Pacific Northwest
NATIONAL LABORATORY

WSH-MA-001, R31

Contractor Environment, Safety & Health Manual (CESH)

For Work Conducted at Pacific Northwest National Laboratory

April 2025

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U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

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Revision History

Revision Number	Date	Changes
31	05/06/2025	• Section 5.4.4 Added Environmental Protection Agency, Toxics Substance Control Act (TSCA) Mandate • Section 16.4.2 added hand digging requirements and use of sod cutter requirements • Section 17.3.5 corrected reference to appropriate fall protection section • Section 21.3 Removed reference to PNNL staff performing offsite work pertaining to LOTO • Section 20.3.20 added 360-degree inspection requirement for clarification on cutting around utility services • Section 21.3.2 Removed pen & ink changes for LOTO per ADM – 001 • Section 21.5.1 Clarified exclusive control of cord and plug applicability for single cord equipment • Section 21.6.5 Changed approval level for tag out plus to WS&H Group Lead per HDI update. • Section 21.8.1 Updated LOTO equivalent refresher course reference to reflect appropriate course number (00313 refresher is now 00316).
30.1	12/30/2024	Minor Revision • Section 6.3.3.4, clarified type 2 helmet requirements, and visitor head protection use on construction sites.
30	11/19/2024	• Section 6.3.3.2, updated glove requirements and added glove chart. • Section 6.3.3.4, updated head protection requirements (helmets). • Section 6.3.3.6, updated requirements on hearing protection/listening devices. • Section 6.3.3.7, added working over/adjacent to water. • Section 8.5 added PNNL crafts utility disconnect verification. • Section 15, added requirement to have Shut-gun for fire sprinklers. • Section 16.2, added precaution for excavating around fire hydrants/water mains • Section 16.2 added clarifications for competent person stopping work

		• Section 20.3.1 clarified contact release training • Section 20.3.6, new section clarifying requirements when working within the arc flash boundary of exposed energized electrical parts. • Section 20.3.8, clarified requirement for two-person rule when working within the restricted approach boundary of exposed energized three-phase electrical parts operating at or above 480VAC. • Section 21.1, clarified conditions of greenfield construction projects which are exempt from lockout tagout. • Section 21.3.2, Editorial update of threshold table regarding "Minimal Action System" to match wording in HDI. • Section 21.5.1, Replaced "Vehicles and ground maintenance equipment" with "engine driven equipment." • Section 21.5.2, Added new section describing the requirements when transitioning from greenfield construction to use of lockout tagout controls. • Section 24.3, added requirements for negative exposure assessment for welding activities. • Section 24.3.2.3, added information on grinding wheels. • Section 25.3, prohibited use of rope grabs. • Section 29.1 Added Lift Directors roles and responsibilities • Section 30.3.3, added requirements and verbiage on spotters.
29.2	06/24/2024	• Removed COVID Section. Effective Monday, June 24, all final controls are being retired, and our workplace occupational health practices are returning to pre-pandemic standards.
29.1	03/20/2024	• Filled in the word "Contractor" for sections 9.7 and 29.6 in the table marked "Expected Records." These boxes were inadvertently left blank.
29.0	03/04/2024	• "Beryllium" section significantly revised to better outline responsibilities and requirements for contractors. • Revised "Demolition" section to address control of dust/debris during demolition activities. • "Scaffolds" section, added transferring of scaffolding from PNNL to contractor for use. • "Hoisting & Rigging" section, added 2 forms: 1) Mechanical Material Handling Plan use, and 2) renamed and revised Lift Plan Checklist to Crane Pick Plan.

		• "Pre-job Planning" section, combined "Subcontractor Daily Pre-job Briefing" and "Construction Supervisor Safety Inspection Checklist" into 1 Form called "Subcontractor Daily Pre-job Briefing and Supervisor Safety Inspection Checklist" (WSH-MA-001-Form-01).
28.1	01/09/2024	• Minor Revision. When Revision 28 was submitted and approved author did not use the 27.1 revision, so those changes were not reflected in version 28. Revision 28.1 includes the revisions already approved in 27.1.
28.0	10/24/2023	• Section 2.3.8, revised guidance on lightning/thunder activity. • Section 17, better defined floor holes. • Section 20, Revised entire electrical section to align with program updates. • Updated Electrical forms and procurement page: EWP form with instructions, Temporary Protective Grounding and Checklist for Rubber Gloves • Updated Section 31: COVID-19 Guidelines
27.1		Minor Revision: Add New Chapter on Construction Ergonomics
27.0	08/03/2023	Annual Review: • Section 2.3.1, addressed personal listening devices on active construction sites. • Updates to Section 3.0 • Section 5.4.6.2 revised to align with NIOSH heat stress guidelines. • Section 16.3 clarified when excavation permit is required. • Section 16.3.1 clarified excavating around buried utilities. • Section 17.3.1 provided definition and clarification for floor opening protection. • Section 20.3.2 addressed generator grounding requirements. • Section 24.3 revised wording for fall protection requirements and the use of SRL's. • Section 26.4.1 defined the usage of step ladders as straight ladders. • Section 28.3, Addressed dual roles during lifts. • Added section 32.0 Wildfire Season/Smoke. • Grammar and clerical changes as needed.
26.0	6/28/2023	• Section 21.0 Revised to align with HDI changes including formatting, tagout plus, temporary lift, challenging locks, and Controlling Organization Training.

		• Grammar and clerical changes as needed. • Added to Chapter 8
25.1	02/17/2023	• Section 9.4 revised to include statement. “Key supervisors must meet requirements defined in the division 1 specification 01 6000 1.5 A(6) section. Revision made to address corrective action E-02022-021.
25.0	02/06/2023	• Added requirements to: • Add exposure limits identified in WAC 296-841. • Require the Contractor's to identify a competent industrial hygienist or other technically qualified person responsible to approved 'for each particular use' of any equipment and technical measures used to avoid exposure of employees to inhalation, ingestion, skin absorption, or contact with any material or substance at a concentration above those specified in chapter 296-841 WAC. • Address the requirement for internal combustion equipment exhausts in enclosed spaces. Require that the PNNL Construction Contractor must make and record tests to ensure that employees are not exposed to unsafe concentrations of toxic gases or oxygen deficient atmospheres. (See chapter 296-62 WAC, the general occupational health standards and chapter 296-841 WAC, identifying and controlling respiratory hazards.) • Repair paragraphing errors in Section 5.
24.0	06/30/2022	• Table of contents section 27.0 title was changed from Aerial Lifts to Mobile Elevated Work Platforms (MEWP). • General Requirements were updated in section 27.2.1 related to MEWP wording. Consideration shall be made to limit the operator from falling any distance outside the work platform. SRL's or lanyards without shock absorbers shall be used. MEWPs shall not be operated around uncovered or unguarded open holes. Information was added regarding wind restrictions and effects of wind on large surface items that could create a tip over hazard. • Section 2.3.5 updated OSHA form 300 to 300A and updated posting requirements from February 1 thru April 30th. • Section 2.3.7 updated safety bulletin board requirements to OSHA 300A form and posting requirements February 1 thru April 30th. • Section 28.3 Hoisting and Rigging Planning section was updated to define required information that makes up a lift plan.

		• Section 31 Respirable Crystalline Silica Control. Added Silica exposure control plan form. • Added section 31.5.2.2 Compliance Monitoring. PNNL may perform compliance monitoring of contractor personnel performing silica related activities to ensure contractor work practices are effective in controlling silica below 25µg/m3 as required by this section. Results will be provided to contractor supervision, who will be responsible for sharing results in writing with affected employees per section 31.5.2. • Section 31.8 updated requirements for contractor to complete the silica exposure control plan form when disturbing silica products. • Form may be valid for one-year. Added section 31.9.1 Special respiratory protection provisions. Indoor concrete saw cutting requires the use of ½ mask APR respirator for activities less than 4 hours. Full-face APR respirators are required for work activities greater than 4-hours. Any concrete grinding or cutting performed inside an enclosure requires the use of a full-face APR respirator. • Added section 31.14.1 Forms with reference to silica exposure control plan. Removed Section 29: Unbound Engineered Particles. This section will develop job specific requirements in the 016000division 1 section of the contract.
23.0	04/18/2022	• Update to Section 32: COVID
22.0	3/15/2022	• Changes made to Chapter 32 only: Aligned contractor vendor staff to the new masking and non-APL requirements based on CDC guidelines that came out March 8, 2022.
21.0	12/17/2021	• Updated to incorporate COVID-19 Contractor Requirements. • Added Pre-Job Safety Briefing Checklist link to Section 8; Forms
20.0	09/29/2021	The CESH revision is primarily associated with the implementation of NFPA 70E 2021. The new standard modified language from 2015 thru 2021 and is now consistent with associated HDI documents referenced within the CESH. The inclusion of permanently installed voltage testing devices allowed to be used to perform a preliminary safe to work check and or a safe condition check as part of establishing an electrically safe work condition. Process and terminology change required by 70E from a hazard analysis to an electrical shock and arc flash risk assessment. PPE requirement for electrical work that has an arc flash value <1.2cal/cm2 was clarified as Category 0 PPE has been removed from the task

		tables identified in 130.7(C)(15)(a). GFCI requirements for construction; Assured Equipment Grounding language was added to be used on fabricated cord sets without GFCI protection. • Hazardous Energy Control Training for Simple LOTO Gap training (formerly AW Verbal) • Requirement For CO to conduct a pre-job briefing with AW's for all LOTO. • LOTO Written Instruction Form revised • LOTO verification by another LOTO trained worker • Authorized Worker Simple LOTO Form (NEW FORM associated with new AW Simple LOTO) • Closeout of AW Simple LOTO Form for completeness by CO, retain in WS&H records • Changes to exhibits: – Hazardous Energy Control Training Matrix – Criteria to Perform Authorized Worker Simple LOTO (formerly Eight Criteria to Perform AW Verbal).

Document Implementation Worksheet

Briefly describe below any actions needed to implement or retire this document. Also indicate if the action must be completed prior to the document becoming effective.

Release Document upon:
- ☒ PNNL approval of document (no actions below must be completed prior)
- ☐ Completion of the required actions below
- ☐ Concurrence of the document owner (after all required actions are complete)
- ☐ No earlier than this date (after all required actions are complete): Click here to enter a date or N/A.

Action Required	Actions	Required Prior to Release (Y/N)	Action Owner	Due Date	OTS/ITS# (Optional)
Training and Qualifications		N	N/A	N/A	N/A
Process/Procedure/ System Changes Required	None	N	N/A	N/A	N/A
Communications	None	N	N/A	N/A	N/A
Other Actions	Minor Update	Y	EA Kirkpatrick	N/A	N/A
External Approval	None	N	N/A	N/A	N/A

Contents

Tables

1.0 Introduction

The Contractor Environment, Safety & Health (CESH) Manual (hereafter referred to as "this Manual") has been developed to identify the minimum requirements for Contractors and Subcontractors performing industrial, construction, service, or maintenance work for Battelle Memorial Institute (Battelle) in Battelle and in U.S. Department of Energy (DOE) facilities. In this Manual, Contractor means the person or organization entering into a contract with Battelle.

Subcontractor means any Subcontractor or supplier at any tier who supplies goods and/or services to the Contractor in connection with the Contractor's obligation under the same contract.

This Manual contains excerpts from, and references to, numerous regulations, codes, and standards, including the following documents:

- U.S. Department of Energy (DOE) Orders
- Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910 and CFR 1926
- Washington Industrial Safety and Health Act (WISHA) WAC 296-155
- American National Standards Institute (ANSI)
- National Fire Protection Association (NFPA)

This Manual does not state the requirements of these regulations, codes, and standards in their entirety.

Each Contractor/Subcontractor is responsible for compliance with ALL applicable requirements that govern their work at Pacific Northwest National Laboratory (PNNL) facilities, including any consensus standards incorporated therein by reference.

This Manual also contains sample forms that exhibit the minimum information required for documentation. Contractor/Subcontractors may use these forms or comparable equivalents.

In addition, Subcontractors may be asked to prepare certain job-specific submittals (e.g., an asbestos work plan or lockout and tag out procedure) for review by PNNL.

1.1 Integrated Safety Management System

The Contractor must use a safety management system that conforms to PNNL's Integrated Safety Management (ISM) requirements. An effective ISM plan establishes a single system that integrates requirements into the work planning and execution process to protect the workers, public, and the environment. ISM provides the mechanisms for increasing worker involvement in work planning, including hazard and environmental impact identification, analysis, and control; work execution; and feedback/improvement processes.

ISM can be framed in the following logical progression of seven topics:

- Define the scope of work in a manner that effectively allocates resources to address safety, programmatic, and operational considerations.

- Analyze the hazards associated with the work.
- Develop/implement hazards controls, evaluating hazards per an agreed-upon set of safety standards and requirements. Administrative and engineering controls that mitigate hazards shall be tailored to the work being performed.
- Perform work under the conditions and requirements established and agreed-upon.
- Provide feedback and improvement on the adequacy of controls, opportunities for improving the planning and execution of the work.
- Clearly define roles and responsibilities for all levels within PNNL and its Contractors.
- Competence must be commensurate with responsibilities for all personnel possessing the experience, knowledge, skills, and abilities that are necessary to discharge their defined responsibilities.

Contractor program flexibility is understood and encouraged as long as program tenets adequately address the spirit and intent of the ISM provisions.

2.0 Program Policy

2.1 Purpose

This procedure provides requirements for identifying key aspects of contractor safety that provide all employees a safe and healthful workplace in compliance with OSHA and WISHA standards while also protecting the environment. The provisions of this procedure apply to work activities associated with tasks performed by Battelle's Contractors and Subcontractors.

2.2 Definitions

The following list identifies terms selected and defined for this procedure. The complete definitions can be found in Appendix A.

- Competent Person
- Personal Protection Equipment.

2.3 Requirements

The provisions for program policy at project locations include:

- Responsibility
- Contractor/Subcontractor Responsibilities
- General Requirements
- Safety Requirements
- Safety Rights
- Safety Responsibilities
- Safety Bulletin Boards
- Adverse Weather Conditions

2.3.1 Responsibility

The Contractor has overall accountability for the safety of their project. The Contractor allocates the proper resources necessary to execute all safety-related tasks. The Contractor is responsible for implementing all required safety-related codes and contract/subcontract requirements.

The Contractor will be fully accountable for safety and health related activities within their purview, including the following activities:

- Implementing this procedure (or Contractor's own procedure when found acceptable).
- Pre-planning work effectively to identify potential hazards and take appropriate steps to control/mitigate/eliminate these hazards.
- Orienting employees to the plan and PNNL-applicable requirements.

- Training employees in safe-work practices.
- Documenting all training on a Training Attendance Record.
- Providing each employee a place of employment which is as free as possible from recognized hazards that are likely to cause harm.
- Providing required personal protection equipment (PPE), making sure employees know how to use the equipment and enforcing its use in the field.
- Monitoring the workplace for unsafe conditions and taking steps to eliminate them.
- Taking immediate action to correct unsafe conditions, acts, and other deficiencies identified during inspections.
- Providing a Competent Person to oversee all activities.
- Providing apprentice craftsmen with appropriate field supervision, safety training and hands-on experience prior to assigning work activities.

All employees shall be responsible for carrying out their assigned work in a safe manner to protect themselves and others from undue hazards and to prevent damage to property and the environment. All employees shall be responsible for:

- Actively complying with applicable safety standards and reporting promptly to their supervisors any condition which may lead to a violation of these standards or any other unsafe condition.
- Correcting unsafe conditions (within their ability and authority).
- Reporting emergencies and responding to warning signals which may be activated.
- Reporting all occupational injuries and illnesses immediately to their immediate supervisor.
- The use of personal listening devices, i.e., headphones, ear buds, or AirPods is prohibited while working on active construction sites.

2.3.2 Contractor/Subcontractor Responsibilities

The following summarizes the responsibilities of the Prime Contractor and any Subcontractors hired by the Contractor in the course of this project.

Contractor Responsibilities

- Immediately rectify any and all conditions that are found to be unsafe and/or unsanitary.
- Report any unsafe conditions to project personnel according to the Battelle contract.
- A follow-up report shall be issued detailing the action taken to rectify any and all inadequacies.
- Coordination of activities with subcontractors shall take place so work will proceed in accordance with applicable safety requirements.

- Project personnel and Subcontractors shall be notified of any recognized hazards, potential problem areas, and safety requirements.
- Coordination of all pertinent certifications, training, and recordkeeping shall take place and their accessibility for review made available.

Subcontractor Responsibilities

- Subcontractors shall retain full responsibility for the safety of their personnel.
- Review possible safety hazards, construction activities, etc., with their personnel.
- Make regular inspections of hand tools and equipment used in all phases of work activities.
- Immediately correct any safety deficiencies when identified and/or notified.
- Immediately inform the Contractor's safety representative of any and all unsafe conditions or activities.

Note: There must be an open and continuous line of communication between the Contractor and Subcontractor to discuss any unsafe acts or conditions that may arise during the project.

2.3.3 General Requirements

The Contractor shall take all reasonable precautions in the performance of work to protect the health and safety of employees, members of the public, environment, and facilities at PNNL.

The contractor shall:

- Allocate sufficient resources to implement this safety program and specific contract requirements.
- Develop, implement, and/or adhere to job safety analysis (JSA) or other pre-job planning documents.
- Establish safety flow-down requirements in all subcontracts.
- Coordinate and plan pre-job planning with Subcontractors, field supervisors, and others, as required.
- Conduct a daily walk-around safety inspection and document this inspection.
- Instruct all employees, initially and periodically, on matters pertaining to employee safety and health rights, protections, obligations, and responsibilities.
- Designate (in writing) a Competent Person in the following areas (as necessary per the contract scope of work):

  Ladders

  Lead

  Excavation/Trenching

Asbestos

Scaffolds

Demolition

Fall Protection

Fire Protection

Safety Monitor

Aerial Lift Trainer

Forklift Trainer/Evaluator

Rigging Evaluator

Silica

Electrical (Assured Grounding Program)

Steel Erection

2.3.4 Safety Requirements

Contractors working in facilities at PNNL are expected to take actions that foster a safe working environment.

Each worker has the right, without fear of retaliation, to raise concerns about work related issues. PNNL will not tolerate retaliation against workers for raising concerns in good faith.

Supervisors must protect staff from harassment, retaliation, or disciplinary action that is based on staff having exercised their safety rights.

Workers are informed of their rights and responsibilities by appropriate means, including access to an appropriate DOE Occupational Safety and Health Protection poster in their workplace (see Section 6.0 below).

2.3.5 Safety Rights

Workers have the right:

- To obtain their personal records on injury, illness, exposure, and medical documentation.
- To review their company's summary information on injury and illness. This information is available through their supervisor and the OSHA Form 300A summary, which is posted in each building during the month of February 01 thru April 30th.
- To obtain and review their radiological exposure information. This information is available through PNNL Field Dosimetry.
- To be represented during regulatory workplace safety inspections (i.e., inspections by DOE or Washington State Department of Labor and Industries, Division of Occupational Safety and Health). Workers may contact their

managers if they wish to request the name of their worker representative or participate in the workplace inspection as a worker representative.

- To have access to DOE worker protection publications, DOE-prescribed standards, PNNL's own protection standards, and their company's procedures applicable to the workplace. Workers should contact their supervisor for more information.
- To observe monitoring or measuring of hazardous agents to which the staff member is exposed and have access to the results of their exposure monitoring. Workers should contact their supervisor for more information.
- To be notified when monitoring results indicate they were overexposed to hazardous materials. Workers may contact their supervisor for more information.
- To request and receive results of inspections and accident investigations. Workers should contact their supervisor for more information.
- To stop work immediately, without fear of reprisal, when convinced a situation exists that places themselves, their coworkers, or the environment in danger.
- To address unsafe working conditions by preventing, avoiding, and reporting them.

2.3.6 Safety Responsibilities

Workers have these responsibilities:

- To conduct only those activities that the manager has approved.
- To use PNNL facilities, equipment, and tools only for the purposes for which they were designed.
- To stop work immediately without fear of retaliation and to notify your manager when you are convinced a situation exists that places you, coworkers, or the environment in danger.
- To follow technical work documents and consult Safety Data Sheets (SDS) associated with the work being done.
- To observe requirements, procedures, instructions, signs, postings, and warning signals.
- To know emergency plans and procedures for your work area.
- To become familiar with potential hazards associated with your work and work area and the measures taken to control the hazards.
- To use the required and appropriate personal protective clothing and equipment.
- To report near-accidents or incidents to your manager before proceeding with the work.
- To report emergencies or work-related accidents, injuries, or illness promptly to your manager.

- To report unsafe conditions and hazards to your manager.
- To be aware of your current exposure status and the applicable control levels and limits. Workers should contact their supervisor for more information.
- To warn fellow staff members about hazards in your work area and point out the controls that are in place.
- To report noncompliance with Environment, Safety and Health (ES&H) requirements to your supervisor.
- To participate in required medical and biological monitoring programs. Workers may contact their supervisor for more information.

2.3.7 Safety Bulletin Boards

The contractor is responsible for installing and maintaining a safety bulletin board (when eight or more persons are working at a jobsite) at the location where the majority of employees report to work.

Mobile crews shall be advised of the location of the nearest bulletin board.

Employees shall be responsible for reviewing the bulletin board to keep informed of safety-related information.

Safety bulletin boards shall be sufficient size to display and post safety bulletins, newsletters, posters, accident statistics, and other safety educational material.

At a minimum, the safety bulletin board shall display:

- DOE Occupational Safety and Health Poster DOE-F 5480.2
- DOE Occupational Safety and Health Complaint Form 5480.4
- Citations and notices as appropriate
- OSHA 300A form during February 1st to April 30th.
- PNNL-furnished safety bulletins and publications
- Your Rights as a Worker (poster)
- Washington State Industrial Notice for Employee's Form II P242-191-000

Suggested items to be posted include:

- Safety & Health posters
- Minutes of safety meetings
- Information on accidents
- Hazard communication information
- Lessons Learned

2.3.8 Adverse Weather Conditions

To keep workers safe, work or portions of work may be temporarily and incrementally shut down due to high winds, lightning, extreme heat, or other inclement weather as determined by PNNL. The Contractor shall issue the following warnings via radio system, public address announcement, or in person. The Contractor shall make sure that Subcontractor personnel are apprised of the warnings and take the required actions as stated below.

- Sustained winds greater than 15 mph – crane operation shall be closely evaluated for necessity.
- Sustained winds greater than 25 mph and/or gusts greater than 40 mph – all crane operations must cease and be secured. All loose outdoor materials shall be secured. Work on roofs and elevated surfaces (roof, scaffolds, aerial lift, etc.) shall be scrutinized before continuing.
- Sustained winds greater than 50 mph – outdoor activities shall be curtailed and limited to those approved by Battelle and Contractor supervision.

PNNL Work Site Safety Guidance for Lightning/Thunderstorm Activity

The Hanford Meteorological Station (373-2716) or the National Weather Service Forecast Office, Pendleton, Oregon (541 276-4493), can be used to obtain hazardous weather information for planning purposes. Contractor personnel shall not work on roofs or elevated surfaces when seeing lightning or hearing thunder within 30 miles. Personnel working outdoors shall seek shelter when lightning or thunder activities are within 20 miles. Personnel shall stay away from construction equipment, such as drill rigs, cranes, boom trucks, or aerial lifts. Remain sheltered for at least 30 minutes after seeing lightning or hearing thunder. These protective actions shall remain in place until PNNL or the Contractor cancels the warning. Again, the Hanford Meteorological Station or the National Weather Service should be used to verify the storm has dissipated or moved past restricted miles. During hazardous weather forecasts, it's the contractor's responsibility to know what to expect during the day and only start those tasks that can be quickly stop and place in a safe configuration.

2.4 References

29 CFR 1910, Occupational Safety and Health Standards

29 CFR 1926, Safety and Health Regulations for Construction

WAC 296-155, Safety Standards for Construction Work

2.4.1 Exhibits

Job Safety and Health Protection poster

Right to a Safe and Healthful Workplace poster

Worker Protection for DOE Contractor Employees poster

2.4.2 Forms (Located on Contracts Page)

Competent Person Designation

Training Attendance Record

2.5 Expected Records (Located on Contracts Page)

Training Attendance Record

Competent Person Designation

3.0 Environmental Protection Plan

3.1 Purpose

This section provides requirements for environmental protection and management of project waste from construction and demolition activities in compliance with federal, state, and local environmental regulations and requirements standards. The provisions of this procedure apply to work activities associated with tasks performed by PNNL's contractors and subcontractors.

3.2 Requirements

Environmental protection and management program elements include:

- cultural and biological resource protection
- excavation
- erosion control and stormwater management
- dust control
- hazardous material storage
- waste accumulation and inspection
- waste disposal
- spill control and prevention
- liquid effluent management
- waste minimization and pollution prevention (P2) program
- equipment and waste transportation

3.2.1 Cultural and Biological Resource Protection

PNNL shall perform site reviews for State and federally protected wildlife, plant, and migratory bird species (e.g., bank swallows) prior to initiation of work activities that have the potential to disturb these species or their habitat whether native or man-made (e.g., equipment, facilities, or soil with vertical banks). In order to prevent disturbance of priority animal habitats and protected plant and animal species, the contractor shall comply with the following:

1. The PNNL Construction Manager (CM) will convey to the contractor any restrictions that are to be implemented, resulting from the biological resources review, to protect the species on the site during the initial work activities and throughout the term of the project. The contractor shall be responsible for implementation of any controls identified.

2. If any bird nest (if not a nest, a pair of birds of the same species or a single bird that will not leave the area when disturbed) are encountered, or defensive behaviors (such as flying at workers or strident vocalizations) are observed or suspected, or other wildlife are encountered in the work area (e.g., equipment,

facilities, or soil with vertical banks), workers are advised to immediately stop work and notify the PNNL CM.

3. Before disturbing native vegetation verify authorization to proceed with the PNNL CM.

PNNL shall conduct cultural/historic site reviews of construction projects that involve ground disturbance or modifications to historic facilities. A cultural/historic clearance will be issued with any conditions or limitations that must be considered during the construction activities. In order to maintain compliance:

1. The PNNL CM will convey to the contractor any restrictions, required notifications, or archaeological monitoring requirements that are to be implemented during construction.

2. The contractor will integrate notification timing into their project planning and provide notifications in a timely manner.

3. The contractor shall provide construction site access to PNNL (and potentially PNSO or Tribal) archaeological monitoring personnel, ensure these staff are briefed on the contractor JSA and comply with the contractor PPE.

3.2.2 Excavation

Excavation may include any operation in which earth, rock, or other material in the ground (below existing grade) is moved, removed, or otherwise displaced by means or use of any hand tools, mechanical equipment, or explosives. An approved excavation permit from PNNL is required prior to any excavation activities. The approval processes are necessary to prevent injury from accidental contact with utilities, to protect sensitive cultural and biological resources, and to meet U.S. Department of Energy and state law requirements.

Excavated earth (excluding stumps and wood) should be placed back into the original excavations or used as fill at the construction site. However, for work that will be conducted on or near the water, an approval from the PNNL POC is required before replacement of dredged materials. Approval from the PNNL POC is also required prior to placing excavated earth that cannot be used for fill outside the construction project area.

3.2.3 Erosion Control and Stormwater Management

Erosion controls and compliance with stormwater requirements should be in place and approved by the PNNL POC prior to any land disturbing activities. Construction activities that result in soil disturbances greater than one acre and where stormwater discharges have the potential to reach a surface water (e.g., river, lake, bay) may require coverage under the Washington State Construction Stormwater General Permit, or if the project is on the Hanford Site, the EPA Construction Stormwater General Permit.

PNNL uses best management practices as described in the Washington State Department of Ecology Stormwater Management Manual for Eastern Washington to

minimize sediment and other impacts to water quality from construction activities. Contractors shall employ the following best management practices, as applicable.

- Unless otherwise directed, construction stormwater discharges shall remain on the project site for infiltration into the ground and shall not leave the property.
- Construction vehicle access and exit shall be limited to one route if possible, and access points shall be stabilized to minimize the tracking of sediments onto roads.
- Design, construct, and cut and fill slopes in a manner that minimizes erosion through terracing, reducing slope steepness, surface roughening, or other methods. Divert runoff around slopes and disturbed areas with pipe slope drains, interceptor dikes, swales, or other devices.
- Protect all operable storm drain inlets from sediment, including catch basins connected to dry wells, infiltration trenches, and swales.
- Perform erosion inspection and sediment controls on a weekly schedule, prior to expected storm events and after each heavy rainfall event.
- Where appropriate, provide temporary or permanent modifications to surface terrain gradient (soil or crushed stone berms, sediment retention basins, etc.) in order to minimize the flow of stormwater into or out of excavated or otherwise disturbed areas.
- All erosion and sediment control measures should be maintained throughout the course of the project and removed at completion of project. Appropriate measures should be taken to return the area to its previous state. Maintenance should include, but not be limited, to the removal of accumulated sediment and repairs and/or replacement of storm damaged or otherwise deteriorated structures.
- All disturbed areas shall be temporarily or permanently stabilized as soon as practicable to minimize erosion from rain and wind. Methods of soil stabilization include mulching, using nets or plastic covers, sodding, and surface roughening.

3.2.4 Dust Control

Dust generated by construction operations needs to be minimized by water or other methods approved by the PNNL POC. PNNL-preferred best practices, consistent with the Washington State Department of Ecology (Eastern and Western Stormwater Management Manuals) are provided below.

- Stabilize, vegetate, or mulch areas that will not receive vehicle traffic through seeding, sodding, mulching, plastic covering, and applying erosion control fabrics or matting. Apply gravel or landscaping rock in areas where planting, mulching, or paving is impractical.
- Soils, stockpiles, or land-cleaning piles must be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Clear vegetation only from those areas where you will work right away.

- Apply water until surface is wet. Repeat as needed. Water applied to the construction site for dust control must not leave the site as surface runoff.
- Cover piles with wind-impervious fabric.
- Use of any chemical dust suppressant must be reviewed and approved by the PNNL POC. Follow the manufacturer's instructions and cautions regarding handling and application.

3.2.5 Hazardous Material Storage

Hazardous materials and chemical products at the project site should be managed in accordance with manufacturer instructions, safety and fire codes, and general safe practices to prevent damage, exposure to elements, and accidental discharge to the environment. This includes closing containers when not in use, using secondary containment when possible, and storing materials inside or under shelter. Materials stored outside shall be stored in a manner to prevent discharge to a stormwater management device (e.g., dry well, catch basin), to the ground or surface water.

3.2.6 Hazardous and Radiological Waste Accumulation

In the event that hazardous wastes (e.g., diesel, battery acid, or other chemical spills, etc.) are generated that would require a satellite accumulation area (SAA) or a central accumulation area to compliantly manage the cleanup material, the PNNL POC shall be notified. Other miscellaneous construction debris may be encountered during demolition that have the potential to be contaminated (e.g., radiological, beryllium, PCBs), these items will be treated as hazardous waste. The hazardous waste must be managed by PNNL under PNNL's waste generator ID registration with WA Department of Ecology.

All radiological or potentially contaminated radiological debris will be managed by PNNL. PNNL will determine containerization and packaging requirements for the debris and coordinate with the contractor through the PNNL CM.

General construction debris that is non-hazardous will be managed onsite by the contractor. All non-dangerous waste should be recycled, if possible, or sent to a PNNL-approved landfill. A copy of the landfill waste disposal record shall be provided to the PNNL POC for documentation purposes. No waste is to be disposed of on PNNL property unless authorized by Battelle in advance. Accumulate non-hazardous waste in containers, or as otherwise appropriate, to prevent nuisance, contamination, dispersal by wind or precipitation, or visual blight. Arrange for periodic collection of non-hazardous waste to prevent excessive accumulation of non-hazardous waste. See the Waste Minimization and Pollution Prevention section below for recyclable materials management.

3.2.7 Spill Control

Contractors will take measures to prevent, contain, and respond to spills of hazardous materials, hazardous waste, sewage, fuel, hydraulic oil, petroleum products, pr other substances, including the following:

- A spill kit should be available at the job site to absorb spilled materials and properly manage spill cleanup residues. At a minimum, the spill kit should contain an appropriately sized container with lid, a spill kit identification sign on the container, absorbent pads/pigs, absorbents, shovels, rags, gloves, and safety goggles.

- In the event of a spill or leak, take prompt action to stop, contain, or otherwise limit the severity of the spill and immediately report releases of any materials, such as oil, fuel, solvents, paints, coolants, acids, caustics, or equipment leaks, to the PNNL CM. Call 509-375-2400 if the PNNL CM is not immediately available. Contain spills as much as possible without compromising personnel safety.

- Do not allow liquids, such as gasoline, diesel fuel, lubricating oil, or antifreeze, to enter the sanitary, process, or storm drains, waterways, drainage ditches, or the ground. Use due caution when operating oil-bearing equipment near such features. Where necessary, implement appropriate control measures, including but not limited to, the use of physical barriers (plastic or tarps, berms, etc.), secondary containment, and/or absorbent materials to capture leaked or splattered contamination.

3.2.8 Liquid Effluent Management

Prior approval from the PNNL POC is needed for all liquid effluents or wastewater discharged to the ground, sanitary sewer, process sewer, storm sewer or surface water. Cleaning waste, demolition debris, and other wastewaters should be handled and disposed of in a manner that does not cause contamination to surface water or groundwater. PNNL-preferred best management practices for common construction wastewater are summarized below.

Concrete or Asphalt Wastewater

- Concrete truck chutes, pumps, and internals shall be washed out only into formed areas awaiting installation of concrete or asphalt.
- Unused concrete remaining in the truck or in the pump shall be returned to the originating batch plant for recycling. Concrete remaining from smaller projects shall be reused, recycled, or disposed of in a dumpster.
- Hand tools, including, but not limited to, screeds, shovels, rakes, floats, trowels, and wheelbarrows, shall be washed off only into formed areas awaiting installation of concrete or asphalt.
- Equipment that cannot be easily moved, such as concrete pavers, shall only be washed in areas that do not directly drain to natural or constructed stormwater conveyances.
- When no formed areas are available, wash water and leftover product shall be placed in a lined container. Contained concrete shall be disposed of in a manner that does not violate groundwater or surface water quality standards.
- Discharge to a storm sewer, surface water, or sanitary sewer is prohibited.

Saw-cutting and Surfacing Operation

All material generated as part of saw-cutting or surfacing operation shall be collected and disposed of at a PNNL-approved landfill. (**Note**: Saw-cutting and surfacing operations include, but are not limited to, sawing, coring, grinding, roughening, or hydro-demolition). A summary of PNNL-preferred best management practices are provided below:

- Slurry and cuttings should be vacuumed and collected during cutting and surfacing operations, when possible.
- Slurry and cuttings should not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings should not drain to any natural or constructed drainage conveyance including storm sewers, catch basins, or other underground injection control wells, trenches, or ditches.
- Process water that is generated during hydro-demolition, surface roughening, or similar operations should be collected and should not drain to any natural or constructed drainage conveyance.
- Collected slurry, cutting, or process water should be placed in a "lined holding pond" for evaporation. The dried residual material can be discarded as non-regulated construction material.

Chlorinated Water

- Chlorinated water generated during disinfection of piping systems or equipment may require de-chlorination to a concentration of 0.1 ppm or less with a reducing agent such as sodium thiosulfate. Chlorinated water shall not be discharged into storm drains or surface waters. Chlorinated water may be discharged into sewers or disposed on land for percolation after receiving approval from PNNL.

3.2.9 Waste Minimization and Pollution Prevention (P2) Program

Waste minimization and pollution prevention opportunities and requirements should be evaluated and addressed on project specifications or job planning packages on a case-by-case basis. Recyclable items should be properly collected, packaged and transported to designated locations as directed by the PNNL POC. Typical recyclable items managed on PNNL sites are:

- aluminum
- cardboard
- scrap metal
- aerosol cans
- batteries
- scrap wood

- fluorescent tubes and lamps
- printed circuit boards
- used oil
- concrete
- asphalt

Equipment and Waste Transportation

Prior to transporting operational equipment, drain, plug, and tag it with the appropriate label or tags. In the case of waste transport, use appropriate containment, such as covering open trucks with plastic or tarps. Vehicles shall have valid Department of Transportation registration, and the drivers shall have a valid commercial driver's license.

3.3 References

29 CFR 1926.59, *Hazard Communication*

40 CFR 261, *Identification and Listing of Hazardous Waste*

40 CFR 279, *Standards for the Management of Used Oil*

40 CFR 761, *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*

49 CFR 172, *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements*

49 CFR 173, *Shippers-General Requirements for Shipments and Packaging*

WAC 173-303, *Dangerous Waste Regulations*

WAC 173-226, Waste Discharge General Permit Program

Benton County Clean Air Authority, Regulation 1

16 USC 5A, *Protection and Conservation of Wildlife*

16 USC 7, *Protection of Migratory Game and Insectivorous Birds*

Stormwater Management Manual for Eastern Washington, Chapter 7 – Construction Stormwater

Stormwater Management Manual for Western Washington, Chapter 7 – Construction Stormwater

Pollution Prevention, Washington Department of Ecology, September 2004, publication number 03-10-038C.

3.3.1 Forms

None

4.0 Occupational Medicine

4.1 Purpose

The purpose of this section is to define the requirements for contractor occupational medicine and to ensure compliance with 10 CFR 851, *Worker Safety and Health Program*, OSHA, or WISHA requirements. The provisions of this procedure apply to work activities associated with tasks performed by Battelle's Contractors and Subcontractors.

4.2 Definitions

None

4.3 Requirements

Contractors will establish and provide comprehensive occupational medicine services to workers who are enrolled in a medical or exposure monitoring program required by federal, state, or local regulation.

Occupational medical service providers are required to be under the direction of a graduate of a school of medicine or osteopathy who is licensed for the practice of medicine in the state in which the site is located. Other medical service personnel who provide occupational medical services must also be licensed, registered, or certified as required by federal or state law where employed.

The Contractor is responsible for assuring that their occupational medical provider maintains medical records associated with the program in a manner meeting requirements for the confidentiality of medical records.

The following health evaluations must be conducted when determined necessary by PNNL or the occupational medicine provider:

- Medical monitoring or qualification-based medical evaluations required by regulations and standards.
- Medical examinations to evaluate an employee's injuries and/or illnesses to determine work-relatedness, medical restrictions, and referral for definitive care or rehabilitation.
- A return-to-work evaluation for work-related injury or illness or any injury- or illness-related absence of five or more consecutive workdays.

4.4 References

10 CFR 851, Worker Safety and Health Program

4.4.1 Exhibits (Located on Contracts Page)

Federal and State Medical Surveillance Requirements

4.4.2 Forms (Located on Contracts Page)

PNNL Contractor Employee Job Task Analysis Form

5.0 Industrial Hygiene

5.1 Purpose

This section defines the requirements and responsibilities for recognizing, evaluating, and controlling employee exposures to chemical, physical, and biological agents encountered during construction activities.

