**DOE-0359**
**Revision 4-4**

# Hanford Site Electrical Safety Program (HSESP)

Prepared for the U.S. Department of Energy

Assistant Secretary for Environmental Management

Approved for Public Release;
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## REV. 4-4 CHANGE SUMMARY

| Revision # | Section Changed | Change Details |
|---|---|---|
| **4-4** | 3.11 | Remove requirement for personnel who dispose of capacitors to attend training, per Change Form DOE-0359-17. |
| **4-4** | 4.2.3 | Changed LAB to Restricted Approach Boundary (RAB), per Change Form DOE-0359-18. This became the first mention of RAB. |
| **4-4** | 4.2.4 | Made editorial correction because Change Form DOE-0359-18 changed the first mention of RAB. |
| **4-4** | 4.3.3 | Made editorial correction to remove comma that was causing misinterpretation per Change Form DOE-0359-19. |
| **4-4** | 4.4.1 | Made editorial correction to remove comma that was causing misinterpretation per Change Form DOE-0359-19. |
| **4-4** | 5.8 | Updated preamble language to match Section 3.11 and deleted list item regarding training, per Change Form DOE-0359-17. |

## REV. 4-3 CHANGE SUMMARY

| Revision # | Section Changed | Change Details |
|---|---|---|
| **4-3** | 4.4.1.2 | Exception reformatted to match Section 4.3.3, per Change Form DOE-0359-15. |
| **4-3** | App F | Corrected wording in Figures F-3 and F-5, per Change Form DOE-0359-16. |

## REV. 4-1 AND 4-2 CHANGE SUMMARY

| Revision # | Section Changed | Change Details |
|---|---|---|
| **4-1** | 4.6.1.b | Corrected reference from Appendix B to Appendix D. |

| Revision # | Section Changed | Change Details |
|---|---|---|
| **4-2** | 4.3.4 | Revised information required to appear on arc flash labels, per Change Form DOE-0359-14. |
| **4-2** | Appendix D, Figure D-4 | Updated sample arc flash labels, per Change Form DOE-0359-14. |

**REV. 4 CHANGE SUMMARY**

| Section | Change Details |
|---|---|
| ***NOTE:*** | *This summary does not identify all requirement changes or editorial clarifications between Revision 3 and Revision 4.* |
| General | Content revisions performed throughout to:<br>• Update existing requirements and implement new requirements of NFPA 70E-2018 and NFPA 70-2017<br>• Update references<br>• Update and add acronyms<br>• Clarify the material being presented<br><br>Additionally, Revision 4 presents a substantial rearrangement of content. Chapters, Sections and Appendices were reordered and renumbered to enhance usability |
| 1.0 | Statement added stating the relationship between work assignments and the collective bargaining agreement and/or jurisdictional decisions. |
| 2.3 | Added requirement for Contractors to verify HSESP compliance through regular supervision or annual inspections. |
| 2.7 | Added AHJ role to review and approve variance requests. |
| 3.0 | Rewrote Section 3, *Electrical Safety Training and Qualifications*, which includes:<br>• General and specific training requirements, as well as qualification and retraining requirements<br>• Training development and delivery by HAMMER and for contractor training organizations<br>• General requirements for unqualified persons and qualified persons<br>• Position-specific requirements for five qualified person categories, including performance of facility/equipment-specific tasks<br>• Demonstration of knowledge, skills, and abilities associated with the electrician and the instrument specialist qualified person categories (listed in Appendices B and C)<br>Requirements for qualified persons to enter the LAB or AFB |

| Section | Change Details |
|---|---|
| 4.1.1 | The Electrical Risk Assessment (ERA) process, a new NFPA 70E requirement based on likelihood of occurrence and severity, replaces the previous Electrical Hazard Evaluation (EHE). Discussion of ERA and Energized Electrical Work Permit (EEWP) implementation appears in multiple locations after Section 4.1.1 (including arc flash for both AC and DC systems). |
| 4.2.2 | A new section, *Operation of Electrical Equipment*, defining "normal operation of electrical equipment" per NFPA 70E was added. |
| 4.2.3 | Conditions added stating when the EEWP is required to be included in work documentation. |
| 4.3 | Application of the ERA/EEWP processes were detailed. |
| 4.3.4 | A labeling exception permitted under NFPA 70E was added for supervised industrial installations. |
| 4.5.2 | PPE testing requirements were added. |
| 5.4 | Several requirements associated with extension cord use were clarified. |
| 5.5 | Requirement for performing Job Hazard Analysis and equipment location marking was added. |
| 5.6.1.6 | Added requirement that live parts of generators operating at more than 50 volts AC or DC to ground shall not be exposed to accidental contact where accessible to unqualified persons. |
| 5.6.3.1 | Automotive vehicle exclusion added. |
| 5.6.3.4 | New stand-alone generator arc flash hazard definition added. |
| 5.7 | New requirements added: exposure levels requiring controls, performance of ERA, worker training, and PPE/safety equipment/tools. |
| 5.8 | New requirements added: exposure levels requiring controls, performance of ERA, worker training and details associated with discharging capacitors. |
| 6.0 | Requirements for performing work and for operating equipment in the vicinity of overhead power lines located in Revision 3 Sections 5.10, 5.11 and 5.12 were combined into Section 6. |
| 7.1 | Added the NFPA 70E requirement for annual field audits. |
| 7.2 | Added the NFPA 70E requirement for incident investigation. |

| Section | Change Details |
|---|---|
| App. A | The following definitions were significantly revised: Arc Flash Hazard, Arc Flash Boundary, Electrically Safe Work Condition, Non-Electrical Workers, Qualified Person, and Working Distance.<br><br>The following definitions were added: Battery System, Construction Worksite, Condition of Maintenance, Normal Operating Condition, Restricted Approach Boundary, Risk, Risk Assessment, Spotter, Supervised Industrial Installation, Transit, and Travel. |
| App. B | New basic experience requirements and knowledge, skills and abilities (KSAs) for Instrument Specialist were established. |
| App. C | New basic experience requirements and knowledge, skills and abilities (KSAs) for Electricians were established. |
| App. D | Sample forms were updated. |
| App. E | Work flow diagrams were updated and clarified. |

This Change Summary contains only the changes made to this revision. Previous Change Summary detailing all historical changes for this document is available by contacting Integrated & Site Wide Safety Systems (I&SWSS).

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## 1.0 PURPOSE AND SCOPE

This document establishes the Hanford Site Electrical Safety Program (HSESP), herein called the Program, which provides the requirements for electrical safe work practices and electrical safety training. This program is intended to provide a workplace free from unplanned exposure to electrical hazards for all Hanford Site contractors, subcontractors, and vendors. This Program implements applicable requirements of the following:

- National Fire Protection Association (NFPA) 70-2017, *National Electrical Code (NEC)*
- NFPA 70E-2018, *Standard for Electrical Safety in the Workplace*
- Code of Federal Regulations (CFR), Title 29, Occupational Safety and Health Administration (OSHA), 1910 Subpart S (29 CFR 1910), *Electrical*
- 29 CFR 1926, Subpart K, *Electrical*
- 29 CFR 1926, Subpart CC, *Cranes & Derricks in Construction*
- 29 CFR 1926, Subpart O, *Motor Vehicles, Motorized Equipment, and Marine Operations*
- 10 CFR Part 851, *Worker Safety and Health Program*
- American Society of Mechanical Engineers (ASME) B30.5, *Mobile and Locomotive Cranes*

**NOTE**: *This Program does not contain all requirements of the above documents. In the event of a conflict between this document and the requirements listed above, the conflict would be resolved by the HSESP committee per their charter.*

Definitions of terms specific to this Program are found in Appendix A.

For any discrepancies between this program and the Contractors Labor Agreement (Hanford Atomic Metal Trade Council (HAMTC), Hanford Site Stabilization Agreement (HSSA), etc.) the Labor Agreement applies.

### 1.1 Not Covered

This document does ***not*** cover any of the following:

- Lockout/Tagout activities: DOE-0336, *Hanford Site Lockout/Tagout Procedure* and MSC-PRO-EU-066, *Electrical Utilities Lock and Tag Program*, provide requirements for lockout/tagout.
- Installations or work involving automotive, watercraft, and similar equipment.
- Installations under the exclusive control of Electrical Utilities (EU) for the purpose of metering, control, transformation, transmission, or distribution of electrical energy.
    - **NOTE**: *Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings that are*

*not an integral part of a generating plant, substation, or control center are not exempt from the requirements of DOE-0359.*

- Telecommunications workers performing work under 29 CFR 1910.268, *Telecommunications*.

