MARTIN MARIETTA**ENVIRONMENTAL
RESTORATION
PROGRAM****Health and Safety Plan for Waste Area
Grouping 6 at Oak Ridge National
Laboratory, Oak Ridge, Tennessee**

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FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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Energy Systems Environmental Restoration Program
ORNL Environmental Restoration Program

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National Laboratory, Oak Ridge, Tennessee

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
BP	boiling point
CE	Construction Engineer
CG	combustible gas
CNS	central nervous system
CPR	cardiopulmonary resuscitation
CRC	contamination reduction corridor
CRZ	Contamination Reduction Zone
CVS	central vascular system
CWP	Comprehensive Work Plan
DAC	derived air concentration
dBA	decibels on the A-weighted scale
DOE	U.S. Department of Energy
ECC	Emergency Control Center
EDT	Explosive Detonation Trench
EMS	Emergency Medical Services
EPA	U.S. Environmental Protection Agency
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
GC	gas chromatograph
GET	General Employee Training
GI	gastrointestinal tract
GW	groundwater
H&R	hoisting and rigging
HAZWOPER	Hazardous Waste Operations and Emergency Response
HP	Health Physics technician
IDLH	immediately dangerous to life or health
IH	Industrial Hygiene
IP	ionization potential
IS	Industrial Safety Section
ISV	in situ vitrification
LEL	lower explosive limit
LLI	lower large intestine
LLW	low-level waste
LSS	Laboratory Shift Superintendent
MP	melting point
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
MW	molecular weight

NIOSH	National Institute of Occupational Safety and Health
ORNL	Oak Ridge National Laboratory
ORP	Office of Radiation Protection
OSHA	Occupational Safety and Health Administration
PA	public address
PEL	permissible exposure limit
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
REAC/TS	Radiation Emergency Assistance Center/Training Site
REL	relative exposure limit
RI	Remedial Investigation
RWP	Radiation Work Permit
S&H	safety and health
SSHM	Site Safety and Health Manager
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SO	soil data
SOP	Standard Operating Procedure
SPM	Site Project Manager
SS	sediment data
SSHEA	Site Specific Hazards Evaluation Addendum
SW	surface water
SWMU	Solid Waste Management Unit
SWP	Safety Work Permit
SWSA	Solid Waste Storage Area
TLD	thermoluminescence dosimeter
TLV	threshold limit value
UEL	upper explosive limit
UL	Underwriters' Laboratory
WAG	Waste Area Grouping
WBGT	wet-bulb globe thermometer

EXECUTIVE SUMMARY

The Martin Marietta Energy Systems, Inc. (Energy Systems), policy is to provide a safe and healthful workplace for all employees and subcontractors. The accomplishment of this policy requires that operations at Waste Area Grouping (WAG) 6 at the Department of Energy (DOE) Oak Ridge National Laboratory are guided by an overall plan and consistent proactive approach to safety and health (S&H) issues.

The policy and procedures in this plan apply to all areas of WAG 6, with the exception of Waste Management operations. The provisions of this plan are to be carried out whenever activities are initiated at WAG 6 which 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 or 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 health and safety requirements such as Site Specific Hazards Evaluation Addendums (SSHEAs) to the Site Safety and Health Plan which should be used in concert with this plan and existing established procedures. This plan, and any addendums addressing S&H, 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 on-site personnel. During on-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.

Since actual working conditions may not be able to be determined in advance of the work, the plan must allow the opportunity to provide a range of protection based upon actual working conditions that could be encountered while conducting on-site activities. Site-specific information will be presented in SSHEAs to the extent possible.

1. INTRODUCTION

This Site Safety and Health Plan (SSHP) has been prepared in response to the proposed Waste Area Grouping (WAG) 6 Facilities Management Plan prepared for the U.S. Department of Energy (DOE), Oak Ridge National Laboratory (ORNL). This plan follows the format recommended by the U.S. Environmental Protection Agency (EPA) for remedial investigations and feasibility studies and complies with the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR 1910.120 for investigations and cleanup at hazardous waste sites.

1.1 SSHP COMPONENTS

This SSHP provides information on the following topics:

- Key health and safety personnel.
- Risk analysis (site hazards).
- Worker training.
- Personal protective equipment.
- Action levels and guidelines.
- Medical surveillance requirements.
- Frequency and types of monitoring.
- Site control measures.
- Contamination control measures.
- Decontamination procedures.
- Standard Operating Procedures (SOPs) for the site.
- Contingency plans.
- Emergency evacuation.
- Spill control.
- Entry procedures for confined spaces.

This SSHP provides information applicable to the activities at WAG 6 that are being addressed by the ORNL Environmental Restoration (ER) Program. These activities may consist of, but are not limited to, well plugging and abandonment, geotechnical drill operations, remedial action activities, environmental sampling, well installation, remedial construction activities, environmental radiological surveys, operations, and maintenance. WAG 6 is located on the Oak Ridge Reservation just southwest of ORNL off Lagoon Road (see Fig. 1). Site Specific Hazards Evaluation Addendums (SSHEAs) will also be prepared on an activity-specific basis. SSHEA instructions will address the hazards associated with a particular activity in greater detail and will discuss any new data that have been received. All ER Program SSHPs and SSHEAs will be reviewed and approved by the ORNL ER Program Environmental Safety and Health (ES&H) Manager and WAG 6 and ORNL personnel listed in the *ORNL HAZWOPER Procedures Manual* to ensure that the plans comply with ORNL organizations and procedures.

Fig. 1. Site map.

1.2 SITE DESCRIPTION

As part of research operations at ORNL, hazardous and low-level radioactive waste (LLW) have been produced and disposed of for ~45 years. WAG 6, which has received waste since 1969, consists of three solid waste management units: Solid Waste Storage Area (SWSA) 6, the Emergency Waste Basin (EWB), and the Explosives Detonation Trench (EDT). The EWB, located in the northeast corner of WAG 6, is an emergency holding basin with a surface area of 2 acres and storage capacity of 15 million gallons. The basin has never been used for waste disposal or storage but does receive some runoff from SWSA 6. The EDT was a trench ~15 ft long, 5 ft wide, and 4 ft deep that was used to detonate explosives and shock-sensitive chemicals. The EDT was located in the southeastern corner of SWSA 6 but has been backfilled so that its exact location is unknown.

SWSA 6, comprising 68 acres, was opened in 1969 for shallow land burial of LLW and nonradioactive wastes. Wastes disposed of in SWSA 6 include laboratory glassware and equipment, protective apparel, mechanical equipment, construction materials, filter media and resins, contaminated earth, biological research wastes, etc. Waste packaging has been highly variable, ranging from plastic bags to stainless steel drums to unpackaged waste.

SWSA 6 was operated under the authority of the Atomic Energy Act of 1954, as administered under the guidance of the Atomic Energy Commission (now known as DOE) for managing radioactive waste materials. In May 1986, DOE temporarily discontinued waste disposal at SWSA 6 when it discovered that RCRA-regulated hazardous and/or mixed wastes were being disposed of there. Once procedures were in place to prevent additional RCRA-regulated waste from being disposed of at SWSA 6, it was reopened.

Much of the information provided in this document concerning potential on-site contaminants has been obtained from *ORNL WAG 6 Site Characterization Summary* (ORNL/ER-11/V2&D, March 1990), from the WAG 6 remedial investigation (RI) results, and from historical informational sources.

ORNL has prepared a Resource Conservation and Recovery Act (RCRA) Closure Plan for SWSA 6, which was approved by the state of Tennessee in September 1988. Environmental restoration of WAG 6, pursuant to the Federal Facility Agreement, is currently under negotiation with EPA and the Tennessee Department of Environment and Conservation. Indications are that a Deferred Remedial Action will consist of the maintenance of access controls; monitoring the environmental releases from the WAG; and conduct of research, development, and demonstration of remedial technologies.

2. COMPREHENSIVE WORK PLAN

A comprehensive work plan (CWP) shall be developed and written to be used in conjunction with this SSHP for each work project conducted at WAG 6 in accordance with the requirements of 29 CFR 1910.120. A review of the CWP shall be conducted by all members or representatives of the review committee for this SSHP. CWPs shall be written and executed in accordance with this SSHP. Each CWP shall contain a scope of work that describes all anticipated tasks to be conducted during the work project and summarizes the tasks required to perform each operation safely.

2.1 SITE SPECIFIC HAZARD EVALUATION ADDENDUM

An SSHEA shall be developed for each project addressed in the CWP and shall meet the requirements set forth in 29 CFR 1910.120 and this SSHP for project-specific information. SSHEA development shall be a cooperative effort among the Site Safety and Health Manager (SSHM), the Site Safety and Health Officers (SSHOs), and the Site Health Physics Technician (Site HP) (see Sect. 3 for a description of site roles). The SSHEA will serve as an extension to this plan and shall address all site-specific information, including, but not limited to, the work site location and anticipated operations of each work project, the anticipated hazards to health and safety, and the prescribed methods for controlling the hazards, including the use of written procedures and work practices.

Review and written approval of all WAG 6 CWPs and SSHEAs shall be performed by the same committee that conducts the review and approval of this SSHP. All key personnel involved in each CWP and SSHEA, such as the Site Project Manager (SPM), the Construction Engineer (CE), the Hazardous Waste Operations and Emergency Response (HAZWOPER) Program Coordinator, the WAG 6 Facility Manager, the ER Program ES&H Manager, and other WAG 6 authorities, may also be required to review the CWP and SSHEAs prior to the start of work activities. All site personnel shall be required to review the information contained in the site SSHEA, to attend a preentry health and safety briefing that shall include the information contained in the SSHEA, and to document their review on the SSHEA Briefing Log (see Appendix A).

An SSHEA shall be developed for each project identified in the scope of the CWP. The format of the SSHEA is shown in Appendix A. Elements that shall be addressed in the SSHEA include, but are not limited to, the following:

Site Organization

- All Energy Systems personnel, subcontractors, and their anticipated services for each work project must be specified in the site CWP.
- The site roles and responsibilities of key personnel for each contractor shall be identified within each CWP, and the key personnel for health and safety shall be identified in each SSHEA.

- The names, telephone numbers, and radio numbers of personnel in all site roles during each work project shall be specified in the project SSHEA.
- In the event that project roles or responsible parties change during the progress of the project, an addendum to the CWP or SSHEA shall be made to include updated information.

Risk and Hazard Analysis

- A task description and an assessment of the health risk to workers for each anticipated site operation shall be developed and included in SSHEAs.
- A detailed evaluation of the radiological and chemical contamination present at each site, and anticipated control measures, will be included in the SSHEA.
- The SSHM or Project Manager (PM) shall obtain Material Safety Data Sheets (MSDSs) for any chemicals that are transported onto the site for site operations. These MSDSs shall be obtained through the ORNL MSDS Database System or be approved by the ORNL Industrial Hygiene Section (IH) and shall be attached to the project SSHEAs.

Site Access Requirements

- The requirements for personal protective equipment (PPE) and respiratory protection (as determined by site hazard and operations) shall be specified in the SSHEAs.
- General procedures for donning and doffing PPE are included in Sect. 5.3.4. Variations in the general procedure, based on site conditions, shall be included in the SSHEAs.
- The requirements for medical monitoring of worker exposures shall be specified in each SSHEA and shall be dictated by the requirements of 29 CFR 1910 and the procedures and exposure control programs of ORNL IH and the ORNL Health Division.

Frequency and Types of Monitoring

- Environmental monitoring requirements for site activities shall be specified in the SSHEA.
- All types of instrumentation used in field operations must be specified in each SSHEA.
- SOPs for the operation and daily field calibration of all environmental monitoring equipment used to detect ambient site conditions and potential personnel exposures shall be included or incorporated by reference in the SSHEA.
- Monitoring response guidelines shall be established for real-time site assessments in each SSHEA.