The Industrial Hygiene (IH) program includes the following elements (as applicable):

- hearing conservation
- hazardous materials
- sanitation
- temperature extremes
- lighting and illumination
- ventilation
- ionizing radiation
- lasers
- contractor work site dust control
- Silica

5.2 Responsibility

The Contractor shall be responsible for reviewing the worksites for compliance with this section, and for providing assistance on industrial hygiene matters.

The Contractor shall identify a competent industrial hygienist or other technically qualified person responsible to approved 'for each particular use' of any equipment and technical measures used to avoid exposure of employees to inhalation, ingestion, skin absorption, or contact with any material or substance at a concentration above selected OELs.

The Contractor shall be responsible for implementing an effective IH program that:

- Identifies, evaluates, and controls potential and existing hazards/agents in the workplace through the pre-job safety planning process.
- Determines that engineering devices, administrative controls, and personal protective equipment (PPE) are available, appropriate, tested, and utilized by employees.
- Determines employees are trained as required.
- Stops work that is not being safely performed.
- Reports occupational exposure data to affected employees.

Employees shall be responsible for:

- Complying with the provisions of this procedure.

- Using all prescribed engineering control devices and PPE.
- Reporting unsafe conditions or suspected exposures to harmful agents to their supervisor.

5.3 General Requirements

5.3.1 Identification of Health Hazards

The Contractor shall identify and document, as part of the JSA, existing and potential physical, chemical, and biological health hazards. The contractor shall protect employees from potentially hazardous exposure while you perform your exposure evaluation, using all available resources to determine adequate protective measures.

The exposure evaluations conducted by the Contractor shall:

Determine or reasonably estimate whether an employee is or could be exposed to either of the following:

a) An airborne contaminant above a permissible exposure limit (see WAC 296-841-20025; OSHA 1926.55; ACGIH® TLV™)

b) Other airborne hazards, such as biological hazards.

Note: 1. When evaluating air contaminants, keep in mind that oxygen deficient conditions may also occur due to:

a. Processes such as fermentation, decomposition of organic matter, or combustion of fossil fuels.

b. Displacement by another gas such as nitrogen or carbon dioxide.

2. Rules for specific substances may contain additional requirements for determining employee exposure.

3. Samples from a representative group of employees may be used for other employees performing the same work activities, when the duration and level of exposure are similar.

Conclude that an atmosphere is immediately dangerous to life or health (IDLH) when you cannot determine or reasonably estimate employee exposure.

Do all the following when you perform your evaluation:

a) Determine the form of the airborne contaminant, such as dust, mist, gas, or biological agent.

b) Make sure you do not use the amount of protection provided to employees by respirators as a factor in determining whether employees are exposed to an airborne hazard.

c) Make sure any air monitoring results used to determine employee exposures are based on personal air samples taken from, or representative of, the employee's breathing zone.

You may use area sampling to screen for the presence of an airborne contaminant; however, results from area sampling cannot be used if they do not adequately represent exposure of affected employees.

d) Include potential emergency and rescue situations that may occur, such as equipment or power failures, uncontrolled chemical reactions, fire, explosion, or human error.

e) Include workplace conditions such as work processes, types of material, exposure control methods, work practices, and environmental conditions.

f) Address extended work periods. For work shifts longer than eight hours, evaluate the continuous eight-hour portion of the shift expected to have the highest average exposure concentration.

Use either of the following types of documentation to conclusively demonstrate that employee exposure cannot meet or exceed any OEL for the airborne contaminant during any reasonably anticipated conditions:

a) Personal air samples that represent an employee's usual or worst-case exposure during the entire shift; or

b) Specific information about products, materials, or activities that provides for an estimate of the level of employee exposure such as safety data sheets (SDSs), observations, previous air sampling results, other measurements, calculations, or pesticide labels.

Note: You should use methods of sampling and analysis that have been validated by the laboratory performing the analysis.

ALARA

In the pre-job planning process, all exposures or potential exposures to employees shall be controlled so that levels are maintained As Low As Reasonably Achievable (ALARA). ALARA is an ongoing program that promotes high levels of employee recognition and understanding about safe practices and principles.

The Contractor will make every attempt to substitute less hazardous substances for any carcinogenic material.

Applicable OELs

The Contractor shall implement as occupational exposure limit (OEL) the American Conference of Governmental Industrial Hygienists (ACGIH®), “Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices,” (2016) when the ACGIH® Threshold Limit Values (TLVs) are lower (more protective) than

permissible exposure limits in either 29 CFR part 1926 for construction, or WAC Title 296 Chapter 841-20025, Permissible exposure limits (PELs).

When the ACGIH TLVs are used as exposure limits, contractors must nonetheless comply with the other provisions of any applicable expanded health standard found in 29 CFR part 1926 and WAC Title 296 Chapter 841.

PPE may be used in emergency situations for short-term exposures or where other methods of control have not proven feasible or available. These devices shall be used in the interim while other controls are being implemented. Gloves, splash protection coveralls, and other kinds of non-respiratory-type PPE may be routinely used.

Periodic Review

The employer shall perform periodic industrial hygiene surveys, inspections, evaluations, and surveillances of work activities. Employees shall have access to the results of these reviews.

Control of Hazardous Materials

Hazardous material exposures shall be maintained at ALARA levels wherever possible. Because of the broad definition of hazardous, a chemical shall not be used in any situation unless an individual has information indicating how the material can be used safely.

Bloodborne Pathogens

Employees who may reasonably be expected to be exposed to blood or other body fluids shall comply with OSHA/WISHA requirements relating to this subject.

First aid kits shall contain “Universal Precautions” items, including chemical splash goggles, medical gloves, cardiopulmonary resuscitation (CPR) masks (with one-way valve), antiseptic hand cleaner, drying cloths, and red bags labeled “BIOHAZARD.” (Disposal of medical waste during first aid shall be in labeled red bags and may be in the same manner as normal refuse.)

5.4 Programs

5.4.1 Hearing Conservation

5.4.1.1 Engineering Controls

Every feasible effort shall be made to “engineer out” noise exposures greater than or equal to an 8-hr time-weighted-average (TWA) sound level of 85 decibels (dBA) on the A-weighted scale. When controls are not feasible or fail to reduce noise to acceptable levels, hearing protection shall be required.

When work is to be performed in an environment that is suspected to exceed the allowable noise exposure as identified in the JSA, mandatory hearing protection requirements shall be implemented.

5.4.1.2 Noise Evaluation

The Contractor shall survey and evaluate suspected high noise areas and work efforts.

Employees may observe surveys and evaluations, and the results shall be made available to employees.

Engineering control measures will be recommended when employee exposures exceed 85 dBA as an 8-hr TWA, or over 115 dBA maximum, or if impulse noise exceeds the standard.

Maximum allowable noise exposure shall not exceed the threshold limit values shown in American Conference of Governmental Industrial Hygiene, TLVs® and BEIs®, Table 1 TLVs® for Noise.

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. Exposure to different levels for various periods of time shall be computed according to the formula set:

F(e)=(T(1)divided by L(1))+(T(2)divided by L(2))+ ... + (T(n) divided by L(n))
where:

F(e) = The equivalent noise exposure factor.
T = The period of noise exposure at any essentially constant level.
L = The duration of the permissible noise exposure at the constant level (from Table D-2).

If the value of F(e) exceeds unity (1) the exposure exceeds permissible levels.

5.4.1.3 Hearing Conservation

Employees who are routinely exposed to noise levels in excess of 85 dBA (based on an 8-hr TWA) shall be included in a hearing conservation program meeting the requirements of OSHA 29 CFR 1910.95 or WAC 296-817.

Noise exposure shall be determined without regard to hearing protection.

Audiometric testing shall be performed in accordance with OSHA/WISHA requirements. The baseline audiogram must be conducted within six months of confirmation of an exposure equal to or exceeding the 85dB action level. Audiograms shall be performed annually. Audiometric test records shall be retained by the Contractor. Employees shall be given access to and notification of testing results. Annual in-depth training on hearing conservation shall be provided. The training shall include:

- Type of hearing protector required for each specific activity/area.
- Proper method of donning and fitting hearing protectors.
- Capabilities and limitations of hearing protectors.

- Care of hearing protectors.
- Effects of noise on hearing.
- Purpose of audiometric testing procedures.
- Explanation of audiometric testing procedures.
- Employee's right of access to records.

5.4.1.4 Hearing Protectors

The selection of the proper hearing protectors shall be based on the:

- Nature of the operation.
- Period of time for which hearing protectors must be worn.
- Activities of workers in the surrounding area.
- Fit of the hearing protector device to the employee.

The Contractor, prior to the commencement of work, shall determine the proper type of hearing protection.

Hearing protectors shall be inspected by the wearer and shall be replaced if not in proper working condition.

Supervisory personnel shall periodically monitor worksites where hearing protection is required to verify that hearing protectors are being worn.

Hearing protectors must reduce the decibel level to the internal ear to a level below an 8-hr TWA of 85 dBA. This attenuation is determined as follows:

- Identify the noise level at the ear (e.g., 95 dBA).
- Subtract the noise reduction rating (NRR) for the hearing protector from the noise level (e.g., 95 dBA – 30 NRR = 65 dBA).
- Add 7 e.g., 95 dBA – 30 NRR = 65 dBA + 7 = 72 dBA to the internal ear).

High noise areas shall be posted with appropriate warning signs at all entrances.

5.4.2 Lead

The General Industry Lead Standard (OSHA 29 CFR 1910/WISHA WAC 296-62-07521) or the Construction Lead Standard (OSHA 29 CFR 1926.62/WISHA WAC 296-155-175) will apply to all lead work performed by the Contractor. The Contractor shall be responsible for compliance with all requirements within the applicable Standards. These requirements include employee training, exposure assessment and monitoring, selection and use of respiratory protective equipment, medical surveillance, and application of methods for controlling the release of lead to the environment.

5.4.3 Asbestos

It is expected that either the General Industry Asbestos Standard (OSHA 29 CFR 1910.1001/ WAC 296-62, Part I-1) standards or the Construction Asbestos Standard (OSHA 29 CFR 1926.1101 / WAC 296-62, Part I-1) standards will apply to all asbestos work performed by the Contractor. The Contractor shall be responsible for compliance with all requirements within these Standards. These requirements include employee training, exposure assessment and monitoring, selection and use of respiratory protective equipment, medical surveillance, and application of methods for controlling the release of asbestos to the environment.

5.4.4 Carcinogen Control

Occupational exposure to chemical carcinogens shall be maintained at ALARA levels. The primary objective shall be to prohibit or reduce the use of known or suspected carcinogens in the workplace.

If hazardous materials containing carcinogenic components are used, control measures outlined in this section shall be included in a detailed JSA. Whenever any employee is exposed to formaldehyde, the requirements of 29 CFR 1910.1048 shall apply.

The JSA shall identify hazardous materials that contain greater than 0.1 percent by weight or volume of components that are known or suspect human carcinogens (as defined by OSHA, the American Conference of Governmental Industrial Hygienists [ACGIH], the National Toxicology Program [NTP], or the International Agency for Research on Cancer [IARC]).

Regulated (access controlled) areas shall be established where chemical carcinogens are used. A record shall be maintained of all personnel who enter the regulated areas.

Engineering controls shall be the primary method used to minimize exposure and to prevent the release of carcinogens into the work environment.

Signs warning of the presence of chemical carcinogens shall be posted at all entrances to regulated areas.

Identified employees shall be provided appropriate notification, monitoring results, and medical surveillance as required by the mandatory OSHA/WISHA requirements for each harmful agent.

Fifty percent of the OEL shall be the “action level” (if a specific action level is not already established in applicable standards).

Carcinogens may be used only when no other practical substitute can be found.

All facilities that store or use carcinogens shall keep a current carcinogen inventory, including the following:

- Carcinogen product name
- Safety Data Sheet (SDS)

- Storage and use location
- Volume on hand
- Description of use

All employees who work with or are potentially exposed to chemical carcinogens shall be provided with documented use-specific training, including instruction on:

- Possible source of exposure, health effects
- Handling procedures
- Specific application of the chemical use
- Potential hazardous conditions
- Decontamination procedures, proper disposal
- Emergency procedures, including spills
- Medical surveillance requirements

JSA-specific training can satisfy this requirement, and documentation may be the JSA sign-in sheet, providing that adequate detail is included on the JSA.

Employees shall wash thoroughly after using or handling products containing carcinogens. Eating, drinking, smoking, chewing, and food utensil storage is prohibited in work areas where carcinogenic materials are used or stored.

The Environmental Protection Agency, under the toxics Substance Control Act (TSCA) mandates that certain chemicals be restricted or banned from use. The Contractor will stay current with these chemical substance and review products/formulations that contain this TSCA-designated. Present chemicals include methylene chloride (CAS 75-09-02), trichloroethylene (CAS 79-01-6), perchloroethylene (127-18-4), and carbon tetrachloride (56-23-5); more chemicals are expected to be added. The Contractor must present a compelling reason for the use of these chemicals and evaluate against TSCA time frame prohibition. Any approval for use will to comply with the Worker Chemical Protection Program (WCPP), monitoring, other relevant requirements outlined in the regulation and certain uses of chemicals will be prohibited with no extended time frame.

5.4.5 Sanitation

All work areas, shops and offices shall be kept clean to the extent the nature of the work allows. The floor of every workroom shall be maintained, so far as practicable, in a dry condition.

Waste receptacles that do not leak and may be thoroughly cleaned and maintained in a sanitary condition shall be used. Lunchroom receptacles shall be equipped with a solid, tight fitting cover.

All sweepings, wastes, refuse, and garbage shall be removed in a timely and sanitary manner.

Housekeeping shall be maintained on a daily basis. Cleaning and sweeping shall be done in a manner, which minimizes the contamination of the air with dust or particulate matter.

Drinking water and ice shall conform to the quality criteria established by local, state, and federal regulations.

Water facilities and containers shall be maintained, cleaned, and sanitized in accordance with applicable regulations. Use of common utensils (e.g., sharing the same cup) is prohibited.

Adequate and well-equipped toilets and wash stations (including eyewash stations and showers, where required) must be readily accessible to all employees. Those facilities shall be maintained in a sanitary manner at all times, and include soap, towels, and waste receptacles.

The Environmental Protection Agency, under the Toxics Substance Control Act (TSCA) mandates that certain chemicals be restricted or banned from use. The Contractor will stay current with these chemical substances and review products/formulations that contain this TSCA-designated. Present chemicals include methylene chloride (CAS 75-09-2), trichloroethylene (CAS 79-01-6), perchloroethylene (127-18-4), and carbon tetrachloride (56-23-5); more chemicals are expected to be added. The Contractor must present a compelling reason for the use of these chemicals and evaluate against TSCA time frame prohibition. Any approval for use will need to comply with the Worker Chemical Protection Program (WCPP), monitoring, other relevant requirements outlined in the regulation and certain uses of chemicals will be prohibited with no extended time frame.

5.4.6 Temperature Extremes

This section describes the recommendations relating to heat stress and cold stress.

5.4.6.1 Heat Stress

Heat stress monitoring shall be measured by the ambient temperature and relative humidity or Wet Bulb Globe Temperatures (WBGT) index method when outdoor ambient or indoor work area temperatures exceed 85º F. The Hanford Meteorological Station (373-2716) provides WBGT readings during daylight hours.

The American Conference of Industrial Hygienists (ACGIH) TLV guidelines shall be followed for developing and implementing heat stress mitigation strategies.

The use of heat stress controls shall be addressed during the planning stages for all work that is to be performed in elevated temperature environments. Engineering

controls, work time limits, work rates, and use of body cooling devices should be described in the JSA.

5.4.6.2 Working Conditions

Adequate amounts of cool drinking water (50º F to 60º F) shall be at each worksite in coolers designated only for drinking water purposes. When ambient temperatures exceed 89º F, mandatory cool down rest periods of 10 minutes every two hours shall be taken. Water breaks should be taken frequently during the day to replenish water lost from perspiration.

Symptoms, such as hot, dry skin, extremely high body temperature, rapid pulse, unconsciousness, or lack of perspiration, suggest heat stroke and constitute a medical emergency.

Solar shielding may be provided (if possible) when workers are exposed to direct sunlight throughout the workday when the temperature exceeds 100º F.

5.4.6.3 Cold Stress

The ACGIH Cold TLV is the prescribed standard for cold exposure. The Cold TLV requires that the air temperature, wind speed, and equivalent wind chill temperature be measured, calculated, and recorded at least every four hours when employees are exposed to temperatures below 30º F.

When work involves continuous employee exposure to an equivalent chill temperature (ECT) below 10º F, the following safe work practices shall be observed:

- Work is conducted using the “buddy system.”
- Workers are instructed on symptoms of frostbite and hypothermia, and appropriate preventive and first aid measures.
- Heated, warming shelters are conveniently available.

Non-emergency work is curtailed when the ECT in the work area is below -25º F.

Workers who experience symptoms of cold exposure, such as hypothermia, are immediately moved to a warm area, and then examined by a physician as a follow-up measure.

5.4.7 Lighting and Illumination

General construction areas including active storage areas, loading platforms and field maintenance areas shall be lighted to a minimum of 3 foot-candles.

The minimum level of task lighting in indoor construction workplaces shall be an average of 5 foot-candles measured 30 in. above the floor.

General illumination for outdoor construction work areas shall be a minimum of 5 foot-candles. Auxiliary lighting shall be used when needed.

First aid stations and offices shall be lighted to a minimum of 30 foot-candles.

5.4.8 Ventilation

Local exhaust ventilation is a primary engineering control and is required to reduce concentrations of hazardous, irritating, and odoriferous air contaminants below allowable exposure limits (where feasible). The operability of such systems shall be evaluated prior to the start of the work.

5.4.9 Lasers

Only qualified and trained employees shall be assigned to install, adjust, and operate laser equipment. Use of non-construction laser equipment may require a laser use permit.

Proof of qualification of the laser equipment operator shall be in possession of the operator at all times.

Employees, when working in areas in which a potentially hazardous exposure to direct or reflected laser radiation exists, shall be provided with anti-laser eye protection devices.

Areas in which Class II and Class IIIa lasers are used shall be posted with standard laser warning placards.

Beam shutters or caps shall be used, or the laser turned off, when laser transmission is not actually required. When the laser is left unattended for a substantial period of time, such as during lunch hour, overnight, or at a change of shifts, the laser shall be turned off.

Only mechanical or electronic means shall be used as a detector for guiding the internal alignment of the laser.

The laser beam shall not be directed at employees.

When it is raining or snowing, or when there is dust or fog in the air, and it is impracticable to cease laser system operation, employees shall be kept out of range of the area of source and target during such weather conditions.

Laser equipment shall bear a conspicuously displayed label to indicate hazard classification. This label shall be prepared in accordance with 21 CFR 1040.10.

Only Class I, II, or IIIa laser equipment shall be used. Class IIIb and IV laser equipment shall not be used without the express written permission of the PNNL Laser Safety Officer.

Laser units shall be set up for operation above the heads of employees, when possible.

5.4.10 Contractor Work Site Dust Control

All contractor projects shall address dust control during pre-job planning.

Areas to be cleared for construction shall be limited to keep dust generation to a minimum.

Construction of permanent roadways and parking areas shall be scheduled during the early stages of a project.

During construction, frequent watering shall be provided to roadways and disturbed areas that are not otherwise treated. Sufficient equipment shall be kept at the jobsite to control dust whenever a nuisance or hazard occurs.

5.4.11 Safety Showers and Eyewash Apparatus

Eyewash/shower apparatus shall be provided where there is significant potential for personnel exposure to injurious materials (e.g., corrosives, skin sensitizes, etc.)

Employees who may have a need for an eyewash/shower apparatus shall know where the nearest eyewash/shower apparatus is located and how to operate it.

Employees involved in work that presents potential exposure shall test the closest eyewash/shower apparatus prior to the start of the job.

Eyewash/shower apparatus shall be functionally tested monthly to flush the line and to verify proper operation. A record shall be maintained to verify testing.

The potable water provided for a portable eyewash/shower apparatus shall be flushed or changed according to manufacturer's specifications.

An eyewash/shower apparatus shall be located such that it would require no more than 10 seconds to reach from the hazard.

Access shall be free of any impediments.

5.4.12 Welding Hazards

Contractors shall evaluate welding fumes and identify control measures using the JSA process outlined in section 8.4. Welding fumes need to be assessed by type of metal along with a number of variables when determining control measures such as: weld type, welder setting, base and core/electrode metal, flux coating, work rate, body positioning, location, which all affect the fume generation and ability of fumes to enter the worker's breathing zone.

JSA's must include an explanation of these variables and control techniques to manage fume generation. Smoke eaters, Ultraviolet (UV) screens, and work area delineation are all common control measures.

Special emphasis on welding fume constituents, such as manganese, chromium, nickel, cadmium, due to either extremely low exposures limits and recent declaration as carcinogenic and must be a point of emphasis when evaluating welding tasks. Various metals have independent standard that govern their use, for instance hexavalent chromium/nickel associated with stainless steel, manganese/iron oxide with mild steel, and zinc oxide fumes with galvanized steel. Other considerations associated with welding include hot work permitting, UV, noise, gases, (ozone, NOx, CO) and material coatings. Coatings shall be removed 4 inches on all sides of weld location.

The contractor shall be provided with a PNNL hot work permit detailing work requirements which may include fire retardant (FR) clothing, fire watch requirements, designated hot work areas, combustible protection, and special conditions.

Welding related exposures are tied to many variables, PNNL requires contractors to provided details of each welding task and when requested provide objective exposure data to backup exposure assessments.

5.5 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

WAC 296-841, *Airborne Contaminants*

5.5.1 Forms

None

6.0 Personal Protective Equipment

6.1 Purpose

The purpose of this procedure is to establish the responsibilities and requirements for PNNL Contractor use of Personal Protective Equipment (PPE) so as to comply with OSHA and WISHA standards.

6.2 Definitions

ANSI — American National Standards Institute. An organization that writes consensus standards that incorporate input from a diverse group of subject matter experts.

PPE — Personal Protective Equipment is clothing or equipment that is intended to protect the worker's body (including eyes, face, feet, hands, head, and hearing) from hazards capable of causing injury, illness, or impairment of any bodily function.

6.3 Requirements

6.3.1 Responsibility

The contractor shall:

- Perform an assessment identifying hazards or potential hazards and determine necessary PPE for activities to be performed.
- Adhere to prescribed PNNL postings and/or PNNL pre-job planning documentation requiring use of PPE.
- Provide adequate PPE for all its employees.
- Properly maintain, use, and store PPE.
- Remove damaged and/or defective equipment from service.

6.3.2 General Requirements

The selection, use, and design of PPE shall comply with the following statutory requirements:

- 29 Code of Federal Regulations (CFR) 1926, Subpart E; *Personal Protective and Life Saving Equipment*
- 29 Code of Federal Regulations (CFR) 1926, Subpart I; *Personal Protective Equipment*
- 10 Code of Federal Regulations (CFR) 835, *Occupational Radiation Protection*
- Washington Administrative Code (WAC) 296-800-160, *Personal Protective Equipment*
- Applicable American Standards Institute (ANSI) Standards

PPE is not a substitute for engineering and administrative controls. These controls shall be implemented, to the extent feasible, to mitigate the hazard so that the need for PPE is reduced or eliminated. Contractors shall provide PPE to its employees in accordance with OSHA/WISHA requirements. PPE will be specified in hazard assessment documentation (as appropriate) based on the activity and associated hazards. Examples of applicable hazard assessment documentation include:

- Job Safety Analysis
- Fall Protection Work Plan (FPWP)
- Confined Space Permit
- Welding, Cutting and Heating Permit
- Electrical Energized Work Permit
- Electrical Work Permit
- Blind Penetration Permit
- Biological Work Permit
- Chemical Process Permit
- Radiological Work Permit

6.3.3 Procedure

Contractors shall provide training to each employee who is required to use PPE. Each affected employee must show understanding of training to their specific PPE. Retraining may be necessary if work activities change or the employee exhibits lack of understanding of the PPE.

6.3.3.1 Foot Protection

Occupations in which there is a danger of foot injuries due to falling and rolling objects, or objects piercing the sole, and/or where feet are exposed to thermal burns from open flames, welding, cutting or grinding, and electrical, employees shall wear protective footwear which comply with American Society for Testing and Materials (ASTM) F2413-05 Standard Requirements for Protective Footwear.

Substantial footwear made of leather or equally firm material shall be worn by all employees within construction areas or laboratory areas where chemical spills may occur. Open-toed sandals, slippers, or other similar shoes shall not be worn. Exceptions may be approved for special or unique situations.

6.3.3.2 Hand Protection

All personnel shall wear, at a minimum, ANSI cut 3 gloves while on construction sites, unless otherwise approved by WS&H. See table 6.1 and 6.2 for examples of acceptable gloves. Employees exposed to specific hazards that could injure their hands shall use appropriate hand protection. Table 6.1 will give guidance on what gloves to use when working with chemicals. Table 6.2 will give guidance on which ANSI cut level glove is appropriate for specific cut hazards. These tables are not

intended to be all inclusive. If you have questions, contact your WS&H professional for guidance. Other examples of these hazards include:

- Severe cuts, lacerations, or abrasions higher ANSI cut level (see Table 6.2)
- Punctures (see Table 6.2)
- Absorbing harmful substances (see Table 6.1).
- Chemical burns and/or thermal burns. (see Table 6.1)
- Harmful temperature extremes. (see Table 6.2)

Employees shall additionally choose hand protection that performs relative to the:

- Task
- Conditions present
- Duration of use
- Potential hazards

Table 6.1. Suggested Gloves When Working With Chemicals

Chemical Hazard	Butyl	Neoprene	Nitrile	Polyvinyl-chloride	Polyvinyl-alcohol	Latex	Poly-ethylene	Vitan
Acids, dilute	X	X	X	X		X		X
Alcohol	X	X	X	X		X	X	X
Alkali bases, dilute	X	X	X	X		X		X
Aromatics					X			X
Chlorinated hydrocarbons	X		X		X			X
Expoxy resins	X	X	X	X				X
Esters	X							
Hydrocarbons	X	X	X		X			X
Ketones	X							
Lacquer thinners	X	X	X		X			X
Oils, grease	X	X	X	X	X			X
Petroleum distillates	X	X	X		X		X	X
PCBs								X

X indicates appropriate for use.
"Blank" indicates not appropriate for use.

Note: Very little data are available for protection against mixtures of chemicals. One permeating chemical may pull another with it through the material much faster than expected. PPE materials with the broadest range of chemical resistance test results should be used when chemical mixtures are involved.

Table 6.2. Suggested Gloves When Working with Sharp Objects/Material

	Majestic Cut-Less: **ANSI Cut Level A3** Majestic 37-3435 **3** (1000) | **A3** Light/medium cut hazards (1000 | ANSI CUT LEVEL A3 | Material handling, small parts assembly (sharp edges), packaging, warehouse, general purpose, forestry, construction, pulp ad paper, automotive assembly
	Majestic Cut Less Watchdog: **ANSI Cut Level 4** Majestic 35-1500 **4** (1500) | **A4** Medium cut hazards (1500) | ANSI CUT LEVEL A4 | Appliance manufacturing, bottle and light glass handling, canning, drywall work, electrical, carpet installation, HVAC, pulp ad paper, automotive assembly, metal fabrication and handling, packaging, warehouse, aerospace industry, food prep/ processing
	Majestic Cut-less: **ANSI Cut Level A4** Goat skin Resistant to oil and water. Arc resistant to 36 cal/cm^2 Majestic 81-155WRK **4** (1500) | **A4** Medium cut hazards (1500) | ANSI CUT LEVEL A4 | Appliance manufacturing, bottle and light glass handling, canning, drywall work, electrical, carpet installation, HVAC, pulp ad paper, automotive assembly, metal fabrication and handling, packaging, warehouse, aerospace industry, food prep/ processing
	Superior Glove – Emerald: **ANSI Cut Level A5** CX Winter Glove **5** (3500) | **A5** Medium/heavy cut hazards (2200) | ANSI CUT LEVEL A5 | Appliance manufacturing, bottle and light glass handling, canning, drywall work, electrical, carpet installation, HVAC, pulp ad paper, automotive assembly, metal fabrication and handling, packaging, warehouse, aerospace industry, food prep/ processing
	Superior Glove – Endura: **ANSI Cut Level A4** Winter Glove **4** (1500) | **A4** Medium cut hazards (1500) | ANSI CUT LEVEL A4 | Appliance manufacturing, bottle and light glass handling, canning, drywall work, electrical, carpet installation, HVAC, pulp ad paper, automotive assembly, metal fabrication and handling, packaging, warehouse, aerospace industry, food prep/ processing
	Magid Cut Master: **ANSI Cut Level A4** Goatskin Leather TIG Welding Glove Item #547HG Used for welding activities. **4** (1500) | **A4** Medium cut hazards (1500) | ANSI CUT LEVEL A4 | Appliance manufacturing, bottle and light glass handling, canning, drywall work, electrical, carpet installation, HVAC, pulp ad paper, automotive assembly, metal fabrication and handling, packaging, warehouse, aerospace industry, food prep/ processing
	Superior Glove Endura Leather Gloves: **ANSI Cut Level A3** **3** (1000) | **A3** Light/medium cut hazards (1000 | ANSI CUT LEVEL A3 | Material handling, small parts assembly (sharp edges), packaging, warehouse, general purpose, forestry, construction, pulp ad paper, automotive assembly

6.3.3.3 Respiratory Protection

Contractors will provide respiratory protection equipment when required by pre-job planning documentation. A written respiratory protection program shall be required in accordance with OSHA 1910.134, Respiratory Protection and/or WISHA 296-842, Respirators, as applicable. Further details regarding respiratory protection are in Section 7 below.

6.3.3.4 Head Protection

Type-2 safety helmets meeting the requirements of ANSI Z89.1 shall be worn by personnel performing work activities when head protection requirements are identified in pre-job planning documentation (JSA's). The Chin strap must be secured and snug (e.g., no more than 2 fingers fit between your chin and strap.

Before using a safety helmet, perform the following inspections:

- Suspension system for firm fit of mounting points.
- Shell for cracks, dents, signs of wear and damage.
- Excessive dirt, grease, and/or chemicals.
- Safety helmets that are defective shall be removed from service.

Note: Visitors may wear type 1 hard hats/safety helmets when visiting construction areas.

6.3.3.5 Eye and Face Protection

Employees exposed to hazards that could injure their eyes and/or face must use appropriate protective equipment. Examples of these hazards include:

- flying particles
- molten metal
- liquid chemicals
- acids or caustic liquids
- chemical gases or vapors
- any light that could injure the eyes such as lasers, ultraviolet, or infrared light
- objects that puncture

Employees exposed to hazards from flying objects must use eye protection with side protection.

Additional eye and face protection (goggles, face shields, etc.) may be required for certain work activities, such as grinding, flying particles, handling chemicals, etc.

Safety glasses (or other appropriate safety eye protection) shall be worn under face shields and welding hoods/helmets.

Eye protection for employees who wear prescription lenses must:

- Incorporate the prescription into the design of the eye protection, **or**

- Be large enough to be worn over the prescription lenses without disturbing them.

PPE used to protect the eyes and face must meet the applicable ANSI (American National Standards Institute) standard. Most commercially available PPE is marked as meeting ANSI standard Z87.1-1989 requirements.

All personnel working in, visiting, or passing through construction areas and other locations where safety glass requirements are posted or indicated in the pre-job planning documentation shall wear safety glasses meeting the requirements of ANSI Z87.1.

6.3.3.6 Hearing Protection

The contractor will take steps to eliminate and minimize high levels of noise. When it is not feasible to reduce noise levels to less than 85 dBA, hearing protection shall be furnished and worn (see Table 6.3).

Two main types of hearing protection devices are used to protect workers' hearing from noise in the workplace: 1) earplugs that are inserted into the ear canal and 2) earmuffs that are worn over the head to cover the outer ear. The ability of the hearing protection device to attenuate noise is expressed as a Noise Reduction Rating (NRR). The higher the NRR, the more protection the device provides. The following table lists suggested hearing protection to be used for work activities that involve physical hazards. If you have any questions about the appropriate type of hearing protection required for your work activity, contact your supervisor or a PNNL WS&H Professional.

Due to the dynamic nature of construction sites and the need to communicate, the use of headphones or ear buds are not allowed. Noise canceling devices cannot be substituted for hearing protection.

Table 6.3. Suggested Types of Hearing Protection

Hazard Category	Product	
	Minimum Exposure	More Severe Exposure
Physical - Noise Select hearing protection with an NRR adequate to reduce the wearer's exposure to below the 85-dB level	Earmuffs (use when frequent removal and replacement of hearing protection is necessary) Earplugs (fit into and seal the ear canal; generally considered "disposable") Ear caps (small, soft pods, pads, or flexible tips that seal at or near the entrances of the ear canal with a minimal degree of insertion)	Earplugs and earmuffs

6.3.3.7 Working Over or Adjacent to Water

When an employee is employed under conditions which expose them to a risk of drowning, they must wear a U.S. Coast Guard approved lifesaving device, unless it can be shown that conditions, such as shallow water near cooling ponds, are such that flotation would not be achieved. Where 100% fall protection can be achieved on walking/working surfaces above water, i.e., the drowning hazard has been eliminated, employees do not need to wear U.S. Coast Guard-approved life jackets or buoyant work vests.

At least one lifesaving skiff must be immediately available when feasible at locations where employees are working over or adjacent to water.

Buoyant life saving devices must be inspected before and after each use. Ring buoys with at least 90 feet of line must be provided and readily available for emergency rescue. Distance between ring buoys must not exceed 200 feet.

6.4 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1910.134, *Respiratory Protection*

29 CFR 1926, *Safety and Health Regulations for Construction*

29 CFR 1926, Subpart E; *Personal Protective and Life Saving Equipment*

29 CFR 1926, Subpart I; *Personal Protective Equipment*

10 Code of Federal Regulations (CFR) 835, *Occupational Radiation Protection*

ANSI Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*

ANSI Z89.1, *Protective Headwear for Industrial Workers*

ASTM F2413-05 *Standard Requirements for Protective Footwear*

WAC 296-155, *Safety Standards for Construction Work*

WAC 296-155, Part C; *Personal Protective and Life Saving Equipment*

6.4.1 Forms

None

7.0 Respiratory Protection

7.1 Purpose

This section identifies a key aspect of the Industrial Hygiene (IH) program, and establishes the requirements and practices for the purchase, issue, control, and use of respirators.

7.2 Responsibility

The Contractor is responsible for a program that includes the following elements:

- assigned protection factors
- program administration
- medical examination
- training
- fit testing
- exposure assessment
- selection of respirators
- respirator issue, control, and use
- cleaning, maintenance, and storage
- emergency/IDLH (immediately dangerous to life and health) use
- compressor use
- voluntary respiratory use

7.3 Application

This section applies to all work activities and personnel under the control of the Contractor and its Subcontractors.

7.4 General Requirements

Respiratory protection will be used only in those instances when engineering or administrative controls are ineffective, impractical, or are in the process of being installed. Employees will be medically cleared, fit tested, and trained prior to using respiratory protection equipment.

7.4.1 Assigned Protection Factors

Differences in assigned protection factors for respirators exist between the various standards and guidelines. To resolve differences in protection factors, this program establishes WAC 296-842 as the overall basis for assigned protection factors for both radiological and chemical hazards. In addition, in situations involving hazards for

which substance-specific standards apply (such as asbestos and lead), the protection factors listed in the applicable substance-specific WISHA standard will be used.

When radiological and non-radiological hazards exist that require respiratory protection, project safety and supervision will collaborate on selecting the appropriate respiratory protection that will provide protection against the combined hazards.

7.4.2 Program Administration

The Contractor's program administrator will serve as the initial point of contact for program administration and issue resolution on projects.

As necessary (for work demanding respiratory protection), the Contractor will appoint a suitably trained respiratory protection program administrator who will perform the following:

- oversee the implementation of practice requirements
- provide problem resolution
- conduct required evaluations of program effectiveness

7.4.3 Medical Examination

The Contractor shall:

- Verify that employees receive an initial medical evaluation or examination prior to wearing a respirator, reviewed by a physician or other licensed health care professional (PLHCP). A WISHA-approved questionnaire may be used for the evaluation.
- For each employee who may wear a respirator, the PLHCP will provide a written recommendation regarding the employee's ability to use a respirator.

Note: A medical clearance is acceptable for all types of respirators unless a specific medical limitation has been designated.

- Provide additional medical evaluations if:

  The employee reports medical signs or symptoms related to the ability to use a respirator, or

  A change occurs in workplace conditions

7.4.4 Training

The Contractor shall:

- Enroll employees into initial respirator training courses as follows:

  employees who may wear respirators

  employees who issue respirators

  employees who supervise respirator wearers

- Enroll the employee into annual refresher training (assuming that the employee has a continued need to issue or wear a respirator or to supervise respirator wearers).
- Document training and maintain records. (Subcontractors and Sub-tier Contractors maintain records on-site.)

7.4.5 Fit Testing

Use only WISHA-accepted fit-test protocols when fit-testing for respirators.

Prior to the use of respirators in a hazardous atmosphere, respirator wearers will receive a fit test annually for each style and type of respirator that will be used. If an employee needs to wear a respirator they have not been fit tested for, arrange for additional fit testing through the fit test station prior to use of the respirator.

Do not allow any worker to obtain a fit test who has facial hair that interferes with proper respirator fit.

Respirator wearers will shave the morning of the fit test and maintain facial hair in a manner that does not interfere with respirator fit.

7.4.6 Exposure Assessment

The Contractor shall:

- Plan and implement a qualitative and quantitative exposure assessment for the purpose of identifying and quantifying airborne contaminants to determine and validate the level of respiratory protection.
- Qualitatively estimate and, as appropriate, quantitatively measure the airborne concentrations of chemical or particulate contaminants, before selecting a respiratory protection device.
- Consider using qualitative hazard analyses, hazard surveys, historical data, objective data, or quantitative source/area/personal monitoring to document the basis for selecting respiratory protection.
- When respirators are specified for a type of activity, validate their adequacy by initial and periodic personal/area monitoring, as appropriate.
- If historical data are not available and monitoring is not performed, the decision logic used to select the respiratory protection will be documented on the JSA.
- Use JSAs, qualitative exposure assessments, work permits, work packages, site-specific safety and health plans, or other appropriate systems to document hazards, specify respiratory protection, and establish job-based exposure monitoring to be conducted.

7.4.7 Respirator Issue, Control, and Use

As necessary, the Contractor shall:

- Establish a controlled distribution point for the proper storage, issue, and return of respiratory protection equipment for the project.
- Designate a project respirator issuer to control the custody and integrity of respirators.
- Inform the respirator issuer of the types and quantities of respiratory protection equipment required for the project.
- In special circumstances where modified issue and control measures are required to accommodate unusual situations, develop supplemental procedures for issue and control.
- Verify that work permits, work packages, or other work control documents clearly identify the types of respiratory protection equipment to be used for worksites and activities, and that respirator issuers have full and convenient access to these documents.
- Verify that respirator wearers have current medical clearance, training, and fit testing appropriate for the types and styles of respirators to be issued for the project.

7.4.8 Cleaning, Maintenance, and Storage

Respirator users will be provided respirators which are clean, sanitary, and in good working order. Cleaning and disinfection of respirators will be conducted according to WISHA standards.