## 2.0 ROLES AND RESPONSIBILITIES

### 2.1 Mission Support Contractor (MSC)

To administer the HSESP, the MSC shall:

- Appoint an Electrical Safety Program Coordinator, responsible for:
  - Ensuring training courses are audited to validate they meet program requirements
  - Maintaining a current list of Authorities Having Jurisdiction (AHJs) for each participating contractor
  - Coordinating electrical safety activities and initiatives with Department of Energy (DOE) and other Hanford Site contractors
  - Ensuring that meeting summaries, interpretations, lessons learned, and other information related to electrical safety is effectively communicated
  - Maintaining an HSESP website, accessible by all Hanford Site contractors, for electrical safety information
- Document decisions/interpretations and recommendations by the HSESP Committee, the Hanford Electrical Codes Board (HECB), and the Hanford Workplace Electrical Safety Board (HWESB)
- Maintain two technical boards as the core of the HSESP, the HECB and the HWESB
- Provide administrative support for the HSESP Committee, the HECB, and the HWESB

### 2.2 Electrical Utilities, Mission Support Contractor

- Comply with the National Electrical Safety Code (NESC), Parts 1-3, and 29 CFR 1910.269, *Electric Power Generation, Transmission, and Distribution*.
- Participate in the Program by providing technical advice on matters relating to EU systems.

## 2.3 Prime Hanford Contractors

Each Prime Hanford Contractor shall ensure:

- The name(s) of the individual(s) appointed as AHJ, as defined in NFPA 70 and NFPA 70E, are submitted to DOE and the Electrical Safety Program Coordinator.
- Personnel (to the lowest subcontractor) who face a risk of electrical hazard are trained and qualified to perform the assigned work in accordance with this Program.
- Safe work practices as described in this Program are used by workers, including Non-Electrical Workers, who use portable electric tools and equipment to perform maintenance, construction, and demolition activities.
- Employees are complying with the safety-related work practices required by this Program through regular supervision or through inspections conducted on at least an annual basis.
- Electrical equipment and supporting equipment (e.g., light poles, power poles) are installed using appropriate technical standards and approved instructions and procedures.
- Electrically knowledgeable members of the HSESP Committee, HECB, and HWESB are appointed.
- Electrical Installation Permits (EIPs) (A-6005-707) are obtained for all electrical system installations and modifications.
- NEC inspections are scheduled at inspection points designated in the EIP and for re-inspection of corrected violations.
- Program Audits are performed in accordance with Section 7.1, *Program Audits*.
- Electrical incidents are investigated and trended, and significant incidents are communicated with the other Hanford Site contractors and the HSESP Committee in a timely manner.

## 2.4 Hanford Site Electrical Safety Program (HSESP) Committee

The HSESP Committee shall be the collective interpretive authority for the HSESP, as per, Attachment 1, *Hanford Site Electrical Safety Program [HSESP] Committee Charter*.

## 2.5 Hanford Electrical Codes Board

The HECB shall provide:

- Technical support and advice to the NFPA 70 AHJ(s) and others when requested

- The opportunity for all Hanford Site projects, facilities, and contractors to be represented
- Periodic meetings to serve as open forums for discussion of issues presented by NEC Inspectors, the HSESP Committee, and other stakeholders
- Recommendations to the AHJ(s) on any disputes not resolved with the NEC Inspectors

## 2.6 Hanford Workplace Electrical Safety Board (HWESB)

The HWESB shall provide:

- Technical support and advice to the NFPA 70E AHJ(s)
- The opportunity for all Hanford Site projects, facilities, and contractors to be represented
- Periodic meetings to serve as open forums for discussion of issues presented by stakeholders
- Discussions of electrical events or trends across the DOE Complex

## 2.7 Authority Having Jurisdiction (AHJ)

The AHJ shall:

- Enforce and interpret all required documents stated in Section 1.0, *Purpose and Scope*, as they apply to this Program
- Review and approve variance requests based upon the design, voltages, and current that will be present using other national standards
- Document company specific AHJ decisions and interpretations

## 2.8 National Electrical Code (NEC) Inspectors

NEC Inspectors shall:

- Be independent from the work they inspect. They shall not inspect work for which they have direct line management, engineering, or construction responsibility
- Act as a field representative of the AHJ(s) to administer and enforce the NEC
- Maintain qualifications established in Section 3.7
- Issue EIPs (A-6005-707)
- Consult with designers and installers on NEC compliance issues
- Perform field inspections for installations and modifications of electrical systems and equipment
- Issue NEC inspection reports to the EIP holder

- Present disputed NEC inspection reports and issues to the company AHJ(s) for resolution

### 2.9 Project/Construction/Maintenance/Operations/Engineering Managers

Project/Construction/Maintenance/Operations/Engineering Managers shall ensure:

- Participation on the HECB and HWESB
- Safe work practices, as described in this Program and NFPA 70E, are used by workers under their direction, including Non-Electrical Workers
- Approved personal protective equipment (PPE) for electrical work is provided and used by workers who are exposed to electrical hazards
- Work assignments do not exceed personnel qualifications
- Personnel are trained to the requirements listed in Section 3.0, *Electrical Safety Training and Qualifications*

### 2.10 Supervisor/Foreman

Supervisor/Foreman shall:

- Ensure work is performed within the controls of the work document(s)
- Understand and follow the Electrical Risk Assessment (ERA) process
- Verify employees are qualified to perform the work assigned (See Section 3.0, *Electrical Safety Training and Qualifications*)
- Identify and communicate potentially unsafe electrical conditions

### 2.11 All Personnel

All personnel shall:

- Comply with applicable requirements of this Program
- Immediately report all electrical shocks, other than obvious static shocks, and be evaluated at a Hanford Site Occupational Medical Contractor first aid station

**NOTE**: *Static shocks should be evaluated on a case-by-case basis, or as requested by the worker, to determine if medical evaluation is necessary.*

## 3.0 ELECTRICAL SAFETY TRAINING AND QUALIFICATIONS

### 3.1 Electrical Safety Training

These training requirements shall apply to employees exposed to an electrical hazard and employees who supervise them, when the risk associated with that hazard is not reduced to a safe level by the applicable electrical installation requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and

procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury. Personnel shall be trained and qualified to a level of proficiency consistent with their assigned tasks. The employer shall document that each employee has received all applicable Electrical Safety Training that the worker needs to perform assigned duties.

Consistent training is critical to successful implementation of the Program; it is recommended that training be provided by the Volpentest HAMMER Federal Training Center (HAMMER); however, contractors providing their own training shall meet the minimum requirements of the *Hanford Site Electrical Safety Program (HSESP) Course Descriptions, Objectives, and Training Requirements* (available on the HSESP website) and be reviewed and approved by the HSESP Committee. Individual training equivalencies, waivers, and extensions for HAMMER courses shall be reviewed, approved, and documented per HAMMER procedures. Facility-specific training equivalencies shall be reviewed, approved, and documented per the appropriate Hanford Site contractor training program.

## 3.2 Emergency Response Training

**Contact Release.** Employees exposed to shock hazards and those responsible for the safe release of victims from contact with energized electrical conductors or circuit parts shall be trained in methods of safe release. Refresher training shall occur annually.

**First Aid, Emergency Response, and Resuscitation**. Employees responsible for responding to medical emergencies shall be trained in first aid and emergency procedures, Cardiopulmonary Resuscitation (CPR), and the use of Automated External Defibrillator (AED).Training shall occur at a frequency that satisfies the requirements of the certifying body.

**Training Verification**. Employers shall verify at least annually that Emergency Response Training for each employee is current.

**Documentation**. The employer shall document that the required training has occurred.

## 3.3 Retraining

Retraining in safety-related work practices and applicable changes in this Program shall be performed and documented at intervals not to exceed three years. The employee shall receive additional training or retraining if any of the following conditions exist:

1. The supervision or annual inspection indicate the employee is not complying with the safety-related work practices.

2. New technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices different from those that the employee would normally use.
3. The employee's job duties change.

Prior to performing work, the employee needs to review tasks that are performed less often than once per year and any safety-related work practices not normally used by the employee during regular job duties.

### 3.4 Unqualified Persons

Unqualified persons shall be trained and familiar with any electrical safety-related practices necessary to perform their job safely. All unqualified persons shall receive electrical hazard awareness training (initial and refresher) through completion of the Electrical Safety module of Hanford General Employee Training (HGET).

Workers operating electrical hand tools, such as drills, grinders, etc., shall attend *Basic Electrical Safety Training.*

### 3.5 Qualified Person

A qualified person shall be trained and knowledgeable in the construction and operation of equipment or a specific work method and be trained to identify and avoid the electrical hazards that might be present with respect to the equipment or work method.

The qualified person shall be familiar with the proper use of the special precautionary techniques, applicable electrical policies and procedures, PPE, insulating and shielding materials, and insulated tools and test equipment that is required for their assigned duties.

A person can be considered qualified with respect to certain equipment and tasks but still be unqualified for others.

An employee who is undergoing on-the-job training for the purpose of obtaining the Knowledge, Skills, and Abilities (KSAs) necessary to be considered a qualified person, and in the course of such training has demonstrated the ability to perform the specific duties safely, and who is under the direct supervision of a qualified person shall be considered to be a qualified person for the performance of those specific duties.

When an employee's assigned duties require the use of test instruments, the employee shall be trained to select an appropriate test instrument and shall demonstrate how to use a device to verify the absence of voltage, including interpreting indications provided by the device. The training shall ensure the employee understands all the limitations of each test instrument that is used for their assigned duties.