Site Zones and Control Measures

- A site-specific map shall be included for the areas covered in each SSHEA.
- The anticipated placement of the site-specific work zones shall be included in the SSHEA and detailed on the site map.
- Details of control methods to be used in site operations to reduce the potential for personnel exposure and contamination control shall be included in the SSHEA.

Decontamination Procedures

- General personnel and equipment decontamination procedures required for site activities are listed in Chap. 8 of this SSHP. Additional requirements based on site conditions will be listed in the SSHEAs.
- Applicable SOPs for equipment decontamination will be maintained on-site and shall be conducted in accordance with established WAG 6, ER, or ORNL Waste Management procedures. General equipment decontamination procedures are listed in Sect. 8.2 of this document. Additional requirements based on site conditions shall be included in the SSHEA.

Standard Operating Procedures

- SOPs for project work activities shall be developed and included in the CWP.

Emergency Preparedness and Contingency Plans

- A listing of emergency contacts and their respective telephone numbers shall be provided in each SSHEA.
- The locations of means of communication at the site shall be specified in the site SSHEA.
- The exact location of spill control kits and fire extinguishers shall be given in the SSHEA, as a part of the site emergency action plan. All heavy equipment is required to have a fire extinguisher on board.
- The location of the site assembly point shall be included in the SSHEA.
- The locations and types of emergency equipment available during site operations shall be given in the SSHEA.

The above elements correspond to sections of this SSHP that contain further details of the SSHEA information requirements.

2.2 PROJECT DOCUMENTATION

2.2.1 Site Logbook

A site logbook shall be dedicated to each project for the purpose of documenting and summarizing all pertinent site activities, work efforts, and events. Observations to be recorded in the site logbook shall include, but are not limited to, the following: site conditions, site operations, instrumentation monitoring and calibration information, site entrants, accidents or injuries, and attendance at preentry and periodic health and safety briefings. 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 may be required as documentation of project activities. Required project documentation may include, but is not limited to, the following:

- The SSHP.
- SSHP acceptance forms signed by each site worker.
- Project logbook.
- Site instrumentation monitoring and calibration logs.
- Safety Work Permits.
- Radiation Work Permits.
- SSHEAs.
- SSHEA briefing records.
- Safety and health self-assessment/-surveillance plan.
- Accident and illness reports.
- Inspection reports.
- Worker medical records.
- Worker training records.

These items shall be considered a part of the project documentation and shall be maintained on site by the SSHO and the Site HP for the duration of the project. Upon completion of the project, all documentation will be maintained with the project logbook as historical records with the project manager and the ORNL ER document control manager.

2.2.2 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.

2.2.2.1 Field activities

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 shall be suspended until the corrective action is performed under the supervision of the SSHO or SSHM.

2.2.2.2 Occurrence reporting

DOE Order 5000.3B, *Occurrence Reporting and Processing of Operations Information*, became effective on February 22, 1993. The occurrence reporting system 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. Any occurrence is to be reported to the Laboratory Shift Superintendent (LSS). If the event involves a real-time occurrence that requires assistance from plant emergency services, on-site personnel should first take actions to mitigate the occurrence, and the situation should be reported as described in Sect. 10.1 of this SSHP. Any other ORNL procedures for occurrence reporting should also be followed.

2.2.2.3 Field changes and variances

Any deviation from the SSHP, CWP, or SSHEA, or change in established work procedures, must be reported and recorded in a specified section of the field logbook for field changes and variances, when the deviation occurs. A Field Change Request/Variance Form (provided as Appendix B) will be completed and signed by the appropriate persons in the event of any deviation from the SSHP, CWP, or SSHEA.

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

A field change is a deviation that could adversely affect the quality of data being generated. For major alterations or field changes, the "Field Change" box on the form is checked, and the signatures of the Facility Manager and the Construction Engineer on-site are required, in addition to the signatures listed on the form (see Appendix B). Changes must be explained to all site personnel. Each signee will receive a copy of the Field Change/Variance Form, which records the deviation, the substituted method or rationale for the change, and an explanation of how data quality will be affected. All variances that affect the health and safety of the site workers shall require the approval of the HAZWOPER Program Coordinator.

3. SITE ORGANIZATION

WAG 6 is currently being managed as a part of the ORNL facility by Energy Systems through a contract with DOE. Energy Systems subsequently subcontracts some site management activities, such as engineering support, construction, technical support, and monitoring, to other firms and organizations. All subcontractors and their anticipated services for each work project must be specified in the SSHEA. Therefore, the roles and responsibilities for site operations may change as different organizations are subcontracted to perform services during various work projects conducted at WAG 6. The specification of names and telephone numbers for all site roles during each work project is required for the SSHEA.

3.1 KEY PERSONNEL

Listed in Table 1 are project roles which, at a minimum, must be specified in each CWP and SSHEA. 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.

Table 1. Site roles

Site Project and Programmatic Manager
Site Health and Safety Manager
Site Health and Safety Officers
Site Health Physics Technician
Hazardous Waste Operations and Emergency Response (HAZWOPER) Program Coordinator
Industrial Hygiene Specialist
Industrial Safety Specialist
Energy Systems Construction Engineer
Energy Systems Project Manager
ORNL ER Program ES&H Manager
WAG 6 Facility Manager

3.2 SITE ROLES AND RESPONSIBILITIES

The sections below contain descriptions of anticipated site roles and responsibilities. Site roles and responsibilities are not limited to those listed below. 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 SSHEA. The roles and responsibilities of key personnel for each contractor or subcontractor shall also be identified in each CWP.

3.2.1 Site Project and Programmatic Manager

The Site Project and Programmatic Manager (SPM) is primarily responsible for managing and coordinating all field activities related to the project. Responsibilities of the SPM may include, but are not limited to, the following:

- Coordinating support personnel required for field operations, including both Energy Systems and subcontractor personnel.
- Notifying the LSS of planned activities, as required.
- Notifying the facility manager of planned activities.
- Coordinating with ORNL the distribution and control of security access badges required for Melton Valley and WAG 6 site access.
- Obtaining all required documentation and permits.
- Providing oversight of field activities.
- Determining and communicating site project objectives to all personnel involved in site activities.
- Requesting or coordinating daily health and safety briefings in order to summarize planned activities, to identify new hazards, or to clarify any task- or project-related issues.
- Coordinating the completion of 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 for their job.
- Assuring that all personnel adhere to all ES&H, QA, Waste Management, and any other procedures appropriate to the project.

3.2.2 Site Safety and Health Manager

The SSHM shall be an Energy Systems employee responsible for the coordination and oversight of all site health and safety issues. The SSHM shall be responsible for the coordination of all site activities with the SPM, CE, SSHOs, and other site personnel. The SSHM is required to have fulfilled the training and medical monitoring requirements for exclusion zone access. Each SSHM must be approved in writing as being able to perform as the SSHM by the HAZWOPER Program Coordinator and reviewed by the ORNL ER ES&H Manager. The approval or disapproval will be determined through a review of qualifications, including those listed above. Responsibilities of the SSHM may include, but are not limited to, the following:

- Assisting the SSHOs, Site HPs, and IH in establishing site work zones and the level of PPE required to ensure that all anticipated activities can be safely performed.
- Providing oversight and quality control of the calibration and response check of all instrumentation used by health and safety site personnel for monitoring worker exposures and site conditions.
- Ensuring through inspection that daily instrument calibration and response checks are properly documented in the work project site logbook.
- Providing oversight of and, as needed, performing monitoring and sampling of site conditions and hazards encountered during work activities.
- Ensuring that all support personnel have up-to-date medical examinations and, as necessary, are placed under a respiratory protection program that complies with the requirements of 29 CFR 1910.120 and 29 CFR 1910.134.
- Ensuring compliance with the requirements of 29 CFR 1910.1200 for hazard communication training on all hazardous materials brought into the site for use in site operations.
- Providing oversight and supervision of all SSHOs.
- Developing the SSHEAs in a cooperative effort with the Site HP, the SPM, the HAZWOPER Program Coordinator, the ORNL ER ES&H Manager, and other authorities.

The SSHM has the authority to order a cessation of any site activities that the Site HP perceives to be immediately dangerous to life, to the health of site personnel or the community, or to the environment. The SSHM 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 personnel consulted. However, if an auxiliary organization (e.g., IH or IS) orders cessation of work, only that organization can order work to resume.

3.2.3 Site Safety and Health Officer

The SSHO shall be designated by the SSHM to perform actual on-site health and safety supervision of all site activities, under the direction of the SSHM. At the ORNL HAZWOPER Program Coordinator's discretion, more than one SSHO may be used during a project if project operations are ongoing at more than one work site. The SSHOs are required to have fulfilled the training requirements and medical monitoring requirements for exclusion zone access, to have a minimum of 2 years health and safety experience through work activities or education, and to have previously performed or been trained as a supervisor for hazardous waste sites. Each SSHO must be approved in writing to the SSHM by the ORNL IH HAZWOPER Program Coordinator. The approval or disapproval will be determined through a review of qualifications, including those listed above. The responsibilities of the SSHO shall include, but are not limited to, the following:

- Overseeing the selection, inspection, storage, and maintenance of personal protective clothing and equipment to be used on-site in conjunction with the Site HP.

- Establishing and maintaining work zones to prevent the potential spread of contamination during work and decontamination activities in accordance with the Site HP.
- Controlling entry and exit of all personnel and observers into the work zones.
- Participating in the preparation and implementation of the SSHP, CWP, and SSHEAs.
- Conducting periodic inspections (self-assessments) to ensure the compliance of all site entrants with health and safety measures outlined in the SSHP, the SSHEA, and other appropriate documents.
- Confirming each worker's suitability for hazardous waste site work based on a physician's recommendation and HAZWOPER physical (as required), as well as maintaining written records to that effect on-site, including documentation of worker participation in the necessary medical surveillance programs and respiratory protection programs.
- Ensuring that any injury or illness related to work performance is reported to the SPM, ORNL ER ES&H Manager, Medical, and IS.
- Maintaining and inspecting records of each on-site worker's training required for each work effort in accordance with 29 CFR 1910.120. (Note: ORNL Special Access training badges will be used to verify training for ORNL employees.)
- Ensuring that all prospective site personnel sign and date the field logbook to verify that the requirements for informing personnel of site-specific potential health hazards and other health and safety information covered in the SSHP and applicable SSHEA have been met and that medical surveillance and training requirements for individual workers for site access have been met.
- Monitoring of ambient site conditions for potential chemical and radiological exposures as well as monitoring of workers for symptoms of exposure or for conditions related to other on-site hazards, including physical stresses such as temperature extremes.
- 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 SSHP, CWP, and SSHEA, as well as maintaining documentation of such instrument calibration in the work project logbook. All calibration shall be performed in accordance with manufacturers' guidelines.
- Ensuring that all monitoring equipment is operating correctly according to this SSHP and the manufacturers' instructions and providing maintenance or ensuring that maintenance is provided, if authorized.
- Conducting preentry 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; and the locations of fire alarms, extinguishers, telephones, and sanitation facilities.
- Conducting S&H briefings if site conditions change.

- Establishing and posting at the site an emergency action plan, telephone numbers, and appropriate radio communication information.

The SSHO has the authority to order a cessation of any site activities that the SSHO perceives to be immediately 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 personnel consulted.