Respirators and associated respiratory protection equipment will be stored in a controlled distribution area. Equipment will be stored in a manner that will protect it against physical and chemical agents such as sunlight, heat, cold, extreme cold, excessive moisture, or damaging chemicals. Equipment will be stored in a manner to prevent distortion of the face piece or elastomeric parts.

7.5 Voluntary Respiratory Use Policy

Employees may wish to use respiratory protection equipment for their own comfort or sense of well-being, even when there is no recognized hazard or over exposure based on the project exposure assessment process. In these cases, not all of the occupational safety requirements apply (i.e., fit testing is not required). In order to voluntarily use respiratory protective equipment in this way, the following criteria must be met:

- There is no recognized hazard or potential for over exposure
- The respiratory equipment must be NIOSH certified
- The respirator must be cleaned, stored and maintained as specified in the cleaning, maintenance, and storage section above.
- The respiratory equipment does not itself present a hazard to the user.
- The employee is medically cleared to use a respirator (Exception: filtering face pieces do not require a medical clearance for voluntary use)
- The employee is given a copy of Appendix D to Sec. 1910.134 (Mandatory) Information for Employees Using Respirators When Not Required Under the Standard

Note: Voluntary respirator users must seek a medical clearance from their occupational medical provider.

7.5.1 Information for Employees Voluntarily Using Respirators

- Read any and all instruction provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirator's limitations.
- Choose respirators certified for use to protect against the contaminant of concern. The National Institute for Occupational Safety and Health (NIOSH) certifies respirators. If a respirator isn't certified by NIOSH, there is no guarantee that it meets minimum design and performance standards for workplace use.
- Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes, smoke, or oxygen deficiency.
- Keep track of your respirator so that you do not mistakenly use someone else's respirator.

7.6 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

7.7 Expected Records (Located on Contracts Page)

Document	Record Submittal Responsibility	Record Retention Responsibility
Respirator Training Certificate (or similar)	Contractor	Contractor
Fit-Test Card	Contractor	Contractor
Respirator Medical Examination	Contractor	Contractor

8.0 Pre-job Planning

8.1 Purpose

This section provides requirements for establishing a method for identifying, controlling, and documenting hazards associated with contractor work activities and communicating this information to all affected workers in compliance with OSHA and WISHA, and applicable environmental and radiological codes and standards. The provisions of this procedure apply to work activities associated with tasks performed by PNNL Subcontractors.

8.2 Definitions

Graded Approach:
A methodology incorporated into the work planning and control process that determines the rigor for implementing these work planning and control attributes based on the importance/significance and associated consequences of the activity.

Job Safety Analysis (JSA):
The written articulation of controls by the contractor who is responsible for identifying and implementing specified hazard controls prior to performing work. Review of the contractor's safety documentation is conducted to verify that the contractor's safety management system conforms to the Contract requirements.

The expectations associated with the completion and content of these plans and checklists set the basis for the interviews and document reviews conducted as part of this assignment.

Acquisition Hazard Assessment (AHA):
A broad hazard-screening tool that includes a review of the work that will be performed and identifies the hazards associated with the work and the work location. The results of the AHA are used to determine the need for additional, more detailed hazard assessment, serve as a precursor documenting that further controls (i.e., training, permits, or assessment) are deemed necessary, and serve as a baseline hazard assessment where further analysis is not indicated.

8.3 General Requirements

The Contractor is responsible for understanding the scope of work in sufficient detail to plan work, identify hazards associated with the work, and develop necessary schedules, priorities, and work instructions.

Work activities need to be understood to a level of detail in order to ensure acceptable results given the complexity of the work, the significance of the work, the hazards associated with the work, and worker knowledge and experience. The quality of work-planning activities must be sufficient in order to ensure safe and reliable performance of work. Work-planning procedures should provide clear guidance on how to apply the graded approach in a manner that ensures thorough planning and worker safety, but allows appropriate flexibility to accomplish work without imposing overly conservative or unnecessary restrictions, costs, or burdens.

The Contractor shall inform non-PNNL staff of the hazards and prescribed safety measures that must be in place prior to the performance of their duties.

The Contractor is prohibited from performing on-site work without authorization from the Battelle Contract Representative.

8.4 Hazard Assessment and Control Process

This section applies to all Contractor activities performed at PNNL locations.

8.4.1 Hazard Recognition and Control Process

Prior to the initiation of any on-site work, the Contractor will collaborate with PNNL staff to ensure facility requirements are discussed and addressed or an Acquisition Hazard Assessment (AHA) form is by the Battelle Technical Oversight Administrator (TOR). An acceptable equivalent document must be approved by the Battelle TOR and Construction Safety Specialist as specified in the Statement of Work (SOW). The equivalent document must contain the following information:

- Summarizing the job scope.
- Providing a description of each activity or phase.
- Identifying potential hazards associated with the activities being performed.
- Specifying safety measures applied to eliminate or control the hazard.
- Designating appropriate protective devices and/or equipment.
- Selecting a mechanism to evaluate the adequacy of those controls.

All non-staff and PNNL staff involved in the work shall review the JSA documentation or AHA prior to starting work. If the work scope, site conditions, or hazards change the contractor shall revise the JSA in accordance with section 8.4.2 to capture the additional hazards if applicable. All affected non-staff and PNNL staff involved in the work being performed shall review the revised JSA prior to continuing work.

8.4.2 Job Safety Analysis Process

All construction activities performed at PNNL require a JSA. The JSA shall be completed by each contractor and/or subcontractor for their anticipated work tasks. The Contractor's JSA will include the following information:

- job scope and description of activities
- listing of each activity or phase
- hazards associated with the activities being performed
- specific safety measures applied to eliminate or control the hazard
- appropriate protective devices and/or equipment specifically designated
- special facility requirements (i.e., Radiological Process Laboratory fuel restrictions)

Contractor JSAs must be developed in sufficient detail to preclude confusion and misunderstanding. Consideration will be given to hazards related to human factors,

fatigue, heat/cold stress, restricted work space, restrictive personnel protective equipment (PPE), elevated work, body positions, and repetitive motion.

The contractor shall submit their JSA to the PNNL Construction Safety Specialist for review and concurrence in accordance with the contract.

A walk-down of the actual construction site will be done before start of work with PNNL staff. The JSA will be developed using the known or potential hazards list identified on the JSA form along with, site conditions, facility hazards (beryllium, asbestos, lead, magnet fields, IOPS, facility restrictions, etc.). Required training and permits must be completed for the items on the known or potential hazards list identified on the JSA form.

All contractor employees and PNNL staff involved in the work shall be initially orientated to the project work scope and JSA using the Subcontractor Daily Pre-job Safety Briefing and Supervisor Safety Inspection Checklist Form. The contractor shall conduct a plan of the day meeting (POD) given daily to all affected personnel before starting work. The POD shall cover the day's activities along with the associated hazards, coordination between subcontractors, special weather advisories, work scope changes, and unique activities for the day (i.e., crane lifts, EWPs, confined space, excavation, fall protection, hot work, roof access). The subcontractor daily pre-job briefing shall be completed by the Key Supervisor to document the POD hazards discussed with affected personnel. Use the Pre-Job Safety Planning Sign-off sheet to document POD.

The original JSA shall be reviewed, revised, and re-approved if the work scope, site conditions, or hazards change. Contractors must be mindful of red line drawing changes that could impact work scope and create additional unplanned hazards. Field changes to the JSA (i.e., red line, pen/ink changes) are acceptable. All affected contractor, subcontractor, and PNNL staff involved in the work scope must be briefed to the work scope change, hazards, mitigations, and sign-off on the updated JSA.

The Contractor JSA shall be placed in a yellow box and conspicuously located on the jobsite and made available to all PNNL, non-staff and visitors.

8.5 PNNL Crafts Utility Disconnect Verification

Prior to moving equipment (i.e., research equipment, fume hoods and gloveboxes) other than cord and plug equipment, the PNNL CM, CSR and contractor supervisor shall perform a walkdown to understand and ensure all utilities have been disconnected. If equipment has been disconnected by PNNL craft, a notice sign as defined in ADM-064 shall be utilized to communicate the status of equipment disconnects. Perform a walkdown with PNNL CM, CSR, BE, and research POC for authorization to remove AW and/or CO locks and tags when used to control hazardous energy sources (i.e., electrical, pressure, chemical, hydraulic, temperature, and motion) during final installation. Research equipment such as radiological, fume hoods, gloveboxes, or other items that have used or retained chemicals shall be cleaned and released by the responsible research organization prior to moving. Non-vented fume hoods and gloveboxes which stored chemicals must be vented to ensure vapors have been removed. Contact PNNL Construction Safety Professional for direction. Fume hoods moved into storage for future utilization shall be labeled with the date it was cleaned to communicate clean status for future installation.

8.6 References

10 CFR 835, Occupational Radiation Protection

29 CFR 1910, Occupational Safety and Health Standards

29 CFR 1926, Safety and Health Regulations for Construction

WAC 296-24, General Industry Safety Standards

WAC 296-155, Safety Standards for Construction Work

8.6.1 Forms (Located in Vault and Contracts Page)

Job Safety Analysis

WSH-MA-001, Subcontractor Daily Pre-Job Safety Briefing and Supervisor Safety Inspection Checklist

Pre-job Safety Planning Signoff

8.7 Expected Records (Located on Contracts Page)

Job Safety Analysis

WSH-MA-001-Form-01, Subcontractor Daily Pre-Job Safety Briefing and Supervisor Safety Inspection Checklist

WSH-MA-001-Form-08, Pre-job Safety Planning Signoff Form

9.0 Safety Orientations

9.1 Purpose

This section defines the requirements, responsibilities, and system for orienting Contractor employees to the safety plan and CESH Manual, and to instruct employees on job-specific requirements.

Note: Contractors may submit their own new hire orientation form for PNNL approval.

9.2 Responsibility

Contractor is responsible for:

- Orienting their employees and subcontractor employees to this Manual (or their own when deemed acceptable by PNNL) and completing the Orientation Checklist.
- Prior to individual employees beginning work activities.

Note: Escorted personnel, including vendors, engineers and infrequent visitors, can be exempt from orientation provided they are escorted and kept out of hazardous areas.

- Verifying that each employee and lower-tier employee has reviewed the applicable/required procedures and signed the Orientation Record.
- Verifying that employees have the required training to perform their designated task.
- The checklist and signature sheet being available at the jobsite.
- Employees being responsible for understanding and complying with the safety plan and job-specific requirements.

9.3 General Requirements

Employees shall be oriented as identified on the Orientation Checklist and to procedures the Contractor identifies that are applicable to the project. These procedures must be checked on the Orientation Checklist.

Topics to be covered during the orientation (as a minimum) include:

- Employer rights and responsibilities.
- Disciplinary procedures.
- Alcohol and Drug Abuse policies.
- Access to exposure monitoring data/records.
- Location of JSAs and company safety program.
- Emergency signals, response, and notification requirements for the area.
- Location of fire extinguishers, pull box alarms, emergency evacuation routes, and first aid facilities.
- How to report injuries.

- How to report unsafe conditions.
- The use and care of PPE.
- Identification of hazards gases, chemicals and materials; instruction on the hazards of these products and their safe use.
- Instruct employees regarding smoking around PNNL facilities. Additionally, Contractors are encouraged to establish designated smoking areas for their facilities. The designated smoking area provides a healthier workplace for the employee where "passive smoke" effects are minimized, and the rights of smokers are respected.
- Location of nearest medical aid station.
- Location of nearest telephone.

The employees, after understanding the procedures identified in the Orientation Checklist, sign the Orientation Record.

9.4 Supervisor Qualification

Key supervisors must meet requirements defined in the division 1 specification 01 6000 1.5 A(6) section.

9.5 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

9.6 Forms (Located on Contracts Page)

Orientation Checklist

Orientation Record

Pre-job Safety Planning Signoff

9.7 Expected Records (Located on Contracts Page)

Document	Record Submittal Responsibility	Record Retention Responsibility
Orientation Checklist	Contractor	Contractor
Orientation Record	Contractor	Contractor
Pre-job Safety Planning Signoff	Contractor	Contractor

10.0 Safety Meetings and Inspections

10.1 Purpose

This section defines the system for conducting safety and health meetings and inspections that will facilitate compliance with OSHA/WISHA.

10.2 Responsibility

The Contractor shall be responsible for:

- Daily safety briefings.
- Weekly documented safety meetings.
- Daily safety and health inspections of the jobsites, documenting the results, and correcting noted deficiencies.

Note: In-frequent contractors shall be a point emphasis for daily jobsite inspections.

- Weekly safety and health inspection of the jobsite with at least one employee.
- Correcting unsafe conditions and acts as soon as possible.
- Responding to employee concerns.

Employees shall be responsible for the following:

- Attending daily safety briefings.
- Attending safety and health meetings at least weekly.
- Reporting unsafe acts/conditions and concerns.

10.3 General Requirements

Supervisors and managers shall exercise their personal leadership in the conduct of operations under their control to afford all practicable protection to employees, PNNL and DOE property, and the environment. The Contractor shall provide for the correction of unsafe conditions and the continual observance of good safety practices.

Safety and health meetings shall address the following items:

- Safety, health, and job-related issues/concerns related to the particular operation.
- Accident investigations conducted since the last meeting to determine if the cause of the unsafe acts or conditions were properly identified and corrected.
- Safety and Health inspection findings since the last meeting.
- Safety Inspection Report items issued to the Contractor by PNNL or DOE personnel since the last meeting.

Minutes of safety and health meetings shall be taken and attendance will be documented on the Safety Meeting Sign-in Roster. (Meeting minutes are retained by the employer for the duration of the job).

10.4 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

10.5 Forms (Located in Vault and Contracts Page)

WSH-MA-001 FORM-01 Subcontractor Daily Pre-job and Supervisor Safety Inspection Checklist

10.6 Expected Records (Located on Contracts Page)

Document	Record Submittal Responsibility	Record Retention Responsibility
Subcontractor Daily Pre-job and Supervisor Safety Inspection Checklist	N/A	Contractor
Weekly Safety Meeting Agenda	N/A	Contractor

11.0 Hazard Communication

11.1 Purpose

The purpose of this section is to ensure that the hazards of all hazardous materials produced, imported, or used are transmitted to the affected employees. Required components of a Hazard Communication Program include the method of hazard determination, Safety Data Sheets (SDS), labels and other forms of warning, employee information training, and a written Hazard Communication Program defining the above.

11.2 Responsibility

The Contractor shall be responsible for the following activities:

- Developing, promoting, updating, and administering the Hazard Communication Program.
- Determining the hazards of materials used in the workplace, making SDSs available to employees, labeling containers, and providing information and training to employees on hazardous materials.
- Maintaining a list of hazardous materials and SDSs to be used on the project.
- Developing work practice requirements for hazardous materials identified in the JSA.
- Labeling secondary and subsequent hazardous material containers.

11.3 General Requirements

The Hazard Communication Program shall comply with the applicable statutory requirements of:

- 29 CFR 1910, Subpart Z, Hazard Communications
- WAC 296-800-170, Employer Chemical Hazard Communication

Employees and contract personnel shall be provided with an overview of the Hazard Communication Program during the hiring process.

Users of hazardous materials shall receive specific training for those materials they use prior to initial use, and periodically thereafter. Specific training shall include the location of SDS and inventory lists in the workplace, and the methods employees may use to access this information.

Each original container of hazardous materials shall have the manufacturer's label affixed to it or be labeled, marked, or tagged showing the identity of the hazardous chemicals, the appropriate hazard warning, and the name and address of the chemical manufacturer, importer, or other responsible party.

Secondary and subsequent containers of hazardous chemicals shall be labeled, marked, or tagged prior to use with the identity of the hazardous materials and the appropriate hazard warnings.

A copy of the written Hazard Communication Program and a list (inventory) of hazardous materials shall be kept in the work area.

Note: The list (inventory) may be a book of SDSs, appropriately labeled and periodically updated to reflect the workplace inventory.

Employees shall have ready access to review and copy SDSs for hazardous materials they work with.

Areas where physical and/or biologic hazards are known to exist shall be clearly designated as such (with signs, placards, etc.) along with control requirements (ventilation, hearing protection, safety glasses, etc.).

11.4 Procedure

11.4.1 Hazard Determination

SDSs supplied by the material manufacturers, vendors, and/or client shall be the principal source of health hazard information. It is the responsibility of the Contractor to provide an SDS that meets the requirements of WAC 296-839-30005

Copies of SDSs received shall be legible.

When an SDS appears inadequate, or is not available, or the composition of the material is unknown or questionable, the manufacturer, vendor, and/or client shall be contacted for more details prior to use of the material.

Examples of qualities that make a material “hazardous” include but are not limited to the following:

- flammable, combustible, and/or explosive
- corrosive (acids/caustics)
- irritating/damaging to the eyes and/or skin on contact
- any human known or suspected carcinogen

11.4.2 Labels and Other Forms of Warning

The Contractor shall comply with the following label/warning requirements:

- Each secondary and subsequent container of hazardous materials in the workplace shall be labeled, tagged, or marked with the identity of the hazardous material contained therein, and show hazard warnings appropriate for employee protection.
- Labels shall be legible, in English (plus other languages if appropriate), and prominently displayed on the container.
- The identity of the hazardous material may be any chemical or common name that is indicated on the SDS and will permit cross-reference to be made among the list of hazardous materials, the label, and the SDS.

- Portable containers into which hazardous chemicals are transferred need no label if all of the following conditions are met:

  The contents of the portable container are for the immediate use of the person making the transfer.

  The container is used only by and remains under the control of the person making the transfer.

  The unlabeled portable container is used only within the work shift during which it was originally filled.

A label shall be used to identify containers that do not meet the conditions noted above.

Labels on incoming containers shall not be destroyed, removed, or defaced.

11.4.3 Employee Information and Training

Employees shall undergo Hazard Communication training at the time of hire and prior to commencing work on the project. Minimum requirements of the training are:

- Signs and symptoms of overexposure.
- Methods and observations that may be used to detect and identify hazardous chemicals, such as odor, visual presence, etc.
- Physical and health hazards of materials used.
- Location of SDSs and the format in which they are maintained.
- How to use SDSs.
- Methods of protection from material hazards.

Prior to using any newly introduce hazardous material or product, supervisors shall obtain a copy of the appropriate SDS and review it with their employees.

11.5 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

11.6 Expected Records (Located on Contracts Page)

Document	Record Submittal Responsibility	Record Retention Responsibility
Training Completion Record	Contractor	Contractor

12.0 Event Investigating and Reporting

12.1 Purpose

This section describes a mechanism for investigating, reporting, and analyzing accidents that occur during construction activities.

12.2 Responsibilities

Contractor and Subcontractor employees are responsible for immediately reporting all injuries, illnesses, occupational exposure to toxic substances, motor vehicle incidents, property damage, and near misses to their immediate supervisor. Supervisors are immediately required to make notification to the PNNL POC (PNNL Construction Manager or PNNL Safety).

Contractor key supervisory personnel are immediately required to make notification to the PNNL Point of Contact (POC). The PNNL POC shall notify the PNNL Operations Center at 509-375-2400. For on-site emergencies (police, fire, rescue, and hazmat) call 509-375-2400.

When a contractor employee is involved in a serious event or accident, the Contractor shall implement the following actions: I. Secure the event scene from disturbance and unauthorized entry pending arrival of PNNL Representatives. II. Keep equipment or articles involved in the event from being operated, moved, or otherwise altered or repaired. III. To verify all necessary questions about the accident investigation/event have been answered the PNNL Project Manager and PNNL Worker Safety and Health (WS&H) Professionals are responsible for releasing the event scene.

Contractors are responsible for notifying OSHA/L&I DOSH when such notifications are required by the regulations.

Contractors are responsible for participating in the accident investigation, fact findings, critiques, and other reporting process. At a minimum, the contractor shall support completion of the PNNL Supervisor's Occupational Injury and Illness Report or an equivalent accident investigations form provided by the contractor.

If work extends beyond fourteen (14) days the contractor shall provide a monthly safety report summarizing all injuries, illnesses, non-injury events, and man-hours worked to the Battelle Contract Representative.

12.3 Recordkeeping Requirements

Daily records of all first aid treatments not otherwise reportable shall be maintained on prescribed forms and furnished to the Battelle Contract Representative upon request.

All records of exposure and accident experience incidental to the work (this includes exposure and accident experience of both the Contractor and its Subcontractors) shall be maintained. As a minimum, these records shall include exposure work-hours and a log of occupational injuries and illnesses (OSHA/L&I DOSH forms).

All records of employee exposure to toxic materials and harmful physical agents shall be maintained. The Contractor shall immediately notify PNNL of any excessive exposure and the hazard control measures that will be taken to control the exposure.

Access to the project's Worker Compensation Claims Report that details the compensable accidents experienced on the project by the Contractor and its Subcontractors will be provided to PNNL upon request.

13.0 Housekeeping

13.1 Purpose

This section establishes the requirements for housekeeping.

13.2 Responsibility

The Contractor shall enforce this section. Employees are responsible for complying with this section.

13.3 General Requirements

Housekeeping activities shall comply with applicable OSHA/WISHA requirements.
During the course of construction, alteration, repair or demolition of buildings and structures, continuous clean-up of the work area shall be performed, including removal of all rubble, scrap, boxes, crates, and excess material to trash disposal areas.

At the end of each work shift, a general clean-up of all work areas shall be performed.

Note: Once a week the contractor shall perform clean-up that includes; removal of debris from inside buildings, general organization of materials and barricades, sweeping of floors, roll-up of cords, adjustment of lights, trash removal, walk around exterior of building to ensure barricades, and debris are picked up.

All floors and walkways shall be maintained in good condition.

Every floor, working surface, and passageway shall be kept free from protruding nails, splinters, loose boards, or openings.

Cleaning and sweeping shall be performed in such a manner as to minimize the contamination of the air with dust.

Hoses and electrical conductors across aisles or passageways shall be covered or suspended overhead so that there is no tripping hazard. Where mechanical handling equipment is used, sufficient safe clearances shall be allowed for aisles, at loading docks, through doorways, and wherever turns or passages must be made.

Storage of material shall not create a hazard. Bags, containers, and bundles of construction materials and other equipment shall be stored in tiers, stacked, blocked or interlocked. They shall be limited in height (in general <5 ft) so that they are stable and secure against falling, sliding, or collapse.

Free access shall be maintained at all times to all exits, fire alarm boxes, fire extinguishing equipment, and any other emergency equipment. Free access means clear of all obstructions.

All lunchrooms, washrooms, and restrooms shall be kept in a clean and sanitary condition. Garbage cans in lunchrooms and restrooms shall be equipped with fitted covers, and the contents disposed of regularly.

Common garbage and other waste shall be disposed of at frequent and regular intervals.

Containers shall be provided for the collection and separation of waste, trash, oily or used rags, and other refuse. Containers used for garbage and other oily, flammable, or hazardous wastes, (such as caustics, acids, harmful dusts, or similar materials) shall be equipped with covers.

Chemical agents or substances, which might react to create a hazardous condition, shall be stored and disposed of separately.

13.4 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

13.4.1 Forms

None

14.0 Chronic Beryllium Disease Prevention Program

14.1 Background Information

The purpose of PNNL's Chronic Beryllium Disease Prevention Program (CBDPP) is to protect workers from health effects related to beryllium exposure. PNNL's approach to protecting workers is by controlling exposures to beryllium. This is done by identifying and minimizing beryllium hazards to levels as low as practical, thus protecting workers who come into contact with beryllium-contaminated materials. Contractor shall comply with DOE 10 CFR 850, PNNLs CBDPP and this Chapter.

Inhaling beryllium (Be) in the form of dust, mists, or welding fumes can cause chronic beryllium disease, a lung disorder resulting from the body's immune response to beryllium in the lung. Chronic beryllium disease is generally preceded by beryllium sensitization, which may develop months or years after exposure. Beryllium sensitization indicates that exposure has occurred, and that the body's immune system has responded to that exposure. There is evidence that skin exposure to beryllium may also produce sensitization. Beryllium sensitization is measured by the beryllium lymphocyte proliferation test (BeLPT), a blood test.

14.2 Applicability

The PNNL CBDPP applies to Contractors, and Subcontractors whose work potentially involves beryllium-related work activities. All contractors and subcontractors must conduct beryllium work in compliance with the provisions of this Chapter and PNNL's CBDPP.

PNNL recognizes that managed facilities have areas of legacy beryllium contamination and pose a potential exposure risk to workers. Work in these areas will be actively assessed and managed to this Chapter and PNNLs CBDPP.

14.3 Program Elements

14.3.1 Baseline Beryllium Data and Facilities

PNNL has conducted surface sampling in facilities with evidence of past beryllium use to determine whether beryllium is still present, and if so, the extent and degree of beryllium contamination. Areas where beryllium contamination is known are considered legacy, PNNL has posted entry requirements and work conditions. Contractors with work scope within these areas shall align with entry requirements.

Contractors may use PNNL internal Beryllium website and surface sample results when determining beryllium requirements, resource included historical data and Beryllium Facility Assessments.

14.3.2 Hazard Assessment

The CBDPP recognizes a risk-based approach to assess beryllium exposure hazards. Work in contaminated, or potentially contaminated areas, is assessed during job planning or alternative hazard analysis processes. The Contractor shall perform hazard assessments, which include analysis of existing conditions, exposure data, medical surveillance needs, and the exposure potential of planned activities. Collectively, this

determines the potential for worker exposure to beryllium and to establish that necessary controls are identified to minimize the exposure risk, minimize the number of workers involved, and prevent or mitigate exposures.

The hazard assessment describes the activity performed; identifies the beryllium exposure hazards; specifies the required controls (engineering, administrative, and PPE) commensurate with the hazard; and identifies sampling, training, and medical surveillance requirements. If sufficient information is not available to determine potential beryllium exposure levels for a work activity, conservative controls are applied.

14.3.3 Exposure Monitoring

Exposure monitoring will be conducted by the Contractor. Sampling will be performed using nationally recognized exposure assessment methodologies. Only accredited industrial hygiene laboratories will be used for sample analysis. Exposure monitoring and sample analysis must comply with the requirements of PNNL's CBDPP, 10 CFR 850.24 and 10 CFR 851. The use of both surface sampling and airborne beryllium monitoring is recommended to assess exposure. Surface sampling and air sampling detection limits must be adequate to assess compliance with CBDPP criteria levels.

CBDPP criteria for 8-hr TWA airborne beryllium investigation level is 0.02µg/m^3. Any air samples that exceed the investigation level require additional sampling and evaluation of work controls. Exposures exceeding the DOE 8-hr TWA action level of 0.2µg/m^3 will trigger the control measures for a Beryllium Regulated Area that are specified in 10 CFR 850.23(b). No work may continue without PNNL concurrence if this level is exceeded.

Contractor will provide monitoring results in writing to monitored employees within 10 working days of receipt of laboratory results. Contractor shall be provided these records to PNNL.

14.3.4 Exposure Risk Reduction and Minimization

The worker exposure minimization goal is as low as practicable. A standard hierarchy of IH controls (engineering controls, administrative controls, and PPE—in that order) is integrated into the Contractors work control processes in a manner to minimize both the number of workers exposed and the potential opportunities for exposure.

If exposure levels meet or exceed the action level, a review of beryllium work practices and controls will be conducted by PNNL Construction Management and modifications made to reduce exposures to as low as practicable. Exposure reduction and minimization plans for exposures meeting or exceeding the action level will be reviewed and concurred by PNNL prior to restart.

14.3.5 Access Control and Signage

Postings for areas with potential or existing beryllium contamination will follow the requirements of the PNNL CBDPP and 10 CFR 850. Contractor recognizes and controls the following types of beryllium areas:

- **Beryllium Contamination Area (BCA)** – an area where baseline facility characterization, hazard assessment, and/or sampling has indicated the presence of beryllium contamination at or greater than 0.2µg/100cm^2 on surfaces or above the background beryllium concentration in soil of 1.25 ppm.
- **Additional Beryllium Sampling Required in Uncharacterized Spaces** – applied in facilities with legacy beryllium contamination which have not been completely characterized. Spaces include inaccessible and elevated surfaces.
- **Beryllium Regulated Area** – an area that is established for work activities that have the potential to generate airborne beryllium at or above the action level (0.2µg/m^3 as an 8-hour TWA).

BRAs and BCAs must be demarcated and controlled to adequately alert workers to the applicable boundaries, and access must be limited to authorized persons. Regulated Areas and BCAs must be posted and records of all individuals who enter Regulated Areas must be maintained.

14.3.6 Protective Clothing and Equipment

Contractor will establishment and maintain a protective clothing and equipment program that complies with the requirements of 29 CFR 1910.132, *Personal Protective Equipment General Requirement*s. At a minimum, PPE is required when dispersible forms of beryllium may contact the worker's skin, enter breaks in the skin, or contact the eyes. PPE will be used whenever surface contamination levels are considered contaminated, at or above 0.2µg/100 cm^2 surface or 1.25ppm bulk.

The types of PPE to be used are determined by the Contractors hazard assessment and are suitable to protect against inhalation, skin contact and eye contact. The Contractor shall determine specific PPE requirements based on the hazard assessment for each beryllium activity, and the required PPE is documented in the appropriate work control documents. Activities with the potential for airborne beryllium at or exceeding the action level require the use of clean, disposable PPE.

14.3.7 Respiratory Protection

Contractor will establishment and maintain a respiratory protection program that complies with the requirements of 29 CFR 1910.134, *Respiratory Protection*, and provides workers with NIOSH-approved respirators. All workers who use respiratory protection must be enrolled in the Contractors respiratory protection program.

Respirators are provided to workers who are exposed to airborne concentrations of beryllium that have the potential to meet or exceed the action level.

Respiratory protective equipment to be used for each beryllium activity is determined by the Contractors hazard assessment and is documented in the appropriate work control documents.

14.3.8 Housekeeping

Surface sampling is used to monitor the effectiveness of controls, evaluate housekeeping efforts, identify beryllium-contaminated surfaces, and verify the effectiveness of cleaning and decontamination efforts. Contaminated surfaces will be cleaned by using certified HEPA filter-equipped vacuums specifically designated for beryllium use or wet-cleaning methods. Wet-cleaning methods include low-pressure water streams, mobile wet scrubber units equipped with HEPA filtration, wet floor mops, and wet wipes, sponges, and cloths. All equipment used for cleaning and decontamination must be labeled, controlled, and prohibited from use outside of designated beryllium areas and for non-hazardous materials. Dry sweeping methods, dry-cleaning methods, and use of compressed air are prohibited.

14.3.9 Waste Disposal

Work should be planned to minimize the generation of beryllium-contaminated waste and beryllium-contaminated items that are disposed of as waste. Wastes generated from BCAs and BRA are defined as beryllium-contaminated waste.

All beryllium-contaminated waste and equipment disposed of as waste are sealed in containers that are impermeable to particulate contamination (e.g., plastic bags, plastic wrap, other containers) to prevent the release of beryllium dust during handling and transportation. The bags, wraps, and containers are clearly labeled in accordance with 10 CFR 850.38.

14.3.10 Medical Surveillance, Consent, and Removal from Potential Exposure

The Contractor shall comply with the occupational medical provisions of 10 CFR 850.34, 850.35 and 850.36.

14.3.11 Training

PNNL provides training on beryllium hazards and controls for contractors and subcontractors that is dependent on potential exposure to beryllium. General awareness-level training on beryllium hazards and controls is required for all persons working at PNNL.

14.3.12 Recordkeeping

Contractor will maintain exposure monitoring and hazard assessment records and will protect the confidentiality of records in accordance with the requirements specified in 10 CFR 850.39. The Contractor will implement the requirements for submission of worker data into the Beryllium-Affected Worker Registry (BAWR). The Contractor will provide the required information for the BAWR submission to PNNL upon request.

15.0 Demolition

15.1 Purpose

This section establishes the requirements for demolition work that complies with WAC 296-155, Part S and OSHA 10CFR 1926.850.

15.2 Responsibility

The Contractor shall be responsible for protecting the health and safety of their staff members performing demolition work.

15.3 General Requirements

15.3.1 Preparation

Prior to the start of demolition work, an engineering survey shall be made, by a competent person, of the structure to determine structural integrity and the possibility of unplanned collapse of any portion of the structure. Any adjacent structure where employees may be exposed shall also be similarly checked.

A copy of the survey report and demolition plans shall be kept at the job site for the duration of the demolition operation. The original report and plans shall be kept by the Contractor. The contractor will be provided a good faith assessment or facility characterization data for known hazardous materials (Asbestos, Lead, Beryllium, Radiological, etc.) to enable the Contractor to prepare a demolition plan and evaluate exposure-rich scenarios. The Contractors JSA will incorporate work practices to mitigate hazards, such as surface/area pre-cleaning as a prerequisite to demolition activities.

All devices or equipment used during demolition work shall be constructed, installed, inspected, maintained and operated in accordance with applicable Federal or State regulations and manufacturer’s instruction.

Safety codes, standards, rules, regulations, and ordinances governing any and all phases of demolition work shall be observed at all times.

Demolition shall be conducted under competent supervision and safe working conditions.

Exceptional care will be taken for all demotion work within a damaged structure. This includes installing shoring and bracing to maintain structural integrity.

All utilities (electric, gas, water, steam, sewer, and other service) shall be deactivated under a PNNL internal process of modification to the facility or under a project specific plan that identifies all energy sources are air gapped with no intent of reconnection. All air gapped utilities shall be shut off, capped, or otherwise controlled, outside the building line before demolition work is started. All affected utility companies shall be notified in advance.

If it is necessary to provide utilities during demolition, such utilities shall be properly located and protected.

Surveys shall be conducted for the presence of asbestos, hazardous materials, hazardous chemicals, gases, explosives, flammable materials, or similarly dangerous substances at the work site. When the presence of any such substance is apparent or suspected, testing and removal or purging shall be performed, and the hazard eliminated before demolition is started.

All structural openings shall be used and protected in accordance with the requirements of the Floor Openings, Open Sides, and Ramps section below and WAC 296-155-775.

Any openings cut in a floor for the disposal of materials shall be no larger in size than 25 percent of the aggregate of the total floor area, unless the lateral supports of the removed flooring remain in place. Floors weakened or otherwise made unsafe by demolition shall be shored to safely carry the intended imposed workloads.

When debris is dropped without the use of chutes, the area onto which the material is dropped shall be completely enclosed with barricades. Warning of the hazard of falling materials shall be posted at each level. Debris removal from the lower level shall not be permitted until debris handling ceases above.

Except for necessary preparatory work, demolition shall begin at the top of the structure and proceed downward.

No work shall be permitted that will expose persons working on a lower level to danger.

Employee entrances to multistory structures being demolished shall be completely protected by sidewalk sheds or canopies, or both, providing protection from the face of the building for a minimum of eight feet. All such canopies shall be at least two feet wider than the building entrances or openings (one foot wider on each side thereof) and shall be capable of sustaining a load of one hundred fifty pounds per square foot.

Dust control in or migrating from the demolition area shall be performed according to the requirements of the project's Environmental Protection Plan.

Prior to demolition, or removal of construction materials from a facility, the contractor shall perform nuisance dust control by wiping down, HEPA vacuuming and/ or picking up loose debris that could create a dusty work environment, damage facility equipment, or create an otherwise hazardous work environment. Allowing demolition dust or materials to free-fall is prohibited. Dust/debris housekeeping includes controlling material that may be dislodged during inadvertent vibration or demolition activities.

When performing demolition, space modifications, or other activities that could potentially cause immediate damage to fire sprinklers, it is required to have a Shut-gun in the immediate vicinity prior to performing work.

All planking, scaffolding, and ladders used for demolition work shall by installed and used in accordance with the Scaffold and Ladder sections of this Manual.

Aerial lifts used for demolition work shall be used in accordance with the Aerial Lifts section of this Manual.

15.3.2 Work Area Access

Only designated access points and ways shall be used. Other access ways shall be entirely closed off at all times.

All access points and ways will be inspected and maintained in a clean, safe condition.

All ladders shall be secured in position.

Proper illumination shall be maintained in all access points, ways, and work areas.

15.3.3 Use of Chutes

No material shall be dropped to any point lying outside the exterior walls of the structure unless the area is effectively protected.

All materials chutes shall be installed and used per WAC 269-155-785.

A substantial gate shall be installed in each chute at or near the discharge end. A competent employee shall be assigned to control the operation of the gate, and the backing and loading of trucks.

15.3.4 Removal of Walls, Masonry Sections, and Chimneys

Masonry walls, or other sections of masonry, shall not be permitted to fall upon the floors of the building in such mass as to exceed the safe carrying capacities of the floors. The Contractor will implement a Silica Exposure Control Plan when necessary.

No wall section more than one story in height shall be permitted to stand alone without lateral bracing, unless such wall was originally designed and constructed to stand without such lateral support, and is in a condition safe enough to be self-supporting.

All walls shall be left in a stable condition at the end of each shift.

In buildings of “skeleton-steel” construction, the steel framing may be left in place during the demolition of masonry. Where this is done, all steel beams, girders, and similar structural supports shall be cleared of all loose material as the masonry demolition progresses downward.

Walls serving as retaining walls to support earth, adjoining structures, or debris shall not be demolished until such earth has been properly braced, adjoining structures have been properly underpinned or debris pile rendered safe.

15.3.5 Manual Removal of Floors

Openings cut in a floor shall extend the full span of the arch between supports.

Before demolishing any floor arch, debris and other material shall be removed from such arch and other adjacent floor area.

When floor arches are being removed, employees shall not be allowed in the area directly underneath, and such an area shall be barricaded to prevent access to it.

Demolition of floor arches shall not be started until they, and the surrounding floor area for a distance of 20 feet, have been cleared of debris and any other unnecessary materials.

15.3.6 Removal of Walls, Floors, and Material with Equipment

Mechanical equipment shall not be used on floors or working surfaces unless such floors or surfaces are of sufficient strength to support the imposed load.

Floor openings shall have curbs or stop-logs to prevent equipment from running over the edge.

Mechanical equipment used shall meet the requirements specified in this Manual and WAC 296-155, Parts L and M.

15.3.7 Debris and Material Storage

The storage of waste material and debris on any floor shall not exceed the allowable floor loads.

In buildings having wooden floor construction, the flooring boards may be removed from not more than one floor above grade to provide storage space for debris, provided falling material is not permitted to endanger the stability of the structure.

When wood floor beams serve to brace interior walls or free-standing exterior walls, such beams shall be left in place until other equivalent support can be installed to replace them.

Floor arches, to an elevation of not more than 25 feet above grade, may be removed to provide storage area for debris provided that such removal does not endanger the stability of the structure.

Storage space into which material is dumped shall be blocked off, except for openings necessary for the removal of material. Such openings shall be kept closed at all times when material is not being removed.

15.3.8 Removal of Steel Construction

Hoisting equipment used shall meet the requirements specified in this Manual and WAC 296-155, Parts L and M.

Steel construction shall be dismantled column length by column length, and tier by tier (columns may be in two-story lengths).

Do not overstress structural members being dismantled.