### 3.5.1 Electrical Risk Assessment Preparer

1. The ERA Preparer is a qualified person who is responsible for the completion of the ERA.

   **NOTE:** *The ERA Preparer is prohibited from entering the Limited Approach Boundary (LAB) or Arc Flash Boundary (AFB), unless continuously escorted by an individual qualified under Section 3.6 and wearing appropriate PPE.*

2. The contractor is responsible for documenting that the ERA Preparer has demonstrated the ability to correctly complete and document the ERA.

   **NOTE**: *Courses available to assist in training include: NFPA-70E, Standard for Electrical Safety in the Workplace, Hanford Site Electrical Safety Program Training, Capacitor Safety Training, Battery Safety Training, and Contact Release.*

### 3.5.2 Non-Electrical Worker

1. Non-Electrical Workers are employees who face a higher than normal risk of exposure to electrical hazards. This includes but is not limited to workers who may operate electrical disconnects or circuit breakers.

2. The employer shall ensure that Non-Electrical Workers demonstrate KSAs and meet all requirements to be classified as qualified persons for the specific task they have been assigned.

   **NOTE:** *The Non-Electrical Worker is prohibited from entering the LAB or AFB, unless continuously escorted by an individual qualified under Section 3.6 and wearing appropriate PPE.*

   **NOTE**: *Courses available to assist in training Non-Electrical Workers include: Basic Electrical Safety Training and Breaker Operation Electrical Safety.*

### 3.5.3 Instrument Specialist

The responsible company shall document that the following knowledge, experience, and training requirements are satisfied.

1. All newly hired instrument specialists shall be trained and qualified via a trade school program or equivalent military experience. See Appendix B for a list of the basic KSAs and experience requirements.

2. The employer shall document that each incumbent instrument specialist demonstrate KSAs to be classified as a qualified person for their assigned task(s). See Appendix B for a list of the basic KSAs.

3. Each employee shall demonstrate KSAs for all facility-specific equipment and tasks relevant to assigned duties that are not outlined in Appendix B.

4. Instrument Specialists who are permitted to work within the LAB or AFB of exposed energized electrical conductors and circuit parts operating at 50 volts or more shall meet all the requirements of Section 3.6 for assigned duties.

A vendor under the direct oversight of an Instrument Specialist (qualified under Section 3.6) shall be considered a qualified person for the performance of their contracted duties.

**NOTE**: *Courses available to assist in training Instrument Specialist include: NFPA-70E, Standard for Electrical Safety in the Workplace, Hanford Site Electrical Safety Program Training, Capacitor Safety Training, Battery Safety Training, Contact Release, and First Aid, Emergency Response, and Resuscitation.*

### 3.5.4 Electrician

The responsible company shall document that the following knowledge, experience, and training requirements are satisfied:

1. All newly hired electricians shall have a general journey-level electrician state license or documented equivalency (e.g., military). See Appendix C for a list of the basic KSAs and equivalency requirements.
2. The employer shall document that each incumbent electrician demonstrate KSAs to be classified as a qualified person for their assigned task(s). See Appendix C for a list of the basic KSAs.
3. Each employee shall demonstrate KSAs for all facility-specific equipment and tasks relevant to assigned duties that are not outlined in Appendix C.
4. Electricians who are permitted to work within the LAB or AFB of exposed energized electrical conductors and circuit parts operating at 50 volts or more shall meet all the requirements of Section 3.6 for assigned duties.
5. The employer shall ensure all electricians receive 24 hours per three-year cycle of the following continuing education:
   - At least eight (8) hours of NFPA 70 code update.
   - Four (4) hours on currently adopted Revised Code of Washington (RCW) 19.28 and related Washington Administrative Codes (WAC).
   - Twelve (12) hours of additional State-approved continuing education courses.

   **NOTE**: *When possible, courses shall meet the State of Washington criteria for Continuing Education Units (CEUs).*

A vendor under the direct oversight of an Electrician (individual qualified under Section 3.6) shall be considered a qualified person for the performance of their contracted duties.

**NOTE**: *Courses available to assist in training Electricians include: NFPA-70E, Standard for Electrical Safety in the Workplace, Hanford Site Electrical Safety Program Training, Capacitor Safety Training, Battery Safety Training, Contact Release, and First Aid, Emergency Response, and Resuscitation.*

### 3.5.5 Supervisor/Foreman

This includes, but is not limited to, first-line managers, field work supervisors, and foremen. They shall have at least the same level of Electrical Safety Training and Emergency Response Training as the workers they oversee or lead.

For supervisors responsible for instrument specialists or electricians who work within the LAB or AFB, the responsible company shall document that the following knowledge, experience, and training requirements are satisfied.

- Meet company-specific qualification requirements.
- Emergency response training listed in Section 3.2, *Emergency Response Training*.
- All requirements listed in Section 3.5, *Qualified Person*.
- Working knowledge of the NEC (applicable only to those who supervise electricians performing technical work). This working knowledge shall, at a minimum, be maintained every three (3) years through the following:
    - At least eight (8) hours of NFPA 70 code update.
    - Four (4) hours on currently adopted Revised Code of Washington (RCW) 19.28 and related Washington Administrative Codes (WAC).
- Supervisors entering the LAB or AFB of exposed energized electrical conductors and circuit parts operating at 50 volts or more shall meet all the requirements of Section 3.6 for assigned duties.

### 3.6 Qualified Persons Entering the LAB or AFB

A qualified person (see Sections 3.5.3, 3.5.4, and 3.5.5) permitted to work within the LAB or AFB shall additionally be trained in all the following:

1. Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment.
2. Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts.
3. Approach distances specified in NFPA 70E Table 130.4(D) (a) and Table 130.4(D) (b) and the corresponding voltages to which the qualified person will be exposed.
4. Decision-making process necessary to be able to do the following:
   a. Perform the job safety planning.
   b. Identify electrical hazards (e.g., shock, arc flash).
   c. Assess the associated risk.
   d. Select the appropriate risk control methods from the hierarchy of controls.

### 3.7 NEC Inspector

1. NEC inspections shall be performed by designated NEC Inspectors who have been authorized by the AHJ to perform such inspections.
2. NEC Inspectors shall pass a nationally recognized test for general electrical inspectors and plan review inspectors. The International Association of Electrical Inspectors (IAEI) or the International Code Council (ICC) shall certify these tests.
3. NEC Inspectors shall have at least ***one*** of the following:
   a. No less than four years of experience as a journey-level electrician installing and maintaining electrical equipment.
   b. Two years electrical training in a college of electrical engineering of recognized standing and four years continuous practical electrical experience in installation work.
   c. Four years of electrical training in a college of electrical engineering of recognized standing and two years continuous practical electrical experience in electrical installation work.
   d. Approval and designation from the AHJ based upon years of experience in the electrical field.
4. NEC Inspectors shall complete NFPA 70E, *Standards for Electrical Safety*, with refresher training at intervals not to exceed three years.

5. NEC Inspectors shall remain cognizant of the latest status of the NEC via continued training and education.

### 3.8 Spotters

1. Spotters for Mobile Equipment shall complete *Equipment Operation Near Powerlines* training.

2. Spotters for Mobile Cranes (dedicated spotters) shall complete *Equipment Operation Near Powerlines* and *Advanced Rigging Techniques*.

### 3.9 Mobile Crane Operators and Crew Members

Training for crane operators and crew members working near overhead lines will be in accordance with DOE-RL-92-36, the *Hanford Site Hoisting and Rigging Manual (HSHRM).*

### 3.10 Battery Training

Personnel who install, maintain, or otherwise work directly with batteries that present a chemical or electrical hazard (battery or battery banks operating over 50 volts or stored capacity exceeding 1 kWh) shall complete *Battery Safety Training*.

### 3.11 Capacitor Training

Personnel who install, examine, maintain, or remove capacitors or capacitor banks rated greater than the values below shall complete *Capacitor Safety Training*:

- 1 joule of stored energy at 100 volts up to 400 volts (≥200 µF), or
- 0.25 joules of stored energy at 400 volts or greater (≥200 µF)

## 4.0 GENERAL REQUIREMENTS AND PRINCIPLES

### 4.1 Electrical Safe Work Practices

1. A risk assessment shall be performed for all work containing electrical hazard(s) in accordance with NFPA 70E and this Program. This assessment shall be documented on the ERA Form (A-6007-595) or Energized Electrical Work Permit (A-6005-704).

2. All electrical equipment, circuit conductors, and circuit parts operating at voltages equal to or greater than 50 volts shall be considered energized until placed in an electrically safe work condition in accordance with DOE-0336, *Hanford Site Lockout/Tagout Procedure* and/or MSC-PRO-EU-066, *Electrical Utilities Lock and Tag Program*, as applicable.

3. Where there is not an accessible exposed point to take contact voltage measurements to determine the absence of voltage at work locations, planning considerations and documentation shall include approval of alternate methods of

verification (e.g., proximity probes, non-contact probes, circuit tracers, current sensing probes).