3.2.4 Radiation Protection and the Site HP

All health physics monitoring and oversight services shall be provided through the ORNL Office of Radiation Protection (ORP). HPs providing support at WAG 6 will be provided by, subcontracted through, or approved by the ORP. A Site HP or Site HPs with working knowledge of the WAG 6 site will be designated by the ORP to provide on-site support for each project. The responsibilities of the Site HP shall include, but are not limited to, the following:

- Reviewing all SSHPs, CWP, and SSHEAs 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 and the adequate address of health physics concerns.
- Attending all preentry and daily health and safety briefings and presenting radiation protection information to all site workers during the briefings.
- Being present during ongoing site operations.
- Assuring that personnel and equipment are frisked for contamination before leaving the area.
- Assuring that the equipment leaving the area has been properly bagged and tagged (rad/green tagged).
- Monitoring and documenting all radiological hazards at the site.
- Implementing and overseeing all site operations to ensure that work is conducted in accordance with all ORNL Radiation Protection procedures and practices.
- Approving or disapproving site personnel who are called upon to perform health physics monitoring (frisking) of personnel or equipment for radioactive contamination.
- Assisting the SSHM or SSHOs in the selection of the appropriated PPE and respiratory protective equipment for use during each project task.
- Assisting the SSHM or SSHCs in establishing zones for work project activities.

The Site HP also has the authority to order a cessation of any site activities perceived to be immediately dangerous to life, to the health of site personnel or the community, or to

the environment. The Site HP is also authorized to permit the commencement of work activities after the subject of concern has been resolved to the satisfaction of all safety and health personnel consulted.

3.2.5 Hazardous Waste Operations and Emergency Response Program Coordinator

The HAZWOPER Program Coordinator of the ORNL IH Section is responsible for the written approval of all WAG 6 SSHPs, CWPs, and SSHEAs and the oversight of all field activities with respect to compliance with the requirements of 29 CFR 1910.120. The HAZWOPER Program Coordinator 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 SSHPs, CWPs, and SSHEAs 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 and the adequate addressing of industrial hygiene concerns.
- 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 or SSHM and the Site HP in the selection of PPE and respiratory protection, as needed.
- Granting the written approval or disapproval to the SSHM of each SSHO as being able to perform as an SSHO at the site, based upon the requirements for SSHO approval that are listed in Sect. 3.2.3 of this SSHP.
- Determining in special circumstances whether equivalent training status as allowed by 29 CFR 1910.120 can be granted and documenting the same in writing, as detailed in Sect. 5.1.2 of this SSHP. This is done in conjunction with the Technical Resources Training Section.

3.2.6 Industrial Hygiene

The IH Section of the Office of Safety and Health Protection at ORNL shall be responsible for the oversight and approval of field operations with respect to industrial hygiene concerns. As all site activities will be conducted in accordance with ORNL procedures, IH may be called upon to perform site assessments or personnel monitoring of ORNL employees, dependent on work project activities (e.g., confined space entry). In addition, IH may be required to assist the SSHOs or SSHM and the Site HP in the selection of appropriate PPE and respiratory protection, as necessary. IH shall review and approve or disapprove all SSHPs, CWPs, and SSHEAs prior to the mobilization of personnel and equipment and the commencement of field activities. IH has the authority to order a cessation of any site activities that IH perceives to be immediately dangerous to life, to the health of site personnel or the community, or to the environment. The IH 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.

3.2.7 Industrial Safety

The Industrial Safety Section (IS) of the Office of Safety and Health Protection at ORNL shall be responsible for the oversight and approval of field operations with respect to industrial safety concerns. IS shall review and approve or disapprove all SSHPs, CWP, and SSHEAs 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 immediately 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.

3.2.8 Field Personnel

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

- Taking all reasonable precautions to prevent injury to themselves and their fellow employees; using *all their senses* and information collected from field instrumentation to alert them to potentially harmful situations.
- Performing only those tasks that the personnel believe they can do safely and immediately reporting any accidents and unsafe conditions to the SSHOs and the Site HP.
- Notifying the SSHOs of any existing medical conditions (e.g., allergies, diabetes, pregnancy) that require special consideration. ORNL Health Division approval and/or a physician's recommendation may be 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, if possible, and notifying the SPM, Site HP, and SSHOs.
- Avoiding splashing contaminated materials.
- Being familiar with the physical characteristics of the site, including
 - wind direction;
 - accessibility to site authorities, equipment, and vehicles;
 - communications of available fire alarm boxes, telephones, and radios;
 - areas of known or suspected contamination, or "hot zones";
 - site access;
 - nearest site resources (e.g., restrooms and breakrooms);
 - overhead power lines; and
 - buried electrical lines and underground piping systems.

- Maintaining for proper disposal all wastes generated during site operations.
- Reporting all injuries, regardless how minor, to the SSHOs and the SPM.
- Reporting in person to the ORNL Health Division of any personnel incurring an injury or illness related to work activities after notifying the SSHM or SSHO.
- 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 Site HP, SSHOs, or approved alternates for frisking prior to egress from the CRZ or Exclusion Zone (EZ), as directed by the SSHOs.
- Becoming familiar with the procedures required within the SSHP, CWP, and SSHEAs.
- Conducting all tasks in accordance with the SSHP, CWP, and SSHEAs for each project.
- Reporting to the SSHM or SSHO, the Site HP, or their direct supervisor any information regarding site operations or conditions that may have an impact on the health and safety of the operation.

3.2.9 WAG 6 Facility Manager

The WAG 6 Facility Manager is a designated Energy Systems employee who is primarily responsible for the oversight and coordination of all WAG 6 operations and activities, with the exception of Waste Management operations. The responsibilities of the WAG 6 Facility Manager include, but are not limited to, the following:

- Managing site access for all personnel entering WAG 6 (e.g., Energy Systems employees, subcontractors, and site visitors).
- Assembling and maintaining all WAG 6 operations, structures, and facilities.
- Approving all site activities, operations, SSHPs, CWPs, and SSHEAs.
- Initiating and approving all RWPs as required for site operations.

3.2.10 ORNL ER Program ES&H Manager

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

- Reviewing and approving all SSHPs and SSHEAs.
- Reviewing all self-assessment and -surveillance reports.
- Interfacing between ER projects and the HAZWOPER coordinator.
- Reviewing qualifications of SSHMs and SSHOs.

4. RISK/HAZARD ANALYSIS

4.1 IDENTIFICATION AND ASSESSMENT OF POTENTIAL SITE HAZARDS

4.1.1 Physical Hazards

4.1.1.1 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 where noise levels are suspected or shown by noise level meter monitoring to exceed 85 dBA. In the event that a new noise hazard, such as a new piece of equipment, is brought on-site, the SSHO or IH will test the equipment or area for possible hazards. Areas where noise levels are greater than 85 dBA will be posted as "Noise Hazard Areas—Hearing Protection Required." Work supervisors will ensure compliance with posted warnings.

4.1.1.2 Site working conditions hazards

Hazards: Because of the nature of the site and the fact that the work will take place outdoors, there will be a large number of physical hazards due primarily to site working conditions. These hazards include, but are not limited to, personnel encounters with objects and conditions 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), and hard-toed footwear.

4.1.1.3 Overhead power lines

Hazards: Overhead power lines pose a hazard for the operation of equipment when there is the possibility of contact.

Controls: A 10-ft minimum clearance shall be maintained from all lines 110 V or greater. If the appropriate clearance cannot be maintained, the power lines shall be de-energized and grounded.

4.1.1.4 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 above 70°F, the wet-bulb globe thermometer (WBGT) shall be monitored to assess the potential for heat

stress. Sufficient cool water and disposable drinking cups will be provided in the rest area, which would, if possible, be located in an area cooler than the work station. The SSHO will be responsible for briefing workers on the signs of heat stress when weather conditions require it. This may be done during the daily S&H briefing. Work/rest schedules will be implemented, when necessary, within the guidelines of the American Conference of Governmental Industrial Hygienists WBGT threshold limit values (*Threshold Limit Values for Chemical Substance and Physical Agents and Biological Exposure Indices*, 1992–1993 edition).

B. 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.

C. Heat Stroke

Symptoms: Body temperatures often are between $107\text{--}110^{\circ}\text{F}$. Initial symptoms often include headache, dizziness, nausea, oppression, and dryness of the skin and mouth. Unconsciousness follows quickly, and 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. Seek medical attention immediately.

D. Cold Stress

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

E. 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.

F. 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. Seek immediate medical attention.

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.

4.1.1.5 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, immediately dangerous to life or health (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. 4.1.1.6. A representative from IH shall be contacted prior to any confined space entry, and IH shall conduct all required atmospheric testing in accordance with established ORNL procedures. Confined space entry will be conducted according to specific IH procedures.

4.1.1.6 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 CE. The permit will detail excavation requirements and must be posted at the job site while excavation activities are being conducted.

4.1.2 Chemical Hazards

Many different types of chemical hazards may be present at the WAG 6 site. These chemical hazards have various origins or functions (e.g., site contaminants, chemicals used in site operations). Chemicals that have been identified in the *ORNL WAG 6 Site Characterization Summary* (ORNL/ER-11/V2&D, March 1990) as known or suspected site contaminants and their potential site locations are listed in Table 2. The table also contains physical and chemical properties, toxicity, health effects, and symptoms of exposure. Specific action levels and guidelines for site chemicals will be addressed in the SSHEA.

Chemical contamination will be assessed by a review of the site characterization information and anticipated work activities by the SSHO. A detailed evaluation of the chemical contamination present at each site will be included in the SSHEA. Chemical hazards will be minimized through the use of engineering and work practice controls, as mandated by the SSHO. Details of control methods to be used in site operations to reduce the potential for personnel exposure shall be included in the SSHEA or CWP.

MSDSs for any chemicals brought on-site for site operations will be obtained by the SSHM or 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 SSHEAs. The MSDSs shall be available on-site during all operations.

4.1.3 Radiological Hazards

Radiological contamination will be assessed by a review of site characterization information and anticipated work activities by the Site HP. On-site monitoring for detection of contamination levels will be performed by the Site HP or an approved representative. A detailed evaluation of the radiological contamination present at each site will be included in the SSHEA. Radiological hazards will be minimized to ALARA (as low as reasonably achievable) levels by the use of time, distance, and shielding, as well as the use of PPE and on-site frisking, as mandated by the Site HP. Maximum contamination guides for frisking personnel and equipment are contained in Table 3. Personal clothing will not be worn in contaminated areas (underwear and socks excluded). Vehicles used on-site will be frisked and smeared at least once a week and will meet green tag levels listed in Table 3. Personnel will be provided the level of PPE deemed appropriate by the Site HP and the SSHO. Details of control methods, in addition to those listed above, to be used in site operations to reduce the potential for personnel exposure shall be included in the site SSHEA. See Table 4 for detailed information on suspected or known radionuclide contaminants at WAG 6.

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

4.1.4 Biological Hazards

Site conditions may present a variety of biological stresses, and it is the responsibility of all personnel to inform the SSHO of health conditions they have that may be affected by site

Table 2. Characteristics for the suspected chemical contaminants at WAG 6

Contaminant and suspected location ^a	Target organs/ miscellaneous information ^b	Chemical and physical properties ^c
1,1,2,2-Tetrachloroethane GW	Liver, kidney, CNS; nausea, vomiting, abdominal pain, tremor in 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-Dichloroethane GW	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.
1,2 cis-Dichloroethene (total) GW, SW	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.
1,4-Dioxane GW	Liver, kidney, skin, eyes; drowsiness; headaches; nausea; vomiting; irritated eyes, nose, and 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 SS	CNS, lungs; irritated eyes and 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.
Benzene GW	Blood, CNS, skin, bone marrow, eyes, respiratory system; irritated eyes, nose, and respiratory system; 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.
Carbon tetrachloride GW	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) GW, SW, SS	Liver, kidneys, heart, eyes, skin; dizziness, mental dullness, nausea, disorientation, headache, fatigue, enlarged liver, irritated eyes and skin, suspected carcinogen	Colorless liquid with a pleasant odor; IP: 11.42 eV, noncombustible liquid.

