protective Clothing

Laundered protective clothing is to be transported from the laundry facility in laundry buggies with white liners or in Clean Bags. Used or dirty protective clothing is to be transported in yellow plastic or nylon bags, with the radiation symbol on them. Ideally these bags will be reusable nylon bags. Used or dirty protective clothing shall be surveyed and tagged appropriately by HP, or may be transported to the laundry by laundry personnel utilizing approved procedures. If protective clothing is properly packaged, and surveyed, as appropriated, it may be left unattended in red-stickered vehicles only. This includes Clean Bags.

Work Gloves

Other work gloves may be worn over those specified anti-C gloves (e.g., welder's gloves) that are taped in place of the anti-C gloves, provided that the following provisions are adhered to: Single use - work gloves disposed of as radioactive waste; Multiple use - stenciled with the radiation symbol and to be used only in radiological areas.

APPROVED CLOTHING

As of March 1, 1994, no protective clothing other than that listed above, or approved as exemptions, may be used. ORNL Radiological Control Manager or his/her designee shall generate a signature approval list for those authorized to procure protective clothing.

EXEMPTIONS

Any facilities or organizations that wish to request exemptions to these requirements may do so by submitting their request(s) for exemptions, as well as justification for the exemption, in writing to the ORNL Radiological Control Manager or his/her designee.

ROTATING EQUIPMENT EXEMPTION

For those personnel working on or around rotating equipment, or other equipment so designated by the Site Safety Department, a blanket exemption is granted such that long-sleeved coveralls and gloves are not required. A lab coat and gloves will be required to move from the BCS to the specific work location, or for movement anywhere away from the rotating equipment. In order that this blanket approval is granted for each individual, it shall be the responsibility of the facility line management to submit a list of personnel in writing to the Site Radiological Control Manager or his/her designee, that work in these areas. This list must include: name, change room location, job duties, and number of coveralls requested. This list **MUST** be updated at least quarterly. If it is not updated, it will be assumed that these short-sleeved coveralls are no longer needed. The laundry will issue short-sleeved coveralls to the approved individuals. A Radiological Awareness Report, or equivalent, per MMES RADCON Manual sub-article 135.2 will be issued if any other person other than those identified on the short-sleeved coveralls is wearing them, or if personnel are wearing the short-sleeved coveralls without a lab coat and gloves in those areas that require them.

If any of these guidelines are observed to be abused, disciplinary action may result. At anytime, radiological control personnel may upgrade the protective clothing requirements based on the observed or potential hazard.

DONNING AND DOFFING PROCEDURES FOR RADIOLOGICAL WORK

Type of Areas: Low General Area Removable Contamination Levels (1 to 10 times Table I.1)

Type(s) of Work: Tours & Inspections

Required Anti-C Clothing: anti-C lab coat
one pair of anti-C shoe covers
one pair of anti-C rubber gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don anti-C lab coat. (Security badge/TLD should be worn on the outside of the coveralls.)
3. Don anti-C shoe covers.
4. Don anti-C gloves. (Tuck anti-C gloves inside lab coat sleeves.)

Doffing

1. Remove arms carefully from lab coat; place lab coat in appropriate container.
2. Remove shoe covers one at a time, stepping onto the step-off pad after removing each shoe cover, and place shoe covers in appropriate container.
3. Keeping the hands over the Radiological Area, remove the gloves and place in the appropriate container.
4. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: Low General Area Removable Contamination Levels (1 to 10 times Table I.1)

Type(s) of Work: Routine Work or Heavy Work

Required Anti-C Clothing: anti-C coveralls with hood or skull cap
one pair of booties
one pair of anti-C shoe covers
one pair of anti-C gloves
one pair of surgeon's gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable.)
3. Don anti-C coveralls; tape legs over booties; tape front of coveralls if snap closure. (Security badge/TLD should be worn on the inside of the coveralls.)
4. Don anti-C shoe covers.
5. Don skull cap or hood, as applicable. Tape hood to coveralls (if applicable).
6. Don surgeon's gloves.
7. Don anti-C gloves; tuck coverall sleeves into gloves and tape.
8. Don any other work gloves as required.