15.3.9 Mechanical Demolition

No workers shall be permitted in any area that can be adversely affected by demolition operations when balling or clamming is being performed. Only those workers necessary for the performance of the operations shall be permitted in this area at any other time.

The weight of the demolition ball shall not exceed 50 percent of the crane's rated load, based on the length of the boom and the maximum angle of operation at which the demolition ball will be used, or it shall not exceed 25 percent of the nominal breaking strength of the line by which it is suspended, whichever results in a lesser value.

The crane boom and loadline shall be as short as possible.

The ball shall be attached to the loadline with a swivel-type connection to prevent twisting of the loadline and shall be attached by positive means in such manner that the weight cannot become accidentally disconnected.

When pulling over walls or portions thereof, all steel members affected shall have been previously cut free.

All roof cornices or other such ornamental stonework shall be removed prior to pulling walls over.

During demolition, continuing inspections by a competent person shall be made as the work progresses to detect hazards resulting from weakened or deteriorated floors, or walls, or loosened material. No employee shall be permitted to work where such hazards exist until they are corrected by shoring, bracing, or other effective means.

15.3.10 Use of Explosives for Demolition

Demolition using explosives shall comply with WAC 296-52.

15.4 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

15.4.1 Forms

None

16.0 Excavation

16.1 Purpose

To define the responsibilities and requirements for protecting personnel engaged in excavation, trenching and shoring.

16.2 Responsibility

The Contractor shall be responsible for the following:

- Compliance with the procedure, including employee training.
- Monitoring excavation, trenching and shoring operations.
- Designating a Competent Person, who has had the training to act in this position, providing the competent person the authority to effectively discharge his/her duties.
- Reviewing activities that have a potential to damage utilities in or near excavations such as; gas, electrical, or other hazardous energy sources as defined by PNNL's lock and tag program requirements. Potential damage includes activities such as; backfill & bedding operations, pipe placement using equipment, removing debris (i.e. concrete) that could fall on to utilities, or other potential tasks which could damage a utility.
- **Precautionary Note:** Prior to excavating around fire hydrants, the contractor must verify (expose) thrust block and mechanical restraints (steel rods) are installed on hydrant branch lines to ensure the hydraulic forces are controlled to prevent pipe separation. Lack of proper restraint can cause the hydrant branch line to fail. If thrust restraints are not installed, de-energize main water line upstream to control hydraulic forces that can cause pipe separation associated with excavating around unrestrained fire hydrants. Water mains shall be reviewed to ensure mechanical restraints are in place prior to excavating around energized water mains at change of direction locations (T's, Y's, 90- and 45-degree angles). If thrust restraints are not in place, de-energize main line upstream to prevent pipe separation.

The Competent Person(s) shall be responsible for the following:

- Defining requirements and control measures.
- Performing daily inspections for compliance.
- Stopping work when non-compliances or problems/concerns are identified from inspections. (i.e., unknown materials; buried wood, presumed asbestos containing materials (concrete piping or vermiculite) or discolored soil.
- Evaluate daily activities that have the potential to damage utilities in or near excavations during backfilling and bedding, pipe placement, debris removal, or other such activities.

Employees shall be responsible for complying with the provisions of this procedure.

16.3 General Requirements

Excavation, trenching, and shoring shall be conducted in accordance with the following statutory requirements:

- 29 CFR 1926, Subpart P; Excavations
- WAC 296-155, Subpart N, Excavations, Trenching and Shoring

Employees in excavations shall be protected from cave-ins by an adequate protective system (sloping, shoring, or shields) in accordance with the provisions of 29 CFR 1926 and WAC 296-155.

An excavation permit is required when hand digging at depths greater than 12 inches, or when using mechanical means at any depth.

16.3.1 Inspections

Daily inspections of excavations, adjacent areas, and protective systems shall be conducted by a designated competent person to identify evidence of a situation that could result in possible cave-ins, for indications of failure of protective systems, and for hazardous atmospheres, hazardous conditions, or activities that could damage existing utilities. The competent person(s) shall be documented on a Competent Person Designation form. See section 16.2 for roles and responsibilities of competent person.

Inspections shall also be conducted after every rainstorm, changing work activities (i.e., going from excavating to backfill operations), or other potential hazard-increasing occurrence.

Inspections shall be performed and documented using the Daily Excavations/Trenches Safety Inspection Checklist and Inspection Log.

Note: These inspections are only required when employee exposure can be reasonably anticipated or changing work activities that have the potential to damage nearby utilities.

When inspection reveals evidence of a situation that could result in a possible cave-in, indications of protective system failure, hazardous atmospheres, or other hazardous conditions, employees shall be removed from the hazardous area until the necessary precautions have been taken.

Employees shall not work in excavations where water is accumulating or has accumulated unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation.

Employees exposed to mobile equipment or vehicular traffic shall be provided with and shall wear warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

When the configuration of an excavation is such that the excavation is deemed to be a confined space, the provisions of the applicable confined space entry program apply.

Adequate barriers for physical protection shall be provided at all excavations. All wells, pits, shafts, etc., shall be barricaded or covered.

When mobile equipment is used or allowed next to excavations or trenches, stop logs or barricades shall be installed. Such devices shall not be required for equipment conducting the actual excavating or backfilling operations.

Special precautions for excavation/trenching around electrical utilities:

- Each underground electrical interface with new construction shall be independently reviewed on a case-by-case basis using the PNNL excavation permit and excavation review board process
- If it can be determined from installation as-builts that the energized cable is protected by a rigid steel conduit raceway or concrete encasement, then de-energizing the cable is not required and excavation with hand tools such as shovels, pry bars, picks or air lances is acceptable.
- If it is determined from installation as-builts that the energized cable is protected by a PVC conduit raceway, then de-energizing the cable is not required. (shovels, vacuum systems, and air lances are acceptable)

Note: De-energizing underground lines when excavating near or around them is always the safest and preferred method to mitigate electrical hazards during excavation.

Exception: If it is determined that the system cannot be de-energized due to the adverse effects on necessary operation or life safety systems, then justification to hand excavate must be provided. Such justification requires concurrence of the PNNL Construction Manager.

- Minimum safety precautions during hand excavations of an energized direct buried cable shall include:

– The excavation worker shall wear protective insulated gloves, rated for the voltage potential with leather protectors, and meeting the specifications of ANSI/ASTM D120-1984.

– A qualified standby person shall be in attendance during excavation. The standby person shall be CPR certified, first-aid trained, and trained in emergency electrical practices. (e.g., contact release).

  – The suspected cable location shall be periodically verified using a hand-held inductance meter.

Note: Unknown underground utilities shall use the same precautions as hand digging around energized direct buried cables.

- Minimum safety precautions during hand excavations of an energized cable protected by PVC conduit shall include:
- The excavation worker shall wear protective insulated gloves, rated for the voltage potential with leather protectors, and meeting the specifications of ANSI/ASTM D120-1984.
- A qualified standby person shall be in attendance during excavation. The standby person shall be CPR certified, first-aid trained, and trained in emergency electrical practices (e.g., contact release).

Hand excavation around unprotected, energized electrical utilities is defined as the removal of surface and subsurface materials, including sand, gravel, soil, and rocks by cautiously utilizing direct labor methods must be approved by PNNL. An acceptable practice would be to use a hand assist tool, such as a common hand shovel to carefully remove soil from the excavation or preferably a vacuum truck. The use of hand-held picks and pry bars is expressly prohibited in situations requiring hand excavation. The use of a hand shovel to stab the soil in an effort to loosen or penetrate excavation material with anything greater than normal foot pressure is prohibited. The only acceptable aid to a hand excavation operation is an air-assisted dielectric soil pick, (e.g., air lance). The air lance is permitted to loosen compacted soil and/or expose a buried utility where soil conditions are sufficiently compacted, rocky or the presence of an underground utility is suspected and not yet physically verified.

16.4 Procedure

16.4.1 Preparation

Prior to excavation, permits (internal and external, when required by contract) shall be obtained from authorized organizations and included with pre-job planning documents where applicable. In addition, the necessary drawings, specification, and restrictions applicable to the excavation shall also be obtained.

Reference drawings and documents shall be checked in detail to determine location of all known underground obstructions, pipes, power lines, phone lines, foundations, etc. These locations shall be marked at the worksite in a conspicuous manner.

Utilities and facilities shall be de-activated, de-energized and/or interrupted, as required, and the source locked and tagged in accordance with the Lockout/Tagout Program. Coordination for this activity will be done through the PNNL Construction Manager.

Just prior to excavation, the excavation crew shall be briefed as to any special requirements or obstructions in the excavation area. The excavation permit and a Survey Scanning Report (when required) shall be at the excavation site during excavation as a reference for the excavation crew.

A spotter is used, when required, to assist the equipment operator during excavation.

All surface items to be protected shall be made visible to the equipment operator by high-viz tape or by a 7-ft bicycle flag mounted above the object.

The equipment operator shall be made aware of these protected items prior to operating equipment such as cranes, trucks, backhoes, or loaders.

A stairway, ladder, ramp, or other safe means of access/egress shall be located at personnel points where there is a break in elevation of 19 inches or more in trenches so as to require no more than 25 ft of lateral travel for employees.

16.4.2 Hand Excavation

All known underground obstructions shall be exposed by hand excavation beginning at a distance of 5 ft from the obstruction.

Note: Machines may be used to remove the soil from excavation but shall not be used to dig undisturbed soil unless utility can be seen by the operator and a smooth face bucket is used. Always dig parallel to the utility never across the top.

In work areas where the exact location of underground electrical power lines is unknown, the contractor must perform GPR scanning and potholing to determine location of underground electrical line before allowing the use of jack hammers, bars, or other hand tools which may contact and damage an electrical line. Employee shall wear class 00 insulated voltage rated gloves. Penetrating solid concrete material requires a blind penetration permit.

If obstructions shown on the drawings and/or permits are not found in the location indicated, or if obstructions are encountered that are not shown, the work in that area shall be stopped and the PNNL Construction Manager shall be contacted.

Machine Excavation: machine excavation, when permitted, shall take place after compliance with the above procedures. The following requirements apply:

PNNL Construction Manager shall be notified of damage to utilities or facilities and of any abnormal conditions encountered.

Equipment (i.e., bucket) shall be kept at least 5 ft horizontally from exposed underground utilities. Unless approved by the PNNL Construction Manager, PNNL Utility Owner, PNNL Safety.

Note: The following applies only to irrigation work:

- Hand digging is allowed within 24 inches laterally and/or 30 inches in depth of an existing irrigation system without needing an excavation permit. BEFORE proceeding past the halfway point of these parameters (12 inches laterally and/or 15 inches in depth), CONTACT the CM and WS&H to evaluate the need for mechanical digging and appropriate permits and notifications.

- Use of sod cutter up to 4 inches in depth anywhere on-site is allowed without an excavation permit.

16.4.3 Protective Systems

Excavations and protective systems shall be designed so that cave-ins and slides are avoided and safe conditions shall be maintained for employees working in and around the excavation.

Whenever practical and feasible, the sides of excavations and trenches shall be sloped at an angle not steeper than 1-1/2 horizontal to 1 vertical (see Excavation Detail Sketch).

When sloping is not practical or feasible, the sides of excavations and trenches may be vertical if they are provided with support systems (shoring or shielding).

Support system shall be required in trenches more than 4 ft/WISHA or 5ft/OSHA deep under the following circumstances:

Note: OSHA requirements apply to construction projects conducted on Federal Lands. WISHA requirements apply to construction projects conducted on non-federal lands within Washington State.

- The slopes are steeper than 1-1/2 horizontal to 1 vertical.
- The slopes are at least 1-1/2 horizontal to 1 vertical but do not extend to the bottom of the trench.

Support systems shall be installed and removed in a manner that protects employees from cave-ins and structural collapses and from being struck by members of the support system.

Excavation of material to a level no greater than 2 ft below the bottom of the members of a support system shall be permitted only if the system is designed to resist the forces calculated for the full depth of the trench and there are no indications, while

Shoring shall support the vertical portion of a trench and shall extend above the bottom of the slope at least 18 in to prevent material from sliding into the trench. The surface of the slope shall be cleared of boulders, stumps, or other hard masses of earth.

A support system may not be required under the following circumstances:

- The trench is less than 4 ft (WISHA)/5ft (OSHA) deep.
- The trench is less than 20 ft deep and the slopes are at least 1-1/2 horizontal to 1 vertical and extend to the bottom of the trench.

Timber cross-brace or trench jacks shall be placed in a true horizontal position, vertically spaced, and secured to prevent sliding, falling, or kick outs. Wales shall be placed with the greater dimension horizontal.

The sides of an excavation next to a previously backfilled area shall be sloped at least one and one-half horizontal to one vertical, particularly when the separation is less than the depth of the excavation.

When employees or equipment must cross over an excavation 6ft in depth, a walkway or bridge with standard guardrails shall be provided.

Engineering-approved portable trench boxes or sliding trench shields may be used instead of a shoring system or slope. They shall protect as well as, or better than, the shoring required for the trench and are used in accordance with the manufacturer’s recommendations.

Materials used for support systems shall be in good, serviceable condition. Sheeting and four-by-4 in timber cross-braces shall be Douglas Fir, No. 2, or better. Wales and 6-by-6 in timber cross-braces shall be Douglas Fir, No. 1, or better.

When employees are required to enter and excavation, excavated material shall be kept back at least 2 ft from the edge of the excavation.

Mudsills (wales installed at the toe of the trench side, having the same size and cross bracing spacing as the wales directly above them) may be used in place of embedding the uprights.

Sloping or shoring designs for trenches and excavations deeper than 20 ft shall have Registered Professional Engineering approval prior to placement.

Shoring, bracing, or underpinning shall be provided to stabilize adjoining structures, which may be endangered by an excavation. Among others, these structures would include the following:

- buildings and walls
- concrete encased raceways, piping, etc.
- storage tanks
- power poles

16.5 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

16.5.1 Exhibits and Forms (Located on Contracts Page)

Daily Excavations/Trenches Safety Inspection Checklist and Inspection Log

Excavation Detail Sketch

16.6 Expected Records (Located on Contracts Page)

Document	Record Submittal Responsibility	Record Retention Responsibility
Competent Person Designation	Contractor	Construction Management
Shoring Designs	Contractor	Construction Management
Daily Excavation/Trenches Safety Inspection Log	NA	Contractor

17.0 Walking/Working Surfaces

17.1 Purpose

This section defines protective measures to be implemented on PNNL work sites that involve conditions where falls of 4 feet or more exist associated with walking/working surfaces.

17.2 Responsibility

The Contractor shall be responsible for compliance with this section.

Employees shall be responsible for complying with the provisions of this section.

17.3 General Requirements

All walking/working surfaces with a fall hazard of 4 feet or more shall comply with the following statutory requirements:

- 29 CFR 1926, Subpart M, Floor and Wall Openings
- WAC 296-880, Unified Safety Standards for Fall Protection

17.3.1 Floor Openings

Floor openings 4 feet or more shall be guarded by a standard railing and toe boards on all exposed sides except at entrances to stairways.

Floor openings that are 12 inches or more in their least dimension in any floor, roof, platform, or surface through which persons may fall shall be protected by a cover or standard guardrails. Hatchways and chute openings shall be guarded by one of the following:

- Hinged covers of standard strength and construction and a standard railing with only one exposed side.
- A removable standard railing with toe board on no more than two sides of the opening and fixed standard railings with toe boards on all other exposed sides. The removable railing shall be kept in place when the opening is not in use and shall be hinged or mounted to be conveniently replaceable.

Pits and trap door floor openings shall be guarded by floor opening covers of standard strength on all exposed sides by removable standard railings.

Skylights not capable of supporting at least twice the weight of employees, equipment, and materials must be protected by a rated cover, guardrail system, or personal fall arrest/restraint system. Barricades are not acceptable.

Manhole floor openings shall be guarded by standard covers, which need not be hinged in place. While the cover is not in place, standard railings shall protect the manhole opening.

Utility manhole openings must be protected by a standard guardrail or personal fall restraint system.

All floor-opening covers shall be capable of supporting the maximum potential load but never less than 200 pounds (with a safety factor of four).

The cover shall be recessed to conform to the level of the surrounding floor or to be flush with the perimeter of the opening.

The cover shall be secured by fastening devices to prevent unintentional removal.

If it becomes necessary to remove the cover, a monitor shall remain at the opening until the cover is replaced. The monitor shall advise persons entering the area of the hazard shall prevent exposure to the fall hazard and shall perform no other duties.

Floor opening covers shall be clearly marked, “HOLE” OR “FLOOR OPENING COVER.”

17.3.2 Floor Holes

Hole means a gap or void 2 inches (5.1 cm) or more in its least dimension, in a floor, roof, or other walking/working surface. Holes through which debris and other material may fall through shall be protected with a cover, or equally efficient means.

Regardless of height, holes into which an employee can trip, step into, or step through shall be protected by a cover or standard guardrails.

Floor holes into which persons can accidentally walk, shall be guarded by either a standard railing with standard toe boards on all exposed sides, or a floor hole cover of standard strength and construction that is secured against accidental displacement. While the cover is not in place a standard railing shall protect the floor hole.

Note: A working surfaces include any surface in which an employee can work from (duct work, equipment, formwork, rebar mat, etc.).

17.3.3 Open Sided Surfaces

Every open sided floor or platform or surface 4 ft or more above adjacent floor or ground level shall be guarded by a standard railing on all open sides except where there is an entrance to a ramp, stairway, or fixed ladder. The railing shall be provided with a standard toe-board beneath the open sides wherever persons can pass, there is moving machinery, or there is equipment with which falling materials could create a hazard.

Runways shall be guarded by standard railing on all open sides 4 ft or more above floor or ground level. Wherever tools, machine parts, or materials are likely to be used on the runway, a toe-board shall be provided on each exposed side.

Where employees entering runways become exposed to machinery, electrical equipment or other dangers that are not a falling hazard, additional guarding shall be provided.

Regardless of height, open sided surfaces, walkways, platforms, impalement hazards, runways above or adjacent to dangerous equipment shall be guarded with a standard railing and toe-board.

17.3.4 Ramps

Ramps (runways) shall be a minimum of 18 inches in width.

Ramps shall be secured so that they cannot be accidentally displaced.

Ramps shall be provided with standard railing when located 4 feet above the ground or floor level.

Ramp specifications: Ramps (runways) and walkways shall not be inclined more than twenty degrees from horizontal and when inclined shall be cleated or otherwise treated to prevent a slipping hazard on the walking surface.

17.3.5 Fall Protection

Where guardrails cannot be provided and the potential for fall injuries exist, employees shall be protected in accordance with section 25, Fall Protection.

17.4 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-880, *Unified Safety Standards for Fall Protection*

17.4.1 Forms

None

18.0 Signs and Barricades

18.1 Purpose

This section establishes requirements for the use of signs, signals, and barricades.

18.2 Responsibility

The Contractor shall be responsible for compliance with the provisions of this section.

Employees shall be responsible for complying with the provisions of this section.

18.3 General Requirements

Prior to commencing construction activities, the construction work shall have signs, signals, and barricades in the work area in accordance with the following statutory requirements:

- 29 CFR 1926, Subpart G; Signs, Signals, and Barricades.
- WAC 296-155, Part E.

Whenever appropriate, traffic control shall be instituted in accordance with the provisions of the U.S. Department of Transportation, Federal Highway Administration's Manual on Uniform Traffic Control Devices for Streets and Highways.

Signs, signals, and/or barricades shall be visible at all times when the work is being performed and shall be promptly removed or covered when the hazard no longer exists.

18.4 Procedure

18.4.1 Construction Activities

Caution signs and appropriate physical barricades shall be used to warn against potential hazards or to caution against unsafe practices.

Caution signs shall be yellow with black lettering.

Danger signs shall be used where an immediate hazard exists.

Danger signs shall be red with black lettering.

Where specific hazards exist (e.g., overhead hazards, noise, chemical exposure, radiation), signs shall be posted to warn of such hazards.

Accident Prevention Tags: Accident prevention (Danger – Do Not Use) tags shall be used as a temporary means of warning employees of an existing hazard such as defective tools, equipment, etc.

Configuration-Control Tags and Locks: Special tags and locks (never a green or red lock -these are used only for energy-isolation lockouts) may be used as configuration control for situations in which the change in configuration of a system or equipment

could have a negative effect on equipment, facilities, or operations (e.g., opening or closing a valve, energizing or de-energizing a piece of equipment).

18.4.2 Traffic Control

Adequate warning, delineation, and routing by means of proper pavement marking, signing, and other devices that will give the motorist positive direction in advancing through the work area must be used.

When construction activities are adjacent to the roadway, warning signs shall be erected on the approach in both directions.

All signs intended for hazard warning during hours of darkness shall be reflectorized and illuminated.

A certified flag person shall be used at worksites to intermittently stop traffic as necessitated by work progress or to maintain continuous reduced-speed traffic past a worksite to help protect the work crew.

A flagger shall possess the following minimum qualifications:

- Each flagger shall have in their possession a valid certification of completion of an approved flagging course.
- Signaling directions by flaggers shall conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, as amended by the Washington State Department of Transportation.
- Good physical condition, including sight and hearing.
- Mental alertness.
- Courteous but firm manner.
- Sense of responsibility for safety of public and crew.

18.5 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

ANSI Z535.1/2535.2, *Specifications for Accident Prevention Tags*

18.5.1 Forms

None

19.0 Confined Space Entry

19.1 Purpose

This section establishes the requirements for confined space work that complies with WAC 296-809.

19.2 Responsibility

The Contractor shall be responsible for protecting the health and safety of their staff members performing confined space entries.

19.3 General Requirements

19.3.1 Identifying Confined Spaces

Employers/supervisors perform the following activities:

- Survey each work area to identify confined spaces.

A confined space is defined as a space that meets all of these criteria:

is large enough and configured such that an individual can bodily enter and perform assigned work, and

has limited or restricted means of entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits), and

is not designed for continuous human occupancy.

- An initial hazard evaluation is performed and documented to assess potential and existing hazards inherent in the confined space. Classify the space as a permit required confined space or non-permit confined space.
- Document the initial hazard evaluation on the Confined Space Hazard Identification form or equivalent documentation.
- Control any confined space that does not have an initial hazard evaluation, as a permit required confined space until a hazard evaluation is performed and documented.
- Label or post permit required confined spaces with a danger sign at potential entry points, stating “DANGER: CONFINED SPACE - Contact Safety & Health Representative before Entering” or using similar language.
- If the space dimensions or configuration do not permit the conventional attachment of signs, use other effective means to inform employees of the space location and hazards.
- A permit required confined space with more than one entry must be labeled with a sign at all access points.

Employers/Supervisors will perform the following activities:

- Comply with the requirements of the Confined Space Entry form and other applicable permits.
- Determine that employees have received confined space training and are qualified to fulfill assigned duties.
- Obtain available information on the specific confined space from PNNL.
- Notify employees of required site-specific arrangements for a confined space entry, and provide additional information as follows:

  Identify hazards and conditions that form the basis for classifying the particular confined space as a permit required confined space.

  Notify employees of required precautions and procedures required by the space owner when employees are working in, or near, a permit required confined space.

  Identify the means to coordinate entry operations when multi-contractor employees will be working in, or near, a permit required confined space.

  Conduct and document a debriefing with employees at the conclusion of entry operations to determine whether unanticipated hazards were encountered or created during the work.

  Coordinate entry operations with other workforces.

  At the conclusion of the confined space operation, inform PNNL of unanticipated hazards and work conditions. Provide the PNNL Construction Manager the canceled permit and other records associated with the entry.

19.4 Classifying Confined Spaces

Before any work is performed in a confined space, the employer/supervisor must identify, evaluate, and plan methods to control potential hazards of the space by performing the following:

- Review existing hazard evaluations, if available.
- Identify the hazards associated with the work to be performed in the confined space.
- Classify the space as a permit required confined space or a non-permit confined space.
- Control all non-permit confined spaces.
- Based on the results of the hazard evaluation, a permit required confined space may temporarily be reclassified as a non-permit confined space under the following conditions:
- If the permit-required space poses no actual or potential atmospheric hazards and if all engulfment, entrapment, and serious safety hazards within the space are eliminated without entry into the space. The space may remain classified as a non-permit-required confined space for as long as the hazards remain eliminated.
- If it is necessary to enter the permit-required space to eliminate hazards, such entry shall be performed under permit-required confined space procedures. If testing and inspection during that entry demonstrate that the hazards within the permit-required

space have been eliminated, the permit-required space may be reclassified as a non-permit-required confined space for as long as the hazards remain eliminated.

Note: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards.

- The Contractor has documented the basis for determining that all the hazards in the space have been eliminated through a certification containing the date, space location, and the signature of the Contractor. The certification must be made available to all entrants. In addition to the above certification, routine work control documents must address the control methods for any other safety and health hazards that may be encountered during the entry.
- When the permit-required confined space cannot be reclassified as non-permit-required confined space, work is conducted in accordance with the Confined Space Entry form, which specifies control measures, and work practices to minimize exposures and maintain health and safety of staff members.

19.4.1 Working on Telecommunication or Electrical Equipment in Manholes or Underground Vaults

When telecommunication or electrical service work is performed in manholes or underground vaults, special requirements apply regardless of the classification status of the confined space (permitted on non-permitted).

Before telecommunication or electrical service work is performed in a manhole or underground vault, employers/supervisors must identify, evaluate, and plan methods to control potential hazards of the space by following these steps:

- Guard the manhole or street opening.

Note: When covers of manholes or vaults are removed, the opening must be promptly guarded by a railing, temporary cover, or other temporary barrier to prevent an accidental fall through the opening and to protect staff working in the manhole from foreign objects entering the manhole.

- Test the space for oxygen levels and combustible gas with a properly calibrated and maintained combustible gas indicator.

Note: If an open flame is to be used in the space, combustible gas monitoring must be performed immediately prior to use of the flame. Storage of fuels is not permitted in the space unless it is in actual use.

- Establish forced air ventilation before entry into space and continue for the duration of the job. Mechanical forced air ventilation must be in operation at all times when workers are required to be in the manhole or vault.

Note: The air should be tempered when necessary and care should be taken so that workers will not be subjected to excessive air velocities. If the forced air ventilation is discontinued during the course of the work (for example, during shift change or lunch breaks) the oxygen and combustible gas measurements must be repeated to verify adequate breathing air quality.

- Provide ladders for entry and exit if manhole is more than 4 ft deep.

- Provide trained staff trained in CPR, first aid, and in methods of contact release during entry to render emergency aid when there is electrical power exposure potential in the space.

Note: See the Electrical Safety section for further electrical safety requirements.

- If the space has been classified as a permit-required confined space for the purpose of this entry, conduct the work in accordance with the Confined Space Entry form, which specifies control measures and work practices to minimize exposures and maintain health and safety of staff members.

19.4.2 Non-Permit Confined Spaces

Before entry, verify and document on the Confined Space Hazard Identification form that the planned work or changes in the space configuration will not introduce permit required space hazards.

Review the initial hazard evaluation, if available and update as necessary.

Appropriately manage all hazards associated with work activities in non-permit confined spaces.

Re-evaluate and, as necessary, reclassify non-permit confined spaces to permit required confined space when changes in the use or configuration of the non-permit confined space increase the hazards to which employees may be exposed.

Use documented engineering controls, or posting/labeling, to prevent inadvertent entry into non-permit confined spaces.

19.4.3 Preparing for Entry into Permit Required Confined Spaces

For each permit-required confined space entry, a job-specific briefing must be held for all employees involved in the entry to cover the known or anticipated hazards associated with the space and the work and the techniques for controlling these hazards.

Designate an appropriately trained entry supervisor to authorize, oversee, and terminate entry operations.

Assign at least one trained attendant to remain outside the permit space for the duration of the entry.

The entry supervisor conducts the job-specific briefing for the entrants and the attendants based on the completed entry permit. Topics that must be included are:

- Work to be performed
- Anticipated hazards, including signs, symptoms, and consequences of exposure to the hazards
- Hazard control measures
- Verification that entrants and attendants have appropriate training.

- Emergency rescue procedures.

The entrants and attendants read and sign the permit. Signing the permit indicates that the signatories have been briefed on the hazards and the techniques used to control the hazards and that they will comply with these techniques and control measures.

19.4.4 Multi-Employer Entries

Confined space entries involving employees of more than one Contractor or Subcontractor working in a space simultaneously will be coordinated so all work is conducted safely.

The following activities will occur:

- Personnel involved in the confined space entry have been informed of hazards that may be introduced by other workforces.
- Entry is authorized by issuance of a single permit signed by a representative from each organization.
- Workers participating in a multi-employer entry attend a single pre-job briefing.

19.4.5 Contractor Activity Interface

During contractor related work activities, control and classification of temporary or newly constructed confined spaces is the responsibility of the PNNL Construction Manager. Confined spaces will be classified prior to entry as part of the hazard evaluation and work planning process.

When the construction phase ends, the completed confined space will be turned over to PNNL and labelled in accordance with PNNL requirements.

19.4.5.1 Making Entries into Permit Required Confined Spaces

Work in a permit-required confined space must be conducted in compliance with the Confined Space Entry form.

Designate qualified and trained entry team members to perform duties described in Attachment 01 below.

If a single attendant is assigned to monitor multiple spaces, determine the means or procedure the attendant can use to respond to an emergency affecting each of the spaces without compromising other assigned duties, and document on the permit.

The initial testing and evaluation of atmospheric hazards will occur before entry, and as often as necessary during re-entry to maintain acceptable conditions.

Determine what engineered controls, PPE, and atmospheric monitoring requirements are needed for chemical and physical hazards.

Provide rescue equipment, harnesses, lifelines, lifting devices, supplemental lighting, communication devices, PPE, ladders, ventilation equipment, or other special equipment as specified on the Confined Space Entry form. Provide for entrant rescue and retrieval, considering both the size and configuration of the space, the size of entrants and rescue personnel.

19.4.5.2 Permit System

Entries into permit required confined spaces are administratively controlled by a Confined Space Entry form. The permit system includes the hazard assessment, entry permit, and supporting documentation. The permit designates a specific operation, location, work package, and time period.

The duration of the permit may not exceed the time required to complete the assigned task or job as identified on the permit. If planned work will continue for more than 1 work shift, the permit may be approved for subsequent re-entries provided that the following conditions are met:

- No new hazards are identified or introduced into the space.
- There are no changes in work scope or permit-prescribed work controls.
- Pre-entry testing is performed and acceptable entry conditions exist.
- Re-entries are authorized and documented on the permit.

Before entry, verify that all authorizing signatures are recorded on the permit.

Document all confined space entries/egresses on the Confined Space Entry Log.

Restrict entry to those listed on the log, unless they are entering as members of the rescue team.

Terminate entry and cancel the permit when entry operations covered by the permit are complete or if conditions occur in or near the space that are not allowed by the permit. When entry operations are complete, do the following:

- Verify that all entrants have exited the space, remove any temporary barricades, and return the space to service as applicable.
- Cancel the permit by completing and signing the Permit Cancellation section on the permit itself.
- Note on the permit any unusual conditions encountered during the entry operation.

19.4.6 Unusual Conditions

Any of the following may be unusual conditions and, as such, require a review of the entry procedures, if observed:

- an unauthorized entry into a permit space
- detection of a permit space hazard not covered by a permit
- occurrence of an injury or near miss during entry

- change in the use or configuration of a permit space
- detection of a condition prohibited by the permit
- when the employer or employee has reason to believe entry procedures do not protect entrants

Obtain assistance from PNNL for conducting a review of permits that report unusual conditions, or when entry operations have been canceled because of conditions not allowed by the permit.

Submit canceled permits with the work package records. Maintain a copy for the project or facility records for annual review.

19.4.7 Atmospheric Testing for Permit Required Confined Spaces

For permit spaces with potential atmospheric hazards, perform atmospheric testing before employee entry and throughout the duration of the entry to maintain acceptable entry condition.

Note: Atmospheric testing will be performed by a qualified person.

Provide atmospheric testing equipment that is calibrated, maintained, and operated in accordance with the manufacturer's operating manual.

Record instrument calibration data and all initial and subsequent atmospheric test results on the permit. Calibration and maintenance records will be maintained with the data collected representative of the levels of contaminants being measured.

Perform atmospheric monitoring, as prescribed by the permit, to determine whether acceptable entry conditions are being maintained during entry operations. Test for the following conditions in this sequence:

1. Oxygen content between 19.5 percent and 23.5 percent.
2. Flammable gases and vapors (not to exceed 10 percent of the lower flammable limit).
3. Toxic air contaminants, as specified on the permit.

Test multiple levels of the space to determine any stratified layers that may be present. If there are areas that cannot be tested from outside the space, then test as the entry progresses. Use extension apparatus or other means to test the atmosphere at least 1.2 meters (4 ft) to the front and sides of the entrant.

If the space configuration limits effective atmospheric testing (as may occur with large spaces or spaces that cannot be isolated, such as sewer system entries), provide entrants with personal monitoring devices that they have been trained to use. Conduct pre-entry testing to the extent possible before authorizing entry, and continuously monitor conditions in areas where employees are working.

When portable mechanical ventilation is used, conduct atmospheric testing first with the ventilation off, then with the ventilation on.

If testing indicates the presence of a hazardous atmosphere in the confined space, prohibit entry until appropriate controls have been implemented, and implement monitoring strategies.

19.4.8 Applying Hazard Controls

Assign controls commensurate with the risk and dependent on the hazards and whether the hazards will be eliminated before entry or controlled before and during entry. Implement hazard control/reduction, whenever feasible, by:

- Redesigning tasks to make personnel entry into confined spaces unnecessary.
- Using accepted engineering control measures.
- Applying administrative controls and work practices.
- Prescribing PPE.

When prescribing recommendations for controls or work practices, consider additional hazards that the control itself may introduce. Prescribed protective measures will not interfere with the ventilation requirements for the space, means of entrance or egress for the occupants, or rescue methods.

Based on the pre-entry hazard evaluation, apply the hazard controls and work practices described in Attachment 02, as applicable.

19.4.9 Emergency Response and Rescue for Permit Required Confined Space

Emergency and rescue planning, procedures, and escape routes will be designed for the characteristics of the space. Consider effective response times in determining rescue measures. When working on the Hanford Site, the Hanford Fire Department is the emergency rescue team.

Attendants will have at least one of the following at the work location:

- telephone
- two-way radio
- cellular phone
- other suitable means of summoning the emergency rescue team

The attendant will maintain constant communication with confined space occupants by voice, signal, or other means as specified on the permit.

The emergency rescue team will be available for response. If the emergency rescue team is unavailable or becomes unavailable for response, reschedule or suspend the entry.

For non-entry rescue from a permit space, determine appropriate retrieval systems or methods to summon the emergency rescue team. If the use of retrieval equipment increases the overall risk of entry or would not contribute to the rescue of the entrants,

then define alternate rescue methods, document them on the permit, and communicate them to employees.

When required by the permit, each authorized entrant will use a full body harness with retrieval line attached at the center of the entrant's back near shoulder level or above the entrant's head. Wristlets may be used in lieu of the full body harness if you can demonstrate that the use of the full body harness is not feasible or creates a greater hazard and that the use of wristlets is the most effective and safe alternative.

Attach the other end of the retrieval line to a mechanical device or fixed point outside the permit space such that the rescue can begin as soon as the rescuer becomes aware that rescue is necessary. Dedicate a mechanical device to retrieve personnel from vertical type confined spaces more than 1.5 meters (5 ft) deep.

The entry attendants and authorized entrants will be trained in the proper use of the retrieval equipment.

Note: Attendants do not enter a space to attempt a rescue.

Inspect required harnesses, retrieval lines, and mechanical lifting devices so they will be immediately available at the work location during permit space entries.

Damaged equipment shall be tagged out-of-service and removed from use.

When a non-entry rescue begins, contact the emergency rescue team in case an additional emergency response or rescue is needed. If retrieval or rescue requires entry into the space, the attendant will summon the designated rescue team, and stand by (the attendant is not to enter the permit space).

Inform the rescue team of all hazards associated with the confined space.

Summon the emergency rescue team under any of the following circumstances:

- Rescuers are required to enter the confined space.
- The rescue involves retrieval of an injured person.
- The attendant needs help in retrieving the confined space occupants.
- Medical assistance is required.

In the event of a chemical exposure, communicate hazard information from the SDS or other sources to the medical providers.

19.5 Training/Qualifications

The following conditions shall be met:

- Attendants, entrants, supervisors, atmospheric testing personnel, and other entry team members are provided initial confined space training before performing their assigned duties for confined space entries.
- Employees are aware of the safety requirements and availability of this program.

Entry team members are appropriately informed of the following:

- There is a change in assigned duties.
- A change in permit space operations introduces a new hazard for which the employee has not been trained.
- Inadequacies in the employee's knowledge or use of this program or entry procedures have been identified.
- Changes in program requirements are communicated to entry team members.

Employees have completed any additional training requirements specified by the permit.

In addition to the initial confined space training course required for all entry team members as required, the designated atmospheric testing person is trained on the proper use, application, and limitations of the instrumentation to be used, including the following:

- Field calibration and performance checks of the instruments.
- Anticipated hazardous contaminants.
- Instrument operation.
- Knowledge of alarm set points and actions required when an alarm occurs.
- Related documentation requirements.

19.6 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

19.7 Expected Records (Located on Contracts Page)

Document	Record Submittal Responsibility	Record Retention Responsibility
Confined Space Form	Contractor (also PNNL for any of its employees who must enter)	Contractor (site), PNNL as necessary
Training/Qualifications	Contractor	Contractor

19.8 Attachments

Attachment 01, Entry Team Duties

Attachment 02, Hazard Controls/Work Practices

Attachment 1– Entry Team Duties

Entry Supervisor

Recognize the hazards that may be encountered during entry and the mode, signs, symptoms, and consequences of exposure.

Before signing the permit to authorize entry, verify completion of pre-entry activities, completion of the permit, and required signatures have been obtained. Post completed permit at the entrance of the confined space so that authorized entrants may confirm completion of pre-entry preparations.

Before entry into a permit space, notify the designated rescue team of the planned entry, location of the space, anticipated hazards, and any special considerations for rescue from the space. Verify availability of rescue service, and that the means to summon them are operable.

Perform a pre-job briefing with all entry team members to review the work scope, hazards associated with the entry, and details of the permit requirements.

If the duties of entry supervisor are transferred from one individual to another during the course of entry, record the name of the current entry supervisor on the permit.

Entry operations will remain consistent with the terms of the entry permit.

Take appropriate measures to remove unauthorized personnel who are in or near the space.

Cancel the entry authorization and terminate entry whenever entry conditions are not acceptable.

When entry procedures are complete, close out entry operations and cancel the permit.

Document problems encountered during an entry operation the permit.

Note: An entry supervisor may also serve as standby attendant or entrant as long as they are trained and equipped to perform each role.

Attendant

Recognize the hazards that may be encountered during entry and the mode, signs, symptoms, and consequences of exposure.

Do not perform other tasks that could prevent, limit, or interfere with implementation of assigned duties as attendant.

Remain stationed outside the permit required confined space during entry operations until relieved by another attendant, documenting any change of duty on the permit.

Monitor any conditions or changes that could occur in or around the confined space that could adversely affect the entrants.