Table 2 (continued)

Contaminant and suspected location ^a	Target organs/miscellaneous information ^b	Chemical and physical properties ^c
Ethylbenzene GW	Eyes, upper respiratory system, skin, CNS; irritated eyes and 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.
Methylene chloride GW	Skin, CVS, eyes, CNS; fatigue, weakness, sleepiness, light-headedness, limb numbness, tingling, nausea, irritated eyes and 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: unknown.
Tetrachloroethylene GW, SS	Liver, kidneys, eyes, upper respiratory system, CNS; irritated 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.
Toluene GW, SS	CNS, liver, kidneys, skin; fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, muscle fatigue, insomnia, dermatitis	Colorless liquid with a sweet, pungent, benzene-like odor; UEL: 7.1%, LEL: 1.2%, IP: 8.82 eV, FP: 40°F.
Trichloroethylene GW, SW, SS	Respiratory system, 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.
Vinyl chloride GW, SS	Liver, CNS, blood, respiratory system, lymphatic system; 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: 0.8%, IP: 8.20 eV, FP: 120°F.
Xylene, total GW	CNS, eyes, GI tract, blood, liver, kidneys, skin; dizziness; excitement; drowsiness; incoherence; staggering gait; irritated 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.

Table 2 (continued)

Contaminant and suspected location ^a	Target organs/ miscellaneous information ^b	Chemical and physical properties ^c
<i><u>Semivolatile Organic Compounds</u></i>		
Benzoic acid SS	Poison by vapor inhalation, irritant	White powder; MW: 122.13; MP: 121.7°F; BP: 249°F, FP: 250°F; reacts with oxidizers.
Bis(2-ethylhexyl) phthalate GW, SW, SO, SS	Poisonous, irritant; GI disorders; suspected carcinogen	Solid; MW: 390.62, emits acid smoke when heated.
<i><u>Metals</u></i>		
Aluminum GW, SW, SO	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.
Antimony GW	Respiratory system, CVS, skin, eyes; Irritated nose, throat, mouth; cough; dizziness; nausea; vomiting; diarrhea; stomach cramps; insomnia; irritated 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 GW, SW, SO	Liver, kidneys, skin, lungs, lymphatic system; 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 GW, SW	Heart, CNS, skin, respiratory system, eyes; upper respiratory irritant, gastroenteritis, muscle spasms, slow pulse, extrasystoles, hypokalemia, irritated eyes and 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.

Table 2 (continued)

Contaminant and suspected location ^a	Target organs/ miscellaneous information ^b	Chemical and physical properties ^c
Beryllium GW, SW, SO	Lungs, skin, eyes, mucus membranes; irritated eyes and 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.
Cadmium GW, SW	Respiratory system, 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.
Chromium (total) GW, SW, SO	Respiratory system; 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.
Copper GW, SW	Respiratory system, skin, liver, kidneys; irritated nasal mucous membranes and pharynx, nasal perforation, eye irritant, dermatitis	Metal is reddish lustrous malleable odorless solid. Noncombustible solid in bulk form, but powdered form may ignite.
Lead GW, SW	GI tract, CNS, kidneys, blood, gingival tissue; weakness, lassitude, insomnia, facial pallor, anorexia, low weight, 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 GW, SW	Respiratory system, CNS, blood, kidneys; Parkinson's, asthenia, insomnia, mental confusion, metal fume fever, dry throat, cough, tight chest, dyspepsia, flu-like fever, low- back pain, vomiting, malaise, fatigue	Metal is a lustrous, brittle, silvery solid. Combustible solid.

Table 2 (continued)

Contaminant and suspected location ^a	Target organs/ miscellaneous information ^b	Chemical and physical properties ^c
Mercury GW, SW, SO	Skin, respiratory system, CNS, kidneys, eyes; cough, chest pain, dyspepsia, bronchial pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, GI disturbance, anorexia, proteinuria, irritated eyes, skin	Silver-white, heavy, odorless liquid. Noncombustible.
Nickel GW	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 ^d SS	Eyes, respiratory system, 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°. IP: 12.60 eV, noncombustible solid.
Selenium SO	Upper respiratory system, eyes, skin, liver, kidneys, blood; irritated 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.
Silver GW, SW, SS	Nasal septum, skin, eyes; blue-gray eyes, nasal septum, throat, irritated skin, ulceration, GI distress	Metal is white lustrous solid. Noncombustible solid but flammable in form of dust or powder.
Thallium SO	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 ^e GW	Lungs; slight lung fibrosis, possible carcinogen	White odorless powder; noncombustible solid.

Table 2 (continued)

Contaminant and suspected location ^a	Target organs/ miscellaneous information ^b	Chemical and physical properties ^c
Vanadium/ GW, SW, SO	Respiratory system, 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.
Zinc ^d GW, SW	Respiratory system; 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.

^aThe following acronyms refer to the area of WAG 6 where the suspected contaminant is most likely to be encountered: GW—groundwater, SW—surface water, SO—soil, SS—sediment.

^bCNS—central nervous system, CVS—central vascular system, GI—gastrointestinal tract.

^cLEL—lower explosive limit, UEL—upper explosive limit, IP—ionization potential, FP—flash point, MW—molecular weight, MP—melting point, BP—boiling point.

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

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

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

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

Source: U.S. Department of Health and Human Services, *NIOSH Pocket Guide to Chemical Hazards*, June 1990.

conditions. Examples of the stresses that may be encountered at WAG 6 include, but are not limited to, the following:

- insect bites or stings;
- ticks or other disease-carrying vectors;
- poison ivy or poison sumac;
- pollens, grasses, and other allergens; and
- wildlife such as snakes, rodents, fowls, etc.

Because animal carcasses produced during experimentation and research and other biological waste products have been disposed of in WAG 6, the potential also exists for exposure to microbial agents that are capable of causing infection. Field personnel should adhere to the sanitation guidelines addressed in Sect. 7.3 of this SSHP to minimize potential contact with any hazardous biological agents.

Table 3. Maximum contamination^a guides

Recommended maximum contamination guide for skin surfaces				
Item	Direct reading ^b		Transferable Smear	
	α	$\beta\gamma$	α	$\beta\gamma$
General Body	300	1000 ^c	None detectable ^d	
Hands	300	1000 ^c	None detectable ^d	
<i>Green Tag Limits: Recommended maximum contamination guide for items given radiation and contamination clearance (e.g., tools and equipment for unrestricted use).</i>				
	Direct reading ^e		Transferable smear	
	α	$\beta\gamma$	α	$\beta\gamma$
	300	1000	20	200 ^f

^aNo 100-cm² area to average greater than this value.

^bValues listed are in disintegrations per minute per 100 square centimeters (dpm/100 cm²).

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

^dDetection limit is related to instrumentation used.

^eThe levels may be averaged over 1 m², provided activity in any area of 100 cm² is less than three times the direct value.

^fExcept 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.

4.1.5 Other Hazards

4.1.5.1 Illumination

Field activities at WAG 6 normally will be conducted during daylight hours, and a minimum of 5 ft-c will be required to conduct operations. (A footcandle is a unit of illumination equal to 1 lumen/ft² when measured at a surface that is everywhere one foot from a source of one candle power.) Actual field measurements of illumination will not be taken. 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-ft-c requirement will be based on the SSHO's best professional judgment.

4.1.5.2 Dusts/mists

Some activities may be conducted during site operations that could have the potential to generate dusts or mists. These activities shall be identified in each SSHEA. 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 Site HP, IH, and the SSHM. Work operations should cease when visible dust is being generated until the health and safety personnel can determine any risks of exposure.

Table 4. Characteristics of suspected radionuclide contaminants at WAG 6

Contaminant and suspected location ^a	DAC ^b			Critical target organs ^c
	D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	
<u>Manmade Radionuclides</u>				
Tritium GW, SW, SS	5 × 10 ⁻¹	5 × 10 ⁻¹	5 × 10 ⁻¹	Body tissue
Cobalt-60 GW, SW, SO, SS		7 × 10 ⁻⁸	1 × 10 ⁻⁸	GI (LLI), total body, lung
Strontium-89 SO	3 × 10 ⁻⁷		6 × 10 ⁻⁸	Bone, lung, GI (LLI)
Strontium-90 GW, SW, SO, SS	8 × 10 ⁻⁹		2 × 10 ⁻⁹	Bone, lung, GI (LLI)
Cesium-137 GW, SW	7 × 10 ⁻⁸			Total body, liver, spleen, muscle, lung, GI (LLI)
Americium-241 GW		2 × 10 ⁻¹²		Bone surface
Plutonium-238 GW, SW		3 × 10 ⁻¹²	7 × 10 ⁻¹²	Bone, lung, GI (LLI)
Plutonium-239/240 GW, SW		2 × 10 ⁻¹²	6 × 10 ⁻¹²	Bone, lung, GI (LLI)
Curium-244 GW		4 × 10 ⁻¹²		
<u>Naturally Occurring Radionuclide</u>				
Potassium-40 GW, SW, SO, SS	2 × 10 ⁻⁷			
<u>Uranium Series</u>				
Uranium-238 GW	6 × 10 ⁻¹⁰	3 × 10 ⁻¹⁰	2 × 10 ⁻¹¹	GI (LLI), kidney, lung
Thorium-234 GW, SW, SO, SS		9 × 10 ⁻⁸	6 × 10 ⁻⁸	Bone
Uranium-234 GW, SS	5 × 10 ⁻¹⁰	3 × 10 ⁻¹⁰	2 × 10 ⁻¹¹	Bone, kidney, GI (LLI), lung
Thorium-230 GW, SW		3 × 10 ⁻¹²	7 × 10 ⁻¹²	Bone
Radium-226 GW, SO, SS		3 × 10 ⁻¹⁰		Bone, lung, GI (LLI)

Table 4 (continued)

Contaminant and suspected location ^a	DAC ^b			Critical target organs ^c
	D (μCi/mL)	W (μCi/mL)	Y (μCi/mL)	
<u>Thorium Series (pCi/L)</u>				
Thorium-232 GW, SW		5 × 10 ⁻¹³	1 × 10 ⁻¹²	Bone
Radium-228 GW, SW		5 × 10 ⁻¹⁰		Bone surface
Thorium-228 GW, SW, SO, SS		4 × 10 ⁻¹²	7 × 10 ⁻¹²	
Radium-224 GW, SW, SO, SS		7 × 10 ⁻¹⁰		

^aThe following acronyms refer to the area of WAG 6 where the suspected radionuclide is most likely to be encountered: GW—groundwater, SW—surface water, SO—soil, SS—sediment.

^bDerived air concentration (DAC) values are based on either a stochastic (committed effective dose equivalent) limit of 5 rem/year or a nonstochastic (organ specific) dose limit of 50 rem/year, whichever is more limiting. The 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 <10 days for class D, from 10 to 100 days for class W, and >100 days for class Y.

^cGI—gastrointestinal tract; LLI—lower large intestine.

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.

4.1.5.3 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, and negotiation of physical obstacles when accessing confined spaces. 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 the buddy system for assistance in lifting loads that are too heavy for one person. Back strain, the most common ergonomic hazard in the field, may be avoided if site workers ask for assistance when they need it.

OSHA sets limits on what an individual can lift without assistance. If an article weighs ~50 lb or less, a single individual can lift that piece without assistance if that person feels that he can without inflicting harm on himself. If an article weighs more than 50 lb, it is recommended that assistance be obtained to aid in lifting.