Doffing

1. Remove all tape from anti-C clothing and place in appropriate waste container.
2. Remove shoe covers, step back down into area, and place shoe covers in appropriate container.
3. Remove anti-C gloves and place in appropriate container.
4. Remove hood or skull cap, as appropriate. Remove hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall. If a skull cap, place in appropriate container.
5. Remove arms carefully from coveralls and carefully roll coveralls down inside out.
6. Step out of coveralls and back down into area. Place coveralls in appropriate container.
7. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
8. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
9. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: Moderate General Area Removable Contamination Levels (10 to 100 times Table I.1)

Type(s) of Work: Routine Work and Tours & Inspections

Required Anti-C Clothing: anti-C coveralls with hood
one pair of booties
one pair of anti-C shoe covers
one pair of anti-C gloves
one pair of surgeon's gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable.)
3. Don anti-C coveralls; tape legs over booties; tape front of coveralls if snap closure. (Security badge/TLD should be worn on the inside of the coveralls.)
4. Don anti-C shoe covers.
5. Don hood. Tape hood to coveralls.
6. Don surgeon's gloves.
7. Don anti-C gloves; tuck coverall sleeves into gloves and tape.
8. Don any other work gloves as required.

Doffing

1. Remove all tape from anti-C clothing and place in appropriate waste container.
2. Remove shoe covers, step back down into area, and place shoe covers in appropriate container.
3. Remove anti-C gloves and place in appropriate container.
4. Remove hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
5. Remove arms carefully from coveralls and carefully roll coveralls down inside out.
6. Step out of coveralls and back down into area. Place coveralls in appropriate container.
7. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
8. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
9. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: High General Area Removable Contamination Levels (>100 times Table I.1)

Type(s) of Work: Routine Work and Tours & Inspections

Required Anti-C Clothing: anti-C coveralls with hood
 one pair of booties
 two pair of anti-C shoe covers
 two pair of anti-C gloves
 one pair of surgeon's gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable.)
3. Don anti-C coveralls; tape legs over booties; tape front of coveralls if snap closure. (Security badge/TLD should be worn on the inside of the coveralls.)
4. Don inner anti-C shoe covers.
5. Don outer anti-C shoe covers.
6. Don hood. Tape hood to coveralls.
7. Don surgeon's gloves.
8. Don inner anti-C gloves; tuck coverall sleeves into gloves and tape.
9. Don outer anti-C gloves.
10. Don any other work gloves as required.

Doffing

1. Remove all tape from outer anti-C clothing and place in appropriate waste container.
2. Remove outer shoe covers, step back down into area, and place shoe covers in appropriate container.
3. Remove outer anti-C gloves and place in appropriate container.
4. Remove hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
5. Remove arms carefully from coveralls and carefully roll coveralls down inside out.
6. Step out of coveralls and back down into area. Place coveralls in appropriate container.
7. Remove inner shoe covers one at a time, stepping onto "Remove Outer Protective Clothing" step-off pad after removing each shoe cover. Place the shoe covers in the appropriate container.
8. Remove inner anti-C gloves and place in appropriate container.

9. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
10. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
11. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: Moderate General Area Removable Contamination Levels (10 to 100 times Table I.1)
 High General Area Removable Contamination Levels (>100 times Table I.1)

Type(s) of Work: Heavy Work

Required Anti-C Clothing: two pair of anti-C coveralls with hoods
 one pair of booties
 two pair of anti-C shoe covers
 two pair of anti-C gloves
 one pair of surgeon's gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable.)
3. Don inner pair of anti-C coveralls; tape legs over booties. (Security badge/TLD should be worn on the inside of the coveralls.) Tape front of coveralls if snap closure.
4. Don inner anti-C shoe covers.
5. Don inner hood. Tape hood.
6. Don surgeon's gloves.
7. Don inner pair of anti-C gloves; tuck coverall sleeves into anti-C gloves and tape.
8. Don outer pair of anti-C coveralls.
9. Don outer anti-C shoe covers.
10. Don outer hood. Tape hood and front of coveralls if snap closure.
11. Don outer pair of anti-C gloves; tuck coverall sleeves into anti-C gloves.
12. Don any other work gloves as required.

Doffing

1. Remove all tape from outer anti-C clothing and place in appropriate waste container.
2. Remove outer shoe covers, step back down into area, and place shoe covers in appropriate container.
3. Remove outer anti-C gloves and place in appropriate container.
4. Remove outer hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
5. Remove arms carefully from outer coveralls and carefully roll outer coveralls down inside out.