**NOTE 1**: *Adequately rated permanently installed mounted test device shall be permitted to be used to verify the absence of voltage of the conductors or circuit parts at the work location provided: It is permanently mounted and installed in accordance with manufacturers' instructions; 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 know source before and after verifying absence of voltage.*

**NOTE 2**: O*n electrical systems over 1000 volts, noncontact test instruments shall be permitted to be used to test each phase conductor.*

4. Personnel may perform or supervise electrical work only to the level for which they have been trained and qualified in accordance with Section 3.0, *Electrical Safety Training and Qualifications*.

5. Alerting techniques such as safety signs, safety symbols, tags, barricades, or an attendant shall be used where necessary to warn employees about electrical hazards that might endanger them. Such signs and tags shall meet the requirements of applicable state, federal, or local codes and standards. If the attendant is required to be within the LAB or AFB, they shall be an individual qualified under Section 3.6 or continuously escorted by an individual qualified under Section 3.6 and wearing appropriate PPE.

6. Where work is performed on equipment that is de-energized and placed in an electrically safe work condition in a work area where look-alike equipment (other energized equipment that is similar in size, shape, and construction) exists, one of the alerting methods listed below shall be employed to prevent the employee from entering look-alike equipment:

   a. Safety signs, safety symbols, and/or tags

   b. Barricades (used to prevent or limit employee access)

   c. Attendant(s)

7. Insulated tools and equipment shall be used when working inside the restricted approach boundary. Insulated tools shall be rated, designed, and constructed for the environment to be used and visibly inspected prior to each use. Insulated tools and equipment shall also be stored, maintained, and tested according to the manufacturer's instructions or industry standards.

8. Portable ladders shall have nonconductive side rails when used within the LAB or where the employee or ladder could contact exposed energized electrical conductors or circuit parts. Non-conductive ladders (i.e., fiberglass, wood) shall meet the requirements of applicable state, federal, or local codes and standards.

9. Electrical PPE and other protective equipment shall meet the requirements of Section 4.5, Electrical PPE.

10. All test instruments and associated test leads used to verify the absence or presence of voltage shall be maintained to assure functional integrity. The maintenance program shall include a functional verification. Test instruments shall be rated, approved, and designed for the environment of their intended use, and visually inspected for external damage before each use. All test instruments and associated equipment shall be used in accordance with any instructions provided by the manufacturer. Damaged or defective equipment shall be removed from service.

## 4.2 Work Involving Electrical Hazards

All electrical hazards to which an employee may be exposed shall be put into an electrically safe work condition (except where energized work can be justified) in accordance with DOE-0336, *Hanford Site Lockout/Tagout Procedure* and/or MSC-PRO-EU-066, *Electrical Utilities Lock and Tag Program*, as applicable, before an employee performs work if any of the following conditions exist:

- The employee is within the limited approach boundary.
- The employee interacts with equipment where conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.

### 4.2.1 Process for Establishing and Verifying an Electrically Safe Work Condition

The process for establishing and verifying an electrically safe work condition shall be performed in the order presented in NFPA 70E Article 120.5, unless infeasible.

### 4.2.2 Operation of Electrical Equipment

Normal Operation of electrical equipment having an arc flash hazard shall be permitted by a qualified person(s) where a normal operating condition exists. A normal operating condition exists when all of the following conditions are satisfied:

a. Equipment is properly installed.

b. Equipment is properly maintained.

c. The equipment is used in accordance with the instructions included in the listing and labeling and in accordance with manufacturer's instructions.

d. The equipment doors are closed and secured.

e. All equipment covers are in place and secured.

f. There is no evidence of impending failure.

The Arc Flash Assessment shall consider both the likelihood of occurrence and severity to determine if additional protective measures are required and shall be used to determine when operation of the equipment will require the use of an Energized Electrical Work Permit (EEWP) (A-6005-704).

### 4.2.3 Perform Work with an Energized Electrical Work Permit

When working within the Restricted Approach Boundary (RAB) or the AFB of energized electrical conductors or circuit parts that are not placed in an electrically safe work condition, justification and authorization shall be documented on an approved EEWP and shall require senior management authorization.

Examples of justification include:

- Increased or additional hazards
- Infeasibility

The EEWP shall be included in the work document (e.g., work package, technical procedure) when:

1. Work is performed within the restricted approach boundary.
2. 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. See NFPA 70E Table 130.5(C), *Estimate of the Likelihood of Occurrence of an Arc Flash Incident for AC and DC Systems*.

### 4.2.4 Perform Work with Exemptions to an EEWP

Electrical work shall be permitted without an EEWP if a qualified person uses appropriate safe work practices and PPE under any of the following work conditions. Additionally, an ERA (A-6007-595) shall be completed prior to starting work.

1. Testing
2. Troubleshooting
3. Voltage and current measurement
4. Thermography, ultrasound, or visual inspection if the RAB is not crossed
5. Calibration/adjustment
6. Lockout/Tagout activities (e.g., Verification of Isolation Check and/or Safe-To-Work checks)
7. Working on the load side of Class 2 circuits

8. Removing/replacing electrical device covers and enclosure covers
9. Re-setting overload devices, removing/installing fuses, miscellaneous non-electrical tasks in electrical enclosures that cannot be de-energized and when the RAB will not be crossed
10. When a qualified person is installing temporary protective measures such as:
    - Voltage rated protective shields/barriers
    - Voltage rated rubber insulating equipment
    - Voltage rated plastic guard equipment
    - Physical or mechanical barriers (field fabricated) outside of the LAB

    Use of temporary protective measures to prevent inadvertent contact with energized conductors or circuit parts shall have documentation of installation and removal. It is acceptable to allow temporary barriers to remain in place for the duration of the task with verification of adequacy by a qualified person each day when work is being performed.
11. When crossing the LAB only for visual inspection by a qualified person or an unqualified person continuously escorted by an individual qualified under Section 3.6 and the RAB will not be crossed.
12. When crossing the AFB only for visual inspection by an individual qualified under Section 3.6, or an unqualified person continuously escorted by an individual qualified under Section 3.6.

### 4.3 Working within the Limited Approach Boundary or Arc Flash Boundary

1. Work within the LAB or the AFB shall be performed using appropriate PPE. The workers shall be provided an electrical hazards brief by a Supervisor/Foreman.

   **EXCEPTION**: *The contractor AHJ may provide exceptions for Hanford Patrol, Hanford Fire Department, and Security Technicians/Specialists to enter the LAB, for systems under their exclusive control, based on specialized training and an ERA that identifies the hazards involved and the associated controls.*

2. A shock risk assessment shall be completed and documented on the ERA (A-6007-595) to determine the voltage (AC and DC) to which personnel will be exposed, boundary requirements, and the PPE necessary to minimize the possibility of electric shock to personnel.

   **EXCEPTION***: An ERA is not required when the only energy source is less than 50 volts.*

3. For all equipment under the jurisdiction of the NEC, an arc flash risk assessment shall be completed and documented to determine the AFB and the

PPE that personnel within the AFB shall use. This assessment shall be documented on the ERA (A-6007-595).

**EXCEPTION**: *An ERA is not required when an EEWP is completed per Section 4.2.*

**EXCEPTION:** *An arc flash risk assessment is not required for the following:*

- *DC circuits less than 100 volts*
- *Single-phase circuits*
- *Three-phase circuits less than 240 volts and supplied by a single transformer (or equivalent) or generator, rated at less than 125 kVA.*

Three approved methods for performing an Incident Energy Analysis are described below:

a. Incident Energy Analysis (preferred method)

The incident energy exposure level shall be based on the working distance of the employee's face and chest areas from a prospective arc source for the specific task to be performed. Arc rated clothing and other PPE shall be used by the employee based on the incident energy exposure associated with the specific task. Recognizing that incident energy increases as the distance from the arc flash decreases, additional PPE shall be used for any parts of the body that are closer than the working distance at which the incident energy was determined.

The incident energy analysis shall take into consideration the characteristics of the overcurrent protective device and its fault clearing time, including its condition of maintenance. The incident energy analysis shall be updated when changes occur in the electrical distribution system that could affect the results of the analysis. The incident energy analysis shall also be reviewed for accuracy at intervals not to exceed 5 years.

NFPA 70E Table 130.5(G) identifies the arc rated clothing and other PPE requirements and shall be permitted to be used with the incident energy analysis method of selecting arc flash PPE.

b. Arc Flash PPE Category Method

If an Incident Energy Analysis has not been performed, then NFPA 70E, Table 130.7(C)(15)(a,b,& c) may be used to determine the arc flash PPE category based on the specific task. When using the category method, ensure all the following limiting conditions are met:

i. The available fault current at the specific work location does not exceed the parameters listed for the equipment.

ii. The clearing time for the protective device that isolates the fault does not exceed the parameters listed for the equipment.

c. Engineering Evaluation

If clearing times and/or available fault current cannot be determined, the ERA shall be prepared via an engineering evaluation, based on assumed values.