4.1.5.4 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 (SWP). The SPM or construction manager is responsible for generating the SWP.
- 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 the work area.
- A dedicated fire watch will be maintained during and for 30 min after all hot work activities.
- The material to be burned or welded upon and the atmosphere in the immediate area shall be examined by the SSHO and/or a representative of IH prior to the commencement of work activities to assess the possibility of hazardous fumes being created during hot work operations.
- A permit is maintained on-site for inspection purposes while work is in progress.

4.1.5.5 Heavy equipment (Industrial Safety)

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. The SPM will verify operator's qualification to operate equipment by requesting and receiving documentation from the contractor.
- 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 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 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.

4.1.5.6 Drum handling

Hazards: Exposure to toxic/hazardous vapors; rupture of drums.

Controls:

- Where buried drums are suspected, conduct a geophysical survey before using any construction equipment 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.
- Use properly grounded pumping equipment when transferring wastes to new drums.
- Use nonsparking hand tools and, if available, nonsparking bucket teeth on excavation equipment and use Plexiglass shields on vehicle cabs.
- Where slings, yokes, or other accessories must be used, they must have current inspection and be permanently tagged. Workers should back away from the work area after attaching the accessory and before the drum is lifted.
- Critically swollen drums should not be handled until the pressure can be relieved by an approved method. SSHO shall contact IS for approval.
- Use bars that fit over the teeth of excavation buckets to prevent drum puncture.
- Where ionizing levels of radiation are detected, the SSHO should be contacted; generally, the drum should be overpacked and isolated promptly.
- Where explosive or shock-sensitive material is suspected, every effort should be made to handle the drum remotely. Gas cylinders should not be dragged during handling.
- Use direct-reading air monitoring equipment when in close proximity to drums to detect any hot spots.

4.1.5.7 Flammable materials

Hazards: Flammable materials pose fire/explosion hazards if ignition sources are present. MSDSs for all site materials will be maintained on-site by the SSHO.

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 IH technician during all activities.
- This area is to be evacuated if readings of 10% of the lower explosive limit (LEL) are recorded.

4.1.5.8 Compressed gases 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, bar, 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.

4.1.5.9 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.
- Eye and head injury hazards caused by flying debris.
- Noise in excess of 85 dBA.
- 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 SSHEA.
- 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.

4.1.5.10 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 thundershowers, shut down equipment and proceed to shelter.
- Wait a minimum of 30 min from the last lightning strike before returning to work.
- If strong storms are forecast, and after a 2-h wait, the project will be shut down for the remainder of the shift.
- 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.

4.1.5.11 Traffic

Hazards: The possibility of vehicle-related injury or accident is inherent in 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.
- 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 the persons 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).

4.1.5.12 Underground hazards

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

Controls: A preexcavation meeting will be held to review the Excavation/Penetration Permit and work area to ensure that all underground installations have been identified.

4.1.5.13 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 (H&R) activities take place. All site operations involving H&R 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 and Rigging Manual* (April 1993). In addition, proposed lift plans for H&R activities shall be submitted to the ORNL H&R Program Manager for approval by the H&R Review Team. All applicable SOPs shall be maintained on-site for quick reference.

H&R 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*. 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.

4.1.5.14 Fall protection

Activities that require work at elevated heights of 4 ft and greater are required to adhere to Sects. 7.3 and 7.4 of the ORNL Safety Manual, which address fall protection. Such activities could include working on top of building, drillings, scaffolds, etc.

4.1.5.15 Hearing conservation program

All workers expected to be exposed to a time-weighted average of 85dBA are required to participate in the ORNL Hearing Conservation Program or some approved hearing conservation program. Elements of ORNL's Hearing Conservation Program include

- Noise monitoring.
- Engineering/administrative controls.
- Audiometric testing.
- Record keeping.
- Training and education.
- Approved hearing protection devices.

4.2 RISK ASSESSMENT OF SITE OPERATIONS

A task description and an assessment of possible health risks to workers for each anticipated site operation shall be developed and included in the SSHEAs prior to their approval.

5. SITE ACCESS REQUIREMENTS

Primary access to the WAG 6 site is controlled by means of a perimeter fence and an ORNL security badge-activated gate. The fence and gate are maintained by ORNL. Distribution and control of site access badges will be coordinated with ORNL by the SPM. To obtain access, all employees who are anticipated to be on-site are to complete a Melton Valley Access request form and meet the requirements described therein.

The minimum requirements for WAG 6 or Melton Valley Access are listed below. The health and safety training complies with the requirements specified in 29 CFR 1910.120. All training requirements presented in this SSHP can be fulfilled only by training courses that have been reviewed for equivalency by the Energy Systems training program.

- The WAG 6 Facility Manager and/or Waste Management operations will have final control over site access.
- All personnel other than facility visitors at ORNL are required to have General Employee Training (GET).
- All visitors and guests are required to see the video, "Site Access Orientation for Visitors and Guests," shown in the lobby at Building 4500N.
- All personnel with access to the WAG 6 badge reader are required to have a minimum of 24 h of health and safety training per 29 CFR 1910.120(e) and a radiation worker training course.
- All personnel who will be performing work as hazardous waste site workers at WAG 6 are required to have a minimum of 24 h of health and safety training and a radiation worker training course. If respirators are required or intrusive activities (penetration, removal) are performed, the workers must have 40 h of health and safety training and a radiation worker training course.
- All visitors who are granted site access are required to be escorted at all times by a person who meets the above-stated access requirements. Additionally, visitors are to abide by all requirements of the SSHP and applicable SSHEAs.
- Access to specific HAZWOPER sites by visitors is controlled by the SSHO, who will determine the level of training required.

5.1 WORKER TRAINING REQUIREMENTS

The requirements for worker training for projects conducted under this SSHP 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, CRZ or EZ workers (Levels A, B, C, and D workers), on-site supervisors, and nonworkers or site visitors are listed in Table 5. The regulatory basis for the requirements presented in Table 5 is located in 29 CFR 1910.120. The presentation of this information was

adapted from the DOE document *OSHA Training Requirements for Hazardous Waste Operations* (Office of Environment, Safety and Health, December 1991).

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.

Table 5. Site training requirements

Operation personnel	Site health & safety briefing	24-h	40-h	8-h supervisor	8-h refresher ^a	Rad worker II
Nonworker or visitor ^{b,c}	X					
Routine or occasional worker	X	X ^d	X		X	X
On-site supervisor		X	X	X	X	X
Level A or B PPE ^e	X		X		X	X
Level C PPE		X	X		X	X
Level D or no PPE	X	X			X	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.

^bNonworkers are DOE employees, contractors, and subcontractors not directly involved with hazardous waste site operations (e.g., management, audit, and oversight personnel).

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

^d24-hour 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.

^ePPE—personal protective equipment.

5.1.1 Training Documentation

Training received outside ORNL or Energy Systems must be reviewed by the Technical Resources and Training Section. Acceptable forms of documentation of worker training will be up-to-date certificates of training 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.

5.1.2 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 Technical Resources and Training Section.

5.2 PREENTRY HEALTH AND SAFETY BRIEFING

All personnel shall be required to attend a preentry health and safety briefing prior to entering the site as a requirement for access to the work site. This preentry health and safety briefing shall be conducted jointly by the SSHM or SSHO and the Site HP or by designated representatives who have been approved by the SSHM or SSHO and the Site HP. The preentry health and safety briefing shall highlight the health and safety information presented in this SSHP and the information contained in the CWP and the project SSHEA. This information may include, but is not limited to, the following:

- Site history.
- Site access requirements.
- Site chemical hazards and symptoms of exposure.
- Site physical and mechanical hazards and recognition of hazards.
- Personnel and equipment decontamination requirements.
- Location of the site emergency assembly point.
- Emergency procedures.
- Spill response procedures.
- Location of the site emergency action plan.
- Other information contained in the site SSHEA.

5.2.1 Documentation of Briefings

Attendance at the initial preentry health and safety briefings will be documented by the signature of all personnel present at the briefing and by the completion of the Site Safety and Health Plan Agreement form, which is provided as Appendix C.

5.2.2 Daily Safety and Health Briefings

Daily S&H briefings shall be held by the SSHM, SSHO, Site HP, 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 S&H 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 (RWPs) and/or SWPs.
- SOPs.

5.3 PERSONAL PROTECTION REQUIREMENTS

5.3.1 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 up-to-date quantitative respirator fit test and will wear only those respirators approved by the quantitative fit test. 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 present. If Energy Systems adopts a similar policy on respirator reuse, it will be allowed on-site at the discretion of the SSHO. No site personnel will be issued a respirator without a valid respirator card. Respirators will be issued only by qualified issuing personnel. The SSHO will verify the qualification of issuers.

Personnel at the WAG 6 site will comply with the ORNL respiratory protection program, which meets the requirements of 29 CFR 1910.134.

5.3.2 Personal Protective Equipment

The SSHO and Site HP 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. The SSHO and/or the Site HP shall instruct all site personnel in donning and doffing procedures prior to beginning any site activities.

Chemical PPE required may include, but is not limited to, the ensembles listed in Table 6.

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 and the Site HP shall determine the appropriate PPE ensemble, with input from IH as needed. The required PPE levels shall be specified in the SSHEAs.

Working in radiological areas pose a different set of hazards. Accordingly, radiological PPE differs somewhat from chemical PPE. Table 7 shows the general requirements for the different levels of radiological PPE.

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 and Site HP and recorded in the SSHEA.

Table 6. Sample 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 self-contained breathing apparatus (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 6 (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 (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. • Long cotton underwear. 	<p>The same level of respiratory protection but less skin protection than Level A.</p> <p>It is the minimum level recommended for initial site entries until the hazards have been further identified.</p>	<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 immediately dangerous to life or health (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 6 (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 (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. • 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^a	<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"> • This level should not be worn in the Exclusion Zone.^b • The atmosphere must contain at least 19.5% oxygen.

^aLevel D+ consists of Level C protective clothing without respiratory protection. This level is used when there is a potential of splash without gases or vapors present.

^bLevel D may be worn in the controlled access area if allowed by the SSHO.

Source: NIOSH, OSHA, USCG, EPA, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, DHHS (NIOSH) Publication No. 85-115, October 1985.