6. Step out of outer coveralls and back down into area. Place outer coveralls in appropriate container.
7. Remove all tape from inner anti-C clothing and place in appropriate waste container.
8. Remove inner shoe covers one at a time, stepping onto "Remove Outer Protective Clothing" step-off pad after removing each shoe cover. Place the shoe covers in the appropriate container.
9. Remove inner anti-C gloves and place in appropriate container.
10. Remove inner hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
11. Remove arms carefully from inner coveralls and carefully roll inner coveralls down inside out.
12. Step out of inner coveralls and back down into area. Place inner coveralls in appropriate container.
13. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
14. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
15. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: Low General Area Removable Contamination Levels (1 to 10 times Table I.1)

Type(s) of Work: Pressurized and Large Volume Liquid Systems

Required Anti-C Clothing: splashproof anti-C coveralls with attached hood and feet
one pair of anti-C boots
one pair of anti-C rubber gloves
one pair of surgeon's gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don splashproof anti-C coveralls with attached feet and hood. (Security badge/TLD should be worn on the inside of the coveralls.)
3. Don anti-C boots and tape to coveralls with waterproof tape.
4. Don surgeon's gloves.
5. Don anti-C rubber gloves and tape to coveralls with waterproof tape.
6. Don face shield (if applicable).
7. Don any other work gloves as required.

Doffing

1. Remove all tape from outer anti-C clothing and place in appropriate waste container.
2. Remove anti-C boots, step back down into area, and place anti-C boots in appropriate container.
3. Remove anti-C gloves and place in appropriate container.
4. Remove face shield (if applicable) and place in appropriate container.
5. Remove splashproof coverall hood by separating closure, leaning head back, and allowing the hood to fall from the back of the head; allow to hang on back of coverall.
6. Remove arms carefully from splashproof coveralls and carefully roll coveralls down inside out.
7. Step out of splashproof coveralls one leg at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each foot from the coveralls. Place coveralls in appropriate container.
8. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
9. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: Moderate General Area Removable Contamination Levels (10 to 100 times Table I.1)

Type(s) of Work: Pressurized and Large Volume Liquid Systems

Required Anti-C Clothing: splashproof anti-C coveralls with attached hood and feet
 one pair of anti-C coveralls with hood
 one pair of booties
 one pair of anti-C shoe covers
 one pair of anti-C boots
 one pair of anti-C rubber gloves
 one pair of surgeon's gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable.)
3. Don inner pair of anti-C coveralls; tape legs over booties. (Security badge/TLD should be worn on the inside of the coveralls.) Tape front of coveralls if snap closure.
4. Don inner anti-C shoe covers.
5. Don inner hood. Tape hood.
6. Don splashproof anti-C coveralls with attached feet and hood.
7. Don anti-C boots and tape to coveralls with waterproof tape.
8. Don surgeon's gloves.
9. Don anti-C rubber gloves and tape to coveralls with waterproof tape.
10. Don face shield (if applicable).
11. Don any other work gloves as required.

Doffing

1. Remove all tape from outer anti-C clothing and place in appropriate waste container.
2. Remove anti-C boots, step back down into area, and place anti-C boots in appropriate container.
3. Remove anti-C gloves and place in appropriate container.
4. Remove face shield (if applicable) and place in appropriate container.
5. Remove outer hood by separating closure, leaning head back, and allowing the hood to fall from the back of the head; allow to hang on back of coverall.
6. Remove arms carefully from outer splashproof coveralls and carefully roll outer coveralls down inside out.
7. Step out of outer splashproof coveralls and back down into area. Place outer coveralls in appropriate container.

8. Remove all tape from inner anti-C clothing and place in appropriate waste container.
9. Remove inner shoe covers one at a time, stepping onto "Remove Outer Protective Clothing" step-off pad after removing each shoe cover. Place the shoe covers in the appropriate container.
10. Remove inner hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
11. Remove arms carefully from inner coveralls and carefully roll inner coveralls down inside out.
12. Step out of inner coveralls and back down into area. Place inner coveralls in appropriate container.
13. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
14. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
15. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: High General Area Removable Contamination Levels (>100 times Table I.1)