Order entrants to evacuate the space immediately when any of the following conditions are observed:

- A condition that is not allowed on the permit (such as interruption of ventilation).

- Activation of an alarm on the atmospheric testing equipment.
- Effects of hazard exposure on behavior of entrants or an uncontrolled hazard in the space.
- A situation outside the space that could affect the safety of the entrants.
- The need of the attendant to leave the workstation and another qualified attendant is not available as a replacement.
- Inability of the attendant to safely and effectively perform all required duties.
- Unavailability of the emergency rescue team to perform a rescue.

Perform non-entry rescue as specified on the permit. Summon emergency/rescue services when required.

Maintain an entry log to identify and track the entry/egress of each authorized entrant.

Restrict access during entry operations to authorized entrants only. If there is an attempted unauthorized entry, notify the entry supervisor.

Authorized Entrants

Recognize the potential hazards that may be encountered during entry, including the mode, signs, and symptoms of exposure.

Review the requirements of the Confined Space Entry form and sign the entry log for each entry/egress.

Understand and implement required measures for work control as defined in the permit. Safely use all required equipment necessary for safe conduct of work in the space.

Communicate with the attendant to facilitate the monitoring of entrant status and conditions in the space.

Alert the attendant and exit the space when a warning sign, symptom of exposure, or prohibited condition is identified.

Exit the space when the order is given to evacuate, on recognition of warning signs/symptoms, or when prohibited conditions are detected or alarms activated.

Attachment 2– Hazard Controls/Work Practices

Isolation/Tagout Requirements

Evaluate energy sources/materials, including equipment not connected to an energy source but having unguarded movable parts. Consider outside sources that could introduce a hazardous substance into the space.

If determined to be potentially hazardous to the entrants, isolate in accordance with the PNNL Lockout/Tag out Program. Examples of hazardous energy include electrical, mechanical, hydraulic, pneumatic, chemical, and thermal energies, in addition to potential energies, such as compressed gases, springs, or suspended objects.

Acceptable means of isolation include blanking or blinding, misaligning or removing sections of lines, pipes, or ducts, a double-block-and-bleed system, lockout/tag out of all sources of energy, or blocking or disconnecting all mechanical linkages.

Purging/Flushing/Ventilation Requirements

Before entry, confined spaces will be emptied or otherwise purged of flammable, injurious, or incapacitating substances, as feasible.

If safe levels cannot be achieved, implement additional ventilation or other engineering controls to reduce contaminants to the lowest level feasible, and provide adequate PPE.

Do not introduce pure oxygen into the space for purposes of ventilation or to improve the breathing air quality.

If flammable gases, vapors, or combustible dusts are present, any ventilating equipment used must be approved for use in the specific hazardous location.

Test the atmosphere before and during ventilation of the space to verify acceptable entry conditions.

If the ventilation system shuts down, entrants shall leave the space and not re-enter until approved by PNNL.

Provide and maintain continuous ventilation or local exhaust ventilation of the confined space during welding, painting, and other operations that generate air contaminants. If ventilation is not possible or feasible, develop alternate protective measures.

The ventilation arrangement for the space will preclude the entry of atmospheric contaminants into the ventilation intake and the exhaust of contaminants into adjacent work areas.

Welding, Cutting, and Heating

Welding and cutting performed in a confined space requires a Hot Work Permit.

Fall Protection and Retrieval

Components making up both systems consist of personal protective gear (harness), connecting devices (retracting lifelines, retrieval devices), and approved anchorages (tripod).

Emergency retrieval equipment is specifically intended to lift injured personnel from a vertical, confined space.

Material hoists must be separate and approved for use as part of the anchorage system.

Devices such as a combination retractable lifeline/retrieval device can meet both fall protection and emergency rescue functions.

Excavations and Trenches

Confined entry procedures may be applicable for certain excavations and trenches. Evaluate each situation separately to determine whether the requirements for confined space entry apply to the anticipated work.

Personal Protective Equipment

PPE selection, as determined by project safety, will be appropriate for the conditions and configuration of the confined space, based on results of the hazard evaluation.

Confined space entrants, whose work requires respiratory protection, will be fit tested, trained, and medically cleared.

Requirements for Equipment and Tools

In confined spaces, ground fault circuit interrupters will be used with all power tools and electrical lighting.

If flammable liquids, gases, or vapors are present, use only tools, lighting, communications equipment, and other electrical equipment that are approved for use in the specific hazardous location.

Illumination Requirements

All lighting used in spaces containing, or having the potential to contain, flammable vapors or explosive dusts will be approved for use in hazardous atmospheres. This requirement also applies to low-voltage lighting such as droplights.

Install temporary lighting in accordance with National Electrical Code requirements.
Lighting will be sufficient for entrants to see clearly, avoid potential hazards, and exit the space quickly in an emergency.

External Hazards

When entrance barriers are removed from below-grade confined spaces, guard the opening with a railing, temporary cover, or barrier to prevent persons or objects from falling into the space.

20.0 Electrical Work Safety

20.1 Purpose

The purpose of this section is to define the requirements for electrical safety and to ensure compliance with National Fire Protection Association (NFPA) 70E, Standard for Electrical Safety in the Workplace Requirements and U.S. Department of Energy; Occupational Safety and Health Act; and Washington Industrial Safety and Health Act requirements. The provisions of this section apply to Subcontractors or vendors who perform work on or near exposed, energized electrical equipment for PNNL.

20.2 Definitions

Automated external defibrillator (AED): A medical device designed to analyze the heart rhythm and deliver an electric shock to victims of ventricular fibrillation to restore the heart rhythm to normal.

Arc-Flash Boundary (AFB): When an arc-flash hazard exists, this is an approach limit from an arc source at which incident energy equals 1.2 cal/cm2 (5 J/cm2).

Arc Rating: The value attributed to materials that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of breakopen threshold (EBT) (should a material system exhibit a breakopen response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value.

Attendant: If alerting techniques (e.g. safety signs, tags, and barricades) do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees. The primary duty and responsibility of an attendant providing manual signaling and alerting shall be to keep unqualified employees outside a work area where the unqualified employee might be exposed to electrical hazards. An attendant shall remain in the area as long as there is a potential for employees to be exposed to the electrical hazards.

Commissioning: A process of assuring that equipment and systems are functioning correctly; installed as designed; and tested, operated, and maintained according to the specifications provided.

Contact Release: Techniques to free a shock victim from an energized conductor without endangering the rescuer.

Cardiopulmonary Resuscitation (CPR): is a medical procedure involving repeated compression of a patient’s chest, performed to restore the blood circulation and breathing of a person who has suffered cardiac arrest.

De-Energized: Equipment or systems where electrical or mechanical energy has been released by disconnecting power, discharging all capacitors, short-circuiting and grounding all high-capacitance elements, releasing or physically restraining springs, and relieving or blocking all other sources of stored energy.

Diagnostic and Testing: Diagnostic, testing, and commissioning include work performed on or near live parts related to tasks such as electrical testing, troubleshooting, or voltage and current measurement. The work may require the use of portable test instruments, but no other tools (i.e., jumper install or lifting of conductors) can be utilized to help diagnose the problem while the system(s) are energized.

Note: Repairing, replacing, or making any physical alteration of electrical equipment, conductors or circuit parts is considered energized work, and is not diagnostic and testing.

Electrical Hazard: A dangerous condition in which inadvertent or unintentional contact or equipment failure can result in shock, arc flash burn, thermal burn, or blast injury.

Electrical Installation: Work that involves installing power circuits, low voltage conductors, installing permanent wiring, attaching new electrical equipment to a facility's permanent electrical wiring, or modifying electrical equipment that is attached to a facility's permanent wiring (i.e., situations where a modification permit is needed). It does not include installing cord and plug connected equipment.

Electrical Work Plan (EWP): A form used to document the overall risk assessment of a particular work task that is not considered energized work that defines the associated controls and PPE.

Energized Electrical Work Permit (EEWP): A form used to document the overall risk assessment of a work task when performed on energized conductors and circuit parts, justified by means of infeasibility or increased risk to be de-energized. An EEWP shall be required and documented under any of the following conditions:

(1) When work is performed within the restricted approach boundary.

(2) When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc-flash hazard exists.

Electrically Safe Work Condition: A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to verify the absence of voltage, and if necessary, temporarily grounded for personnel protection.

Energized: Equipment or systems electrically connected to, or is an energy source. All electrical equipment is considered to be energized until proven otherwise (using an adequately rated test instrument).

Exposed: As applied to energized electrical conductors or circuit parts: capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to electrical conductors or circuit parts that are not suitably guarded, isolated, or insulated.

Incident Energy (IE): The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. IE is typically expressed in calories per square centimeter (cal/cm2).

Limited Approach Boundary (LAB): An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

Qualified Electrical Worker (QEW): A person who has demonstrated skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risk. Such a person is familiar with the proper use of precautionary techniques, PPE, insulating and shielding materials, insulated tools, test equipment, and approach distances. A person may be considered qualified with respect to a certain equipment and methods, but still be unqualified for others.

Risk Assessment: An overall process that identifies hazards, estimates the likelihood of occurrences of injury or damage to health, estimates the potential severity of injury or damage to health, and determines whether protective measures are required.

Restricted Approach Boundary (RAB): An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.

Safe Condition Check: The comprehensive inspection or test of the isolating boundary performed for or by the controlling organization to confirm that the isolating boundary is controlled to prevent exposure from all sources of hazardous energy and material.

Safe-to-Work Check: The inspection or test that an authorized worker performs to confirm that no hazardous energy exists where servicing or maintenance will be performed. For electrical energy, this involves the use of adequately rated test instrument (A category III or IV is required to test each phase conductor or circuit component both phase-to-phase and phase-to-ground (this includes the neutral-grounded conductor when present) (Only contact type such as voltmeters, etc.) by the qualified electrical worker performing the work.

> NOTE: The safe to work check performed by the use of an adequately rated, permanently mounted test device shall be permitted to be used to verify the absence of voltage of the conductors or circuit parts within the location the device is installed, provided it meets all of the following requirements: It is permanently mounted and installed in accordance with the manufacturer's instructions and tests the conductors and circuit parts at the point of work; It is listed and labeled for the purpose of verifying the absence of voltage; It tests each phase conductor or circuit part both phase-to-phase and phase-to-ground; The test device is verified as operating satisfactorily on any known voltage source before and after verifying the absence of voltage.

Safety Standby Person: A person knowledgeable of the specific work procedure and the scope of work assigned no other duties that preclude observing and rendering aid, if necessary, who knows the location of the shutdown controls and disconnects and is able to de-energize equipment and alert emergency rescue personnel. The safety standby person should be trained in first aid/CPR and methods of contact release. The safety standby person is in addition to the two-person rule and does not serve the same function.

Technical Work Document: The instructions that govern the work activity (e.g., isolation/outage request form, procedure, etc.).

Thermography: A process in which a heat-sensing infrared camera is used to record the surface heat produced by different parts of electrical equipment.

Two-Person Rule: A QEW is within visible and audible contact with the other QEW(s) and has been briefed on the specific work procedure and the scope of work, is able identify existing or

predictable hazards, to de-energize equipment and alert emergency rescue personnel and is trained in first aid/CPR and methods of contact release. The two-person rule is used for 3 phase 480 VAC equipment and/or if arc-flash IE is > 1.2 cal/cm2.

Visual Inspection: An internal inspection of electrical equipment made using only the naked eye.

Working Distance: The dimension between the possible arc point and the head and body of the worker positioned in place to perform the assigned task.

20.3 Requirements

The electrical work safety requirements address:

- Training
- Underground or temporary electrical installations
- Approach boundaries
- Shock risk assessment
- Arc flash risk assessment
- Working on or near exposed energized electrical parts within the limited approach boundary
- Working on or near exposed energized electrical parts within the restricted approach boundary
- Electrical work planning process
- Visual inspections, thermography, and non-electrical tasks
- Testing and troubleshooting on live, energized parts
- Establishing an electrically safe work condition
- PPE
- Insulated /nonconductive equipment use
- Measuring and Testing Instruments
- Use of ground fault circuit interrupter (GFCI)
- Flexible cords and cables
- Blind penetrations
- National Electrical Code inspections and compliance
- Work affecting electrical utilities operations
- Specific activities/requirements

20.3.1 Training

Contractor or Subcontractor employees receive basic instruction on electrical safety as part of their orientation. This instruction is covered in the PNNL Non-staff

Construction Subcontractor Orientation (Course 2856) when work is to be performed on PNNL managed work sites.

Contractor or Subcontractor employees who face a higher-than-normal risk of contact with electrically energized parts (e.g., technicians, vendors, craftsmen, etc.) must be trained to contact release, understand electrical hazards and associated risk with work related activities in accordance with NFPA 70E, Standard for Electrical Safety in the Workplace. Such training must be deemed acceptable to PNNL and supplemented by PNNL electrical safety training as appropriate. Electrical qualification is documented using the Activity Specific Electrical Worker Qualification form #2024. Retraining shall be performed at intervals not to exceed three years.

Note: Such persons shall also be familiar with PNNL procedural requirements, emergency procedures, personal the proper use of precautionary techniques, personal protective equipment (Shock and Arc PPE), insulating and shielding materials, insulated tools, test equipment, and associated approach distances. A person can be considered qualified with respect to certain equipment and methods, but still be unqualified for others.

The Contractor or Subcontractor shall be responsible for providing apprentice electricians with appropriate electrical safety training prior to assigning work assignments that involve electrical hazards. When working under the direct supervision of a Licensed Journeymen Electrician, it is the responsibility of the Licensed Journeymen Electrician to assign work that is appropriate for the apprentice's experience, skill level, and training. PNNL doesn't allow apprentice electricians to perform work on energized electrical conductors or circuit parts that have not been placed in an electrically safe work condition.

20.3.2 Underground or Temporary Electrical Installations

Underground and/or temporary electrical installations shall meet the requirements of NFPA 70. Installations shall be inspected by PNNL's third party NEC inspector (these inspectors are Construction Electrical Equipment Inspectors [CEEI's]) prior to cover, concealment or being energized. PNNL may require underground electrical services to be marked above ground with danger buried electrical.

20.3.3 Shock and Arc Risk Assessments

Estimate Likelihood and Severity Based on the Job Scope and Identified Hazards

Risk determination can be evaluated for electrical work based on the source of energy hazard class (severity), how the worker is interacting with the equipment (types of work), conditions that increase risk and impact from environmental conditions. Initial risk determination is to be performed by trained, qualified, and authorized workers. The following risk matrix (Table 1-1) can be used in conjunction with evaluating equipment, environmental, and work/worker conditions. The result of this evaluation will provide the risk determination.

Note:

1. Likelihood of occurrence can either increase or decrease based on equipment, work, worker, and environmental conditions.
2. Severity can increase based on environmental conditions. The exception is Negligible ≤50V, where only extreme environmental conditions could increase the severity of the injury.
3. All Hazard Classes in an electrically safe work condition are considered to be Low Risk.

Table 20-1, Risk Matrix for Electrical Work

Table 20.1 Risk Matrix for Electrical Work

	Likelihood of Occurrence				
Severity / Class	**Frequent**	**Probable Energized Work**	**Occasional Energized Diagnostics & Testing**	**Improbable Establishing an Electrically Safe Work Condition and Equipment Operation**	**Remote**
Catastrophic >151V to ≤1000V >1.2 to <40 cal/cm^2	HIGH	HIGH	HIGH	MODERATE	MODERATE
Critical >50V to ≤1000V <1.2cal/cm^2	HIGH	HIGH	MODERATE	MODERATE	LOW
Moderate >50V to ≤150V	HIGH	MODERATE	MODERATE	LOW	LOW
Negligible ≤ 50V	MODERATE	LOW	LOW	LOW	LOW

20.3.4 Shock Risk Assessment

A shock risk assessment shall be documented using an Electrical Work Plan (EWP) to determine the voltage to which personnel will be exposed, boundary requirements, and the PPE necessary in order to minimize the possibility of electric shock to personnel.

Limited Approach Boundary (LAB) – Working Near (refer to Table 20.2): This boundary establishes the distance around exposed energized parts that only a qualified person may enter. If an unqualified person must enter the limited approach space to perform a minor task, like an inspection, then a qualified person must continuously escort and advise this person of the potential hazards and ensure that the unqualified person is under his/her direct supervision.

To enter the limited approach boundary, the qualified person must:

- Verify that a shock risk assessment has been performed and documented on the Electrical Work Plan (EWP). Approach boundaries for the voltage to be encountered are clearly defined, and the required PPE (if applicable) is donned as prescribed.

- Understand and follow the requirements established on the EWP.

Restricted Approach Boundary (RAB) (refer to Table 20.1 This boundary establishes the distance around exposed, energized parts that only a qualified person may enter (no unqualified persons are allowed to enter under any circumstances). To enter the restricted approach boundary, the qualified person must:

- Meet the requirements of entering the Limited Approach Boundary
- Use adequately rated shock protection for all tools, instruments and PPE entering the Restricted Approach Boundary

Table 20-2. Shock Approach Boundaries to Exposed Live Parts

Nominal System Voltage Range	Limited Approach Boundary		Restricted Approach
Phase-to-Phase	Exposed Movable Conductors	Exposed Fixed Circuit Parts	
50 V to 150 V	10 ft 0 in.	3 ft 6in.	AVOID CONTACT
151 V to 750 V	10 ft 0 in.	3 ft 6 in.	1 ft 0 in.
Over 751 V, not over 15 kV	10 ft 0 in.	5 ft 0 in.	2 ft 2 in.
15.1 kV to 36 kV	10 ft 0 in.	6 ft 0 in.	2 ft 7 in.
36.1 kV to 46 kV	10 ft 0 in.	8 ft 0 in.	2 ft 9 in.

20.3.5 Arc Flash Risk Assessment

An electrical arc flash risk assessment shall be performed and documented on the EWP. The assessment shall determine the arc flash boundary, working distance and the required PPE that workers must wear when they are within the arc flash boundary.

Note: If the arc flash risk assessment determines the incident energy to be 40 cal/cm^2 or greater the work must not be performed unless an electrically safe work condition has been established (equipment de-energized). The EWP will specifically address any special instructions needed to create the electrically safe work condition.

Note: For AC systems, the arc flash risk assessment is to be performed by contacting Construction Safety for assistance.

Note: For electrical work <1.2cal/cm^2 PPE shall consist of non-melting, natural occurring fiber clothing. Long sleeve shirt, pants, safety glasses and leather gloves shall be worn unless an electrically safe work condition has been established.

20.3.6 Working within the Arc Flash Boundary of Exposed Energized Electrical Parts

Qualified electrical workers (QEW), the EWP author, and a PNNL construction safety or delegate will determine the electrical hazards during a site visit.

Before starting each shift a PNNL Qualified Electrical Worker conducts a pre-job safety briefing for participants involved with the work to be performed. The pre-job briefing shall be documented using the Pre-job Safety Planning Sign-off Form. The PNNL Qualified Electrical Worker gives the briefing again for any new workers or the oncoming shift workers if the job continues through a shift change.

Verify that the pre-job safety documentation is consistent with the scope of work. Restrict access with safety signs, tags, barricades, attendants, or a combination of to isolate the work area and warn others of the potential electrical hazards. Electrical safety warning signs are to be worded:

DANGER

ELECTRICAL HAZARDS

AUTHORIZED PERSONNEL ONLY

Systems with an incident energy equal to or greater than 1.2 cal/cm^2 shall employ the two-person rule for work on energized components and establishing an electrically safe work condition. The second person is also a QEW and assists to ensure that clearances are maintained and performs electrical emergency rescue if required. QEW's must be trained in CPR/First aid, and in methods of contact release.

Since each job may differ in electrical hazards, the required Arc Flash PPE may vary according to the electrical hazards present. PPE may include but is not limited to arc-rated clothing, an arc flash face shield/hood, insulated gloves with leather protectors, insulated tools, voltage-rated rubber blankets, or insulated shielding (see the EWP for required PPE for the specific task).

20.3.7 Working within the Limited Approach Boundary of Exposed Energized Electrical Parts

Qualified electrical workers, the EWP author, and a PNNL construction safety or delegate will determine the electrical hazards during a site visit.

Since each job may differ in electrical hazards, the required PPE may vary according to the electrical hazards present. PPE may include but is not limited to arc-rated clothing, an arc flash face shield/hood, insulated gloves with leather protectors, insulated tools, voltage-rated rubber blankets, or insulated shielding (see the EWP for required PPE for the specific task).

Before conducting work, follow these safety practices:

- Ensure a suitable working clearance for the equipment is provided (i.e., minimum depth of 36 inches in front of equipment, 30 inches wide or the width of the equipment witch ever is greater, below the footprint of the equipment and 6 feet high based on conditions).
- Locate the disconnecting means that will deenergize equipment before starting work.
- Confirm that lighting is adequate.
- Do not reach blindly into areas that might contain exposed live parts where an electrical hazard exists.
- Secure doors and hinged panels to prevent swinging into the worker.

- Restrict access with safety signs, tags, barricades, attendants, or a combination of to isolate the work area and warn others of the exposed energized electrical conductors and or circuit parts.
- Use voltage rated tools and test instruments when required.

Verify that the pre-job safety documentation is consistent with the scope of work. Use safety signs (designed in accordance with NFPA 70E) to isolate the work area and warn others of the exposed energized electrical conductors and or circuit parts. Electrical safety warning signs are to be worded:

DANGER

ELECTRICAL HAZARDS

AUTHORIZED PERSONNEL ONLY

Before starting each shift a PNNL Qualified Electrical Worker conducts a pre-job safety briefing for participants involved with the work to be performed. The pre-job briefing shall be documented using the Pre-job Safety Planning Signoff Form. The PNNL Qualified Electrical Worker gives the briefing again for any new workers or the oncoming shift workers if the job continues through a shift change.

If a worker receives an electrical shock (other than static if clearly known) during work performance, stop work and report to the immediate supervisor. Due to potential risks associated with electrical shocks, highly recommends workers to be evaluated by a trained medical provider prior to returning to work.

20.3.8 Working within the Restricted Approach Boundary of Exposed Energized Electrical Parts

In addition to the requirements in safe practices for work within the limited approach boundary found above. The following applies when working within the restricted approach boundary: Do not wear or carry any conductive accessories (such as rings, watches bracelets, metal frame glasses, or metal hats) in clothing pockets where they may make contact with exposed, energized parts. Clothing made of flammable materials, such as acetate, nylon, polyester, polypropylene, and spandex, shall not be worn. Three-phase systems operating at 480VAC or above shall employ the two-person rule for work on energized components and establishing an electrically safe work condition. The second person is also a QEW and assists to ensure that clearances are maintained and performs electrical emergency rescue if required. QEW's must be trained in CPR/First aid, and in methods of contact release.

Note: Unless specified otherwise in the EWP, all equipment and circuits to be worked on or to be near shall be placed in an electrically safe work condition (de-energized, locked out /tagged out and verified) before initiation of work. When applying the two-person rule, an electrician apprentice may act as the second person for electrical safe to work checks that are performed by a QEW if authorized as part of the Activity Specific Electrical Worker Qualification Course #2024.

20.3.9 Electrical Work Planning Process

An Electrical Work Plan (EWP) is required for all electrical work that has a potential electrical hazard such as when working within an arc flash, the limited and/or restricted approach boundaries.

Working on energized parts must be considered a last resort after all other opportunities for establishing an electrically safe work condition have been exhausted. After consulting with electrical qualified workers and a PNNL Electrical Safety Engineer or delegate (e.g., PNNL Construction Safety Representative), ensure that measures have been taken to de-energize all electrical sources and that there is no feasible alternative to completing work on the energized equipment that is within the approach boundaries.

- Construction activities involving energized work including the process to establish an electrically safe work condition requires completion of an Electrical Work Plan.
- EWPs may be approved up to six months in accordance with approved engineering documentation.
- Include the completed EWP with other pre-job safety planning documents.
- Have a copy of the completed EWP available at the jobsite.

20.3.10 Diagnostic Testing, and Commissioning on Live, Energized Parts

Diagnostic, testing, and commissioning on live, energized parts is allowed when a EWP for diagnostic and testing is developed and approved. The work may require the use of adequately rated portable test instruments, but no other tools (i.e., making a physical alteration jumper install or lifting of conductors) can be utilized to help diagnose the problem while the system(s) are energized. All guards, shields, screws, and fasteners reinstalled to a safe configuration when diagnostic, testing and/or commissioning is complete.

Once the problem is discovered and identified during the diagnostic phase the repair and replacement of the components shall be performed in an electrically safe work condition managed under PNNL's lock and tag program requirements.

Electrical parts and components (see Table 20.3) are other than low risk equipment shall be de-energized and locked and tagged out to the maximum extent feasible before they are worked on (Refer to the PNNL Lockout/Tag out Program for further guidance).

Establishing an electrically safe work condition

The following steps must be used to verify the correct energy isolation point.

Note: The Qualified Electrical Worker verifies that the equipment is properly de-energized, isolated, and locked and tagged out before applying their Authorized Worker lock and tag.

Step 1: If the circuit is in service, use an adequately rated portable test instrument or an adequately rated permanently installed absence of voltage tester to verify that the correct energy isolation point has been identified as follows:

- When the energy isolation for a component must be confirmed on the device being manipulated, verifying the presence of energy before isolation then verifying the absence of energy after isolation by testing each phase conductor or circuit part on both phase-to-phase and phase-to-ground (neutral included if available).
- If a method other than those described above is used to verify the energy isolation point, the method must be identified on LOTO written instruction form.
- If the circuit is not in service but can be safely energized and energization does not create any safety concerns, energize the system or equipment and proceed as above for a circuit that is in service.

If the system or equipment source is unknown, the source must be verified and positively identified before work can proceed.

Guards, shields, and other non-energized parts may be removed with insulated tools to expose conductors to obtain access to terminals for voltage readings to verify the correct energy isolation point (verification of isolation check) and safe-to-work checks. All guards, shields, screws, and fasteners reinstalled to a safe configuration when testing is complete.

Where isolating elements are visible, verify that all blades of the disconnecting devices are fully open or that draw out type circuit breakers are withdrawn to the fully disconnected position.

Step 2: Lock and tagout the equipment or system following the Controlling Organization written instructions.

Step 3: Complete a safe-to-work check by using an adequately rated test instrument (A category III or IV is required to test each phase conductor or circuit component both phase-to-phase and phase-to-ground (this includes the neutral-grounded conductor when present). Test before touching. Retest equipment for absence of voltage when circuit conditions change or when the job location has been left unattended. Removal of non-energized guards, shields, etc., using voltage-rated insulated tools in order to expose conductors may be planned as part of performing safe-to-work check. All guards, shields, screws, and fasteners reinstalled to a safe configuration when testing is complete.

Or

The safe to work check performed by the use of an adequately rated, permanently mounted test device shall be permitted to be used to verify the absence of voltage of the conductors or circuit parts within the location the device is installed, provided it meets all of the following requirements:

- It is permanently mounted and installed in accordance with the manufacturer's instructions and tests the conductors and circuit parts at the point of work.
- It is listed and labeled for the purpose of verifying the absence of voltage.
- It tests each phase conductor or circuit part both phase-to-phase and phase-to-ground.
- The test device is verified as operating satisfactorily on any known voltage source before and after verifying the absence of voltage.

Step 4: Apply temporary protective grounding when required in accordance with Temporary Protective Grounding Exhibit.

Table 20-3, Threshold for Low-Risk Equipment

Equipment	Voltage/Capacity Values (voltage is line-to-ground or line-to-line, whichever is greater)
Low	Voltage <50 V or Energy, Output current < 5 mA **Capacitors:≤ 1 joule if voltage is 50 – 400 V** **≤ .25 joules if voltage is > 400 V**

Note: Lockout/tagout is not required for cord and plug connected equipment if the cord and plug is within line of sight, within arm's reach, and under exclusive control of the qualified person performing the work. (only one worker may use the exception of exclusive control, if more than one worker is necessary a LOTO must be installed).

Note: Electrical equipment that is considered low risk is not required to be de-energized and/or locked or tagged out. It's recommended to de-energize this equipment before working on it when practical. Energized parts that are considered minimal risk need not be de-energized if there is no increased exposure to electrical burns or to explosion due to electric arcs.

Note: If de-energizing requires lifting or cutting neutrals or equipment grounding conductors, perform the following:

- Treat all disconnected/cut neutrals and equipment grounding conductors in the affected circuit as energized until zero energy is verified and any lifted, cut, or otherwise disconnected neutrals and equipment grounding conductors are insulated (i.e., wire nut, electrical tape, or other approved insulating material is installed). Some equipment grounding conductors are bare they cannot be insulated, but must be treated as energized until zero energy is verified. PPE shall be worn as required in this section while performing absence of voltage checks and establishing an electrically safe work conditions (i.e., insulating cut/disconnected neutrals).
- PPE is required when removing and reconnecting these wires due to the potential for changing electrical conditions in previously de-energized circuits via ungrounded or shared neutrals. PPE for this task can be downgraded to shock protection only if the arc flash risk assessment has been conducted and no arc flash hazard exists.

20.3.11 Personal Protective Equipment

When Subcontractor employees are working within the arc flash boundary, they must be a QEW and shall wear properly rated arc flash protective clothing (AR/FR) and other electrically protective equipment. Clothing selection is based on the calculated available incident energy and is documented on the EWP. Subcontractor employees are required to wear protective equipment for all parts of the body (head, face, neck, chin, torso etc.) entering the arc flash boundary whenever there is exposure to an arc flash hazard. Shock protection (gloves, blankets, insulated tools, and instruments) shall be used for hand and arm protection when entering the restricted approach boundary in addition to any arc rated PPE identified on the EWP. Inspect PPE before each use. PPE found to be damaged or contaminated with grease or oil shall not be used. Follow manufacturer's instructions for care and maintenance.

Subcontractor employees must be trained to understand the manufacturer's instructions, characteristics, and PPE ratings.

20.3.12 Insulated/Nonconductive Equipment Use

A qualified worker shall inspect the insulated equipment to be used before each use to verify the item is in satisfactory condition and has been tested at intervals as required by the driving standard. Inspect gloves for holes by air testing before use.

Inspect voltage-rated tools for defects and surface contamination, such as moisture, before each use. Do not rely on insulated tools alone for complete protection. Store and use equipment according to the manufacturer's recommendations.

Subcontractor employees are trained (QEW's) or briefed Non-Electrical Workers(e.g. Laborers, Carpenters, Core Drillers) on the proper inspection and use of insulating rubber gloves. The Checklist for Insulating Rubber Gloves exhibit provides a checklist for users of insulating rubber gloves, as well as a basic outline for initial briefings and on-the-job-training for non-electrical workers.

20.3.13 Measuring and Testing Instruments

Only qualified personnel, who are trained on the operation and limitation of the equipment, shall use electrical measuring and test equipment. Verify portable test instrument is listed by a Nationally Recognized Testing Laboratory (NRTL). Visually inspect portable test instrument before use for a broken case, worn test leads, and frayed or broken wires. Ensure the portable test instrument is 600 volt or 1000-volt CAT III or CAT IV rated.

Portable Electrical Test Instrument Ratings

Measurement Category	Description	Examples
CAT III	Three-phase distribution, including single-phase commercial lighting ‹50 kA short circuit current	• Equipment in fixed installations, such as switchgear and polyphase motors. • Bus and feeders in industrial plants. • Feeders and short branch circuits, devices fed directly from distribution panels. • Lighting systems in larger buildings. • Appliance outlets with short connections to service entrance
CAT IV	Three-phase at utility connection, any outdoor conductors Limited only by the utility transformer feeding the circuit ››50 kA short circuit current	• The "origin of installation"—where low-voltage connection (service entrance cables) is made to utility power. • Electricity meters, primary overcurrent protection equipment. • Outside and service entrance, service drop from pole to building, run between meter and panel • Overhead line to detached building, underground line to well pump.

Identify defective test equipment by tagging it out of service, and repair or dispose of it properly. Use electrical test equipment only for intended applications. Determine electrical test equipment is operating satisfactorily immediately before and after use when verifying that circuits are placed in an electrically safe work condition. When performing absence of voltage checks, ensure that stored electrical energy has been released and/or mechanical energy has been blocked or relieved and cannot re-energize the circuit.

20.3.14 Use of Ground Fault Circuit Interrupter (GFCI's)

Use GFCIs on 120-volt circuits as specified below:

- in outdoor or indoor damp/wet work locations
- for temporary wiring methods (e.g., extension cords, cord sets) during construction, remodeling, maintenance, service and repair or similar activities
- when using portable, electric hand tools with cord/plug connectors

20.3.14.1 Ground Fault Circuit Interrupter (GFCI) Testing

GFCI protection shall be provided where an employee is operating or using cord sets (extension cords) or cord- and plug-connected tools related to maintenance and construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment without GFCI protection an assured equipment grounding conductor program shall be implemented.

Test GFCI devices prior to use or per manufacturer's instructions (usinge34 a small load). Users test portable GFCIs adapters using the test button provided before each use.

If the GFCI device fails the pre-use test, tag out of service with a "DANGER — DO NOT USE" tag and (if portable) remove from service.

Tripped GFCI devices shall be reset only once. If tripped during reset, they may not be re-set again until it has been determined the cause of tripping.

Tripped GFCI circuit breakers shall be investigated to determine the cause. Once the cause of the upset condition is addressed the breaker may be reset. If the breaker trips again during reset, they may not be re-set again until further investigation identifies the cause.

DO NOT test, re-set or operate facility circuit breakers. Contact the construction manager or delegate.

If an Assured Equipment Grounding Conductor Program (AEGCP) is used in place of ground-fault circuit interrupters (GFCIs) for ground-fault protection, the following minimum requirements apply:

- Keep a written description of the program at the jobsite. Outline specific procedures for the required equipment inspections, tests, and test schedule, and make them available to the Electrical AHJ *upon request.*
- Designate one or more competent persons to implement the program.
- Perform two OSHA-required tests on all electrical equipment: a continuity test, and a terminal connection test. Tests are required:
    - Before first use.
    - After any repairs, and before placing back in service.
    - After suspected damage, and before returning to use.
    - Quarterly not to exceed 3 months.
- Maintain a written record of the required tests, identifying all equipment that passed the test and the last date it was tested (or the testing interval). Like the program description, make it available to the Electrical AHJ upon request.

20.3.15 Flexible Cords and Cables

Use NRTL flexible cords suitable for the conditions and the location of use. Flexible cord sets used with grounding-type equipment must contain an equipment grounding conductor.

Portable cord and plug connected equipment and flexible cord sets (extension cords) shall be visually inspected before use on any shift for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket).

Cord and plug connected equipment and flexible cord sets (extension cords) which remain connected once they are put in place and are not exposed to damage need not be visually inspected until they are relocated. Protect flexible cords and cables from damage. Extension cord sets are not to be used as a substitute for the permanent wiring of a building.

Note: Cords and cables may be damaged by foot traffic, vehicles, sharp edges, pinching, improper storage and/or use.

Note: Extension cords are an acceptable means of extending power provided they do not contribute to overload, are protected from damage, and are removed when not in use. Daisy chaining extension cords is not allowed on PNNL project sites.

Discard damaged cord sets. Cord sets that have breaks in the insulation may be repaired by a qualified person so that the insulation is equal, or better than, the original insulation. Do not use or repair cords smaller than number 12 American Wire Gage on any PNNL construction project.

20.3.16 Entering a Space

Do not reach blindly into areas that may contain energized parts.

Do not enter a space or perform functions, such as connecting or disconnecting cords, actuating circuit breakers or switches, or any other operation that may require being close to exposed energized parts, if lighting is not adequate or an obstruction prevents adequate observation of the work.

20.3.17 Blind Penetrations

20.3.17.1 Class I Penetrations

Class I penetrations are penetrations into hollow walls, ceiling, or floors where the absence of utilities or other hazards has been determined, or two inches or less into solid material.

Sub-contractor supervision assigning workers to perform Class I penetrations must consider the location and type of work to be performed and provide oversight as necessary.

Workers performing Class I penetrations must evaluate the location of intended penetrations to identify potential hazards due to presence of hidden utilities (e.g., electrical, gas, steam) or hazardous materials (i.e., potential asbestos-containing materials). The worker evaluates the hazards, with assistance, if needed, by examining the material to be penetrated and checking behind walls, under floors, or above false ceilings to attempt to locate hidden utilities or other hazards that could be contacted during the penetration.

Upon completion of the evaluation, workers must implement the following controls:

- Use existing penetrations/holes when possible.
- Use self-tapping nylon wall anchors where appropriate for the application (e.g., anchoring light loads on sheetrock walls).
- Use non-conductive manual tools (e.g., star drills, screwdrivers, wooden handle punches, or similar tools with non-conductive handles) when feasible to make penetrations.
- Limit depth of penetration to the thickness of the external surface of hollow cavities or no more than 2 inches into solid materials when using power tools by use of short drill bit, depth gage, or other means.

Exception: Use of self-tapping nylon wall anchors is exempt from this requirement.

- Use tools equipped with a GFCI, where electric power tools are needed. Test GFCIs before use.
- Battery-powered tools can only be used in hollow cavities.
- Visually inspect or probe (tools with nonconductive handles) completed penetrations before inserting screws, toggle bolts, etc. that might contact hazards.
- Scanning is not required for penetrations of less than 2 inches in solid materials. However, regardless of depth, electric power tools are required to be protected by grounded metal contact/power cut-off circuitry ("drill stop box" attachment or integral circuitry).
- The minimum PPE required for a Class I penetration is:
    - Safety glasses with side shield, leather gloves, and substantial footwear.
    - Wear rubber outer boots over foot protection when using electric cord connected power tools with water coolant or in a wet environment.
    - Pre-use inspect & wear at a minimum Class 00, 500-volt rated insulated gloves and leather protectors when penetrating solid materials (does not apply to hollow cavities).

Note: When a hollow cavity must be penetrated beyond the thickness of the exterior surface, a check for hazards (e.g., utilities, asbestos) must be made after penetration of the outside surface by looking into the hole with a flashlight, borescope, or probing with a nonconductive or insulated tool such as a screwdriver or wooden handle punch. Stop work and notify your supervisor if this check reveals potential asbestos-containing materials or other hidden objects not anticipated. Take steps as necessary to move or remove fiberglass insulation or other non-hazardous materials that may obscure hazards. The absence of hazards in the area to be penetrated must be verified before proceeding.

Exception: Use of nylon wall anchors is exempt from this requirement.

A Class II Penetration Permit is required when penetrating solid materials beyond a depth of 2 inches or in hollow structures where the absence of utilities or other hazards cannot be determined as described above. Contact the Construction Manager or TOR for this permit form.

20.3.17.2 Stopping Work – Class I Penetration

If any unusual conditions are encountered while performing a penetration, the operation must be stopped, and the responsible manager/delegate must be informed.

Note: Examples of unusual conditions are evidence of metal shavings, electrical or insulating material, or other unexpected materials, or an unusual sound such as

that caused by contact of a drill bit with a metal object; lighting or other equipment unexpectedly turning off, or a GFCI or breaker trip.