Table 7. Sample radiological personal protective equipment

Level	Equipment description
A	Required, Inner-Set —Hospital “greens,” or equivalent modesty garments —Tyvek (chemical resistant ^a as appropriate) coveralls with openings taped closed —Chemical-resistant gloves ^a taped to coveralls —Steel-toe and steel-shank work boots —Chemical-resistant coveralls ^a taped to coveralls
	Required, Outer-Set —Pressure-demand, full-facepiece SCBA, or pressure-demand supplied-air respirator with escape SCBA provisions ^b —Chemical-resistant coveralls ^a or chemical-resistant splash suit ^a with openings taped closed —Chemical-resistant hood ^a taped to coveralls —Hard hat —Neoprene fireman’s boots, or chemical-resistant boot covers ^a taped to coveralls —Chemical-resistant gloves ^a taped to coveralls —Whole-body thermoluminescence dosimeter (TLD) badge —Personal air sampler —Flashlight or lantern —Two-way radio
	Optional, As Required —0- to 200-mR pocket dosimeter (0.025 to <1.0 mGy/h) ^c —0- to 200-mR plus 0- to 1-R pocket dosimeter (≥1.0 mGy/h) ^c —Extremity dosimeters (>0.035 mGy/h) ^c —Personal flotation device —Ear plugs/muffs —Sweat bands —Flashlight or lantern
	Note: Areas/operations requiring Level A PPE shall have controlled access. Each such area shall be constructed with a two-barricade system comprised of an inner “hot line” and an outer “contamination control” line. Construction and operation of a Level A PPE controlled access area shall ensure that environmental dose rates and airborne exposure levels are <0.025 mGy/h and <0.1 CG/PEL/TLV/REL, respectively.
B	Required, Inner-Set —Regulated cloth coveralls with openings taped closed —Steel-toe and steel-shank work boots —Chemical-resistant shoe covers ^a taped to cloth coveralls —Chemical-resistant gloves ^a taped to cloth coveralls
	Required, Outer-Set —Full-facepiece, air-purifying, canister-equipped respirator ^b —Chemical-resistant coveralls or chemical splash suit ^a with openings taped closed —Chemical-resistant hood ^a taped to coveralls —Neoprene fireman’s boots, or chemical-resistant boot covers ^a taped to coveralls —Hard hat —Whole-body TLD badge —Personal air sampler —Two-way radio

Table 7 (continued)

Level	Equipment description
	Optional, As Required —0- to 200-mR pocket dosimeter (0.025 to <1.0 mGy/h) ^c —0- to 200-mR plus 0- to 1-R pocket dosimeter (≥1.0 mGy/h) ^c —Extremity dosimeters (>0.035 mGy/h) ^c —Personal flotation device —Ear plugs/muffs —Sweat bands —Flashlight or lantern Note: The same controlled access restrictions that apply to Level A PPE areas also apply to Level B PPE areas/operations.
C	Required —Tyvek coveralls with openings taped closed —Regulated cloth coveralls —Chemical-resistant outer gloves ^a taped to Tyvek coveralls —Chemical-resistant inner gloves ^a taped to cloth coveralls —Steel-toe and steel-shank work boots —Neoprene fireman's boots or chemical-resistant boot covers ^a taped to Tyvek coveralls —Hard hat —Safety glasses —Whole-body TLD badge Optional, As Required —0- to 200-mR pocket dosimeter (0.025 to <1.0 mGy/h) ^c —0- to 200-mR plus 0- to 1-R pocket dosimeter (≥1.0 mGy/h) ^c —Extremity dosimeters (>0.035 mGy/h) ^c —Personal flotation device —Ear plugs/muffs —Two-way radio —Flashlight or lantern Note: Areas/operations requiring Level C PPE shall have restricted access. Each such area shall be barricaded so that dose rates and airborne exposure levels are <0.025 mGy/h and <0.1 CG/PEL/TLV/REL, respectively, at its boundary.
D	Required —Nonregulated cloth work coveralls —Steel-toe and steel-shank work boots —Safety glasses —Hard hat —Disposable gloves ^a —Whole-body TLD badge Optional, As Required —Work gloves ^a —Personal flotation device —Ear plugs/muffs —Two-way radio —Sweat bands —Flashlight or lantern

Table 7 (continued)

^aClean or new chemical-resistant gloves should always be used when handling samples. The most appropriate chemical-protective clothing shall be chosen based on historical information and/or field measurements. Where data are inadequate, conservative assumptions shall be used to ensure that clothing resists permeation, degradation, and penetration.

^bThe decision to use respiratory protection for airborne concentrations in excess of the appropriate CG and/or TLV may be based on field evaluations with a Photovac-TIP or equivalent instrument for hazardous chemical organic vapors; decisions must always be confirmed with laboratory analyses.

^cRadiation dosimetry shall be issued in direct relation to field measured dose rates, as indicated. If field conditions change from those shown on the RWP, that RWP shall be terminated, PPE requirements shall be reevaluated, and a new RWP initiated.

5.3.3 PPE Upgrade Authority

In various circumstances, upgrading or downgrading of PPE levels may be necessary. 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 indication 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.

These are only guidelines and not rules for upgrading or downgrading PPE. The decision to change PPE levels will be made based on 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 SSHM; the SSHO; the Site HP, IH, and IS; and the HAZWOPER Program Coordinator. At a minimum, the upgrade or downgrade of PPE levels must have the approval of both a health and safety representative and the Site HP. The consensus to upgrade or downgrade PPE levels and the basis for the decision shall be recorded on all applicable project documentation, including the project logbook, SWPs, and RWPs. The SSHM shall ensure that this documentation is completed.

All site personnel shall be made aware of the upgrade or downgrade and shall be provided updated procedures for donning and doffing and decontamination activities. These updated procedures shall be included as attachments or appendices to the CWP or the SSHEA or incorporated by reference.

5.3.4 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 are listed below. Specific procedures shall be determined by the SSHO and Site HP and, if different from the procedures listed here, shall be included in the SSHEA.

Sample Donning Procedure

- Inspect the clothing and respiratory equipment before donning.
- Adjust hard hat or headpiece, if worn, to fit user's head.
- Open back closure used to change air tank (if suit has one) before donning suit.
- 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.
- 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.
- 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.
- Perform negative and positive respirator facepiece seal test procedures.
- 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.
- 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.
- Put on hard hat, if needed.
- Raise hood over head carefully so as not to disrupt face seal of SCBA mask. Adjust hood to give satisfactory comfort.
- Begin to secure the suit by closing all fasteners on opening until there is only adequate room to connect the breathing hose. Secure all belts and/or adjustable leg, head, and waist bands.
- Connect the breathing hose while opening the main valve.

- Have assistant first ensure that wearer is breathing properly and then make final closure of the suit.
- Have assistant check all closures.
- Have assistant observe the wearer for a period of time to ensure that the wearer is comfortable and stable and that the equipment is functioning properly.

Sample Doffing Procedure

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

- Remove any extraneous or disposable clothing, boot covers, outer gloves, and tape.
- Have assistant loosen and remove the wearer's safety shoes or boots.
- 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.
- 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.
- Sitting, if possible, remove both legs from the suit.
- Follow procedure for doffing SCBA.
- After suit is removed, remove internal gloves by rolling them off the hand, inside out.
- Remove internal clothing and thoroughly cleanse the body.

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

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

5.4 MEDICAL SURVEILLANCE

5.4.1 HAZWOPER Physicals

According to the requirements of 29 CFR 1910.120, site personnel who meet the criteria listed below must have a physical examination conducted by a physician to determine and document the qualification of the worker to perform work at hazardous waste operations. Criteria for inclusion in the medical surveillance program are listed below:

- employees who are, or may be, exposed to permissible exposure limits (PELs) of hazardous substances or health hazards for 30 or more days a year;
- employees who wear a respirator for 30 or more days a year;
- members of organized HAZMAT (hazardous materials) teams; and
- employees who are injured as a result of overexposure during a site emergency or who show symptoms of illness that may have resulted from exposure to hazardous substances.

The HAZWOPER Coordinator, in conjunction with the ORNL Health Division, will determine which workers, meeting the criteria listed above, will be required to participate in the hazardous waste worker medical surveillance program. Physicals shall be documented through a written approval by the examining physician.

5.4.2 Medical Monitoring

The requirements for additional medical monitoring of worker exposures shall be specified in each SSHEA and shall be dictated by the requirements of 29 CFR 1910 and the procedures and exposure control programs of ORNL IH. Medical monitoring for ORNL employees shall be performed through the Health Services Division of ORNL and shall be coordinated with ORNL IH. Subcontractors must provide/obtain medical services elsewhere.

The frequency of bioassay measurements has been set by Energy Systems for workers in radiological areas. Table 8 shows the frequency and requirements as listed in the *ORNL Health Physics Manual*.

Table 8. Frequency of bioassay measurements

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

Table 8 (continued)

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

6. FREQUENCY AND TYPES OF MONITORING

6.1 EXPOSURE MONITORING

6.1.1 Area Monitoring

Periodic, real-time assessment of potentially hazardous chemical and radiological concentrations using direct reading instruments will be performed by the SSHO and the Site HP while operations are being conducted at the site. While work is being performed in the EZ/HAZWOPER designated site, monitoring will be performed approximately every 15 min with the best equipment available. Prior to the commencement of any field activities, background concentrations and levels near the site will be monitored and recorded in the site logbook. To obtain accurate results, daily background readings shall be taken away from areas of potential contamination. Background readings shall be taken into account before action levels are established by the Site HP and the SSHOs. Monitoring of air concentrations for any confined space entries will be conducted in accordance with ORNL procedures by a representative from IH. Details of monitoring will be contained in the SSHEA.

6.1.2 Monitoring of Personnel

Personal exposure monitoring (i.e., exposure monitoring for specific contaminants with air sampling pumps) shall be conducted in accordance with the requirements of 29 CFR 1910, Subpart Z. Monitoring for ORNL employees will be conducted by a representative of IH in accordance with established ORNL IH procedures. Subcontractors must provide their own IH and HP personnel. The need for personal exposure monitoring will be based upon site contaminants and work hazards and will be determined by the SSHM, the Site HP, IH, and the HAZWOPER Program Coordinator. These requirements shall be detailed in the SSHEA.

A project is currently being implemented to establish a secondary personnel monitoring station and associated equipment, housed in a mobile trailer at the entrance of SWSA 6. This project will provide radiological contamination monitoring for each worker or visitor exiting WAG 6 in addition to the monitoring performed at each site. The monitoring will be performed to ensure that human contamination is identified so that immediate decontamination can be undertaken and control of the potential spread of contaminants is effected.

6.1.3 Dosimetry

All site entrants shall be regulated by the ORNL Radiation Dosimetry program and shall comply with all provisions of the requirements of ORNL Radiation Protection. The Site HP, based on the characterization of the site, will inform the workers of the radionuclides of concern so that they may inform Health Physics. This will determine the type and frequency of the bioassays (refer to Table 8). The radionuclides of concern for each project will be listed in the SSHEA.

6.2 MONITORING EQUIPMENT/ACTION LEVELS

Various types of monitoring equipment may be required to conduct worker exposure monitoring during WAG 6 operations. The SSHO shall ensure that adequate monitoring equipment is available prior to the start of work. The SSHM shall ensure that the instruments are used only by persons with training and experience in the care, operation, calibration, and limitations of the equipment. Persons performing monitoring shall be approved by ORNL Radiation Protection and ORNL IH. 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. Action level for this meter is 10% lower explosive limit (LEL) or >22% O₂.
- **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:** Photoionization detector (PID) or flame ionization detector (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 is 1 ppm at uncharacterized sites and 5 ppm for characterized sites.
- **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 permissible exposure limit (PEL).
- **Noise Monitoring Equipment:** To identify "problem" noise areas and equipment. These instruments shall be calibrated prior to use. Action level is 85 dBA.
- **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° F. Action levels follow American Conference of Governmental Industrial Hygienists 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.
- **Personal Thermoluminescence Dosimetry (TLD) Badges and Direct-Read Pocket Dosimeters:** Issued to each employee through ORNL Radiation Protection programs

to track individual worker exposure to radiological contamination. 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 3).
- **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 SSHEA.

6.3 MAINTENANCE AND 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 used on-site and incorporated into this SSHP by reference or by attachment. All instrumentation operation and calibration shall be conducted in accordance with ORNL Radiation Protection and IH procedures, where applicable and available. If field or standard instrumentation procedures are used during site operations, the written procedures must be attached as an appendix to this SSHP. These written procedures shall be reviewed by the appropriate parties including, but not limited to, the HAZWOPER Program Coordinator, the SSHM, the SSHO, and the Site HP prior to use in field operations.

Both radiological and chemical detection instruments must be on an instrument maintenance tracking system. This system should follow each instrument and provide a mechanism for sending instruments back to the manufacturer for yearly calibrations, response checks, and/or repairs. ORNL IH- and HP-owned instruments that might be used on-site by an Energy Systems technician will be part of that department's maintenance tracking system. Departmental calibration procedures will be maintained at their respective facilities.

Contractors and subcontractors will be responsible for ensuring maintenance and calibration of their own instruments. Maintenance and calibration procedures must be provided for review by the ORNL IH or HP Departments, and those procedures must be maintained on-site.