4. If an incident energy analysis has been performed, and an arc flash hazard exists, the equipment likely to be worked on while energized shall be field marked prior to work being performed with a label containing the following information:

   1. Nominal system voltage
   2. AFB
   3. At least one of the following:
      - Available incident energy and the corresponding working distance or the arc flash PPE category in Table 130.7(C)(15)(a) or Table 130.7(C)(15)(b) for equipment, but not both.
      - Minimum arc rating of clothing.
      - Site-specific level of PPE.

   **EXCEPTION**: *In supervised industrial installations where conditions of maintenance and engineering supervision ensure that only qualified persons monitor and service the system, the information required for labeling listed above shall be permitted to be documented in a manner that is readily available to the persons likely to perform examination, servicing, maintenance, and operation of the equipment while energized.*

   Where the calculated incident energy is 40 cal/cm$^2$ or below, the label shall be an orange "WARNING" label; where the calculated incident energy exceeds 40 cal/cm$^2$, the label shall be a red "DANGER" label. See Appendix D, Figure D-4, *Incident Energy Labels*, for sample labels.

5. When an unqualified person must cross the LAB, an individual qualified under Section 3.6 shall advise the unqualified person of the possible hazards and continuously escort the unqualified person(s) while inside the LAB. Under no circumstance shall the escorted unqualified person(s) be permitted to cross the RAB.

6. Under no circumstances shall an unqualified person(s) be permitted to cross the AFB without arc flash PPE and being continuously escorted by an individual qualified under Section 3.6.

7. At least two qualified persons (per Section 3.6) shall be assigned to any work occurring inside the AFB or the RAB of exposed parts operating at more than 300 volts.

**NOTE***: A non-electrical worker qualified person working with an Electrician qualified person assigned as part of a Refrigeration Equipment Services (RES) Composite crew may fulfill the role of the second qualified person.*

8. A qualified person (per Section 3.6) has the right to request an evaluation to determine if additional qualified person(s) are needed when performing a task that presents a risk of shock or arc flash hazard to ensure employee protection.
9. Conductive articles of jewelry and clothing (e.g. watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn within the RAB where they present an electrical contact hazard with exposed energized conductors or circuit parts.

## 4.4 Over Current Protective Devices

### 4.4.1 Operating Circuit Breakers, Electrical Disconnect Switches, and Similar Switchgear Equipment

1. Operation shall be performed by a qualified person.
2. Component operation requires completion of an ERA.

   **EXCEPTION:** *An ERA is not required for:*

   - DC circuits less than 100 volts
   - Single-phase circuits
   - Three-phase circuits rated less than 240 volts and supplied by a single transformer (or equivalent) or generator, rated at less than 125 kVA
3. Protective device operation shall be simulated for emergency preparedness drills.
4. During an actual emergency situation (e.g., fire or take cover), equipment shall be shut down by the most expedient means available (including operation by unqualified personnel). Recovery actions that include equipment restart shall follow established building/facility procedures and policies, and be performed by a qualified person.

#### 4.4.2 Reclosing (Re-Energizing) Circuits After Protective Device Operation

After a circuit is de-energized by an over current protective device, the circuit shall not be manually re-energized until it has been determined by an Electrician (qualified person) that the equipment and circuit can be re-energized safely.

**NOTE 1:** *Over current protective devices may be, but are not limited to, fuses, circuit breakers, and overloads.*

**NOTE 2**: *See Section 5.1, Ground Fault Circuit Interrupters (GFCIs), for re-setting tripped GFCI receptacles/in-line GFCI devices.*

### 4.5 Electrical Personal Protective Equipment (PPE)

1. Electrical PPE includes, but is not limited to, the equipment and clothing necessary to protect personnel performing electrical work from hazards involving electrical shock, arc flash, and any other electrical hazards that may be encountered.

   **NOTE**: *PPE for non-electrical hazards (e.g., battery acid) shall also be considered.*

2. PPE shall conform to applicable State, Federal, or local codes and standards and be:

   a. Tested in accordance with manufacturer's instructions and/or the applicable American National Standards Institute (ANSI) or American Society for Testing and Materials (ASTM) standard(s).

   b. Maintained in a safe, clean, and reliable condition and in accordance with manufacturer's instructions.

   c. Stored in a manner that protects against physical damage, moisture, dust, or other deteriorating agents.

   d. Visually inspected before each use.

3. Electrical PPE and other protective equipment that has an expired testing date or fails visual or functional inspection shall be removed from service.

4. All personnel are to be provided, and shall use, PPE appropriate for the shock and arc flash hazards to which they are exposed. All parts of the body inside the AFB shall be protected.

5. Personnel shall wear hearing protection whenever working within the AFB.

6. Personnel shall be instructed in the proper use and maintenance of PPE prior to use.

7. Voltage rated rubber-insulating equipment shall be marked with the issue date. The equipment shall not be used if the testing interval listed in Table 1 has

expired. Equipment may be returned to service after satisfactory re-testing is complete.

8. Electrical PPE shall be subject to periodic electrical tests with the maximum test intervals as identified in Table 1:

**TABLE 1: TEST INTERVALS**

| Rubber Insulating Equipment | Testing Interval |
|---|---|
| Blankets | Before first issue; every 12 months thereafter |
| Covers | If insulating value is suspect |
| Gloves | Before first issue; every 6 months thereafter |
| Line hose | If insulating value is suspect |
| Sleeves | Before first issue; every 12 months thereafter |

9. Voltage rated gloves, preferably with leather protectors, shall be used when working within the RAB or when there is a danger of injury from electric shock due to contact with energized electrical conductors or circuit parts.
   a. The following inspection shall be performed prior to using gloves and immediately following any incident that is suspected of having caused damage to the gloves:
      i. Check test date on gloves to verify it is within periodicity.
      ii. Visually inspect for cracks, holes, tears, foreign substances, and other visible defects.
      iii. Perform air leakage test on gloves.

      Gloves found with any defects that may affect its insulating properties shall be removed from service.
   b. Voltage rated insulating sleeves shall also be used when there is an additional danger of arm injury from electric shock due to contact with energized electrical conductors or circuit parts.
   c. Gloves exposed to chemicals, damaged, or requiring periodic testing, cleaning and sanitizing shall be returned to EU.
10. Personnel shall wear appropriate layers of arc-rated clothing that meets or exceeds the incident energy level specified on the ERA.

## 4.6 Electrical Equipment Listing, Labeling, and Approval Requirements

1. All electrical equipment installed or used on the Hanford Site shall be approved by the contractor appointed NFPA 70 AHJ. Electrical equipment shall be approved if it has been accepted, certified, listed, labeled, or otherwise determined to be safe by an OSHA Nationally Recognized Testing Laboratory (NRTL) (as indicated by an NRTL label applied by the manufacturer). If that criteria is not met, the AHJ shall use one of the two following methods:

   a. If there is an Underwriters Laboratories (UL) standard for the piece of equipment; it shall be field evaluated and labeled by an OSHA recognized NRTL representative.

   b. Inspection and/or testing shall be completed using the Hanford Site Non-NRTL Labeled Electrical Equipment AHJ Approval Form (A-6005-705), Hanford Site Non-NRTL Labeled Electrical Equipment Evaluation (A-6005-706) when required by the AHJ, and labeled using the AHJ Approval for Non-NRTL Equipment (BL-6004-154). For an image of the required tag, see Appendix D, *Authority Having Jurisdiction (AHJ) Approval for Non-Nationally Recognized Testing Laboratory (NRTL) Equipment Label.*

   **EXCEPTION:** *Non-NRTL certified equipment that operates at less than 50 volts* (*such as cable assemblies, instruments, security systems, low voltage lighting, communication systems, etc.) may be approved by the AHJ using an informal method, if it is determined that an NRTL certified alternative is not readily available to meet the application.*

   **EXCEPTION:** *Equipment connected to the load side of a Class 2 or 3 power supply when it has been determined that listed equipment for the intended use is not available, does not require AHJ approval prior to use.*

   **NOTE 1**: *Legacy equipment (in use prior to September 2003) and Non-NRTL equipment in use prior to the implementation of this Program (February 2013) may remain in service and does not require reevaluation, so long as it has not been modified, not found to be defective or damaged, and does not present a hazard to the workers.*

   **NOTE 2:** *See the OSHA website for a list of OSHA recognized NRTLs.*

2. Equipment shall be suitable for its intended purpose and used in accordance with the manufacturer's instructions and any instructions or requirements of the NRTL listing or labeling.

3. All electrical multi-meters, including the external test leads, used on electrical equipment that operates at 50 volts or more shall be approved per Section 4.6.1. The standard multi-meter will be rated Category III or higher. Category II or less rated test instruments shall be permitted only when no instrument with a higher rating is available for the purpose and it can be assured the instrument will not be used outside the limits of its category rating.

# 5.0 SPECIFIC REQUIREMENTS

## 5.1 Ground Fault Circuit Interrupters (GFCIs)

1. Ground Fault Circuit Interrupters (GFCIs) are for personnel protection to limit the severity of a shock to a non-injury level (less than 4 to 6 milliamps to ground). GFCIs do not eliminate shock.