20.3.17.3 Class II Penetrations

A Class II Penetrations must be completed for work requiring cutting, drilling, or otherwise penetrating deeper than 2 inches into solid material or through hollow structures (walls, floors, roofs, etc.) where the absence of utilities or other hazards has not been determined).

The following steps must be followed for Class II penetrations.

- The immediate manager or delegate for staff performing the work, with assistance from knowledgeable personnel, must evaluate the hazards and document this assessment on the Class II Penetration Permit.
- Review historical records, engineering drawings, and plans that pertain to the area/location of the planned penetration.
- Consult with the PNNL construction manager, TOR or other knowledgeable personnel, to assist in identifying potential hidden hazards.
- Visually inspect the proposed location of the penetration for evidence of hidden utilities in or behind walls, above false ceilings, and under sub-floor systems.
- Obtain a utility location with nondestructive testing devices (e.g., penetrating ionizing radiation, and ground-penetrating radar; magnetic and inductive devices) and mark the penetration point. If the responsible line manager or delegate has knowledge that a structure, wall, floor, or other surface does not contain electrical, gas, or other hazards, a Class II penetration may be authorized without a scan.
- If it is suspected that hidden hazards exist at the point of penetration, relocate the work if possible. If penetration cannot be relocated to a site free of obstructions, then de-energize and lock and tag utilities in the location of the penetration.
- If the penetration is to be made into a solid load-bearing wall or floor or if it cannot be relocated to avoid suspected reinforcing bar, consult a structural engineer prior to performing the penetration to make sure that the penetration does not unacceptably reduce load-bearing capacity of wall.
- Class II penetration permits must be reviewed and approved by the building manager/delegate, line manager responsible for staff performing the penetration, and the WS&H Professional.
- Post the permit at the job site.

Workers must implement the following controls:

- Wear PPE and follow requirements specified by the Class II Penetration Permit.

- AC power tools must be protected by grounded metal contact/power cut-off circuitry ("drill stop box" attachment or integral circuitry). If the power tool with ground-sensing capability detects metal objects, stop work immediately and notify your manager. DC power tools must not be used for class II penetrations.

Note: The work cannot be restarted until the penetration is relocated or the grounded metal object is identified by removing the concrete material. Only qualified electrical workers with appropriate PPE can expose embedded material.

- After identifying the grounded metal object, the responsible line manager/delegate determines the appropriate method to proceed.

Note: If the embedded object appears to be conduit, conductors, or presents other hazards to workers, stop work, isolate the area, warn other workers and notify the PNNL construction manager. Do not proceed.

- If the material is rebar or other structural material and the penetration cannot be relocated, consult a structural engineer for approval to remove it. A smaller diameter core may be required in order for power tools with ground-sensing capability to continue operation, or multiple pilot holes may be drilled to check that additional embedded metal objects do not exist in the penetration path. Once absence of additional metallic objects has been verified, power tools with ground-sensing capability can be removed and penetration completed.

20.3.17.4 Stopping Work - Class II Penetrations

If any unusual conditions are encountered while performing a penetration, the operation must be stopped, and the responsible manager/delegate must be informed.

Note: Examples of unusual conditions are evidence of metal shavings, electrical or insulating material, loss of water during core drilling, or other unexpected materials; or an unusual sound such as that caused by contact of a drill bit with a metal object; lighting or other equipment unexpectedly turning off; GFCI or breaker trip.

In addition, work must be stopped if any of the following conditions occur before or during the penetration:

- Penetration area boundaries have changed.
- Additional penetration work beyond the scope of the original work is required.

20.3.18 National Electrical Code Compliance

Electrical work such as underground installations prior to backfill/cover, temporary power installations and removals prior to energization, raceways, boxes, and cables prior to concealment, equipment connections, modifications to existing installations prior to re-energizing, service inspections initiating utility provided power, shall be inspected by a certified and qualified electrical inspector in accordance with NFPA 70

and WAC 296-46B contract requirements. These inspectors are third party and assigned Construction Electrical Equipment Inspectors (CEEI's) that report directly to the PNNL Electrical Authority Having Jurisdiction (E-AHJ). Requests for inspections from Battelle for electrical inspections will be made directly to the inspector, to also include the Electrical AHJ (cc'd for notification of project status) including the service request number. Typically, the request will come from Construction Managers, Building Engineers, Craft Supervisors/Planners, or in-house electricians. The requests are not to be made by subcontractors to the CEEI directly.

20.3.19 Work Affecting Electrical Utilities Operations

When work takes place within a horizontal distance 20 feet of the center line of the nearest voltage line, considered the "right of way" notify the electrical utility owner for an on-site meeting to establish conditions to safely complete the operations. The limited approach boundary of moveable conductors is 10 feet for ≤50 kilovolts (kV). If the vehicle/equipment is in transit, stowed in its lowest practical position, the boundary may be reduced to 4 feet. If the voltage is ≥50 kilovolts, increase the distance by 4 inches for every 10 kV over 50 kV. For other reduced clearances, consult the appropriate PNNL WS&H Professional and E-AHJ.

In addition to the requirements above, notify utilities if you intend to:

- Move any equipment taller than 14 feet under overhead power lines.
- Operate equipment within 20 horizontal feet from overhead power lines. If a vehicle is in transit with its structure lowered, the clearance may be reduced to 14 feet.
- Perform any operations near power lines during bad weather or hazardous conditions (rain, range fires, dust or windstorms, etc.).

20.3.20 Working Near Conduits (Flexible, PVC, EMT, Rigid, and MC)

Flexible Metal Conduit (FMC) & Liquid tight Flexible Non-metallic Conduit (LFNC) are meant to be used in relatively short runs and for ease of raceway installation and in locations where the equipment is subject to vibration (motors, fans, etc.). This type of raceway per NFPA 70 Article 348 Flexible Metal Conduits and Article 356 (Liquid tight Flexible Non-metallic Conduits) cannot be used where they are subject to physical damage. Therefore, care shall be taken when working near these types of conduits and around energized electrical equipment in general. Specifically, when working (electrical or non-electrical tasks) near these types of conduits the following precautions shall be taken:

- Evaluate your work activity against types of conduits found in your work area. Some conduits have a higher rate to become damaged in the work area. Safety precautions will depend on the nature of the work and types of conduit found within your work area. Planning your work will be essential for working around and near conduits safely. Remember hazards are identified and evaluated for every task, every time. Make certain work activities will not interfere or impede upon conduits. If conduits are located in your work area:
    - All employees receive basic awareness for working around conduits and electrical components.

- Machinery and equipment shall not operate within 5 feet of conduit or the circuit it carries must be de-energized. Follow PNNL lock and tag program process.

- Before cutting any utility services, including ductwork, piping systems, conduit, tubing, vacuum air, sewer, and similar installations, employees must conduct a comprehensive 360-degree inspection of adjacent areas. This inspection is critical in congested locations such as suspended ceilings, mechanical spaces, and utility trenches. If systems with hazardous energy are within the boundary or envelope of the cutting tool, or if the entire blade or cutting surface is not visible during the cutting operation, the hazardous energy sources (such as electrical, pressure, gas, toxic gases/chemicals, etc.) must be de-energized and locked out and tagged out.

- The subcontractor performing the work can propose tools, methods, shielding, or other alternatives to de-energizing the hazardous energy source. The proposed alternative solutions must be reviewed and approved by both the PNNL Construction Manager and the PNNL Construction Safety Representative as being safe and acceptable. These approved solutions must be documented in the contractor's Job Safety Analysis (JSA).

  Note: A "360-degree inspection of adjacent areas" refers to a thorough and comprehensive examination of all surrounding utilities using a full-circle perspective. This inspection aims to identify any potential issues, hazards, or points of interest by observing the entire vicinity without leaving any blind spots.

- Report any broken conduits, missing faceplates, open ended wires that could potentially expose employees to energized parts.
- Never attempt to move a permanently installed equipment and/or electrically connected equipment via a flexible conduit without properly isolated and establishing an electrically safe work condition and if necessary, disconnecting it from the power source.
- Flexible conduits are not meant to be treated like a cord used in cord & plug equipment. (Typically cord and plug equipment can be relocated while connected to a power source).
- Prior to moving light fixtures wired by metal clad cable, PNNL's approval is required.

20.3.21 Working on Flexible metal/non-metallic Conduits (performing electrical work):

When working on equipment connected to an electrical power source via a metallic or non-metallic flexible conduit, always perform the following:

- Ensure electrical power is isolated and controlled per PNNL's Lockout and Tagout (LOTO) Program.
- Ensure no damage exists to the conduit system (i.e., flexible conduits are not broken, or pulled out of connectors, couplings and connectors are tight, covers are in place, knockouts are covered).
- Contact the CEEI or PNNL E-AHJ for assistance with electrical code applicability and implementation of the following: Use of such conduit is approved and appropriate for that location per NFPA 70, Articles 348 and 356.
- Determine whether it is appropriate to use the conduit itself as an equipment grounding conductor (EGC).
- Determine raceway itself can be used as an equipment grounding conductor, verify proper continuity is maintained after installation and or modification.
- Determine raceway cannot be used as an EGC, a separate EGC must be included as part of the circuit conductors and routed with the current carrying conductors within the same raceway.

20.4 Requirements and References

20.4.1 Requirements

Activity Specific Electrical Worker Qualification Course #2024

20.4.2 References

NFPA 70E, Standard for Electrical Safety in the Workplace

NFPA 70, *National Electrical Code*

WAC 296-24, *General Safety & Health Standards Part L, Electrical*

WAC 296-46B, *Electrical Safety Standards, Administration & Installation*

29 CFR 1926, *Safety and Health Regulations for Construction*

29 CFR 1910, *Occupational Safety and Health Standards*

20.4.3 Exhibits and Forms (Located on Contracts Page)

Activity Specific Electrical Worker Qualification Form, Course #2024

Checklist for Insulating Rubber Gloves

Electrical Work Plan and Instructions

Temporary protective grounding

21.0 Lockout and Tagout

21.1 Purpose

This section applies to contractors when installing, servicing, and/or performing maintenance on machines, equipment, or systems that could potentially start-up and cause injury to personnel or unexpectedly release hazardous energy. The potential to cause injury or release hazardous energy is identified during planning, hazard analysis, or when recognizing changed or unexpected conditions during the performance of work.

The requirements in this section apply to contractors in Battelle-owned and operated facilities or working on Battelle-owned and operated equipment located off-site or in a leased facility. When working off-site, use this work control in addition to any applicable requirements from the host facility.

This section does not apply when:

- It is determined there is no potential for the release of hazardous energy.
- Compressed gas cylinders are being installed or removed.
- Pressure, vacuum, and compressed gas supply systems are physically disconnected in accordance with the Pressure and Vacuum Systems or Compressed Gas Supply Systems work controls.
- Greenfield Construction activities, where infrastructure systems (e.g., mechanical, electrical, piping) are built toward the energy source but not connected (no less than 5 feet between) to a service point lockout and tagout is not required. Lock out tag out is required when there is an ability to connect the system to the energy source (conduit/duct/piping installed without breaks, and conductors pulled into the utility vault).
- Leased facility owners or their contractors are working on leased-facility equipment.
- Configuration locks and/or warning tags are used to control facilities and equipment in a specific configuration. See the Warnings and Barriers for Hazards work control for configuration control methods.
- Equipment or system configuration is being controlled for a business or production purpose (i.e., for purposes not associated with the protection of personnel from hazardous energy during service and/or maintenance). See Sample Accident Prevention Tags for examples of tags to use for configuration control.

The following are exceptions to this section (i.e., when hazardous energy needs to be controlled, but lockout and tagout is not required):

- Work on equipment that needs to remain energized for service and/or maintenance (e.g., troubleshooting activities; voltage checks; current checks; hot-tap operations involving transmission and distribution systems for substances such as gas, steam, water, or petroleum products within a pressurized system) and is performed in accordance with an approved procedure. This only applies if the Controlling Organization has demonstrated that the continuity of service is essential and shutdown of the system is impractical, and a review or approved work plan has been completed.

- Work on electrical equipment conducted in accordance with section 20.0 Electrical Work Safety work control when it can be conclusively demonstrated that de-energizing creates additional or increased hazards, or when it is infeasible due to equipment design or operational limitations.
- Emergency situations (e.g., freeing an individual from an energized electrical component, rescue of an individual from a confined space) if other compensatory measures are in place and followed.

21.2 Definitions

See Appendix A for the complete definition of terms used in this procedure.

21.3 Planning for Lockout and Tagout

Installation, servicing, and maintenance of machines, equipment, and systems must be performed, and there is a potential for unexpected release of hazardous energy or the start-up of the machines, equipment, or systems could cause injury to personnel. This potential is identified during previous planning, hazard analysis or recognition of concern during the performance of work.

Note: Refer to hazard-specific work controls or contact the WS&H Professional if there are questions.

Contractors shall utilize the Isolation/Outage Request Form to identify facility systems, utilities, or services that meet the requirements for hazardous energy isolation for LOTO. This request allows the Controlling Organization to review the work scope, evaluate the hazards, and determine how the lock and tag will be performed.

21.3.1 General Requirements

These requirements do not apply to the following:

- When it is determined that there is no potential for the release of hazardous energy.
- Equipment and/or facility have been deactivated under a PNNL internal process of modification to the facility or under a project specific plan and all energy sources are air gapped with no intent of reconnection, and LOTO is no longer required.
- Greenfield Construction activities, where infrastructure systems (e.g., mechanical, electrical, piping) are built toward the energy source and LOTO is not required until there is an ability to connect the system to the energy source.
- Leased facility owners or their contractors working on leased-facility equipment.
- The use of locks and tags for configuration control. See Section 18.0 Signs and Barricades for configuration control methods.
- Emergency situations (e.g., freeing an individual from an energized electrical component, rescue of an individual from confined space) when alternative protective controls are in place and followed.

The following are exceptions apply to this procedure:

- Installation and removal of compressed gas cylinders.
- Work on equipment where the servicing or maintenance requires the equipment to be energized (e.g., troubleshooting activities, voltage checks, current checks, hot-tap of a pressurized system).
- Work on electrical equipment when it can be conclusively demonstrated that de-energizing introduces additional or increased hazards, or when it is infeasible due to equipment design or operational limitations, should be conducted in accordance with section 20.0 Electrical Work Safety.
- Instances where equipment or system configuration is being controlled for business or production purposes (i.e., for purposes not associated with the protection of personnel from hazardous energy during service and maintenance).

21.3.2 Required Procedure

An authorized worker trained individual evaluates the potential for unexpected release of hazardous energy. Based on training and LOTO requirements, evaluate the scope of work to determine if there is a potential for the unexpected release of hazardous energy and if LOTO is needed. Only a worker that is knowledgeable about all the hazards associated with the system and PNNL LOTO training (692) shall make this determination. See the LOTO Threshold Table below to determine if LOTO is required. If lockout is not possible, follow the Alternative Means of Isolating Hazardous Energy from Specific Equipment_exhibit. Provide recommendation to the controlling organization.

Type of Hazardous Energy		Threshold Requiring Lockout and Tagout	Examples
Electrical (i.e., alternating and direct current)		≥ 50 volts and ≥ 5 milliamps	Electrical equipment, batteries, motors, microscopes, uninterruptable power supplies
		50-400 volts and > 1 joule stored energy	Electrical capacitors
		400 volts or greater and > 0.25 joules	
Thermal	Hot	Liquids or gases ≥ 120°F Surfaces ≥ 140°F	Steam, hot water, piping
	Cold	Liquids and surfaces < 27°F	Cryogens
Mechanical Motion (i.e., kinetic energy)		Motion that could generate hazardous energy	Linear travel or rotation; engines, pumps, fans
Stored Energy (i.e., potential energy)		Object(s) that could generate hazardous energy if released.	Springs, elevated objects
Compressed Gas		>150 pounds per square inch (psi), evaluate all pressures when flammable and toxic gases are	Compressed air, specialty gas,

Type of Hazardous Energy		Threshold Requiring Lockout and Tagout	Examples
		involved, based on existing controls.	
Pressurized Systems	Minimal Action	Lockout and tagout is not required for pressure hazard, evaluate need for lockout and tagout for toxic and flammable materials based on existing controls.	Bench scale low hazard research equipment
	Action-required vessels systems	All, except when hazardous energy is controlled following applicable work controls.	Air compressor, research process equipment
	Facility Systems	>150psig, evaluate all pressures when flammable and toxic gases are involved, based on existing controls.	Heating hot water, steam, boiler
	Alternate measures and definitions for pressurized systems and compressed gas can be found in the Pressure and Vacuum Systems and Compressed Gas Supply Systems work controls.		
Non-ionizing radiation **Note:** Other forms of electromagnetic radiation may require lockout and tagout to mitigate the personnel hazard (i.e., magnets). Contact the Lockout and Tagout Program) for guidance.		Class 3B or 4 lasers, except as specified in the Laser Use Permit.	
Ionizing Radiation		Radiation generating devices that have the potential to exceed a control level. Contact the Lockout and Tagout Program for guidance.	X-ray devices
Chemical		Evaluate based on the chemical hazards, container/system, activity, and existing controls in place.	Flammable gases, toxic, reactive

The Controlling Organization determines if and how LOTO will be performed. The Controlling Organization is responsible to evaluate the scope of work and the potential for unexpected release of hazardous energy, and determine if and how the LOTO will be performed. The options include:

- **Simple LOTO** – Controlling Organization determines the criteria for Simple LOTO can be met and provides authorization for the Authorized Worker to perform the Simple LOTO using the Authorized Worker Simple Lockout and Tagout Form. No controlling organization locks will be used. Refer to the How to Perform Work Under Lockout and Tagout Exhibit.
- The machine or equipment has no potential for stored or residual energy, or re-accumulation of stored energy after shutdown that could endanger staff.

- The machine or equipment has a single energy source that is readily identifiable and isolated.
- Isolating and locking out the energy source will completely de-energize and deactivate the machine or equipment.
- The machine or equipment is isolated from its energy source and is locked out during service and/or maintenance.
- A single lock will achieve a locked-out condition.
- The lock is under the exclusive control of the authorized worker performing the service and/or maintenance (i.e., the key to the lock is in the possession of the authorized worker). Transferring a lockout and tagout during shift or personnel changes is not permitted.
- The service and/or maintenance does not create hazards for other staff members.
- No accidents have resulted from the unexpected activation or re-energization of the machine or equipment during service and/or maintenance.

Use the Authorized Worker Lockout and Tagout with Written Instructions process or the Controlling Organization Lockout and Tagout with Written Instructions process, and prepare a Lockout and Tagout Written Instruction Form if any of the following conditions apply:

- All eight of the Simple Lockout and Tagout criteria cannot be met
- Tagout plus energy isolating device(s) are required
- An authorized worker representative will perform a safe-to-work check for other authorized workers.
- Temporary protective grounding will be used
- Lockout and tagout will be transferred during a shift or personnel changes
- The Controlling Organization determines it is needed.
- **Authorized Worker LOTO with Written Instructions** – Controlling organization issues written instructions for the Authorized Worker to perform the LOTO. Refer to the How to Perform Work Under Lockout and Tagout Exhibit.
- **Controlling organization "Danger - Do Not Operate" LOTO** – Controlling organization issues written instruction and requires the use of Controlling Organization LOTO. Refer to the How to Perform Work Under Lockout and Tagout Exhibit.

Identify the energy isolating device(s), using approved engineering drawings, on the selected lockout and tagout form. If engineering drawings are not available or up to date, use other methods to identify the energy isolating device(s), such as:

- Visual inspection of system or equipment to verify the system status, services abandoned in place and/or other system configuration considerations.
- Hand over hand verification of services/utilities

- Documentation of circuit verification.
- Approved documentation that previously identified energy isolating device(s).

Implement energized work processes until all energy isolating device(s) are confirmed to be effective and are controlled using lockout and tagout if the above methods of identifying the energy isolating device(s) cannot guarantee the complete isolation from the energy source.

Evaluate existing engineering controls, administrative controls, and personal protective equipment that are in use to determine if lockout and tagout is required. Lockout and tagout may be required to maintain an engineering control in a safe configuration while service and/or maintenance is being performed.

The *Lockout Tagout Written Instruction Form* must be technically reviewed and signed, by someone who did not prepare the form but is knowledgeable about the system being isolated, before the energy isolating devices can be authorized to be installed. The Lockout and Tagout Program must approve the use of procedures or documents (e.g., a Standard Operating Procedure or permit) other than the Simple Lockout and Tagout Form or the Lockout and Tagout Written Instruction Form. Procedure must communicate the scope of work, energy of work, energy source(s), magnitude of energy, and the means/methods to control the energy. Contact the Lockout and Tagout Program for a template.

Perform the following when the Controlling Organization determines that a lockout and tagout form needs to be corrected:

- Obtain a new technical review if the isolating boundary has not been established and the revision will affect how the lockout and tagout is performed (e.g., adding or deleting energy isolating device[s], changing the method of performing a system isolation check). Pen and ink changes are not allowed.

Additional isolation points must not be added to the isolating boundary after it has been established without completely revising the written instructions and rehanging the LOTO.

1. LOTO devices will be used in accordance with the requirements described in the Locks, Tags, and Other Devices for Hazardous Energy Control exhibit.

2. If an energy isolating device cannot be physically locked out, performed, follow guidance in Exhibit *Locks Tags and Other Devices for Hazardous Energy Control* for tagout-only. Additionally, review the Alternative Means of Isolating Hazardous Energy from Specific Equipment exhibit.

21.4 Make Appropriate Authorized Worker and Affected Worker Notifications

Notify affected workers that may be impacted (e.g., isolation of the equipment or system, the duration of the work) by the work before and after it is performed.

Inform authorized workers of the specific scope of work, energy type/magnitude, and the means and methods (i.e., energy isolating devices, special instructions) required to perform the work safely.

21.5 Set Up Appropriate Hazardous Energy Control

21.5.1 Alternative Means of Isolating Hazardous Energy from Specific Equipment

When service and/or maintenance is performed on equipment or tools with no residual energy, an alternative means of isolating hazardous energy can be used instead of a physical installing lockout and tagout device(s).

Cord-and-plug-connected electric equipment can be completely isolated by unplugging the equipment from the energy source and keeping the single plug under the exclusive control (i.e., the plug remains within arm's reach and within line of sight) of the staff member performing the service and/or maintenance. Only one staff member at a time can perform service and/or maintenance work using this exception.

Pneumatic driven tools can be completely isolated from their energy source by physically disconnecting them from the pressure sources and maintaining them under the exclusive control of the staff member performing the service and/or maintenance. Only one staff member at a time can perform service and/or maintenance work using this exception.

Alternative means can be used if making a minor service, adjustment, or tool change during a routine, repetitive, and integral activity that takes place during normal operations. However, do not remove or bypass a guard or other safety device, or place any part of the body within the point-of-operation or danger zone during an operating cycle. Contact a Worker Safety and Health professional to evaluate the work activity and determine if alternative controls are required to provide effective protection from hazardous energy.

Do not use alternative means for non-routine activities that take place outside of the normal production process and require disassembling machines or equipment (e.g., changing a cutting blade, or replacing a belt, valve, gauge, or support structure).

For engine driven equipment, consult the equipment manufacturer service and/or maintenance guidelines (e.g., operating manuals and bulletins) to establish hazardous energy control measures.

For engine driven equipment, the following methods may be used to control the unexpected release of hazardous energy while performing service and/or maintenance:

- When service and/or maintenance is performed by one person and will not involve work on or near electrical/ignition circuitry:
    - shut off the equipment and remove the key from the ignition switch.
    - the person who is performing service and/or maintenance maintains exclusive control of the key.

- When service and/or maintenance is performed by more than one person and will not involve work on or near electrical/ignition circuitry:
  - shut off the equipment
  - place the ignition key in a locking device (e.g., lock box).
  - Each staff member performing the service and/or maintenance must apply their authorized worker lockout and tagout to the locking device (e.g., lock box).
- When service and/or maintenance will involve work on or near electrical/ignition circuitry
  - Disconnect the battery and install a locking device (e.g., cord locking device) on the battery connector.
  - Each staff member performing service and/or maintenance applies their authorized worker lockout and tagout to the locking device (e.g., cord locking device).
- Control equipment without an ignition switch/key from unexpectedly starting in accordance with the manufacturer service and/or maintenance guidelines (e.g., disconnecting the ignition wire from the spark plug).
- Use the battery isolator switch if it is installed. If not already installed, a battery isolator switch may be installed and used.
- For engine driven equipment, if there are circumstances where other sources of energy also need to be controlled or other means to control the hazard are appropriate, perform the following:
- Notify the work team lead or immediate manager
- Obtain the approval of the Lockout and Tagout (SME) to establish the additional measures necessary to protect staff members.
- Decide if additional measures are needed (e.g., disconnecting the power take-off (PTO), bleeding pneumatic or hydraulic lines, and/or blocking gravitational energy).

Service and maintenance may be performed on a system or facility without using lockout and tagout if all the following conditions can be met:

- There is a visually verified physical separation from the energy source(s)
- It is not intended to be re-connected (i.e., the disconnection is permanent)
- The separation eliminates all sources of hazardous energy with no residual energy
- It cannot be readily restored
- It is accomplished using a project specific plan (e.g., Lockout and Tagout Written Instructions, a procedure).

Obtain the approval of the Controlling Organization and Lockout and Tagout Program before using any alternative protective measures (e.g., freeze plugs) not identified in this work control.

21.5.2 Locks, Tags, and Locking Devices (Including coordination with Configuration Control Tags)

Machines or equipment must be designed to accept lockout device(s) whenever a major repair is performed, during renovation or modifications, when parts are replaced, or when new machines or equipment is installed.

Use standardized lockout devices:

- Controlling Organizations must use red locks
- Authorized workers must use green locks
- Locks must be compatible with the energy isolating device and hardware.
- Locks used for hazardous energy control should be made of a composite material and have ¼" diameter shackle.

Use tagout devices that have a standardized print and format and are appropriate for the environmental conditions.

- Controlling Organizations must use Danger, Do Not Operate tags
- Authorized workers must use Danger, Equipment Locked Out tags

See Locks, Tags, and Locking Devices for Hazardous Energy Control for additional information.

Lockout and tagout devices and hardware used for hazardous energy control must be durable, substantial, and not create additional hazards.

Do not use red and green locks for applications other than protecting personnel from the unexpected release of hazardous energy.

Lockout and tagout devices must be affixed to each energy isolating device by authorized employees. The key to authorized worker assigned locks must remain under the exclusive control of the authorized worker.

Lockout devices, where used, must be installed in a manner that will hold the energy isolating devices in a "safe "on "off", "open", or "closed" position.

Other hardware must be available for isolating, securing, or blocking machines or equipment, as needed. Use these devices in accordance with the manufacturer's instructions.

Tags must be installed on the energy isolating device using the lock.

Secure tags so they are easily visible, but do not obscure indicators or controls.

Lockout and tagout devices must be applied to energy isolating devices that are capable of being locked out. See the *Tagout Plus* section if an energy isolating device is not capable of being locked.

Authorized Workers who install a lockout device (i.e., either an Authorized Worker lockout device, or as delegated by the Controlling Organization to hang a Controlling Organization lockout device) should physically challenge energy isolating device(s) and/or locks to confirm it can hold the desired position.

When performing Authorized Worker Lockout and Tagout with Written instructions or Controlling Organization Lockout and Tagout with Written Instructions, the verifier should challenge energy isolating device(s) and/or locks prior to Authorized Worker performing work.

Do not physically challenge energy isolating devices and/or lockout devices after Authorized Workers have begun work under lockout and tagout.

If approved by the Controlling Organization, the authorized worker may leave their lockout and tagout in place if work will continue the following day. If the authorized worker will not be able to complete the job (e.g., taking vacation) and the removal of the lockout and tagout would leave an unsafe condition:

- The authorized worker communicates the status of the job and the potential unsafe condition to the Controlling Organization.
- The Controlling Organization is then responsible for controlling the operation of the equipment.

Controlling Organization and/or authorized worker lockout and tagout devices may be used in parallel with configuration control methods when all the following conditions are met:

- The position of the energy isolating device(s) required for configuration control do not conflict with the required position for lockout and tagout.
- Configuration control is required following removal of lockout and tagout device(s).

And it has been determined by the Controlling Organization that configuration control methods in use do not create a hazard to affected and/or authorized workers.

Energy Isolating Devices

Do not use the following items as energy isolating devices:

- pushbuttons
- selector switches
- Programmable Logic Controller systems
- safety interlocks
- emergency stops
- lanyard switches
- other control circuit type devices.

Do not use relief valves, regulators, and check valves as energy isolating device unless they are mechanically restrained in the required position with a gagging device designed for that

purpose, and a lockout is applied to the gagging device. See Compressed Gas Supply Systems for additional information.

To use a pneumatically or electrically operated valve that fails in the desired position as an energy isolation device, verify:

- The valves are in the desired position
- The valve operating mechanisms (local and remote) are isolated
- A lockout and tagout device is installed.

To use a pneumatically or electrically operated valve that fails in an undesired position as an energy isolation device, verify:

- The valves are placed in the desired position
- The valve operating mechanisms (local and remote) are isolated
- A jacking device or gag is installed
- A lockout and tagout device is installed to keep the valve in the desired position.

Hazardous Energy Isolation Practices

An access barricade must be established whenever barriers (e.g., guards or other safety devices) are removed in order to prevent access by anyone who has not installed a lockout and tagout device(s) to the energy isolating device(s). See the Warnings and Barriers for Hazards work control for additional information.

Energy sources must be isolated with a manually operated control device that directly controls the power source.

When working on an uninterruptible power supply (UPS) system (i.e., a system with a battery power source), the Controlling Organization must identify the type of system installed and develop specific steps to isolate the battery power supply and/or normal power sources.

Single block valves may be used as an energy isolating device if the valve is:

- Intended for the service of the system
- Rated for the pressure of the system
- Verified it is holding and there are no signs of leakage which has potential to expose workers to a hazardous condition.

When isolating single block valves, safe conditions can be verified by loosening the fasteners on flanged connections or valve bonnets, or by removing the instrument tubing.

Consider using double block and bleed protection for jobs that involve:

- Flammables or toxic materials that may be unexpectedly released into an area where hot work is being performed.

- Pressurized steam systems.

Use double block and bleed protection for jobs that involve entry into a confined space where hazardous energy in the form of chemical, pneumatic, hydraulic, or pressurized steam could potentially be released into the space.

Blanking, blinding, blocking, or disconnecting potential hazards may be acceptable instead of double block and bleed when approved by the Controlling Organization and Lockout and Tagout Program.

If double block and bleed protection is required:

- Verify that block valves that are closed and tight
- Verify that bleed valves or atmospheric drains are open and clear
- Verify that block valves and bleed valves are locked in the desired position.

If double block and bleed is required but not achievable, a specific written work plan must be prepared identifying the hazards and work methods that will achieve equivalent protection. The plan must be approved by the Worker Safety and Health professional and the Controlling Organization. Authorized workers must be trained to this plan prior to performing the work.

If isolation from the energy sources does not eliminate the potential energy or movement of equipment due to springs, gravity, or other potential energy, block or otherwise secure the equipment to prevent such movement. If possible, lockout and tagout the blocking or securing devices in place. In all cases, a tag should be placed on or near the blocking device.

For equipment with capacitors, follow Capacitor Safety and Risk Assessment.

Specific examples of hazardous energy isolation practices can be found in Hazardous energy Isolation Practices.

Temporary Protective Grounding

The need for temporary protective grounding must be determined by the Controlling Organization.

If temporary protective grounding is required, use the Authorized Worker Lockout and Tagout with Written Instructions or Controlling Organization Lockout Tagout process. The location, sizing, and application of temporary protective grounding equipment must be included on the Written Instruction Form. Do not use Simple Lockout and Tagout.

Ground phase conductors or circuit parts before touching them if:

- There could be induced voltages or stored electrical energy
- The conductors or circuit parts being deenergized could contact other exposed energized conductors or circuit parts.

Temporary protective grounds must be installed and arranged in a way that prevents any employee from being exposed to hazardous differences in electrical potential.

Remove all temporary protective grounding equipment, conductors, or devices prior to restoring electrical energy to the system or component. This must be verified by the person-in-charge of the work.

Temporary protective grounds must be capable of conducting the maximum fault current that could flow at the point of grounding for the time necessary to clear the fault.

Temporary protective grounds must have an impedance low enough to cause the immediate operation of protective devices in case the electric conductors or circuit parts are accidently energized.

Personal protective ground cable sets must be inspected for cuts in the protective sheath and for damage to the conductors. Clamps and connector strain relief devices must be checked for tightness. These inspections must be completed prior to each use.

Temporary protective grounds that have been repaired or modified must be tested prior to returning them to service.

Grounding and testing devices must be stored in a clean and dry area and must be properly inspected and tested before each use.

Transitioning from Greenfield Construction to Lockout Tagout

During greenfield construction, lockout tagout is required once there is an ability to connect. When planning and carrying out this work, it is important to sequence work to prevent an ability to connect until the project is ready.

A physical separation of no less than 5 feet for the service lateral or service drop must be maintained (i.e., no conduit/duct connection and conductors).

If the physical separation is lost or cannot be established, and a comingled installation has been achieved (conduit/duct is connected to utility owned equipment), then LOTO controls are required. Once the ability to connect has been reached:

A Controlling Organization Lockout Tagout isolation boundary will be established by hanging a Controlling Organization lock and tag on the transformer enclosure AND temporary protective grounds applied at the service disconnecting means in accordance with grounding for personnel protection.

All personnel working on the system being controlled by this lock are authorized workers and must have a personal lock on a hasp or lock box. This will allow for authorized workers to maintain exclusive control of the isolation boundary.

When energizing the premises wiring, the service disconnecting means must be locked out in the open position and a safe-to-work check performed at the switchboard bus after energizing the service disconnect line side.

21.6 Perform Work Within Established Isolating Boundary Using Required Procedures

If performing a Simple Lockout and Tagout, follow How to Perform Work Under Lockout and Tagout. The Controlling Organization reviews and determines if all the criteria listed on the Simple Lockout and Tagout Form are met and then authorizes the work using the Simple Lockout and Tagout Form. If the criteria in the form cannot be met, or if the task is more complex and carries too much inherent risk, consider using one of the other types of lockout and tagout.

Do not use a lock box with this lockout and tagout method.

If performing an Authorized Worker Lockout and Tagout with Written Instructions, follow How to Perform Work Under Lockout and Tagout.

Do not use a lock box with this lockout and tagout method.

If performing a Controlling Organization Lockout and Tagout with Written Instructions, follow How to Perform Work Under Lockout and Tagout.

A lock box may be used with this lockout and tagout method.

Do not authorize another person to ignore or violate this program.

Stop work and notify the Controlling Organization if unexpected hazards or conditions are discovered.

21.6.1 System Isolation Check

The system isolation check must be performed before the safe-to-work check. It can be performed before or after each energy isolating device has been locked and tagged.

If the system isolation check requires a voltage check, follow the Electrical Work Practices work control.

When performing a Controlling Organization Lockout and Tagout with Written Instructions, the system isolation check must be conducted under the direction of the Controlling Organization before the authorized workers perform their safe-to-work check.

21.6.2 Safe-to-Work Check

Each authorized worker must perform or witness a safe-to-work check:

- Before the start of work
- If the configuration changed
- If the job location has been left unattended (i.e., the authorized worker has removed their lockout and tagout device). Equipment or a lock box with an authorized worker lockout and tagout device installed is considered “attended” for that worker only.

Follow the Electrical Work Practices work control if performing a safe-to-work check for electrical energy.

When an authorized worker is not qualified to perform the necessary safe-to-work check, they must witness it being performed by a qualified authorized worker.

A safe-to-work check must be performed in addition to the system isolation check even if the authorized worker observed the system isolation check. In some cases, the safe-to-work check may use identical methods as the system isolation check, but it must be witnessed or performed by each authorized worker.

Perform a safe-to-work check using one or more of the following methods:

- Attempt to restart (after confirming that personnel are clear of the potential hazard)
- Use of instrumentation
- Use of other appropriate methods, approved by the Controlling Organization and/or Lockout and Tagout Program, to verify all sources of hazardous energy have been controlled

Voltage checks must be conducted where electrical shock hazards (direct exposure) exist. In the case where hazardous energy is mechanical with an electrical motive force (indirect exposure), an authorized worker may request a voltage check on the electrically powered component.

21.6.3 Safe-to-Work Check by Authorized Worker Representative

When work is performed inside a radiation area, confined space, arc flash boundary, or similar hazardous environment, an authorized worker representative(s) may be designated to perform the safe-to-work check (witnessed or not) on behalf of others with their consent.

- Consent must be documented on the Lockout and Tagout Written Instruction Form.
- The authorized worker representative(s) performs or witnesses a safe-to-work check.

The authorized worker representative communicates to the work crew that the safe-to-work check is complete.

21.6.4 Lock Boxes and Group Lockout and Tagout

When service and/or maintenance is performed by a crew, craft, department, or other group each authorized worker must have a level of protection equivalent to what is provided to the authorized worker installing the lockout and tagout device.

When a lockout and tagout will extend over multiple shifts, a lock box may be used to facilitate the transfer process.

Each authorized worker performing a service and/or maintenance activity must be in control of the hazardous energy throughout the entire period of exposure. Each authorized

worker in the group must install their own lockout and tagout device(s) as part of the group lockout and tagout.

A lock box can only be used for a Controlling Organization Lockout and Tagout with Written Instructions if:

- The lock box, numbered lock(s) and tag(s) are placed on each energy isolating device(s) after de-energization.
- The key(s) to the numbered locks are placed into the corresponding lock box. The controlling organization secures the lock box with a controlling organization lock, and numbered lock box tag, after all the keys to the numbered locks (from the lockout and tagout devices that were installed on the equipment) are inside the lock box.
- Each authorized worker assigned to the job installs their authorized worker lockout and tagout device to the lock box. As a member of a group, each authorized worker verifies that all hazardous energy has been rendered safe and performs a safe-to-work check.
- The Controlling Organization lockout and tagout device(s) cannot be removed or the energy isolating device(s) turned on until each authorized worker removes their lockout and tagout device from the lock box. After all authorized workers have completed their work and removed their lockout and tagout device from the lock box, the controlling organization can restore the machinery/equipment to service when it is determined safe to do so.

Facilities and Infrastructure Operations lock boxes must be numbered according to their implementing procedure. Other organizations that utilize lock boxes must obtain a lock box number from the Lockout and Tagout Program.

21.6.5 Tagout Plus

If an energy isolating device can be locked out, it must be locked out.

If energy isolating devices cannot be physically locked out, the Controlling Organization must obtain Worker Safety and Health Group Lead (WS&H GL) approval to perform "Tagout Plus" instead of lockout and tagout. WS&H GL approval must be documented in the Lockout and Tagout Written Instruction form. Tagout Plus cannot be used if performing a Simple Lockout and Tagout.

Tagout Plus controls must use at least one additional safety measure designed to protect employees from injury or death through the inadvertent activation of an energy isolating device. This could be the result of human error, inadvertent contact, the loss or detachment of a tag, or from other tag limitation. Examples include, but are not limited to:

- The removal of an isolating circuit element
- Blocking of a controlling switch
- Opening of an extra disconnecting device
- Closure of a second in-line valve (e.g., double block and bleed)

- Barricading a controlling switch
- Removal of a valve handle to reduce the likelihood of inadvertent energization.