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 parts per million 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, which is a section of the project field logbook dedicated to daily instrumentation calibration, maintenance, and use, as well as other information pertinent to field instruments.

The SSHO will ensure that monitoring equipment has been calibrated and is functionally tested. Work requiring the use of monitoring/sampling will not be performed unless properly maintained and calibrated instruments are available and provided for use.

6.4 MONITORING RESPONSE GUIDELINES

During site operations, the decisions to upgrade or downgrade PPE levels; to reestablish site EZs, CRZs, and/or Support Zones; or to cease work activities may be made on the basis of site monitoring results. These changes can be authorized only by site authorities, including the SSHM, the SSHO, the Site HP, the ORNL Health and Safety Organization, and the HAZWOPER Program Coordinator. These response guidelines are dependent 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. In an uncharacterized site, a reading of 1 ppm for 30 s in the breathing zone or 5 ppm in the breathing zone at a characterized site will cause an immediate withdrawal of workers from the area. IH will be notified, the area will be sampled, and the chemical will be identified before work continues. This can often be done on-site without a long delay. Conditions vary from site to site; therefore, monitoring response guidelines shall be established for real-time site assessments in each SSHEA.

7. SITE ZONES AND CONTROL MEASURES

Where there is a potential for employee exposure to hazardous chemicals or radiation or the accidental spread of hazardous substances to clean areas, work zones will be established to separate certain operations and to control the flow of personnel and equipment. 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.

7.1 WORK ZONES

Work zones will be cordoned off with HAZWOPER (orange and black) flagging, and HAZWOPER signs (if available) 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 SSHEA will be detailed on the site map included in the SSHEA. The posting of work zones may be modified to accommodate ORNL HP procedures. In some cases, based on site conditions, the individual zones may not be necessary, and the site will be posted as a HAZWOPER site, and access will be controlled.

Fig. 2. Illustration of typical work zones. Source: U.S. EPA, Office of Solid Waste and Emergency Response, *Establishing Work Zones at Uncontrolled Hazardous Waste Sites*, April 1991.

The SSHM or SSHOs and the Site HP 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 EZ and the CRZ. The SSHOs and the Site HP will periodically monitor the perimeter of the zones to ensure their effectiveness.

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. No person will enter the EZ or CRZ without proof of sufficient training and appropriate medical clearance as required by this SSHP and OSHA 1910.120. A daily log of all persons entering and leaving the CRZ will be maintained by the SSHO or designee in the project logbook.

7.1.1 Exclusion Zone

The EZ 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 Site HP and clearly marked. All persons who enter the EZ will have the prescribed level of protective clothing and training and will be placed on the medical monitoring program, as determined by the SSHO. An entry and exit checkpoint will be visually defined at the periphery of the EZ to regulate the flow of personnel and equipment into and out of the zone.

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

- Beards, stubble, and long sideburns (in the event respiratory protection were required).
- Eating, drinking, tobacco products, or chewing gum.
- Failure to inform the SSHM or 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 company clothing will be allowed under PPE under these conditions.
- Removal of respiratory protective equipment except when exiting the EZ through the decontamination line set up in the contamination reduction corridor (CRC).
- 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 who 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.

7.1.2 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 CRC 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 contaminant being spread outside the CRZ. Each person will be monitored by the Site HP 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. 7.1.1.

Equipment will be surveyed for radiological contamination by the SSHO, the Site HP, or a designee before entering and before exiting the CRZ. The Site HP performing the survey will log the results of these surveys in the daily HP log and in the project logbook. All equipment will be tagged by the Site HP or approved designee to show the results of the survey for radiological contamination.

7.1.3 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 WAG 6 Facility Manager and the Site HP), 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.

7.2 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 preentry health and safety briefing and shall be specified in the SSHEA.

7.2.1 Two-Way Radios

Some personnel, such as the SSHO, the Site HP, the HAZWOPER Program Coordinator, IH, and the SPM, will have two-way radios for use in plant-wide communications. Radio numbers of key personnel will be listed in the SSHEA. Other site personnel who will have access to two-way radios should be identified during the preentry health and safety briefings. Radio checks will be performed prior to site entry.

7.2.2 Cellular Phones

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.

7.2.3 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).

7.2.4 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!"

7.3 SANITATION

7.3.1 Housekeeping

The site shall be maintained in an orderly manner, free of congested construction debris. All uncontaminated waste shall be handled according to the project waste management plan. Disposable contaminated PPE will be checked and bagged by the Site HP and placed in the proper containment system according to the waste management plan. An accumulation area will be designated to store these drums for removal by Energy Systems Waste Management.

7.3.2 Potable Water

- Cool drinking water shall 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.

7.3.3 Consumption of Food and Tobacco Products

Eating, drinking, chewing gum, and use of tobacco products on the WAG 6 site are confined to designated areas only. These areas will be designated per the WAG 6 Facility Manager and appropriately marked by the Site HP, IH, and the SSHM and 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 CRZ 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. At the WAG 6 site, food and beverages will be allowed only in areas designated by the SSHO and WAG 6 Facility Manager.

7.3.4 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 or may be present. Facilities for washing hands and face will be available in the CRZ and in break zones or areas designated for eating. Wash water will be collected in buckets and properly disposed of in accordance with the Waste Management Program.

7.3.5 Restroom Facilities

Restroom facilities consisting of Port-O-Lets® or, as available, facilities located in project trailers shall be provided on-site for workers. The restroom facilities will be located in designated “clean” areas or break areas, which will be indicated during preentry health and safety briefings.

8. DECONTAMINATION PROCEDURES

8.1 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 particulated 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 in 29 CFR 1910.120(k) require the development of a decontamination plan prior to site entry; the development of 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 HAZWOPER designated zone. Decontamination procedures for PPE Levels C and D+ are described and illustrated in Figs. 3 and 4. 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 attached to this SSHP as an attachment or included in the CWP and SSHEAs. The Site HP and SSHOs shall determine and instruct site personnel in the proper decontamination steps once the decontamination procedures have been approved by the HAZWOPER Program Coordinator, IH, Site HP, and SSHM or SSHOs. This task-and site-specific training shall be documented by an attendance sheet.

8.1.1 Level D Protection Decontamination

Station 1: Work area (refer to Fig. 3)

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

Fig. 3. Minimum decontamination requirements for Level C protection.

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

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 potable water. Disposable boots and gloves need not be scrubbed and may be disposed of in compactible waste drums. Clean safety glasses and hard hat in 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 SSHP 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: Outer garment, boots, gloves, safety glasses, and hard hat removal

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

Station 4: Inner glove removal

Remove inner gloves.

Station 5: Frisking

To ensure that no radiological contamination is transferred to the Support Zone, personnel shall be frisked (screened for radiological contamination) by the Site HP or by a member of the SSHO group after approval from the Site HP prior to leaving the CRZ/HAZWOPER designated zone for the Support Zone. Frisking will be performed according to the ORNL Health Physics Manual, RP 2.5, page 27 of 27.

Equipment necessary: Alpha detector
 Beta-gamma detector

If contamination is detected on personnel, immediately notify the Site HP and await decon instructions. After decon, 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.

8.1.2 Level D+ Protection Decontamination

Follow the steps for Level D decontamination; the only difference occurs at Station 3. Remove the disposable chemical protective coverall and deposit it in a lined 55-gal compactible waste drum. Level D+ protective clothing is deemed necessary when 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.

8.1.3 Level C Protection Decontamination

Station 1: Work area

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

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

Scrub outer garment (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 SSHP. NOTE: This station is not necessary when disposable PPE is used.

Equipment necessary: Washtubs
Potable water
Detergent
Scrub brushes
Sprayer for rinsing

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 SSHP document. Reusable outer garments and boots will be placed in plastic bags for screening by the Site HP. This equipment must be scanned and green-tagged before it may be reused. Refer to HP Manual Sect. RP 2.7 for release limits. NOTE: This station 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. Because of the single-use respirator policy, respirators may not be reused until they have been scanned and tagged by Site HP, sent to the laundry and QA, and returned to ORNL IH. Finally, remove disposable inner gloves and deposit them in a plastic trash bag.

Equipment necessary: Plastic trash bags

Station 5: Frisking

To ensure that no radiological contamination is transferred to the Support Zone, personnel shall be frisked (screened for radiological contamination) by the Site HP or by the SSHO prior to leaving the CRZ/HAZWOPER designated zone for the Support Zone.

Equipment necessary: Alpha detector
Beta-gamma detector

If contamination is detected on personnel, immediately notify the Site HP and await decon instructions. After decon, 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.

Proceed to Station 7.

Station 7: Step across line

Enter the designated Support Zone.

8.1.4 Segregated Equipment Drop and Canister or Cartridge Change

This procedure is diagrammed in Fig. 5.

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, and clipboards) 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.

Fig. 5. Segregated equipment drop and canister cartridge change.

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

8.1.5 Emergency Decontamination

In the event that the emergency decontamination of site personnel is required because of site conditions, exposure to site contaminants or other hazards, or 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 SSHM or SSHO, and site emergency decontamination will be overseen or administered by the Site HP. 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.

8.2 EQUIPMENT DECONTAMINATION

Equipment decontamination procedures will be performed under the direction of the Site HP and in accordance with applicable ORNL Environmental Restoration, WAG 6, and Waste Management procedures. The applicable procedures should be available on the site. General decontamination procedures are listed below:

Instrument and hand tool decontamination

- In decon area, instruments and hand tools will be cleaned with soap and water using a brush and rinsed in potable water. Note: Follow manufacturer's instructions for monitoring instruments.
- Tools will be placed in a specified area lined with plastic to air dry.
- After drying, the tools will be frisked by the IH/HP technician for contamination. Contamination levels must meet release limits listed in the ORNL HP Manual, Sect. RP 2.7.
- If contamination remains, repeat procedure using diluted cleaner such as 409.

Heavy equipment decontamination (steam cleaning)

- Work area to be roped off with magenta rope and signs, per SSHO.
 - Storage area for contaminated material
 - Steam cleaning area
 - Drying area
 - Storage area for full 55-gal drums
 - CRZ for workers and storage facilities
- The HP and operator will check items to be cleaned and indicate what type contamination was found: general, spots, low or high.
- The rigging crew will place the item/items inside the diked area.
- The operator will start the steam cleaner and check the equipment.
- The laborer will dress out as follows:
 - company clothes and shoes;
 - company "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; and
 - hard hat, safety glasses, and full-face shield.
- The steam cleaner, laborer, will start 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 HP 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 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 area.
 - The area will then be steam cleaned again.
 - The HP will then check for contamination.
 - If the items are decontaminated, the rigging crew will place the items outside the diked area on plastic to air dry.
 - After the items have air dried, the HP 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, Energy Systems will be notified.
- If performing chemical decontamination (sampling equipment, etc.), do not use 409. Use Alconox or some other phosphate-free detergent.
- Any and all wash water will be pumped, using a small gasoline pump, into the 55-gal drums. The drums will be adequately labeled and stored.
- As necessary, the drum contents will be sampled for proper disposal methods.

9. STANDARD OPERATING PROCEDURES

All site SOPs shall be in accordance with established ORNL procedures that are applicable to site operations. Work project SOPs shall be developed and included in the CWP and the SSHEAs as necessary. Specific ORNL SOPs that are applicable to work project operations should be listed or incorporated in the work project SSHEAs.

10. EMERGENCY PREPAREDNESS AND CONTINGENCY PLANS

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 WAG 6. The information presented in this section was developed from the ORNL *Radiation Worker Training Manual* and the *Energy Systems General Employee Training Manual* and should be in concert with the *X-10 Site Emergency Plan* and the *WAG 6 Emergency Response Plans* (currently under development), which define emergency response requirements and responsibilities.