2. GFCI protection for personnel shall be used when portable electric tools and equipment are used with temporary wiring methods including extension cord sets. This applies to portable tools and equipment connected to 125-volt single-phase 15, 20, or 30 amp receptacle outlets. (See Appendix E, *Acceptable and Unacceptable Combinations of Extension Cords and Power Strips*).

3. All 125-volt single-phase 15, 20, or 30 amp receptacle outlets not part of the permanent wiring shall be provided with GFCI protection.

   **EXCEPTION:** *Surge protection devices and relocatable power taps used indoors for supplying office equipment (e.g., computers, monitors, printers) do not require GFCI protection.*

4. Cord(s) sets powered by other than 125-volt, single-phase, 15, 20, and 30 amp receptacles, not part of the permanent wiring, shall have either GFCI protection or be tested in accordance with the Assured Equipment Grounding Conductor Program (AEGCP), Section 5.2, *Assured Equipment Grounding*.

5. GFCI protection devices are not required where GFCI operation could interrupt power to critical systems (e.g., air monitoring equipment, egress lighting) and the requirements of Section 5.2, *Assured Equipment Grounding*, shall be met.

6. Portable electric equipment used in highly conductive work locations (such as those inundated with water or other conductive liquids) or in job locations where employees are likely to contact water or conductive liquids shall be listed and labeled for those applications, and GFCI protection for personnel shall also be used.

7. Permanently installed GFCI protection devices shall be tested in accordance with the manufacturer's instructions.

8. GFCI receptacles shall not be used unless they have been tested within the past month.

9. GFCI receptacles located in areas that are not accessible, unoccupied facilities under long-term surveillance or undergoing deactivation/demolition, or that would create a greater hazard, shall be tested per Section 5.1.7 prior to use.

10. Portable GFCIs shall be tested prior to use.

11. Portable GFCIs should be located closest to the source, although equipment configuration may require locating the GFCI device closer to the worker.

12. 125-volt GFCI receptacles/in-line GFCI devices that trip during use may be reset one time. If the GFCI trips a second time, do not reset it. Contact management.

    **NOTE:** *For the purposes of this program, a portable GFCI is a factory assembled, listed, in-line device with a cord and attachment plug.*

## 5.2 Assured Equipment Grounding

1. All cord sets (including cords hardwired on one end) shall be provided GFCI protection or maintained through the AEGCP.

   **EXCEPTION:** *This requirement does not apply to re-locatable power taps (RPTs) or surge protection devices (SPDs) when they are used in accordance with Section 5.4, Use of Extension Cords and Multiple Outlet Power Strips.*

2. Where a GFCI cannot be used (due to design or a power interruption[s] creating a greater hazard) for temporary wiring methods or extension cord sets providing power to supply portable electric tools and equipment that are used for construction, repair, maintenance, remodeling, and similar activities, a documented AEGCP shall be maintained and implemented through a work control document. The following requirements shall be met:

   a. All equipment grounding conductors shall be tested for continuity and shall be electrically continuous.

   b. Each receptacle and attachment plug shall be tested for correct attachment of the equipment grounding conductor. The equipment grounding conductor shall be connected to its proper terminal.

   c. Testing shall be performed:

      i. Before first use on site or if the inspection is not current

      ii. When there is evidence of damage

      iii. Before equipment is returned to service following any repairs

      iv. Before equipment is used after any incident which may be reasonably suspected to have caused damage (e.g., when a cord set is run over)

      v. Quarterly: cords shall not be used unless they have been inspected for the current quarter; inspections for the next quarter can occur during the last month of the current quarter.

         1. Quarterly inspection tags (G605911) (See Appendix D, Figure D-3, *Quarterly Inspection Tag*, for an image of the required tag) shall be applied to the cord near the attachment plug in a visible location.

d. Quarterly testing may be exempted by the NFPA 70 AHJ, in unoccupied areas, if testing will present a greater hazard to personnel (e.g., High Radiation Area, High Contamination Area, Confined Space).

e. If testing could potentially cause equipment damage due to freezing temperatures, quarterly testing may be deferred by the NFPA 70 AHJ, until temperatures allow.

## 5.3 Cord-and-Plug-Connected Equipment and Flexible Cord Sets for Maintenance, Construction, and Demolition Activities

1. General Use

   a. Cord-and-plug-connected equipment and flexible cord sets shall be maintained in a safe working condition.

   b. The attachment cord connected to the equipment shall be protected from accidental damage at all times.

   c. Damaged or defective equipment shall be immediately removed from service, marked as out-of-service, and not used until a qualified worker performs repairs and necessary tests to render the equipment safe. Management shall be notified when equipment is removed from service.

2. User Inspection

   Cord-and-plug-connected equipment and flexible cord sets used for maintenance, construction, and demolition activities shall be visually inspected prior to each use for external damage to ensure there are no:

   a. Breaks or cracks exposing energized conductors and circuit parts.

   b. Missing cover plates.

   c. Missing, loose, altered, or damaged cord, blades, or pins/prongs, etc.

   **EXCEPTION:** *Cord-and-plug-connected equipment and flexible cord sets (extension cords) that remain connected once put in place and are not exposed to damage are not required to be visually inspected until they are relocated.*

## 5.4 Use of Extension Cords and Multiple Outlet Power Strips

1. To meet the requirements for use, manufactured extension cords and multi-tap adapters (splitters) shall:

   a. Be inspected for damage prior to use. Damaged equipment shall not be used.

   b. Not be used as a permanent substitute for the fixed wiring of a structure.

   c. Have a current rating that is greater than the connected load. The minimum size shall be 14/3 American Wire Gauge (AWG). It is recommended for longer cords (100 feet or greater) that a minimum size of 12/3 AWG be used.

d. Not be connected in series (daisy-chained), unless specifically designed and approved for this use (See Appendix E, *Acceptable and Unacceptable Combinations of Extension Cords and Power Strips*).

e. Be unplugged and properly stored when not in use.

f. Not create a tripping hazard.

g. Be protected from damage; sharp corners and projections shall be avoided. Where passing through doorways or other pinch points, there shall be substantial protection provided to avoid damage.

2. Extension cords may be field-assembled by a qualified person (per Section 3.5.4), provided that:

   a. Each component is compatible with the other components and is NRTL-listed for the purpose.

   b. Correct wiring of the extension cord and continuity of the grounding conductor are verified.

   c. The extension cord is durably marked to indicate the organization responsible for its assembly, the maximum allowable load in amps and watts, and whether or not it is suitable for outdoor use. See Appendix D, Figure D-2, *Field-Assembled Extension Cord Label*, for sample label.

3. Extension cords shall contain an equipment grounding conductor.

4. Extension cords must not be permanently fastened in place or attached in a manner that may damage the cords or restrict their movement.

5. Extension cords used outdoors shall be rated and labeled as suitable for outdoor use.

6. An extension cord may be plugged into a portable GFCI protective device less than six feet in length that is listed and labeled for its intended use.

7. Multi-tap adapters less than six feet in length are allowed to be used with extension cord sets if they are listed and labeled for their intended use.

8. Multiple outlet power strips, such as SPDs and Relocatable Power Taps (RPTs) may not be used outdoors or at construction sites or similar locations unless specifically listed and labeled for such use.

   **NOTE:** *SPDs should only be used for electronic equipment such as computers and telecommunication devices. If there is any uncertainty about the proper use or application of SPDs or RPTs, contact a qualified person (per Section 3.5.4)or an Electrical Subject Matter Expert (SME).*

   **WARNING:** *All SPDs manufactured prior to 1996 shall be taken out of service and disposed of.*

9. Multiple outlet power strips shall be connected only to permanently installed branch circuit receptacles. They shall not be connected (daisy-chained) to other power taps, surge suppressors, or to extension cords.

   **EXCEPTION:** *Multiple outlet power strips may be connected to a single extension cord temporarily for testing, training, demonstrations, and similar purposes. This temporary configuration may not extend beyond one shift.*

10. Electrical loads such as space heaters, heat-generating devices (e.g., coffee pots), and large appliances (e.g., refrigerators, freezers, microwaves, etc.) shall not be connected to an RPT, unless pre-approved by the AHJ on a case-by-case basis.

## 5.5 Drilling, Excavations, and Blind Penetrations

1. This section addresses performing drilling, saw cutting and other blind penetrations greater than 1.5 inches, and excavations into surfaces containing concealed electrical conduits and cables.
2. Excavations shall be performed per the requirements of DOE-0344, *Hanford Site Excavating, Trenching and Shoring Procedure*.
3. If the presence and location of electrical circuits or conductors cannot be accurately identified and completely de-energized, appropriate mitigating controls shall be used for penetrations greater than 1.5 inches. At a minimum, the following steps are required prior to the start of work:
   a. All applicable drawings and documentation shall be reviewed.
   b. A Job Hazard Analysis (JHA) shall be completed.
   c. A scan shall be performed if possible, prior to penetrating into concrete or masonry surfaces.
   d. The location of conductors, cables, raceways, and equipment shall be identified and marked to the maximum extent possible.
   e. Circuits or conductors shall be de-energized to the maximum extent possible and placed in an electrically safe work condition.
   f. Workers performing blind penetrations shall use appropriate voltage-rated gloves with protective outer leather gloves and nonconductive safety glasses with side shields.