Type(s) of Work: Pressurized and Large Volume Liquid Systems

Required Anti-C Clothing: splashproof anti-C coveralls with attached hood and feet
 one pair of anti-C coveralls with hood
 one pair of booties
 one pair of anti-C shoe covers
 one pair of anti-C boots
 two pair of anti-C rubber gloves
 one pair of surgeon's gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable.)
3. Don inner pair of anti-C coveralls; tape legs over booties. (Security badge/TLD should be worn on the inside of the coveralls.) Tape front of coveralls if snap closure.
4. Don inner anti-C shoe covers.
5. Don inner hood. Tape hood.
6. Don surgeon's gloves.
7. Don inner pair of anti-C gloves; tuck coverall sleeves into anti-C gloves and tape.
8. Don splashproof anti-C coveralls with attached feet and hood.
9. Don anti-C boots and tape to coveralls with waterproof tape.
10. Don outer anti-C rubber gloves and tape to coveralls with waterproof tape.
11. Don face shield (if applicable).
12. Don any other work gloves as required.

Doffing

1. Remove all tape from outer anti-C clothing and place in appropriate waste container.
2. Remove anti-C boots, step back down into area, and place anti-C boots in appropriate container.
3. Remove outer anti-C gloves and place in appropriate container.
4. Remove face shield (if applicable) and place in appropriate container.
5. Remove outer hood by separating closure, leaning head back, and allowing the hood to fall from the back of the head; allow to hang on back of coverall.
6. Remove arms carefully from outer splashproof coveralls and carefully roll outer coveralls down inside out.

7. Step out of outer splashproof coveralls and back down into area. Place outer coveralls in appropriate container.
8. Remove all tape from inner anti-C clothing and place in appropriate waste container.
9. Remove inner shoe covers one at a time, stepping onto "Remove Outer Protective Clothing" step-off pad after removing each shoe cover. Place the shoe covers in the appropriate container.
10. Remove inner anti-C gloves and place in appropriate container.
11. Remove inner hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
12. Remove arms carefully from inner coveralls and carefully roll inner coveralls down inside out.
13. Step out of inner coveralls and back down into area. Place inner coveralls in appropriate container.
14. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
15. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
16. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: All Airborne Radioactivity Areas Involving Pressurized and Large Volume Liquid Systems

Type(s) of Work: Pressurized and Large Volume Liquid Systems

Required Anti-C Clothing: splashproof anti-C coveralls with attached hood and feet
one pair of anti-C coveralls with hood
one pair of booties
one pair of anti-C shoe covers
one pair of anti-C boots
one pair of anti-C rubber gloves
one pair of surgeon's gloves

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable.)
3. Don inner pair of anti-C coveralls; tape legs over booties. (Security badge/TLD should be worn on the inside of the coveralls.) Tape front of coveralls if snap closure.
4. Don inner anti-C shoe covers.
5. Don skull cap.
6. Don surgeon's gloves.
7. Don specified respiratory protection.
8. Don inner hood. Tape hood to coveralls and respiratory protection, where practical.
9. Don splashproof anti-C coveralls with attached feet and hood.
10. Don anti-C boots and tape to coveralls with waterproof tape.
11. Don anti-C rubber gloves and tape to coveralls with waterproof tape.
12. Tape attached waterproof hood to respiratory protection, where practical.
13. Don any other work gloves as required.

Doffing

1. Remove all tape from outer anti-C clothing and place in appropriate waste container.
2. Remove anti-C boots, step back down into area, and place anti-C boots in appropriate container.
3. Remove anti-C gloves and place in appropriate container.
4. Remove outer hood by separating closure, leaning head back, and allowing the hood to fall from the back of the head; allow to hang on back of coverall.
5. Remove arms carefully from outer splashproof coveralls and carefully roll outer coveralls down inside out.

6. Step out of outer splashproof coveralls and back down into area. Place outer coveralls in appropriate container.
7. Remove all tape from inner anti-C clothing and place in appropriate waste container.
8. Remove inner shoe covers one at a time, stepping onto "Remove Outer Protective Clothing" step-off pad after removing each shoe cover. Place the shoe covers in the appropriate container.
9. Remove inner hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
10. Remove respiratory protection and place in appropriate container.
11. Remove skull cap and place in appropriate container.
12. Remove arms carefully from inner coveralls and carefully roll inner coveralls down inside out.
13. Step out of inner coveralls and back down into area. Place inner coveralls in appropriate container.
14. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
15. Keeping the hands over the Radiological Area, remove the surgeon's gloves, and place in the appropriate container.
16. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: Low General Area Removable Contamination Levels (1 to 10 times Table I.1)