10.1 EMERGENCY CONTACTS AND NOTIFICATIONS

A listing of emergency contacts' telephone numbers and radio numbers shall be provided in each SSHEA and shall be posted during all site operations in a designated location that is easily accessible to all site personnel. These emergency telephone numbers shall include, but are not limited to, the following ORNL entities:

- LSS
- Emergency Control Center (ECC)
- WAG 6 Facility Manager
- Emergency Response
- Spill Response
- Industrial Safety
- Health Physics
- Industrial Hygiene
- Health Division
- Plant Security
- Public Relations
- Protective Services Department

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 vs 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.

10.1.1 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 be used only by personnel who know how to operate them safely, in addition to knowing the type of fire (e.g., electrical, petroleum product, wood) 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, eye wash 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.

10.1.2 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 and then notifying the LSS and/or the Laboratory ECC of the emergency situation so that the emergency response system can be activated.

10.1.2.1 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
	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 during the day shift by the ORNL Health Services offices. 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.

10.1.2.2 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 CWP or SSHEA 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.

10.1.2.3 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. 10.1.2.1, item 3, should be conveyed to the LSS's office.

10.1.3 Emergency Coordinator

In the event of an emergency situation, the SSHO will act as the site emergency coordinator. 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.

10.1.4 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, 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 orient emergency response units.

10.2 EMERGENCY ACTION PLANS

10.2.1 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

10.2.1.1 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.

10.2.1.2 Laboratory evacuation alarm

The laboratory evacuation alarm is a continuous 30-s warbling wail that is followed by PA instructions for the safest exit routes from the laboratory.

10.2.1.3 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.

10.2.1.4 Radiation emergency alarm

The local radiation emergency alarm is a clarion siren that 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 reenter the building or area under any circumstances.

10.2.1.5 All clear signal

The all clear signal is an announcement given over the PA system which indicates that it is safe for personnel to return to work areas and resume normal activities.

10.2.2 Emergency Assembly Points

An emergency assembly point shall be designated for each project. The location of the assembly point shall be included in the SSHEA and shall be addressed in the preentry 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 because of site activities.

10.2.3 Evacuation Routes

Evacuation routes shall be established for all site operations. EZ evacuation routes shall be through the CRC, if possible. With the assistance of the SSHO, the Site HP shall

designate the safest site operations evacuation route. The location of the route and the recommended progression shall be discussed in the preentry 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.

10.2.4 Fire or Explosion

Fire suppression and response services shall be provided for field activities by the on site ORNL Fire Department. The ORNL Fire Department can be summoned through the LSS or ECC offices as described in Sect. 10.1.2.1.

10.2.5 Emergency Equipment

The locations and types of emergency equipment available during site operations shall be given in the SSHEA and addressed in the preentry health and safety briefing.

10.3 EMERGENCY MEDICAL SERVICES

10.3.1 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 SSHM or SSHO, as necessary, and transportation to EMS will be made at the discretion of the SSHM or SSHO or at the injured person's request. All site injuries and the circumstances involved will be recorded in the project logbook by the SSHM or SSHO. The completion of state worker compensation forms will be coordinated with the injured person, the person's supervisor, the SSHO, and the SPM.

10.3.2 First Aid and Cardiopulmonary Resuscitation

At least one person shall be designated to perform first aid and cardiopulmonary resuscitation (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.

10.3.3 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.

10.3.4 Emergency Medical Services

First aid treatment and emergency CPR 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.

10.3.5 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.

10.4 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 Sect. 10.1.2.

10.5 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 Sect. 10.1.2

Appendix A

**SITE SPECIFIC HAZARDS EVALUATION ADDENDUM
TO THE WAG 6 SSHP PLAN**

**SITE SPECIFIC HAZARDS EVALUATION
ADDENDUM APPROVAL
WAG 6**

SSHEA NUMBER: _____

**COMPREHENSIVE WORK PLAN
TITLE:** _____

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SITE SPECIFIC HAZARDS EVALUATION ADDENDUM

WORK PROJECT TITLE: _____

DATE: _____

- To be applicable, the SSHEA must be attached to the approved project Site Safety and Health Plan and Comprehensive Work Plan.
- This SSHEA must undergo review and approval and have an approval page attached to it documenting the same in order to be valid.

SECTION I: Project Hazard Evaluation

Place an X in each ☐ to indicate existing conditions or those that may be a result of site operations.

Note: If there are several tasks, duplicate and complete this page for each task.

Task: (provide description of task) _____

Names of key staff, health and safety personnel, and alternate to SSHO: _____

Physical hazards

☐ Heat stress	☐ Cold stress	☐ Noise
☐ Confined space	☐ Enclosed space	☐ Manual lifting
☐ Tripping/falling	☐ Ergonomic	☐ High pressure
☐ Oxygen deficient atmosphere	☐ Explosive/flammable	☐ Vibration
☐ Oxygen enriched atmosphere	☐ Water	

Safety/Construction Hazards

☐ Trenching	☐ Excavating	☐ Heavy Equipment Operation
☐ Demolition	☐ Elevated work heights	☐ Welding/cutting/burning
☐ Hoisting/rigging	☐ Underground hazards	☐ Overhead hazards
☐ Personnel decon	☐ Equipment decon	☐ ISV
☐ Drilling	☐ Drum handling	☐ Work in water/boat
☐ Environmental sampling		

Chemical Hazards

☐ Volatile organic	☐ Inorganics	☐ Carcinogen
☐ Corrosive	☐ Reproductive toxicant	☐ Metals
☐ Mutagen	☐ Asbestos	☐ PCBs
☐ OSHA specific	☐ Flammable/explosive	

Ionizing Radiological Hazards

☐ Internal exposure ☐ External exposure ☐ Contamination

Nonionizing Radiological Hazard

☐ UV ☐ RF ☐ Microwave
☐ Laser ☐ High Voltage

Biological/Vector Hazards

☐ Wildlife ☐ Plants ☐ Medical Waste
☐ Bacterial ☐ Parasites

For every block checked, specify hazard and list controls (attach sheet if necessary) _____

SECTION II: Monitoring Requirements

Note: The IH or HP should be consulted to assist in preparing this section.

List known chemicals on-site and exposure limits for each (refer to Table 2 for target organs and toxic effects).

Chemical	TLV/PEL/STEL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

List known or suspected site radionuclides below (refer to Table 3 for exposure limits).

Contamination level: ☐ Fixed ☐ Removable ☐ Potentially respirable
Water contamination: ☐ Yes ☐ No

If checked, list controls:

	<u>Task(s)</u>	<u>Monitoring Frequency</u>	<u>Action Levels</u>	<u>Action Guidelines</u>
Direct Reading Instruments				
LEL Meter	_____	_____	10% LEL	_____
O ₂ Meter	_____	_____	>22% O ₂	_____
Colorimetric Indicator Tubes	_____	_____	1/2 PEL	_____
Photoionization Detector (PID)	_____	_____	5 ppm*	_____
Flame Ionization Detector (FID)	_____	_____	5 ppm*	_____
Alpha Meter	_____	_____	See Table 3	_____
Beta/Gamma Meter	_____	_____	See Table 3	_____
Area Radiation Monitors				
Noise Meter	_____	_____	85 dBA	_____
Other (Specify)	_____	_____	_____	_____
Personal Monitoring				
Whole-body dosimetry	_____	_____	_____	_____
Extremity dosimetry	_____	_____	_____	_____
Whole-body count	_____	_____	_____	_____
Urinalysis/bioassay	_____	_____	_____	_____
Chemical air sampling	_____	_____	_____	_____
Radiation air sampling	_____	_____	_____	_____
Personal sampling pumps	_____	_____	_____	_____

*For characterized sites only. Uncharacterized sites have action level of 1 ppm.

Instruments used by IH will be calibrated and maintained in accordance with IH SOP. Instruments used by the Office of Radiation Protection are calibrated and source checked in accordance with established Health Physics procedures.

Site monitoring requirements may change based on site conditions. All changes must be approved by the Facility Manager and HAZWOPER Coordinator.

SECTION III: Initial Level of Personal Protective Equipment

Level of Protection:	☐ A ☐ B	☐ C ☐ D	☐ Modified
Respirator:	☐ SCBA ☐ PAPR	☐ Full-face ☐ Other	☐ Half-face
	Cartridge: _____		
Protective Clothing:	☐ Encapsulating Suit ☐ Saranex ☐ C-zone ☐ Other		☐ Tyvek ☐ Splash Suit ☐ Company Clothing
Head/eye/ear:	☐ Hard Hat ☐ Splash Shield	☐ Safety Glasses ☐ Ear Plugs	☐ Goggles ☐ Other
Gloves:	☐ Nitrile ☐ Latex ☐ Other	☐ Neoprene ☐ Vinyl	☐ PVC ☐ Leather
Footwear:	☐ Steel-toed Leather ☐ Steel-toed Rubber		☐ Chemical Overboots ☐ Other

Describe the donning/doffing steps if different from those in Sect. 5.3.4 of SSHP:

SECTION IV: Training/Medical Requirements

List applicable training/medical requirements for this project. All site personnel and visitors requiring access to the work zones (contamination reduction zone and exclusion zone) will be required to meet the access requirements. Copy this sheet and fill out for each worker.

Name _____ Title _____

Training

- _____ GET
- _____ 24-hour HAZWOPER (SARA/OSHA) training
- _____ 40-hour HAZWOPER (SARA/OSHA) training
- _____ Current HAZWOPER 8-hour Annual Refresher (as applicable)
- _____ 8-hour HAZWOPER Supervisor training
- _____ Radiation Worker Training I
- _____ Radiation Worker Training II
- _____ Respirator fit test/training
- _____ Confined space entrant
- _____ Confined space attendant
- _____ Whole-body count (in vivo)
- _____ Bioassay (in vitro)
- _____ List specific radionuclides assayed as part of the bioassay program
- _____ Specialized equipment training
- _____ SSHO training
- _____ First aid/CPR
- _____ Additional training or medical requirements (specify)

Medical Surveillance

- _____ ORNL Medical Surveillance Program
- _____ ORNL Hazardous Waste Worker Medical Surveillance Program (only for individuals meeting criteria as specified in Sect. 5.4.1 of the WAG 6 SSHP and Sect. 9 of the ORNL HAZWOPER Program Manual).

Note: If site conditions change, or other hazards are detected, the training and access requirements will be revised accordingly.

SECTION V: Special Work Practices or Procedures

If there are any unusual practices or procedures that are not described in a manual or SOP, describe below, along with justification for the procedure.

SITE SPECIFIC HAZARDS EVALUATION ADDENDUM

SITE MAP

[illegible]

Appendix B

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: _____

Justification: _____

Site Project Manager: _____ Date: _____

Approvals: (Field Changes Only)

Project Manager: _____ Date: _____

QA Specialist: _____ Date: _____

QA Representative: _____ Date: _____

Analytical Representative: _____ Date: _____

Other Approvals:

Name / Organization

_____ Date: _____

_____ Date: _____

_____ Date: _____

Appendix C

SITE SAFETY AND HEALTH PLAN AGREEMENT

**SITE SAFETY AND HEALTH PLAN AGREEMENT
WAG 6 SITE**

COMPREHENSIVE WORK PLAN TITLE:_____

NAME:_____

BADGE NUMBER:_____

COMPANY:_____

My signature below indicates that I have reviewed the information presented in the Site Safety and Health Plan for the above-mentioned comprehensive work plan. I also agree to abide by all the requirements for site activities and operations described therein.

Signature

Date

ACKNOWLEDGMENTS

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