## 5.6 Generators

### 5.6.1 General Requirements

1. Any connection or disconnection of cables at the generator output terminals, load side terminals of the generator output circuit breaker, or connections at the load end of the feeder when electrically connected to

a generator require lockout/tagout in accordance with DOE-0336, *Hanford Site Lockout/Tagout Procedure*.

2. Cables shall be disconnected from the generator source output circuit breaker or output terminals when they are not terminated at the load end.
3. When portable or vehicle-mounted generators are used to supply electrical loads from a generator-supplied feeder, a grounding electrode conductor connection to an electrode in accordance with NFPA 70 Article 250 is required.
4. When manufacturer's instructions or equipment labeling require supplemental grounding, those instructions shall be followed.
5. Live parts of generators operating at more than 50 volts AC or DC to ground shall not be exposed to accidental contact where accessible to unqualified persons.

### 5.6.2 Portable Generators

1. Portable describes equipment that is easily carried by personnel from one location to another.
2. The frame of a portable generator is not required to be connected to a grounding electrode (unless required by the manufacturer's instructions) for a system supplied by the generator that meets both of the following conditions:
   a. The generator supplies only equipment mounted on the generator, and/or cord-and-plug-connected equipment through receptacles mounted on the generator.
   b. The normally non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are connected to the generator frame.

### 5.6.3 Vehicle Mounted Generators

1. Vehicle-mounted generators include generators that are mounted on a powered vehicle (excluding automotive vehicles) and generators that are supported by a wheeled trailer (including light plants or light towers).
2. The frame of a vehicle shall be required to be connected to a grounding electrode for a system supplied by a generator located on the vehicle, unless all of the following conditions are met:
   a. The frame of the generator is bonded to the vehicle frame.
   b. The generator supplies only equipment located on the vehicle or cord-and-plug-connected equipment through receptacles mounted on the vehicle, or both equipment located on the vehicle and cord-

and-plug-connected equipment through receptacles mounted on the vehicle or on the generator.

c. The normally non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are connected to the generator frame.

d. Not required by the manufacturers' instructions.

3. Initial energization of vehicle-mounted generators shall be accomplished via the *Generator Initial Start-Up Checklist* (A-6005-436). Subsequent generator startups shall be accomplished via the *Generator Re-Start-Up Checklist* (A-6005-437).

   **EXCEPTION**: *This does not apply to single-phase 120/240 volt generators that supply only cord-and-plug-connected equipment that is connected to the generator's mounted receptacles*.

4. No arc flash hazard exists for a stand-alone generator not connected to any other electrical source where the generator has been visibly and audibly confirmed to be disabled. A shock hazard still exists until an electrically safe work condition is established, per DOE-0336, *Hanford Site Lockout/Tagout Program*.

## 5.7 Batteries and Battery Rooms

1. Energy exposure levels shall not exceed those identified in the following list unless appropriate controls are implemented:
   - AC: 50 volts and 5 milliamperes
   - DC: 50 volts
2. Prior to any work on battery systems operating at 50 volts or greater, an ERA shall be performed and documented to identify the chemical, electrical shock, and arc flash hazards, and assess the risks associated with the type of tasks to be performed.
3. Employees who are likely to perform installation, examination, servicing, maintenance or the operation of battery systems that exceed the energy thresholds shall complete Battery Safety Training.
4. The following protective equipment shall be available to employees performing any type of service on a battery with liquid electrolyte:

   a. Goggles and face shield appropriate for the electrical hazard and chemical hazard

   b. Gloves and aprons appropriate for the chemical hazards

   c. Portable or stationary eyewash facilities and equipment within the work area that are capable of drenching or flushing of the eyes and body for the duration necessary to mitigate injury from the electrolyte hazard.

**NOTE**: *Guidelines for the use and maintenance of eyewash facilities for vented batteries in nontelecom environments can be found in ANSI/ISEA Z358.1, American National Standard for Emergency Eye Wash and Shower Equipment.*

d. Protective footwear

5. Employees performing any activity not involving the handling of electrolytes shall wear safety glasses.
6. Personnel shall not use electrically conductive tools or objects while working on any battery components.
7. Before making or breaking connections within a group of cells, open the battery system disconnecting means (if available) to minimize the possibility of arcing.

## 5.8 Capacitors

Implement the controls in this section for capacitive systems rated greater than the values below::

- 1 joule of stored energy at 100 volts up to 400 volts (≥200 µF), or
- 0.25 joules of stored energy at 400 volts or greater (≥200 µF)

1. Perform an ERA to identify electrical shock hazards, identify arc flash hazards, and assess the risks associated with the type of tasks to be performed.
2. Access to capacitor areas shall be restricted until all capacitors have been discharged, shorted, and grounded or verified to be less than 50 volts.

   **NOTE**: S*ee discharge requirements in NFPA 70 Article 460.6 for 600 volts nominal or under; or Article 460.28 for systems over 600 volts nominal*.

3. Any residual charge from capacitors shall be removed by shorting the terminals before servicing or removing.
4. Capacitors shall be discharged using an appropriately voltage rated shorting probe. If capacitors have been removed from the circuit or are being transported, the terminals shall be continuously short circuited using no smaller than a #14 AWG bare conductor.
5. The discharge means shall be either permanently connected to the terminals of the capacitor bank or provided with automatic means of connecting it to the terminals of the capacitor bank on the removal of voltage from the line. Manual means of switching or connecting the discharge circuit shall not be used. Automatic discharge and grounding devices shall not be relied upon.
6. Shorting probes shall be inspected before each use.
7. Capacitor terminals shall be considered “charged” until the terminals are shorted or verified to be less than 50 volts.

## 5.9 National Electrical Code (NEC) Inspections

1. NEC Inspections are required for new electrical installations and modification of existing electrical installations to ensure compliance with the NEC.

   **NOTE**: *NEC inspections are not required for modifications that remove electrical equipment.*

2. NEC Inspections are not required for installation or replacement of electrical utilization equipment approved for connection to permanently installed receptacles with cord attachments, or for minor maintenance and repair work including like-for-like replacements, such as, but not limited to, switches, fuses, lamp sockets, receptacles, replacing worn cords, and tightening connections on a wiring device.

3. Electrical assemblies (e.g., Underwriter's Laboratories (UL) 508A, *Industrial Control Panels*) that are listed and labeled by an NRTL are not required to be individually NEC inspected when being installed as a component of a system or facility that is subject to NEC inspection.

4. EIPs (A-6005-707) are required to be initiated prior to performing any electrical installations or modifications. EIPs are prepared to document the scope of the inspection, any corrections of deficiencies that were performed, and whether the work inspected is approved or not approved.

5. Block EIPs may be used to cover a specified boundary such as a managed building, facility, or area. Block EIPs shall be valid for no more than 12 months. The NEC Inspector shall evaluate the scope of work, and reserves the right to deny the use of a Block Permit and require an individual Permit to cover the scope of work.

6. An NEC inspection is required to energize an electrical service. The NEC Inspector shall document the inspection and approval of the electrical service on the NEC Service Inspection Label (BL-6002-745) (See Appendix D, Figure D-5, *National Electrical Code [NEC] Inspection Labels*) and shall attach the inspection label to the electrical service equipment.

7. An NEC inspection is required for non-service modifications. The NEC Inspector shall document the inspection and approval of an electrical modification. Attach the NEC Equipment Inspection Label (BL-6003-435) (See Appendix D, Figure D-5, *National Electrical Code [NEC] Inspection Labels*) to electrical equipment as applicable.

8. NEC Inspectors shall notify the requestor of non-compliant conditions following the inspection.

9. NEC Inspectors shall approve corrections of deficiencies.

10. Code compliance issues that the requestor and the NEC Inspector cannot resolve satisfactorily shall be referred to the contractor-appointed AHJ.

11. Design organizations should consider consulting with an NEC Inspector during the design of new facilities or modification of existing facilities to assure compliance with the NEC and to promote early identification of problems.

## 6.0 WORK ACTIVITIES THAT HAVE THE POTENTIAL TO BE WITHIN 20 FEET OF OVERHEAD LINES

### 6.1 Planning Work Activities that have the Potential to be Within 20 Feet of Overhead Lines

**NOTE:** *For the purposes of this Program, trucks, rollers, dozers, graders, and scrapers, etc., are considered in transit at all times as long as the combined height of the equipment and load [or worker] are less than 14 feet.*

1. If the following activity will be near overhead lines, plan and conduct the activity as indicated in a, b, c, d, or e below:

   a. Mobile equipment in transit: See Appendix F, Figure F-2, *Mobile Equipment In Transit That Has the Potential to be Within 20 feet of Overhead Lines*, for planning guidance and Section 6.1.2 through 6.1.8 for additional requirements.

   b. Mobile crane in transit: See Appendix F, Figure F-3, *Mobile Crane In Transit That Has the Potential to be Within 20 feet of Overhead Lines*, for planning guidance and Section 6.1.2 through 6.1.8 for additional requirements.

   c. Mobile equipment (e.g., excavator, aerial lift, backhoe) performing work: See Appendix F, Figure F-4, *Mobile Equipment Performing Work With the Potential to be Within 20 feet of Overhead Lines*, for planning guidance and Section 6.2.1.2 and 6.2.1.3 for additional requirements.

   d. Mobile crane travelling or performing work: See Appendix F, Figure F-5, *Mobile Crane Performing Work With the Potential to be Within 20 feet of Overhead Lines*, for planning guidance and Section 6.3 for additional requirements.

   e. Personnel performing work involving ladders, scaffolds, painting equipment, irrigation pipe, poles, tools, or similar equipment. See Section 6.2.1.4 for additional requirements.