Type(s) of Work: Airborne Radioactivity Work

Required Anti-C Clothing: anti-C coveralls with hood and skull cap
 one pair of booties
 one pair of anti-C shoe covers
 one pair of anti-C gloves
 one pair of surgeon's gloves
 specified respiratory protection

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable)
3. Don anti-C coveralls; tape legs over booties; tape front of coveralls if snap closure. (Security badge/TLD should be worn on the inside of the coveralls.)
4. Don anti-C shoe covers.
5. Don skull cap.
6. Don surgeon's gloves.
7. Don anti-C gloves; tuck coverall sleeves into gloves and tape.
8. Don specified respiratory protection.
9. Don hood. Tape hood to coveralls and respiratory protection, where practical.
10. Don any other work gloves as required.

Doffing

1. Remove all tape from anti-C clothing and place in appropriate waste container.
2. Remove shoe covers, step back down into area, and place shoe covers in appropriate container.
3. Remove anti-C gloves and place in appropriate container.
4. Remove hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
5. Remove respiratory protection and place in appropriate container.
6. Remove skull cap and place in appropriate container.
7. Remove arms carefully from coveralls and carefully roll coveralls down inside out.
8. Step out of coveralls and back down into area. Place coveralls in appropriate container.

9. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
10. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
11. Perform a Whole Body Frisk, including badge and dosimeter.

Type of Areas: Moderate General Area Removable Contamination Levels (10 to 100 times Table I.1)
 High General Area Removable Contamination Levels (>100 times Table I.1)

Type(s) of Work: Airborne Radioactivity Area

Required Anti-C Clothing: two pair of anti-C coveralls with hoods
 one skull cap
 one pair of booties
 two pair of anti-C shoe covers
 two pair of anti-C gloves
 one pair of surgeon's gloves
 specified respiratory protection

Donning

Note: When donning the anti-C clothing, the clothing must be worn fully closed. When tape is used, fold the end of the tape over to form a tab to facilitate easy removal.

1. Obtain proper clothing from clothing bin and check clothing integrity.
2. Don booties. (Tuck pant legs into booties, if applicable.)
3. Don inner pair of anti-C coveralls; tape legs over booties. (Security badge/TLD should be worn on the inside of the coveralls.) Tape front of coveralls if snap closure.
4. Don inner anti-C shoe covers.
5. Don skull cap.
6. Don surgeon's gloves.
7. Don inner pair of anti-C gloves; tuck coverall sleeves into anti-C gloves and tape.
8. Don specified respiratory protection.
9. Don inner hood. Tape hood to coveralls and respiratory protection, where practical.
10. Don outer pair of anti-C coveralls.
11. Don outer anti-C shoe covers.
12. Don outer hood. Tape hood and front of coveralls if snap closure.
13. Don outer pair of anti-C gloves, tuck coverall sleeves into anti-C gloves.
14. Don any other work gloves as required.

Doffing

1. Remove all tape from outer anti-C clothing and place in appropriate waste container.
2. Remove outer shoe covers, step back down into area, and place shoe covers in appropriate container.
3. Remove outer anti-C gloves and place in appropriate container.

4. Remove outer hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
5. Remove arms carefully from outer coveralls and carefully roll outer coveralls down inside out.
6. Step out of outer coveralls and back down into area. Place outer coveralls in appropriate container.
7. Remove all tape from inner anti-C clothing and place in appropriate waste container.
8. Remove inner shoe covers one at a time, stepping onto "Remove Outer Protective Clothing" step-off pad after removing each shoe cover. Place the shoe covers in the appropriate container.
9. Remove inner anti-C gloves and place in appropriate container.
10. Remove inner hood by separating Velcro closure, leaning head back, and bringing open ends of the hood across the shoulders allowing the hood to fall from the back of the head. If an unattached hood, place hood in appropriate container. If an attached hood, allow to hang on back of coverall.
11. Remove respiratory protection and place in appropriate container.
12. Remove skull cap and place in appropriate container.
13. Remove arms carefully from inner coveralls and carefully roll inner coveralls down inside out.
14. Step out of inner coveralls and back down into area. Place inner coveralls in appropriate container.
15. Remove booties one at a time, stepping onto "Remove Protective Clothing" step-off pad after removing each bootie. Place the booties in the appropriate container.
16. Keeping the hands over the Radiological Area, remove the surgeon's gloves and place in the appropriate container.
17. Perform a Whole Body Frisk, including badge and dosimeter.

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