If needed, contact the Lockout and Tagout Program for assistance identifying the appropriate additional safety measures.

When using tagout plus, document the following on the Lockout and Tagout Written Instruction Form:

- the Tagout Plus controls
- what additional safety measures were taken
- the specific energy isolating device that needs additional control(s)
- the position of the component being tagged out (e.g., tagged open, tagged closed, removed).

Securely attach tagout devices directly on energy isolating devices using an environmentally tolerant nylon cable tie, or an equivalent item that has a minimum unlocking strength of at least 50 lbs.

If a tagout device cannot be attached directly to an energy isolating device, they must be located as close as safely possible to the energy isolating device and in a position that is immediately obvious to anyone attempting to operate the device.

Secure tagout devices so they are readily apparent, but do not obscure indicators or controls.

21.6.6 Transferring a Lockout and Tagout During Shift or Personnel Change

To transfer a lockout and tagout during shift or personnel changes, perform the following:

- The outgoing and incoming authorized workers walk down the job jointly.
- The incoming authorized worker verifies the energy is isolated.
- The incoming authorized worker places their lockout and tagout device(s) on the energy isolating device(s).
- The outgoing authorized worker performs a safe-to-work check witnessed by the incoming authorized worker.
- The outgoing workers remove their lockout and tagout device(s).

Do not transfer a lockout and tagout if performing a Simple Lockout and Tagout.

21.6.7 Temporary Lift

If one or more lockout and tagout devices needs to be temporarily lifted for testing or troubleshooting prior to the removal of all lockout and tagout devices, the Controlling Organization must approve.

When a temporary lift is being performed using the Lockout and Tagout Written Instruction Form, complete the Lockout and Tagout Temporary Lift section to identify the energy isolating device, date and time of the temporary lift, when it is reinstalled, and that another authorized worker completed the verification. Temporary lifts performed using the Simple Lockout and Tagout Form are not required to be documented.

Retain the *Lockout and Tagout Temporary Lift* section of the *Lockout and Tagout Written Instruction Form*.

Suspend all service and maintenance activities associated with the lockout and tagout before performing the temporary lift.

Remove all applicable lockout and tagout device(s) that will be affected by the temporary lift.

Consider other controls that may be necessary to protect workers or equipment during activities that require the temporary lift.

The following conditions must be met to temporarily remove lockout and tagout devices:

- The removal will only occur during the limited time necessary for testing and troubleshooting, or situations authorized by the Controlling Organization and Lockout and Tagout Program.
- All staff members are in a safe location.
- Equipment is cleared of tools and materials.
- Lockout and tagout device(s) are removed and retained for re-installation, if needed.

  Affected workers are informed when equipment is be energized or de-energized.

If lockout and tagout devices are reinstalled, a system isolation check is performed for each energy isolating device that was lifted and safe-to-work checks are performed by authorized workers.

21.7 Remove Lockout and Tagout Devices and Release Location

Each authorized worker can only remove their own lockout and tagout devices(s) from an energy isolating device(s). If an authorized worker is not available to remove their lockout and tagout device(s) (i.e., the authorized worker is not on-site) and there is a compelling reason to remove the device(s) that cannot be postponed until they return, the device(s) can be removed if the authorized worker's immediate manager and the Facility Manager complete the Management Removal of Authorized Worker Lockout and Tagout form. The Controlling Organization must verify the form is completed prior to the removal of the absent worker's device(s).

Authorized workers must not remove a lockout if doing so creates an unsafe condition.

Do not remove equipment from its installed location if lockouts and/or tagout devices are installed.

Submit the following to Worker Safety and Health Records when the work is complete:

- Simple Lockout and Tagout Form
- Lockout and Tagout Written Instruction Form
- Management Removal of Authorized Worker Lockout and Tagout Form.

21.8 Training

21.8.1 Required Procedure

All Contractor and Subcontractor employees are considered affected workers and will receive an initial lockout/tag out general awareness briefing before they begin work for PNNL and an annual refresher briefing thereafter.

To become an authorized worker Contractor and Subcontractor employees must complete the PNNL Lock and Tag for Authorized Workers (course 692) training within the previous year. Course 002863 Annual LOTO Refresher is required to maintain Authorized Worker qualification. PNNL will accept reciprocity for HAMMER Lockout/Tagout training course 00313 Initial or 00316-Refresher (formerly 00313 Refresher).

To assume delegated Controlling Organization responsibilities, an individual must be a PNNL staff member trained as an authorized worker and complete PNNL Course 2790 Controlling Organization LOTO Training.

An alternative to becoming an authorized worker or Conditional Authorized Worker is for the Contractor and Subcontractor employee to remain outside the control boundary and direct a PNNL authorized worker to perform the work.

Vendors and service personnel may receive on-the-job training (2592) and be qualified as a conditional authorized worker when the following criteria can be met:

- Work will be performed on specific equipment or machine.
- The scope is well defined (e.g., service contract, statement of work).
- The task will be completed in short duration for a specific timeframe agreed upon by the PNNL point of contact and the LOTO subject matter expert (SME).
- Approved by the WS&H Group Leader.
- The PNNL point of contact and LOTO SME review work scope to determine applicability. If agreement is reached, the PNNL point of contact develops a plan with the assistance from the LOTO SME to provide on-the-job training to each vendor/service person covering the following topics:
    - Purpose and function of the PNNL LOTO program.
    - Roles and responsibilities associated with hazardous energy control (e.g., controlling organization, authorized workers).
    - Recognition of applicable hazardous energy sources.
    - The type and magnitude of the energy associated with the specific task.

    - The methods and means necessary for energy isolation and control including placement of their individually-assigned locks and tags prior to initiating the work activity.
- Each vendor/service must complete the on-the-job training and sign an attendance roster.
- Records documenting on-the-job training attendance must be provided to the Laboratory training coordinator.

This on-the-job training qualifies the non-staff member as conditional authorized to perform Authorized Worker duties only for the scope of work described in the work plan. Course 2592 does not qualify an individual as an authorized worker as achieved by *Lockout Tagout for Authorized Workers* (692) or *Lockout and Tagout Gap Training* (1992).

Restriction of Authorized Worker Qualifications

Restrict an authorized worker's qualifications if they are involved in administrative errors regarding hazardous energy control and/or they are involved in a non-Occurrence Reporting and Processing System (ORPS) reportable event that included hazardous energy control activities.

An authorized worker whose qualifications are restricted cannot perform any work under lockout and tagout as a Controlling Organization or authorized worker until their qualifications are restored.

An authorized worker with restricted qualifications may have them restored by completing a coaching session, which must be documented in an Optional Tracking System (OTS) action, with the Worker Safety and Health Group Lead and a senior leader of the authorized worker's directorate.

- For Facilities and Infrastructure Operations authorized workers, the senior leader is the Division Director or their delegate.
- For research authorized workers, the senior leader is their Research Operations Manager or their delegate.

Removal of Authorized Worker Qualifications

Remove an authorized worker's qualifications if they have been involved in an ORPS reportable event that included hazardous energy control activities.

An authorized worker whose qualifications have been removed cannot perform any work under lockout and tagout as a Controlling Organization or authorized worker until they complete and document the following in an Issue Tracking System (ITS) or OTS action:

- Meet with the Worker Safety and Health Group Lead and a senior leader of the authorized worker's directorate and have them both agree that the authorized worker's qualification can be restored.

- An internal office memorandum communicating that the authorized worker must follow the PNNL Hazardous Energy Control program is signed by the applicable personnel.
- The worker successfully completed the Lockout and Tagout training course (692) to reestablish their proficiency.

21.9 References

29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tag out)*

29 CFR 1910.333, *Selection and Use of Work Practices*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC Chapter 296-803, *Lockout/Tag out (Control of Hazardous Energy)*

WAC 296-155-429, *Lockout and Tagging of Circuits*

NFPA 70E, *Standard for Electrical Safety in the Workplace*

21.9.1 Exhibits and Forms (Located on Contracts Page)

Isolation-Outage Request Form

Hazardous Energy Isolation Practices

How to Perform Work Under Lockout and Tagout

Locks, Tags, and Other Devices for Hazardous Energy Control

Lockout and Tagout Temporary Lift Form

Lockout and Tagout Written Instruction Form

Management of Removal of Authorized Worker Lockout and Tagout Form

Simple Lockout Tagout Form

Temporary Protective Grounding

21.10 Expected Records (Located on Contracts Page)

Lockout and Tagout Written Instruction Form

Authorized Worker Simple LOTO Form

Lockout and Tagout Temporary Lift Form

Management Removal of Lock and Tag (Word)

Course 2952 On-the-Job training evaluation

22.0 Hand and Power Tools

22.1 Purpose

This section establishes the requirements for the selection, use, and maintenance of hand and portable power-operated tools.

22.2 Responsibility

The Contractor shall be responsible for implementing this section.

Employees shall be responsible for complying with the provisions of this section.

22.3 General Requirements

The selection, use, and maintenance of hand and portable power-operated tools shall comply with the following statutory requirements:

- 29 CFR Part 1926, Subpart I; Tools – Hand and Power.
- 29 CFR Part 1910, Subpart P; Hand and Portable Powered Tools and Other hand-held Equipment.
- WAC 296-155; Part G; Tools - Hand & Power

Hand and power tools and similar equipment shall be maintained in safe condition.

Employees shall inspect hand and power-operated tools prior to use. Defective tools shall be tagged with an accident prevention tag and turned in for repair or replacement.

When power-operated tools are designed to accommodate blade/wheel guards, they shall be equipped with such guards when in use.

Appropriate PPE shall be identified, provided, and used for the safe operation of hand/power tools in accordance with the JSA requirements.

Power tools shall be disconnected from their energy source when changing attachments or conducting repairs/maintenance on the tool.

Portable power tools shall be equipped with a constant-pressure switch that will shut off power when the operator releases the pressure. **Exceptions:** Hand-held powered grinders with wheels 2 in or less in diameter, routers, planers, laminate trimmers, nibblers, shears, scroll saws, and jig saws with blade shanks ¼ in wide or less, may be equipped with a positive “ON-OFF” switch.

Blades and wheels shall have the proper rating and revolutions per minute for the tool.

22.4 Procedure

22.4.1 Hand-Tools

Impact tools, such as drift pins, wedges, and chisels, shall be kept free of mushroomed heads.

Wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tool.

22.4.2 Electric Tools

Electric power-operated tools shall be double insulated or grounded in accordance with applicable OSHA/ANSI standards.

Power tools shall not be hoisted or lowered by their electric cords.

22.4.3 Pneumatic Tools

Pneumatic tools shall not be hoisted or lowered by their hoses.

Safety clips or retainers shall be securely installed and maintained on pneumatic impact tools to prevent attachments from being accidentally expelled.

All pneumatically driven nailers, staplers, and other similar equipment provided with an automatic fastener feed shall be equipped with a safety device on the muzzle to prevent the tools from ejecting fasteners when the muzzle is not in contact with the work surface. **Exception:** Pneumatic nailers or staplers utilizing “fine wire” brads or staples do not require a muzzle contact safety device under the following circumstances:

- The overall weight of the fastening device does not exceed the weight of 1-1/2 in of standard 18 gauge wire.
- The operator and any other person within 12 ft of the point of operation wear approved eye protection.

All hoses exceeding ½ in ID shall have a safety device at the source of supply or branch line to reduce pressure in case of hose failure.

Pneumatic power tools shall be secured to the hose or whip to prevent the tool from becoming accidentally disconnected.

All pneumatic tools shall be equipped with deadman switches. Governor-controlled pneumatic tools shall be equipped with an air filter and oilier.

Pneumatic tools shall not be connected to an air supply that exceeds the tool rating.

22.4.4 Fuel Powered Tools

Fuel powered tools shall be stopped and allowed to cool prior to being refueled, serviced, or maintained.

22.4.5 Hydraulic Powered Tools

The manufacturer's safe operating pressures for hoses, valves, pipes, filters, and other fittings shall not be exceeded.

22.4.6 Powder Actuated Tools

Only qualified operators (trained by the manufacturer) shall be permitted to use powder-actuated tools.

When in use, powder actuated tools shall be tested each day before loading (in accordance with the manufacturer's recommended procedure) to verify that safety devices are in proper working condition.

Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools shall be pointed at people.

Loaded tools shall not be left unattended.

Powder actuated tools shall not be use in atmospheres having a 10% or greater reading for Lower Explosive Limit.

Tools shall always be used with the correct shield, guard, or attachment as recommended by the manufacturer.

Powder actuated tools shall be stored in labeled, lockable containers so as to render them unavailable to unauthorized persons.

Tools shall be operated in strict accordance with the manufacturer's instructions. Only those types of fasteners and powder loads recommended by the tool manufacturer shall be used.

Prior to driving a fastener, the operator shall inspect the line-of-fire to assure safety should the fastener penetrate completely through the work surface.

In the event of a misfire, the operator shall follow the explicit instructions set forth by the tool manufacturer.

A sign at least 8 x 10 in using boldface type at least one inch in height shall be posted in plain sight on all construction projects where powder actuated tools are in use. The sign shall bear wording similar to the following: "POWDER ACTUATED TOOL IN USE."

Spent shell casing shall be picked up and deposed daily.

Misfire shells shall be placed in water until the end of shift.

22.4.7 Abrasive Wheels and Tools

Abrasive wheels shall be closely inspected for cracks or defects and ring-tested before mounting.

Machine spindle speeds shall be checked before mounting the wheel to be certain that the wheel will not exceed the maximum operating speed marked on the wheel.

Abrasive wheels shall be used only on machines with safety guards except as follows:

- Wheels used for internal work while within the work being ground.
- Mounted wheels 2 in and smaller in diameter used in portable operations.
- Types 16, 17, 18, 18R, and 19 cones and plugs, and threaded hole pot balls where the work offers protection.

Abrasive wheels shall be handled and stored in a manner that prevents damage to the wheels.

Stationary grinding machines shall be equipped with a transparent spark shield, tongue guards (adjusted within ¼ in of the wheel), and a work rest (adjusted within 1/8 in of the wheel).

Pneumatic grinding machines shall be operated at the correct pressures and off a regulated air supply.

22.4.8 Woodworking Tools

All portable power-driven circular saws shall be equipped with guards above and below the base plate or shoe. Lower guards shall be properly maintained to so they will automatically and instantly return to the covering position when the tool is withdrawn from the work.

22.5 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

ANSI B7.1-1988, *The Use, care, and Protection of Abrasive Wheels*

ANSI 01.1-1961, *Safety Code for Woodworking Machinery*

ANSI A10.3-1985, *Safety Requirement for Powder Actuated Fastening Systems*

23.0 Construction Ergonomics

23.1 Purpose

This section establishes the requirements, responsibilities, and procedures for the ergonomics considerations and requirements for construction workers.

23.2 Responsibility

The provisions of this procedure apply to contractors performing work at any locations at PNNL where ergonomic hazards are known or anticipated. The contractor shall be responsible for implementation and compliance with this procedure and developing and implementing it. Employees shall be responsible for complying with the provisions of this section and best practices adopted by the contractor.

23.3 Requirements

Contractors are required to identify risk factors; such as lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, awkward body positions, and performing repetitive tasks, which increase risk for developing Musculoskeletal Disorders (MSDs). Proper identification can help prevent the possibility of MSDs. MSDs include conditions that involve the nerves, tendons, muscles, and supporting structures such as intervertebral discs. They represent a wide range of disorders, varying in severity from mild periodic symptoms to severe chronic and debilitating conditions.

Examples of common MSDs and their symptoms include:

- Carpal tunnel – Numbness or tingling in your hand and fingers (especially the thumb, index, and middle fingers); pain in your wrist, palm, or forearm, and trouble gripping objects.
- Tenosynovitis – Difficulty moving joint(s), pain, tenderness around a joint, and pain on joint movement.
- Tension neck – Fatigue and stiffness in the neck, neck pain, and headache radiating from the neck.
- Lower back pain – Persistent aching or stiffness along the spring, sharp, localized pain the neck, upper back, or lower back, and chronic ache in the middle or lower back.

The risk of developing MSDs is high on a construction site, but there are effective ways to mitigate this. One method is to use the Job Safety Analysis (JSA) to identify and mitigate ergonomic factors such as excessive force, repetitive tasks, awkward postures, localized pressure, cold temperatures, vibration, and combined exposure to multiple risk factors. Worker training can ensure ergonomic related tasks are understood and identified. Additionally, PNNL requires a stretch and flex program to promote employee wellness and prevent injuries. As such, the contractor shall conduct daily stretching exercises to warm up muscles and help prevent soft tissue injuries. The stretch and flex component should not exceed 10 minutes.

23.4 References

10 CFR 851, *Worker Safety and Health Program*

ACGIH TLVs – Ergonomics ACGIH Threshold Limit Values (TLVs)

24.0 Cutting, Welding, Grinding

24.1 Purpose

This section outlines required controls for conducting safe hot work in compliance with Occupational Safety and Health Act and Washington Industrial Safety and Health Act standards. The provisions of this procedure apply to work activities associated with open flames, welding, cutting, or grinding and other tasks performed by PNNL Contractors and Subcontractors.

24.2 Definitions

Hot Work: In this context, refers to work involving open-flame, welding, cutting, and grinding (any work that generates sparks).

Fire Watch: Process of watching for fire for a specified period during and after hot work. The fire watch person is solely dedicated to this task. Fire watch person require special training, including hands-on fire extinguisher training.

24.3 Requirements

This procedure has the following program elements:

- Working with Open Flame, Welding, Cutting, or Grinding
- Fire Safety Precautions
- Personnel Protective Equipment (PPE) for performance of hot work
- Contractor personnel shall know how to respond to fires in the work area, including initiating alarms, fire department contact and communication with PNNL Single Point of Contact (375-2400)
- Welding activities shall be analyzed for exposure to Manganese (Mn), Chromium (Cr) and Nickel (Ni). A negative exposure assessment containing objective data will be required prior to performing welding activities. Respiratory protection will be required in the absence of adequate documentation.

24.3.1 Working with Open Flame, Welding, Cutting, or Grinding

The following requirements apply to Contractors conducting hot work:

- Contractor personnel will identify when Hot Work is required.
- The contractor shall perform Hot Work in accordance with a Hot Work Permit approved by PNNL. Contact the CM for this form.
- Contractors must use approved listed (Factory Mutual or “FM Approved”) fire curtains, blankets, or pads meeting the requirements of NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*. The selection and use of the fire curtains, blankets, or pads shall be consistent with the manufacturer’s instructions.

- The permit requirements will be communicated to all applicable contractor personnel via a pre-job briefing.
- Contractor personnel who perform fire watch duties must receive PNNL fire watch training (PNNL Course #002504). Individual performing fire watch duties must complete hands-on fire extinguisher training (PNNL Course #000654 or equivalent).
- Alternatives to performing hot work (e.g., saw cutting instead of grinding wheel or torch cutting; crimp-type pipe fittings instead of soldered fittings) should be used where practical. Hot work should be performed in contractor shops or designated areas (e.g., pre-approved weld booths or shop areas) where practical.
- Return completed Hot Work Permit to the CM when work is complete.

24.3.2 Fire Safety Precautions

PNNL's best management practices on fire safety precautions while conducting hot work are provided below. However, the descriptions below do not provide comprehensive requirements; contract and/or project-specific requirements should be evaluated on a case-by-case basis.

24.3.2.1 Equipment for Open Flames or Welding

Inspect hoses, tubing, cable or wire insulation, or other easily damaged parts to be sure they are in good condition. Clamped hose or tubing connections must be used to prevent the hose/tubing from becoming disconnected while under pressure. Repair or replace damaged hoses or cables before starting work.

Protect fuel and oxidizer hoses or tubing from the heat of the flame or sparks during operations.

When fuel gas and oxygen are used together, properly designed and FM-approved and/or UL-listed hose, fittings, and reverse flow check valves must be installed.

Use welding and cutting equipment that is FM-approved or UL-listed.

Keep the equipment in good condition and remove unsafe equipment from service.

Compressed gas cylinders, including propane cylinders, must be secured to prevent them from tipping or falling over. Gas cylinders must be protected from damage, such as overhead movement of materials and moving vehicles.

24.3.2.2 Facility Features

Do not conduct open-flame, welding, cutting, or grinding work during facility fire-sprinkler system outages.

Know where fire extinguishers are mounted. When applicable, a fire watch shall have dedicated fire extinguishers available. Building fire extinguishers are not to be used by fire watch personnel.

Know where fire alarm pull boxes are located.

Know how to call the fire department from the work location where you are located.

Have emergency communications, such as cellular phones or radios, available when working in remote or outside areas.

24.3.2.3 Grinding Wheels

Inspect grinding wheels for deficiencies prior to use. Discard any wheels if damaged.

Do not use bonded abrasive grinding wheels after the marked expiration date (EXP) or "V" date if provided. The bond material of bonded abrasive wheels may degrade with time when exposed to adverse environmental conditions.

Do not use a worn-down large wheel on a small angle grinder. Original size and speed specifications must be met for wheel and tool.

Use the appropriate wheel guard for the wheel type. Position the wheel guard between the workpiece and the operator. Tighten the wheel guard securely in position.

Rated wheel RPM must exceed tool RPM.

Never store wheels where they are exposed to water/condensation or freezing temperatures.

24.3.2.4 Fire Prevention

Remove or protect combustible materials as specified in the Hot Work Permit

Fully inspect areas below/underneath equipment and the work location for combustible materials. For overhead or elevated work, fire watches may be necessary on multiple levels.

Protect openings in walls, floors, roofs, and ceilings where sparks can travel beyond the work area to inaccessible or unprotected areas.

Beware of heat conduction through penetrations.

Keep flammable liquids in closed containers and remove the containers from the work area.

Before performing work, clean containers that have been used to store flammable materials or materials that produce flammable or toxic products. Make sure no cleaning solvent remains on the portion of the container that will be exposed to

flame. Be aware that heating nonflammable solvents can produce toxic vapors or gases.

Wear fire retardant personal protective clothing when exposed to open flames or to welding, cutting, or grinding operations in confined spaces, radiation areas, hazard waste sites, and controlled access areas.

24.3.2.5 Operational Practices

Remain at the work area whenever an open flame is present.

Confirm that the personnel who will be operating the equipment have been trained in its use and know how to use it safely.

Maintain a fire watch for unplanned fires during hot work operations and for at least 1 hour after the completion of the hot work operation (or as specified by the Hot Work Permit). The fire watch observes staff conducting the welding, cutting, or grinding operations and monitors adjacent areas. Stop work if sparks travel beyond the area that fire watch can observe. The fire watch is not assigned any other duties during hot work operations and for the 1 hour after completion of the hot work.

Maintain good housekeeping in the work area.

Provide adequate ventilation in the hot work area in accordance with the Hot Work Permit.

Post a guard, flash barrier, or other type of warning to keep passersby away from the work area in accordance with the Hot Work Permit.

When using arc-producing equipment, use protective screens positioned to protect staff from exposure to light from the arc.

Shut down electric welding machines and shut off gas supplies at the point of supply when work is halted even for a short time, such as when stopping for a break.

Remove electrodes and place them far enough away from the machine so accidental contact cannot occur. Welding machines that have been used outside a designated area must be disconnected at the power source.

24.3.3 Personal Protective Equipment

24.3.3.1 General

Select clothing to minimize the risk of ignition based on the location and nature of the work being performed.

Select heavier materials, such as woolen clothing, heavy cotton, or leather, when possible.

Keep sleeves and collars buttoned with no pockets on the front of clothing. Do not cuff or roll pant legs (e.g., to discourage lodged sparks).

Avoid wearing frayed clothing.

Select clothing that provides sufficient coverage to minimize the potential for burns.

Select clothing that is clean with no contaminants (e.g., oils or grease that could reduce effectiveness of the protective properties).

24.3.3.2 Aprons, Leggings, Capes, Sleeves

Wear flame-resistant leggings or guarding where necessary to give added protection.

Wear flame-resistant cape-sleeves or shoulder covers with bibs for overhead welding, cutting, or other operations, as necessary.

Wear durable, flame resistant aprons to protect the front of the body when additional protection against sparks and radiant energy is needed.

Use insulated linings to protect areas exposed to high-radiant energy.

24.4 References

29 CFR 1926, *Safety and Health Regulations for Construction*

NFPA 51B, *Standard for Fire Prevention during Welding, Cutting, and Other Hot Work*

ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

24.5 Expected Records

None

25.0 Fall Protection

25.1 Purpose

This section establishes the requirements, responsibilities, and procedures for the selection, assembly, use, maintenance, and disassembly of fall restraint/arrest systems and equipment.

25.2 Responsibility

The provisions of this procedure apply to Contractors performing work at locations where fall hazards of 6 feet or more are known or anticipated. See section 17 for requirements related to walking/working surfaces involving exposure to falls 4 feet or more.

The Contractor shall be responsible for implementation and compliance with this procedure and developing and implementing FPWPs.

Employees shall be responsible for complying with the provisions of this section.

25.3 General Requirements

Each employee subject to a fall hazard of 6 feet (OSHA/WISHA) or more shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall protection systems, such as personal fall arrest, travel restraint, or positioning systems at all times.

Fall arrest/restraints shall be provided, maintained, and documented in accordance with the Contractor's FPWP.

Prior to the start of activities, a FPWP shall be developed and implemented for areas where employees may be exposed to fall hazards of 6 feet or more. The plan is a supplement to the JSA and shall be maintained at the jobsite until activities have been completed. The JSA can be used as the FPWP if all elements are met.

If a fall hazard of 6 feet or more is recognized after activities have begun, the work in that area shall be stopped and a FPWP shall be written and implemented (or the existing plan modified) prior to allowing activities to restart in the area of the hazard.

Fall arrest/restraint shall be provided during the erection of scaffolding whenever feasible.

Work shall not be performed on a ladder over 24 feet from the ground or floor unless a safety harness is worn and the safety lanyard is secured to an adequate fall arrest or fall restraint attachment point.

Whenever feasible, fall arrest/restraint shall be provided when employees are establishing fall protection anchorage points on roofs.

Fall arrest/restraint shall be provided when employees are working within 4 feet of a leading edge, outer edge, or other unprotected perimeter where the fall hazard is 4 feet or more. See section 17 for open sided floors and walking/working surfaces.

The use of safety monitors shall only be permitted when approved by PNNL. Circumstances include:

- During inspection, investigation, and estimating of roof level conditions where the workers will not be within 6 feet of an unguarded perimeter edge, leading edge, or open hole.
- During maintenance and construction activities where the workers will not be within 6 feet of an unguarded perimeter edge, leading edge, or open holes.
- During initial installation of the fall protection anchor prior to engaging in any work activity, or disassembly of the fall protection system.
- During installation of warning line system.

The use of warning line systems shall be permitted for roof activities taking place no closer than 6 ft to an unguarded perimeter edge, leading edge, or open holes. For non-roofing activities the warning line system must be erected no closer than 15 feet from unguarded perimeter edge or open holes. When used, warning line systems shall be deployed in accordance with the applicable OSHA/WISHA requirements.

Where employees must work within 4 feet of an unguarded perimeter edge, leading edge, or open holes, the appropriate fall arrest/fall restraint systems/guardrail system shall be required. A safety monitoring system is prohibited by PNNL unless approved.

A leading edge self-retracting lifeline (SRL) manufactured specifically to meet ANSI Z359.14 standard shall be used for leading edge, horizontal applications, and foot-level fall events. Fall restraint shall consist of standard guardrails or full body harnesses attached to securely rigged restraint lines or other appropriate anchorage points rated for four times the intended load.

Fall restraint shall be rigged to allow employees to move only as far as the edges of the unprotected walking/working surfaces.

Fall arrest protection shall consist of a Class III full body harness. Safety belts shall not be used. The full body harness system shall be rigged to minimize free fall distance to a maximum of 6 feet and such that the employee will not contact any lower level. If the available free-fall distance is less than 18.5 feet from an obstruction or floor a self-retracting lifeline is required to be used.

Lifelines, harnesses, and lanyards shall be used only for employee safeguarding. Any of these devices subjected to an actual fall-arrest load situation (as distinguished from static load testing) shall be immediately removed from service and destroyed to preclude their inadvertent continued use.

When Class A self-retracting lifelines or other deceleration devices are used which limit free fall to 2 feet, anchorages shall be capable of withstanding 3,000 pounds.

Self-retracting lifelines (Class B) and lanyards which limit free fall distance to 54 inches (4 feet 6 inches) or less shall be capable of withstanding 5,000 pounds of tensile strength.

The use of Rope Grab lanyards is prohibited on PNNL projects. Exceptions may be granted by PNNL WS&H professionals based on specific work evolutions and detailed planning.

Horizontal lifelines shall be designed, installed, and used, under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two. Lifelines shall be protected against being cut or abraded.

Ripstitch, tearing, and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds.

For lifelines, lanyards, droplines, etc., suitability for service (including tensile strength) shall be determined based on the manufacturer's data and visual inspection of the equipment.

For lifeline and lanyard attachment points, suitability for use (including breaking strength meeting the requirements of applicable OSHA/WISHA standards shall be determined by at least one of the following:

- manufacturer's data
- existing engineering/design documents
- evaluation by a qualified engineer

The means by which attachment points have been determined to be suitable for use shall be documented on the FPWP.

Exceptions to fall protection requirements (including those situations where providing fall protection is not feasible) shall be justified on the FPWP and approved by PNNL prior to beginning the activity.

Snap hooks shall not be connected to loops made in webbing-type lanyards unless designed by the manufacture. To any object which is incompatibly shaped or dimensioned in relation to the snap-hook such that unintentional disengagement could occur by the connected object being able to depress the snap-hook keeper and release itself. Only locking type snaphooks shall be used.

25.3.1 Training Requirements

Employees shall be trained by a competent person, prior to starting work, to the requirements of the job-specific FPWP and the manufacturer's instructions for inspection, maintenance, and use of equipment. Training shall include the following topics:

- recognition of fall hazards
- nature of fall hazards
- correct procedure for erecting, maintaining, disassembling, and inspecting the fall protection system to be used
- use and operations of guardrail systems, PFAS, warning-line systems, safety monitoring systems, controlled access zones, and other protection to be used
- role of each employee in the safety monitoring system when this system is used
- limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs

- correct procedures for handling and storage of equipment and materials, and the erection of overhead protection
- role of employees in fall protection plans
- rescue considerations
- requirements of this section

Training shall be documented on the Training Attendance Record.

25.3.2 Fall Protection Work Plan

The FPWP consists of the following mandatory elements:

- identification of all fall hazards in the work area
- description of the method of fall arrest or fall restraint to be provided
- description of the correct procedures for the assembly, maintenance, inspection, and disassembly of the fall protection system to be used
- description of the correct procedures for handling, storing, and securing tools and materials
- description of the method of providing overhead protection for workers who may be in or pass through the area below the worksite
- description of the methods for prompt, safe removal of injured employees
- description of the method used to determine the adequacy of attachment points

25.3.3 Fall Protection Equipment/Systems

Fall restraint/arrest systems shall be used to eliminate employee exposure to fall hazards at elevations of 4 feet or more above the ground, water, skylights, floor holes, manholes, formwork, dangerous equipment or floor levels.

Fall restraint/arrest systems shall be selected based on evaluation of the following:

- nature of the work to be performed
- duration of the work to be performed
- number of affected personnel
- degree of mobility necessary for personnel to accomplish the work
- limitations dictated by facility/worksite layout
- physical or environmental factors affecting the integrity of the fall protection equipment
- proximity of acceptable attachment/anchorage points

In as much as possible, fall restraint/arrest equipment shall be protected against damage and maintained in a clean, dry condition. Fall protection equipment damaged by cuts,

abrasions, burns, excessive moisture, etc. (when such damage affects the integrity of the equipment) shall be destroyed to preclude its inadvertent continued use.

Self-retracting lifelines shall be functionally inspected prior to use, and returned to the manufacturer for inspection as specified by the manufacturer's recommendations.

Catch platforms, when used, shall be installed within 4 vertical feet of the fall hazard. The catch platform's width shall equal the distance of the fall but shall be a minimum of 45in wide and shall be equipped with standard guardrails on all open sides. Catch platforms require PNNL approval.

A person acting in the capacity of safety monitor shall be trained in the function of both the safety monitor and warning lines system, and shall:

- Be a competent person.
- Have control authority over the work as it relates to fall protection
- Be instantly distinguishable over members of the work crew.
- Engage in no other duties while acting as safety monitor.
- Be positioned in relation to the workers under their protection, so as to have a clear, unobstructed view and be able to maintain normal voice communication.
- Supervise no more than eight exposed workers at one time.
- A safety monitor system must not be used during adverse weather conditions (snow, frost, ice, high winds, etc.).

Warning lines shall consist of a rope, wire, or chain and supporting stanchions erected as follows:

- The rope, wire, or chain shall be flagged at not more than 6 ft intervals with high-visibility material.
- The rope, wire, or chain shall be rigged and supported in such a way that its lowest point (including sag) is no less than 36in from the roof surface and its highest point is no more than 45in from the roof surface.
- After being erected, with the rope, wire, or chain attached, stanchions shall be capable of resisting, without tipping over, a force of at least 16 pounds (71 Newtons) applied horizontal against the stanchion, 30in (0.76 meters) above the roof surface, perpendicular to the warning line, and in the direction of the roof edge.
- The rope, wire, or chain shall have a minimum tensile strength of 500 pounds (227 kilograms), and after being attached to the stanchions, shall be capable of supporting, without breaking, the loads applied to the stanchions.
- The line shall be attached at each stanchion in such a way that pulling on the section of the line between stanchions will not result in slack being taken up in adjacent sections before the stanchion tips over.
- Must be inspected daily by the contractor to ensure the above requirements are met.

Access paths shall be erected as follows:

- Points of access, materials handling areas, and storage areas shall be connected to the work area by a clear access path formed by two warning lines.
- When the path to a point of access is not in use, a rope, wire, or chain, equal in strength and height to the warning line, shall be placed across the path at the point where the path intersects the warning line erected around the work area.

25.4 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-800, *Unified Safety Standards for Fall Protection*

25.5 Expected Records (Located on Contracts Page)

Document	Submittal Responsibility	Record Retention Responsibility
Fall Protection Work Plan	Contractor	Jobsite
Pre-job Safety Planning Signoff	Contractor	Jobsite

26.0 Scaffolds

26.1 Purpose

This section defines the responsibilities and requirements for the safe use, erection, and maintenance of scaffolds.

26.2 Responsibility

The Contractor shall be responsible for compliance with this section.

Employees shall be responsible for complying with provisions of this section.

26.3 General Requirements

Construction, maintenance, use, and inspection of scaffolds shall comply with the following statutory requirements:

- 29 CFR 1926, Subpart L; Scaffolding
- 29 CFR 1910, Subpart D; Walking and Working Surfaces
- WAC 296-874, Scaffolds.

A competent person shall be designated in writing who will:

- Direct scaffold selection and erection/dismantling.
- Train scaffold erectors and inspectors.
- Resolve issues.

Scaffolding materials purchased, erected, and used shall meet applicable OSHA/WISHA safety standards and the manufacturer's rules and instructions for safe use and erection of scaffolding.

Scaffolds and component parts shall be maintained in a safe condition. Any scaffold parts damaged or weakened from any cause shall not be used.

Scaffolds and their components shall be capable of supporting at least four times the maximum intended load without failure. Ladders or makeshift devices shall not be used to increase the working height of scaffolds.

Standard guardrails (capable of sustaining 200-pound lateral force) and toe-boards shall be installed on all open sides and ends of scaffolds and platforms more than 10 ft above the ground or floor.

Baker scaffolds 6 feet or greater require standard guardrails, due to limited work platform size.

The height of manually propelled mobile scaffolds shall not exceed four times the minimum base dimension.

Platforms shall be fully secured. Platforms shall be a minimum width of two 10” planks (if using planking), or at least 18 in (if using other material, such material shall be of sufficient type and strength/thickness).

A personnel FPWP shall be developed for workers exposed to fall hazards of 10 feet or more. Personal fall protection equipment or other means of equivalent protection shall be provided and used when guardrails cannot be installed.

Tube and coupler scaffolds shall be erected according to manufacturer’s design.

The poles, legs, or uprights of scaffolds shall be plumb and securely and rigidly braced to prevent swaying and displacement.

26.4 Procedure

Scaffolds shall be erected, dismantled, or altered under the supervision of a competent person. All scaffolds shall have the appropriate status tag attached to or near the access ladder. This status tag shall be installed by the scaffold erectors, and shall be attached at all times during erection, use, and dismantlement of scaffold. The status tags (see scaffold sample tags below) shall be color-coded and shall have the following meanings:

- Red Tag: KEEP OFF/DO NOT USE. This tag is used to prohibit use of the scaffold during installation, alteration, or dismantlement except by the erecting crew performing installation, alteration, or dismantlement activities
- Yellow Tag: SPECIAL CONDITIONS/ADDITIONAL CONTROLS. This tag indicates special safety measures for use of scaffold (e.g., fall protection or head protection).
- Green Tag: SCAFFOLDING IS ERECTED TO CODE/APPROVED FOR USE: This tag is used to indicate that the completed scaffold meets all erection codes, standards, and company procedures, and is safe for use. The backside of the tag is signed and dated to indicate that the scaffold has been inspected by a competent person before each work shift.

Test Scaffolding planks are scaffold grade or equivalent as recognized by approved grading rules for the species of wood used.

An access ladder or equivalent safe access shall be provided for each working level.

Scaffold work levels shall be kept clear of trash, snow, ice, and excess accumulation of materials or tools.

Footings and anchorages for scaffolds shall be firm and capable of carrying the maximum intended load without settling or displacement. Unstable objects, such as boxes, barrels, and concrete blocks, shall not be used. Mud plates shall be used on loose footings.

Scaffolds shall be placed as close to the work as possible. Where fall protection is being provided by the structure (building, wall, adjacent platform, etc.) on which work is being performed, the maximum allowable distance between the scaffold platform and the structure is 14 inches.

Where a scaffold's height exceeds 4 times its smallest base dimension, guy, tie, or brace the unit at the closest horizontal member to the 4:1 height. Repeat every 26 feet vertically or 20 feet for those units less than or equal to 3 feet in width and 30 ft horizontally.

Planking shall be secured from movement.

Planking 10 feet or less in length shall extend over end supports a minimum of 6 in but not more than 12in unless guard railed or designed to prevent cantilevering. Planking greater than 10 feet in length shall extend over end supports a minimum of 6in but not more than 18 in unless guard railed or designed to prevent cantilevering.

Where persons are required to work or pass under the scaffold, scaffolds shall be provided with a screen between the toe-board and the guardrail, extending along the entire opening, consisting of No. 18 gauge U.S. Standard wire ½-in mesh, or the equivalent.

Conductive parts of scaffolds shall not be erected or positioned within 10 feet of exposed live electrical equipment unless the equipment is de-energized and locked out, or it is protected from contact by insulating blankets.

When scaffolding is to be erected within 20 feet of overhead utility or electrical lines, Utilities shall be notified.

If the scaffolding is to be erected 10 feet or less from overhead electrical lines, Utilities shall be contacted for assistance in de-energizing or insulating the lines prior to scaffold erection.

Workers shall not ride a manually propelled scaffold while it is being moved.

Workers shall not straddle or work outside of the guardrails.

All tools and materials shall be secured or removed from the platforms of mobile scaffolds before the scaffold is moved.

Mobile scaffolds rest upon suitable footings and stand plumb. The casters or wheels are locked to prevent movement.

A registered professional engineer shall design scaffolding over 125 feet in height.

The height of freestanding scaffolding towers shall not exceed four times the minimum base dimension. All scaffolding components and materials shall be inspected before use.

For rolling towers under 30 feet, 5in or larger casters shall be used. For rolling towers 30 feet and over, 8in or larger casters shall be used.

Where moving vehicles are present, the scaffold area shall be marked with warnings such as flags and/or barricades.

26.5 Transferring PNNL Erected Scaffolding to a Contractor for Use.

Transferring of scaffolding ownership between the PNNL Scaffold Custodian and Construction Subcontractor shall include the following:

Schedule a turnover meeting to walk down the erected scaffold with the PNNL Scaffold Custodian, Construction Manager, Worker, Safety and Health Professional and PNNL Construction Subcontractor Competent Person.

Remove all PNNL scaffold tags and forms.

Contractor shall perform a scaffold inspection by the designated Subcontractor Competent Person scaffold inspector.

Contractor will complete required forms and attach the appropriate status tags. Status tags shall be attached to or near the access ladder. Contractor scaffold user shall be briefed and sign all required forms.

Once work is completed by the contractor, schedule a turnover meeting with the PNNL Scaffold Custodian, Construction Manager, Worker, Safety and Health Professional and PNNL Construction Subcontractor Competent Person to transfer scaffold ownership.

Note: Contractor is prohibited to make scaffolding changes.

26.6 Training

A competent person shall provide training to employees who are involved in erecting, dismantling, moving, and inspecting scaffolds. Training shall include:

- The nature of scaffold hazards.
- The correct procedures for erecting, dismantling, moving, repairing, inspecting, and maintaining the type of scaffold in use.
- Design criteria and load-carrying capacities.
- Other pertinent requirements.

A qualified person shall provide training to employees who perform work while on a scaffold. Training shall include:

- The nature of any electrical hazards, fall hazards, and falling object hazards in the work area.
- The correct procedures for dealing with electrical hazards and for erecting, maintaining, and disassembling the fall protection systems and falling object protection systems.
- The proper use of the scaffold, and the proper handling of materials on the scaffold.
- Design criteria and load-carrying capacities.
- Other pertinent requirements.

Retraining of employees is required:

- Where changes at the worksite present a hazard for which an employee has not been previously trained.
- Where changes in the types of scaffolds, fall protection, falling object protection, or other equipment is made when an employee has not been previously trained.
- When employees demonstrate inadequacies while working with scaffolds.

26.7 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-874, *Scaffolds*

26.7.1 Forms and Exhibits (Located on Contracts Page)

Scaffolds Inspection Checklist

Scaffold Status Tags

26.8 Expected Records (Located on Contracts Page)

Document	Record Submittal Responsibility	Record Retention Responsibility
Competent Person Designation	Contractor	Contractor
Training Attendance Record	Contractor	Contractor

27.0 Ladders

27.1 Purpose

This section defines the responsibilities and requirements for the safe use, handling, storage, and construction of ladders that ensure compliance with applicable ANSI, OSHA/WISHA, and the NFPA requirements.

27.2 Responsibility

The Contractor shall be responsible for ensuring compliance with this section.

Employees shall be responsible for complying with the provisions of this section.

27.3 General Requirements

Use, care, and storage of ladders shall comply with the following statutory requirements:

- 29 CFR 1926, Subpart X; Stairways and Ladders.
- 29 CFR 1910, Subpart D; Walking and Working Surfaces.
- WAC 296-876, Ladders, portable and fixed.

Ladders shall be maintained in good condition at all times. Those that are defective in any way shall be removed from service and tagged with an unsafe equipment tag until made safe for use, or destroyed.

Ladders may be repaired only if repairs will restore the ladder to a condition meeting its original design criteria.

Ladders used on construction sites shall be appropriate for industrial applications (Class I or 1-A). Light-duty household ladders are not permitted.

Job-made ladders shall be constructed in accordance with ANSI A14.4, Safety Requirements for Job-Made Ladders.

When ascending or descending a ladder, the user shall face the ladder and always keep 3 limbs in firm contact with the ladder. Carry tools or equipment in a work belt or fanny pack, or hoist them to the work area using a rope or bucket.

Metal ladders shall not be used where potential electrical hazards exist. Wood or fiberglass ladders having metal parts (other than hardware) shall not be used where potential electrical hazards exist unless they bear a manufacturer's label that indicates the following:

- The ladder complies with ANSI A14.5.
- The ladder is approved for electrical use.

Wood ladders shall not be coated with any opaque covering (i.e., paint) except for identification or warning labels, which may be placed on one face only of a side rail.

Employees shall be trained to the requirements of this section.

27.4 Procedure

27.4.1 Use of Ladders

Ladders shall be inspected by the user before each use.

Employees shall ensure that their shoes and the ladder steps are free of grease, mud, or other materials that could cause them to slip while climbing.

Do not place ladders against any structure or equipment that is not strong and rigid enough to support the ladder, or that is not sufficiently anchored.

Straight ladders shall be used at an angle of approximately 75 degrees from the horizontal. The ladder is set at the proper angle when the horizontal distance from the top support to the foot of the ladder is approximately one-quarter the working length of the ladder.

No type of work shall be performed on a ladder 25 feet or more from the ground or floor unless a safety harness is worn and the safety lanyard is secured to an adequate fall arrest or fall restraint attachment point.

Use ladders only for short duration jobs with limited work scope.

Ladders shall be used only on firm, stable, and level surfaces and shall be secured to prevent accidental displacement.

Note: Step ladders need not be secured except when required by this section.

Ladders shall not be used on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental displacement. Slip-resistant feet shall not be used as a substitute for care in placing, lashing, or holding a ladder that is used upon slippery surfaces.

Ladders placed in any location where they can be displaced by workplace activities or traffic, such as in passageways, doorways, or driveways shall be secured to prevent accidental displacement or a barricade shall be used to keep the activities or traffic away from the ladder.

Ladders shall not be spliced together to form longer sections.

Prior to climbing an extension ladder, the user shall ensure that the rung locks are securely in place.

Ladders used to gain access from one level to another shall be long enough for the top to extend 3 feet above the landing or suitable grab rails shall be provided for safe movement to or from the point of access.

The platform and top step of ordinary types of stepladders shall not be used as steps.

Cross-bracing on the rear section of stepladders shall not be used for climbing unless the ladder is designed and provided with steps for climbing on both front and rear sections.

Standard step ladders shall not be used as straight ladders. These ladders shall be used with legs fully extended and locked open. Lean-safe step ladders can be leaned against a fixed object only when following the manufacturer's recommendations.

Ladders shall not be used as braces, skids, levers, runways, platforms, scaffolds, or for any other purpose for which they are not intended.

Ladders shall not be climbed by more than one person at a time unless designed to support more than one person.

27.4.2 Care of Ladders

Ladders shall be handled with care and shall not be subjected to unnecessary abuse or misuse.

When not in use, ladders shall be stored where they are protected from potential damage by collision, temperature, moisture, etc.

Ladders shall be returned to the proper storage location when the job is completed.

Ladders shall not be painted.

27.4.3 Training Requirements

The employer shall train each employee using ladders. This program shall enable each employee to recognize hazards related to ladders.

The employer shall ensure that each employee has been trained by a competent person in the following areas, as applicable:

- The nature of fall hazards in the work area.
- The correct procedures for erecting, maintaining, and disassembling the fall protection system to be used.
- The proper construction, use, placement, and care in handling of ladders.
- The maximum intended load-carrying capacities of ladders used.
- The information contained in this section.

Retraining shall be provided for each employee as necessary so that the employee maintains the understanding and knowledge acquired through compliance with this procedure.

27.5 References

29 CFR 1926, Subpart X; *Stairways and Ladders*

29 CFR 1910, Subpart D; *Walking and Working Surfaces*

WAC 296-876, *Ladders, portable and fixed*

ANSI A14.1, *Ladders – Portable Wood – Safety Requirements*

ANSI A14.4, *Safety Requirements for Job-Made Ladders*

ANSI A14.5, *Safety Requirements for Portable Reinforced Plastic Ladders*

27.5.1 Forms (Located on Contracts Page)

Training Attendance Record

27.6 Expected Records (Located on Contracts Page)

Document	Record Submittal Responsibility	Record Retention Responsibility
Training Attendance Record	N/A	Contractor

28.0 Mobile Elevated Work Platforms

28.1 Purpose

This section defines the system for safe operation and maintenance of mobile elevated work platforms (MEWP's)

28.2 Responsibility

The Contractor shall be responsible for compliance with this section.

Employees shall be responsible for complying with the provisions of this section.

28.2.1 General Requirements

Aerial lifts and elevating work platforms shall comply with the following statutory requirements:

- 29 CFR 1926, Subpart N; Cranes, Derricks, Hoists, Elevators and Conveyors
- 29 CFR 1910, Subpart F; Powered Platforms, manlifts, and Vehicle-Mounted Work Platforms
- WAC 296-155, Part J-1, Elevating Work Platforms

Personnel who operate MEWP's shall be trained to the requirements of this procedure and applicable statutory requirements.

Lift controls shall be tested by the user each day prior to use to determine that controls are in safe condition.

Fall protection for employees in vehicle-mounted articulating or extensible boom type elevating and rotating aerial devices (i.e., JLGs) shall be in accordance with the following:

- Workers shall stand on the basket floor and shall not sit or climb on the edge or handrail. Workers also shall not use planks, ladders, or other devices for a work position.
- A full body harness and lanyard shall be worn and attached to the manufactured attachment point. Consideration shall be made to limit the operator from falling any distance outside the work platform. Self-retracting lanyards or lanyards without shock absorbers shall be used.
- Tying-off to an adjacent pole, structure, or equipment while working in an aerial lift is prohibited.

Fall protection for employees on self-propelled elevating work platforms (scissor lifts) shall be in accordance with the following:

- Self-propelled elevating work platforms (scissor lifts) shall be provided with standard guardrail or the equivalent.

- Personnel shall maintain a firm footing on the platform or basket. Do not stand, sit, or climb on the guardrail. Do not use planks, ladders, or other devices to reach work locations.
- MEWP's shall be equipped with a swing gate, or solid locking bars at the point of access and egress to the work platform.

Boom and basket load limits posted on the unit shall not be exceeded.

Elevating work platforms or aerial lifts shall not be used to hoist materials that would otherwise require special lifting equipment such as chain-falls, forklifts, cranes, etc. Only material that can be readily handled by the employee using the work platform shall be lifted or moved using the platform. Additionally, only those materials that will be readily utilized (i.e., within two hours) shall be taken on a platform at one time.

Aerial lift trucks shall not be moved when the boom is elevated in a working position with personnel in the basket. The only exception is equipment specifically designed for this type of operation.

Articulating boom and extensible boom platforms shall have both upper and lower controls. Lower controls shall be capable of overriding upper controls. All controls shall be plainly marked as to their function.

The brakes shall be set and outriggers shall be fully extended and positioned on pads or a solid surface. Wheel chokes shall be used when working on inclines.

MEWPs shall not be operated around uncovered or unguarded open holes.

Operators shall verify that the area surrounding the work platform is clear of personnel and equipment before lowering the platform.

All lift activities exposed to the wind shall be evaluated at wind speeds above 15 mph and shut down according to manufacturer guidance, which is usually 28mph.

Winds create additional force on MEWPs, which create a tip over hazard if large surface items are being used during windy conditions increasing possible side loads.

To calculate the effect wind can have use the following formula:

- Wind mph (X) surface area (X) 2 = lbs. of force

<u>Example:</u>

A 4' X 8" (32 sq ft) sheet of plywood being used by a carpenter on a lift in 20 mph wind conditions.

20 mph wind (X) 32 sq ft (X) 2 = 1280 lbs. of side (horizontal force added. This added force may be enough to cause tip over. Refer to manufacturer's limitations.

The user shall inspect aerial lifts and elevating work platforms (based on the manufacturer's manual) prior to use. Defective equipment shall be reported to the supervisor/manager, tagged out of service, and not used until repaired.

Aerial lifts shall be inspected daily.

Limit switches shall be checked weekly.

Manufacturer's maintenance and operator's manuals shall be provided with each work platform.

28.3 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

28.4 WAC 296-155, Safety Standards for Construction Work Records

Document	**Record Submittal Responsibility**	**Record Retention Responsibility**
Maintenance, Operator Manuals	Contractor	Job Site
Inspection Records	Contractor	Contractor

29.0 Hoisting and Rigging

The Contractor, and affected Subcontractors, must follow the DOE Standard *Hoisting and Rigging* (DOE-STD-1090-2020) for all hoisting and rigging activities.

29.1 Lift Director

The lift director is deemed competent and qualified by their employer. Duties and responsibilities are as follows:

- Identify the objective of the lift by defining what is being lifted, and the type of equipment being used to perform the lift.
- Ensures that personnel involved understand how the lift is to be made.
- Ensures that personnel involved are current in training and qualification.
- Surveys the lift site for hazardous/unsafe conditions.
- Checks basic operating instructions of all lifting equipment, to include required charts, tables, or diagrams, are appropriately posted or otherwise available to the operator.
- Ensures that a signal person is assigned, if required, and is identified to the operator.
- Completes pre-lift plan checklist

29.2 Sling Inspections

29.2.1 Initial Inspection

Before any new or repaired slings (synthetic or wire rope) are used, a qualified person shall inspect them to ensure the slings are safe for use in the field.

29.2.2 Frequent Inspection

This inspection shall be made by the person handling the sling each day and after each use.

29.2.3 Periodic Inspection

The periodic inspection shall be at least annually and performed by a qualified person using one of the following documentation methods.

- Mark a serial number on the sling and maintain inspection records by serial numbers

- Institute a comprehensive marking program (such as color coding) to indicate when the next periodic inspection is required. The following color codes are used to indicate current status of annual inspections:

Color	Years Covered
Orange	Even Numbered Years
Purple	Odd Numbered Years

- Mark each sling with a tag that indicates when the next periodic inspection is required. This tag becomes the record.

29.3 Portable A-Frame Assembly

Portable A-Frames shall only be assembly by qualified personnel and in accordance with manufacturer's requirements for setup and assembly. The competent person form shall be used to document personnel are qualified to perform assembly and initial inspection requirements prior to use. Initial, periodic and preoperational checks shall be conducted in accordance with the manufacturer's recommendations. The initial and periodic inspection shall be documented using the following color code system.

Color	Years Covered
Orange	Even Numbered Years
Purple	Odd Numbered Years

29.4 Planning

Planning for the use of cranes, derricks, hoists, cableways, aerial devices, and material handling moves, material lifting accessories shall use ASME P30.1, *Planning for Load Handling Activities* to provide guidance on general planning considerations and practices for load handling operations occurring on PNNL property.

The Contractor shall complete the Crane Pick Plan (CPP) when utilizing a crane(s) to move a load. The Contractor shall complete the Mechanical Material Handling Plan (MMHP) , when handling material that is heavy, awkward or directed by PNNL personal. A pre-lift plan checklist shall be completed prior to any lift requiring a crane pick plan or mechanical material handling plan.

Note: For crane operations hand signal charts must be either posted on the equipment or conspicuously posted in the vicinity of the hoisting operations.

Note: During lift and or material handling planning, designated roles shall be identified using the Crane Pick Plan (CPP), or the Mechanical Material Handling Plan (MMHP). The identification of "Dual" rolled personnel will be subject to review by PNNL.

Critical lifts will require singular roles identified throughout the entire lift process.

29.5 References

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

AMSE P30.1 2014 *Planning and Load Handling Activities*

DOE-STD-1090-2020 *Hoisting and Rigging*

WAC 296-155, *Safety Standards for Construction Work*

29.6 Forms (Located in Vault and Contracts Page)

WSH-MA-001-Form-03, Crane Pick Plan (CPP)

WSH-MA-001-Form-05, Mechanical Materials Handling Plan (MMHP)

29.7 PNNL Hoisting and Rigging Manual Records

Document	Record Submittal Responsibility	Record Retention Responsibility
Inspection Records (lift equipment, rigging)	Contractor (for own equipment.	Contractor
Training and Qualifications Records (including medical)	Contractor	Contractor
Crane Pick Plan (CPP)	Contractor	Contractor
Mechanical Materials Handling Plan (MMHP)	Contractor	Contractor
Pre-lift plan checklist	Contractor	Contractor

30.0 Equipment and Motor Vehicle Operation

30.1 Purpose/Scope

To define the responsibilities and requirements for operating motor vehicles and equipment on PNNL work sites.

Contractors/subcontractor/vendors are not allowed to use PNNL owned or leased vehicles.

30.2 Responsibility

The Contractor shall be responsible for compliance with this section.

Employees shall be responsible for complying with the provisions of this section.

30.3 Requirements

30.3.1 General Vehicle Use Safety Practices

Personnel must have a current state or international driver's license in their possession when operating any contractor vehicle at a project site.

All personnel operating a motor vehicle, as well as the occupants in the vehicle, will wear a seatbelt/shoulder harness regardless of the distance to be traveled.

Articulating Dump Trucks (ADT's) must have written approval from PNNL prior to being operated on PNNL jobsites.

Practices that are not condoned during the operation of motor vehicles at project sites include:

- Cell phone use while driving
- Wearing devices that restrict or impair hearing or vision
- Leaving an unattended motor vehicle running and/or with its keys in the ignition
- Carrying more passengers than a vehicle is designed for
- Transporting passengers in cargo area of vehicles
- Exceeding posted speed limits and not observing traffic signs
- Transporting prohibited items (e.g., weapons, alcohol, controlled substances)
- Committing any such act that could result in the suspension or revocation of a class C driver's license of a Commercial Driver's License

30.3.2 Vehicles and Equipment

Employees exposed to vehicular or mechanized equipment must wear reflective or high visibility clothing (i.e., shirt, vest, or jacket). Prior to vehicle operation check the

overall vehicle condition and surroundings. Inspect the vehicle for such items as properly functioning lights, brakes, windshield wipers, steering, and tires before operating the vehicle. Verify that the vehicle contains emergency equipment. Secure and support loads that are carried outside of the vehicle cab.

Vehicles believed to be unsafe and/or delinquent on necessary maintenance shall not be driven and removed from service (Tag out of service).

The contractor will document using the Competent Person Designation that only trained and qualified operators are authorized to operate mechanized (heavy) equipment on-site.

When internal combustion equipment exhausts in enclosed spaces, the Contractor must make and record tests to ensure that employees are not exposed to unsafe concentrations of toxic gases or oxygen deficient atmospheres.

Mechanized equipment will be equipped with:

- Cabs that have safety glass or equivalent installed with no visible distortions affecting the safe operation of any machine.
- Roll over protection (ROP).
- Seat belts except for equipment designed for standup operation.
- Braking systems capable of stopping and holding the equipment fully loaded.
- Fenders on wheels for earthmoving haulage equipment with pneumatic tires.
- 10 lbs. ABC fire extinguisher.
- Audible backup alarm.

When using operating heavy equipment:

- Inspect mechanized equipment daily and correct any unsafe conditions.
- Handle loads being lifted or transported by mechanized equipment in a manner that ensures stability, prevents loss of the load, and protects employees working underneath loads.
- Place barricades or reflectors around equipment left unattended and adjacent to roadways.
- Maintain 20 feet working distance from power lines or energized transmitters.
- Do not operate equipment while talking on cell phone.
- Secure loose items in operator cab (i.e., thermos, clothing, lunch box, etc.).
- Do not mount or dismount equipment while it is in motion.
- Wear seatbelts provided and do not allow riders on equipment unless it is designed for more than one person.
- Set the parking brake when equipment is parked.
- Do not operate tracked units on paved roads except for approved crossings.

- Stop, secure, and substantially block or crib the equipment being repaired to prevent falling or shifting before allowing employees to work under or between equipment.
- Loose clothing could catch on operating controls and cause the equipment to suddenly move. Operator must engage safety interlocks prior to exiting equipment.
- Spill Kit shall be available on-site.

30.3.3 Control of Roadways and Spotter Use during Contractor Activities

In preparation for construction, maintenance, or other contractor activities that causes a detour, restriction, or otherwise affects access to PNNL facilities or traffic on roads the contractor shall initiate the following action:

- Notify PNNL Construction Manager 5 days prior to detours or road closures.
- Submit a traffic control to PNNL for approval.
- In accordance with U.S. Department of Transportation, Federal Highway Administration Manual on Traffic Control Services for Streets and Highways identify effective locations for temporary traffic controls signs, devices, signals, and barricades.
- Once activities begin the following controls must be in place and supported by qualified personnel:
- Warning signs erected facing in all directions when activities are adjacent to a roadway or intersection.
- Illuminated signs or signs with reflectors intended for warning during hours of darkness.
- Flaggers shall possess a Washington State Flagger Certification or equivalent.
- Covering existing warning devices (lights/traffic signs) if not utilized for traffic flow.

Once activities are completed regular traffic controls signs and devices should be returned to operational status or the temporary traffic controls put in place should be removed.

A spotter shall be used for guiding trucks or equipment when the driver/operator doesn't have full view of the working area and hazards.

A spotter is required when:

- Backing earthmoving or compacting equipment with an obstructed rearview or when not equipped with a back-up alarm.
- Backing a truck larger than a van, or any other vehicle that has large blind spots in congested work site areas visibility is poor.
- Near overhead power lines.
- Driving larger vehicles forward near overhead, side, or other obstructions.

- Driving or moving any piece of equipment in a congested area.
- A driver requests a spotter for added safety.

Spotters and drivers (or equipment operators) must work together, and both be completely focused on the task during the signaling activities.

Together, the spotter and the driver should:

- Agree on hand signals before backing up.
- Know the driver's blind spots.
- Discuss the plan for getting the driver where they need to go including positioning and planned movement of the vehicle.
- Survey the area surrounding the vehicle and along the path of travel for potential hazards.
- Always keep each other in view.

Spotters shall wear high-visibility clothing. During night operations, reflective safety vests are required, and spotters may use flashlights to help signal when there is limited visibility or darkness.

Spotters shall not be assigned any other duties while acting as a spotter. Spotters shall not look at a cell phones, wear headphones, chat with a co-worker, or do anything else that could pose a distraction during signaling or spotting activities.

30.3.4 Accident Management

If any driver is involved in a motor vehicle accident in association with contracted work activities s/he will notify their direct supervision as well as PNNL's Single Point of Contact.

30.3.5 Training

Contractor personnel who operate utility vehicles and other motor equipment will be trained for the specific equipment they use. Seatbelts must be installed in utility vehicles.

Contract drivers of special purpose vehicles or driver's transporting hazardous waste will obtain proper training and certification to perform this function. A state commercial driver's license with proper endorsements for the class of vehicle driven is acceptable proof of training.

30.4 References

41 CFR, Subpart 109-38.51 *Utilization of Motor Equipment*

49 CFR, *Transportation, Section 3.4, Commercial Driver's License*

Washington State Licensing

10 CFR 851, *Worker Safety and Health Program*

30.5 Expected Records

None

31.0 Respirable Crystalline Silica Control

31.1 Purpose

This section defines the responsibilities and requirements for protecting personnel engaged in silica work scope that has the potential for employee exposure to respirable crystalline silica in excess of the PNNL OEL of 25 µg/m^3, calculated as an 8-hour time-weighted average (TWA_8). The required work controls including work planning, exposure assessment, and engineering controls, administrative controls, PPE, training, and medical surveillance.

31.2 Responsibility

The Contractor shall be responsible for the following:

- Compliance with the procedure
- Employee training
- Complete the Silica Exposure Control Plan form
- Designate competent person
- Review and evaluate the effectiveness of the silica exposure control plan
- Medical Surveillance Requirements
- Annual review of silica exposure control plan
- Records

31.3 General Requirements

Exposure to occupational respirable silica shall be conducted in accordance with the following requirements:

- 10 CFR 851
- 29 CFR 1926, Subpart Z Respirable Crystalline Silica
- WAC 296-840 Respirable Crystalline Silica
- 2016 ACGIH TLV for Crystalline Silica

Employees shall not be exposed to respirable crystalline silica in excess of the PNNL Respirable Silica OEL of 25µg/m^3 (TWA_8).

31.4 Exposure Assessment Requirements

Contractor shall assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the OEL in accordance with either the Performance Option or the Scheduled Monitoring Option.

31.4.1 Performance Option

Contractor shall assess the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures to respirable crystalline silica.

31.4.2 Scheduled Monitoring Option

Contractor shall perform initial monitoring to assess the 8-hour TWA exposure for each employee on the basis of one or more personal breathing zone air samples that reflect the exposures of employees on each shift, for each job classification, in each work area.

Where several employees perform the same tasks on the same shift and in the same work area, the contractor may sample a representative fraction of these employees in order to meet this requirement. In representative sampling, the contractor shall sample the employee(s) who are expected to have the highest exposure to respirable crystalline silica.

If initial monitoring indicates that employee exposures are below the OEL, the contractor may discontinue monitoring for those employees whose exposures are represented by such monitoring.

- Where the most recent exposure monitoring indicates that employee exposures are above the OEL, the contractor shall repeat such monitoring within three months of the most recent monitoring.
- Where the most recent (non-initial) exposure monitoring indicates that employee exposures are below the OEL, the contractor shall repeat such monitoring within six months of the most recent monitoring until two consecutive measurements, taken 7 or more days apart, are below the TWA, at which time the contractor may discontinue monitoring for those employees whose exposures are represented by such monitoring.
- When unable to meet the performance option or scheduled monitoring option the employer must provide respirators to workers when dust control methods cannot limit exposures to the OEL.

31.4.3 Reassessment of Exposures

The contractor shall reassess exposures whenever a change in the production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures at or above the OEL, or when contractor has any reason to believe that new or additional exposures at or above the OEL have occurred.

31.5 Exposure Sampling Requirements

31.5.1 Methods of Sample Analysis

Contractor shall ensure that all samples are evaluated by a laboratory that analyzes air samples for respirable crystalline silica in accordance with NIOSH Manual of Analytical Methods (NMAM).

31.5.2 Employee Notifications

After completing a quantitative exposure assessment contractor shall individually notify each affected employee in writing of the results of that assessment or post the results in an appropriate location accessible to all affected employees. Notifications for construction work must occur within 5 days, all other notifications must occur within 15 days.

Whenever an exposure assessment indicates that employee exposure is above the OEL, contractor shall describe in the written notification the corrective action being taken to reduce employee exposure to or below the OEL.

31.5.2.1 Observation of Monitoring

Where air monitoring is performed to comply with the requirements of this section, affected employees or their designated representatives are given an opportunity to observe any monitoring of employee exposure to respirable crystalline silica.

When observation of monitoring requires entry into an area where the use of protective clothing or equipment is required for any workplace hazard, the contractor shall provide the observer with protective clothing and equipment at no cost and shall ensure that the observer uses such clothing and equipment.

31.5.2.2 Compliance Monitoring

PNNL may perform compliance monitoring of contractor personnel performing silica related activities to ensure contractor work practices are effective in controlling silica below 25µg/m^3 as required by this section. Results will be provided to contractor supervision, who will be responsible for sharing results in writing with affected employees per section 31.5.2.

31.6 Engineering and Work Practice Controls

31.6.1 Required Exposure Control Methods

Contractor shall use engineering and work practice controls to reduce and maintain employee exposure to respirable crystalline silica to or below the OEL, unless contractor can demonstrate that such controls are not feasible.

Wherever such feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the OEL, contractor shall nonetheless use them

to reduce employee exposure to the lowest feasible level and shall supplement them with the use of respiratory protection.

Contractor shall comply with other OSHA standards (such as 1926.57 ventilation) when abrasive blasting is conducted using crystalline silica-containing blasting agents, or where abrasive blasting is conducted on substrates that contain crystalline silica.

31.7 Restricted Areas Requirements

31.7.1 Written Plan to Restrict Access

Contractor shall establish a procedure used to restrict access to work areas, when necessary, to minimize the number of employees exposed to respirable crystalline silica and their level of exposure, including exposures generated by other subcontractors.

Means and methods are detailed in the silica exposure control plan discussing how to restrict access to silica levels above the OEL.

31.8 Written Exposure Control Plan

Contractor shall complete the silica exposure control plan prior to disturbing building products that contain crystalline silica.

- A description of the activities in the workplace that involve exposure to respirable crystalline silica.
- A description of the engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task.
- A description of the housekeeping measures used to limit employee exposure to respirable crystalline silica.
- Designate a competent person to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan.
- Review and evaluate the effectiveness of the written exposure control plan at least annually and update the plan as necessary. A silica exposure control plan maybe valid for one year.
- The written exposure control plan shall be readily available for review by PNNL and copying, upon request, to each employee covered by this section.

31.9 Respiratory Protection

When respiratory protection is required, contractors must provide each worker training, fit test, and medical evaluation prior to issuing an appropriate respirator. Respiratory protection must comply with CESH section 7.0 Respiratory Protection.

- Where exposures exceed the OEL during periods necessary to install or implement feasible engineering and work practice controls.
- Where exposures exceed the OEL during tasks, such as certain maintenance and repair tasks, for which engineering and work practice controls are not feasible.

- During tasks for which the contractor has implemented all feasible engineering and work practice controls and such controls are not sufficient to reduce exposures to or below the OEL.
- During periods when the employee is in restricted areas.

31.9.1 Special Respiratory Protection Provisions

- Indoor concrete saw cutting requires the use of ½ mask APR respirator for activities less than 4 hours. Full-face APR respirators are required for work activities greater than 4 hours.
- Any concrete grinding or cutting performed inside an enclosure requires the use of a full-face APR respirator.

31.10 Housekeeping

Contractor shall not allow dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.

Contractor shall not allow compressed air to be used to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:

- The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air.
- No alternative method is feasible.

31.11 Medical Surveillance

31.11.1 Initial Medical Surveillance

Contractor shall make an initial (baseline) medical examination available; by a qualified physician, at no cost to its employees, and at a reasonable time and place, when employees are:

- Performing silica related construction tasks and required to use a respirator for thirty or more days per year.

The baseline examination shall consist of:

- A medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing); history of tuberculosis; and smoking status and history.
- A History of tuberculosis. The history of tuberculosis should include completion of the WA State Department of Labor and Industries *Form F 252-113-000, Adult Tuberculosis Screening Tool for Workers Exposed to Respirable Crystalline Silica.*

- A physical examination with special emphasis on the respiratory system.
- A chest X-ray (a single posteroanterior radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems), interpreted and classified according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconiosis by a NIOSH-certified B Reader.
- A pulmonary function test to include forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) and FEV1/FVC ratio, administered by a spirometry technician with a current certificate from a NIOSH-approved spirometry course.
- Testing for latent tuberculosis infection.
- Any other tests deemed appropriate by the Physician or other licensed health care professional (PLHCP).

31.11.2 Periodic Examinations

Contractor shall make available medical examinations at least every three years, or more frequently if recommended by the PLHCP.

31.12 Information provided to the PLHCP

Contractor shall ensure that the examining PLHCP has a copy of this standard, and shall provide the PLHCP with the following information:

- A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica.
- The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica.
- A description of any PPE used or to be used by the employee, including when and for how long the employee has used or will use that equipment.
- Information from records of employment-related medical examinations previously provided to the employee and currently within control of the employer.

31.12.1 PLHCP Written Medical Report for the Employee

Contractor shall ensure that the PLHCP explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:

- A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment.
- Any recommended limitations on the employee's use of respirators.

- Any recommended limitations on the employee's exposure to respirable crystalline silica.
- A statement that the employee should be examined by a specialist if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.

31.12.2 PLHCP's Written Medical Opinion for PNNL

PNNL shall obtain a written medical opinion from the SOMD within 30 days of the medical examination. The written opinion shall contain only the following:

- The date of the examination.
- A statement that the examination has met the requirements of this section.
- Any recommended limitations on the employee's use of respirators.
- If the employee provides written authorization, the written opinion shall also contain either or both of the following:
- Any recommended limitations on the employee's exposure to respirable crystalline silica.
- A statement that the employee should be examined by a specialist if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.
- Contractor shall ensure that each employee receives a copy of the written medical opinion within 30 days of each medical examination performed.

31.12.3 Additional Examinations

If the PLHCP written medical opinion indicates that an employee should be examined by a specialist, contractor shall make available a medical examination by a specialist within 30 days after receiving the PLHCP’s written opinion. Contractor shall ensure that:

- The examining specialist is provided with all of the information that the contractor is obligated to provide to the PLHCP.
- The specialist explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of the examination.
- A written opinion is obtained from the specialist within 30 days of the medical examination.

31.12.4 Communication of Hazards to Employees

31.12.4.1 Hazard Communication

Contractor shall include respirable crystalline silica in the *Hazard Communication.* Each employee shall have access to labels on containers of crystalline silica and safety data sheets, and is trained. Contractor shall ensure that at least the following hazards are addressed: Cancer, lung effects, immune system effects, and kidney effects.

31.12.4.2 Signs

Contractor shall barricade and post signs at all entrances to minimize access to work areas where employees are performing silica related work activities in accordance with their written exposure control plan.

31.12.4.3 Employee Information and Training

Contractor shall ensure that each employee covered by this section can demonstrate knowledge and understanding of at least the following:

- The health hazards associated with exposure to respirable crystalline silica.
- Specific tasks in the workplace that could result in exposure to respirable crystalline silica.
- Specific measures to protect employees from exposure to respirable crystalline silica, including engineering controls, work practices, and respirators to be used.
- The contents of CESH.
- The purpose and a description of the medical surveillance program.
- The identity the designated competent person.

Contractor shall make section 31 of the CESH readily available without cost to each employee.

31.13 Recordkeeping

31.13.1 Air Monitoring Data

Contractor shall make and maintain an accurate record of all exposure measurements taken to assess employee exposure to respirable crystalline silica. This record shall include at least the following information:

- The date of measurement for each sample taken.
- The task monitored.
- Sampling and analytical methods used.
- Number, duration, and results of samples taken.

- Identity of the laboratory that performed the analysis.
- Type of PPE, such as respirators, worn by the employees monitored.
- Name, employee number, and job classification of all employees represented by the monitoring, indicating which employees were actually monitored.
- Ensure employee notification is completed per section 31.6.b.

Contractor shall ensure that exposure records are maintained and made available.

31.13.2 Objective Data

Contractor shall make and maintain an accurate record of all objective data relied upon to comply with the requirements of this procedure. This record shall include at least the following information:

- The crystalline silica-containing material in question.
- The source of the objective data.
- The testing protocol and results of testing.
- A description of the process, task, or activity on which the objective data were based.
- Other data relevant to the process, task, activity, material, or exposures on which the objective data were based.

Contractor shall ensure that objective data are maintained and made available. PNNL may request copies of objective data to help with the development of a data base for silica related work activities. This information can be leveraged for future exposure assessments when working with respirable crystalline silica.

31.13.3 Medical Surveillance

Contractor shall make and maintain an accurate record for each employee covered by medical surveillance. The record shall include the following information about the employee:

- Name and employee number.
- A copy of the PLHCP and specialists' written medical opinions.
- A copy of the information provided to the PLHCP and specialists.

PNNL shall ensure that medical records are maintained and made available.

31.14 References

29 CFR 1926, *Safety and Health Regulations for Construction*

WAC 296-155, *Safety Standards for Construction Work*

2016 ACGIH TLV’s and BEL’s

31.14.1 Forms (Located on Contracts Page)

Silica Exposure Control Plan

32.0 Wildfire Season/Smoke

32.1 Purpose

The purpose of this section is to inform contractors of the requirements to protect their personnel from the health effects of wildfire smoke, where it can reasonably be anticipated that employees may be exposed to a $pm_{2.5}$ concentration of 20.5 µg/m^3 (Air Quality Index 69) or more. The following operations are exempt:

a) Indoor work in which the windows, doors, bays, and other exterior openings are kept closed, except when it is necessary to briefly open doors to enter and exit.

b) Enclosed vehicles in which the air is filtered by a properly maintained cabin air filter and the employer ensures that windows, doors, and other openings are kept closed except when it is necessary to briefly open doors to enter or exit.

c) Employees exposed to a PM2.5 concentration of 20.5 µg/m3 (Air Quality Index 69) or more for a total of one hour or less during a 24-hour period.

32.2 Definitions

AirQualityIndex (AQI) AunitlessindexusedbytheU.S.Environ-33
mentalProtectionAgency(epa)tocommunicateairqualityforseveral34
pollutants,includingpm2.5.Referencestotheaqiusedthroughoutthis35
chaptermeans“aqiforpm2.5”.

$PM_{2.5}$ Solid particles and liquid droplets suspended in the air, known as particulate matter, with an aerodynamic diameter of 2.5 micrometers or smaller. Measured in micrograms per cubic meter (µg/m3).

32.3 Hazard Communication

For any worksite covered by this section, the employer must establish and implement a system for communicating wildfire smoke hazards in a form readily understandable by all affected employees, including provisions designed to encourage employees to inform the employer of wildfire smoke hazards at the worksite without fear of reprisal.

PNNL will communicate AQI through PNNL CNS system to subcontractors.

32.4 Training

The contractor must provide all employees with effective information and training regarding wildfire smoke before work that exposes the worker to a $pm_{2.5}$ concentration of 20.5 µg/m3 (AQI 69) or more, and at least annually thereafter.

Note: Training shall be updated every May.

At a minimum, the training shall include the information in Appendix B of **WAC 296-62-08550**.

32.5 Respiratory Protection

Where the current pm2.5 is 20.5 µg/m3 (AQI 69) or more, the employer is encouraged to provide respirators at no cost to employees upon request. Employees may provide and wear their own respiratory protection as long as voluntary use of these respirators does not introduce hazards to the work environment.

Where the current pm2.5 is 35.5 µg/m3 (AQI 101) or more, the employer must provide n95 filtering-facepiece respirators at no cost to all exposed employees, and must encourage respirator use.

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Approval History for: WSH-MA-001, R31_CESH Manual

Final Process State: APPROVED

Name	Activity Name	Date
✔ Kirkpatrick, Evan	Approval	4/24/2025 4:49:13 PM
✔ Hara, Neal T	Approval	4/25/2025 12:26:17 PM
✔ Haller, Alisa D	Approval	4/25/2025 2:29:07 PM
✔ Morris-Benavides, Sarah	Approval	4/28/2025 7:57:11 AM
✔ Deichman, Mark L	Approval	4/28/2025 9:55:14 AM
✔ Jivelekas, Adam P	Approval	4/28/2025 10:11:33 AM
✔ Buchanan, Clint R	Approval	4/29/2025 8:58:34 AM
✔ MacInnis, Carol C	Approval	5/6/2025 9:35:33 AM

*** All actions are stored digitally and viewable at https://approvals.pnl.gov/ProcessView.aspx?pid=6496598**