2. If movement/transport of vehicular or mechanical equipment over 14 feet high on Hanford roads is planned, the use of a Hanford Site Oversize/Overweight Permit (A-6003-609) is required.

3. In this section the term “in transit” refers to mobile equipment (e.g., excavator, aerial lift, back hoe), or a crane, that is moving under its own power or being transported by trailer, without load, and the structure is lowered to its lowest practical stowed position prior to movement. Any mobile equipment, or a crane, not in this configuration is considered to be performing work/travel.

Controls shall be implemented to ensure the mobile equipment, or crane, is configured in the lowest practical stowed position prior to movement.

Moving a forklift truck is considered "mobile equipment in transit" and requires the clearance between the top of the mast or the load, whichever is higher, and overhead lines to be maintained in accordance with Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*. Forklift trucks must be operated such that the vehicle is not moved with the forks raised to encroach on the "In Transit LAB."

4. A truck (e.g., dump truck, garbage truck, Environmental Restoration Disposal Facility [ERDF] truck) is considered in transit when moving under its own power with the structure lowered to its lowest stowed position. If the truck is carrying a load, the combined height of the mobile equipment and load shall be less than or equal to 14 feet. After a truck bed has been raised, the truck bed shall be verified as fully lowered prior to traveling. Methods of verification include: audible alarm, visual indication, or trained spotter verification.

5. For mobile equipment, crane, or truck in transit, see Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*, for the Equipment in Transit LAB or the Cranes in Transit LAB. If insulated barriers, rated for the voltages involved, are installed and they are not part of an attachment to the mobile equipment, crane, or truck, the Equipment in Transit LAB or the Cranes in Transit LAB shall be permitted to be reduced to the design working dimensions of the insulating barrier.

6. If the mobile equipment, crane, or truck in transit will encroach upon the Equipment in Transit LAB or the Cranes in Transit LAB found in Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*, the following controls shall be met.

    i. Block or disengage electrical system protective devices that automatically re-energize the circuit after a fault

    ii. Install nonconductive barricades to restrict access to the area

    iii. Only allow essential personnel in the area; all ground personnel are discouraged from touching the equipment

7. While a crane is in transit without load and the boom and boom-support system is lowered, the Cranes in Transit LAB, as listed in Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*, must not be encroached upon. When planning transit of a crane, the effect of speed and terrain on the boom and the crane movement shall be considered. If any part of the crane, while travelling on a construction worksite, will get closer than 20 feet to a power line, a dedicated spotter who is in continuous contact with the driver/operator shall be used.

8. When planning equipment or crane movement that has the potential to be within 20 feet of overhead lines, contact EU, or the owner of the line, to

determine the line voltage and the line height, unless this information was recorded from a previous EU contact and conditions at the job site have not changed. Use Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*, to determine the limited approach boundaries once line voltage has been verified.

9. Mobile equipment or cranes performing work near overhead lines shall be considered to have the potential to come within the Equipment Performing Work LAB or the Cranes Performing Work LAB if the area 360 degrees around the equipment, up to the equipment's maximum charted working radius, including load, intersects the Equipment Performing Work LAB or the Cranes Performing Work LAB.

10. EU involvement shall also be included in the following:

    i. Consultation, preferably a minimum of 48 hours prior to the start of work, to determine effective controls, standby support, and outage support when planning work that may affect EU equipment or facilities;

    ii. Consultation, as necessary, when planning work that may affect facility owned overhead electrical lines over 600 volts;

    iii. When any combination of equipment, ladders, tools, personnel, etc., may come within the Equipment Performing Work LAB of an energized overhead line;

    iv. When any combination of the crane's equipment, load line, load, or fully extended boom length may come within a crane's Prohibited Zone or No Work Zone (as shown in Appendix F, Figure F-1, *Operating Cranes near Energized Overhead Lines*).

11. Work that has the potential to come within the Equipment Performing Work LAB or the Cranes Performing Work LAB of overhead lines shall require the following personnel, as applicable, to be involved in a planning meeting to establish control measures for the protection of personnel: facility electrical maintenance, engineering organization, equipment operators, trained spotters, supervisors directly involved in the work, and EU.

12. During planning for work that has the potential to come within the Equipment Performing Work LAB or the Crane Performing Work LAB of overhead lines, and whenever related equipment or worksite conditions change, the following activities require a site visit:

    i. Equipment operation (e.g., back/track hoe, aerial lift, dump truck, vacuum excavator) requires completion of *Electrical Utilities Site Visit Form* (BC-6003-941).

    ii. Other work activities that may encroach upon the Equipment Performing Work LAB (e.g., ladder, scaffold, painting equipment)

requires completion of *Electrical Utilities Site Visit Form* (BC-6003-941).

iii. Crane operation requires completion of *Electrical Utilities Mobile Crane Site Visit Form* (BC-6005-774).

13. Call EU Dispatch (509) 373-2321 prior to the start of work and upon completion of the work each day, when work has the potential to come within the Equipment Performing Work LAB or the Cranes Performing Work LAB of overhead lines.

14. The work location and all paths of movement shall be walked down to identify potential electrical hazards.

15. Crane Operations shall not rely on conductor insulation for personnel protection.

16. When moving at night, or in conditions of poor visibility, the following additional requirements shall be met:

    i. The power lines are illuminated or another means of identifying the location of the lines is used.

    ii. A safe route is identified and used.

17. All overhead lines shall be considered energized until appropriate hazardous energy control measures are implemented.

18. De-energizing and grounding lines is the preferred condition for work activities or equipment moves near overhead lines, since the hazard of injury or death due to electrocution will be removed. Overhead lines shall be de-energized when work is planned to be performed within the Equipment Performing Work LAB or the Cranes Performing Work LAB unless it is determined after a documented evaluation, that de-energizing is infeasible or creates a greater hazard. If de-energizing overhead lines introduces additional/increased hazards, or is infeasible the responsible senior manager (as designated by the specific contractor) shall provide documented justification for performing the work energized. Maintain this evaluation documentation with the Work Control Document.

19. If energized overhead lines are to be de-energized, arrangements shall be made with the person or organization that operates or owns the overhead lines to de-energize them. The owner of the overhead lines or a designated representative of EU shall be on the site to verify that the overhead lines are no longer energized in accordance with applicable lockout/tagout requirements.

20. If work will be performed within the Equipment Performing Work LAB or the Cranes Performing Work LAB of energized overhead lines under the exclusive control of EU, it is the responsibility of the organization performing the work to follow Section 6.2.1.3, *Mobile Equipment Working Inside the Equipment Performing Work LAB of Energized Overhead Lines* or follow Section 6.3.3,

*Overhead Lines Energized, Crane within the Prohibited Zone or No Work Zone*, or contact EU to:

i. De-energize the overhead lines and tag (hold-off).

ii. Work with the Controlling Organization to lock out the overhead lines by over locking the utility's hold-off tag (or equivalent) in accordance with DOE-0336, *Hanford Site Lockout/Tagout Procedure.*

21. If mobile equipment or crane operations have the potential to enter the Equipment Performing Work LAB or the Cranes Performing Work LAB of energized overhead lines under the exclusive control of EU, it is the responsibility of the organization performing the work to follow Section 6.2.1.2, *Mobile Equipment Working Outside the Equipment Performing Work LAB of Energized Overhead Lines with the Potential to Enter the Equipment Performing Work LAB* or follow Section 6.3.2, *Overhead Lines Energized, Crane Operating Less than the Erected/Fully Extended Boom Length Away (has the Physical Capability to Enter the Prohibited Zone or No Work Zone)* or contact EU to:

    i. De-energize the overhead lines and tag (hold-off).

    ii. Work with the Controlling Organization to lock out the overhead lines by over locking the utility's hold-off tag (or equivalent) in accordance with DOE-0336, *Hanford Site Lockout/Tagout Procedure.*

    **WARNING:** *Synthetic materials such as ropes or slings may be contaminated by moisture, dirt, etc., and may become conductive and not provide shock protection as intended.*

22. When working near transmitter/communication towers with a crane, where the equipment is close enough for an electrical charge to be induced in the equipment or materials being handled, the transmitter must be de-energized or the following precautions must be taken: the equipment must be provided with an electrical ground; and if tag lines are used, they must be non-conductive. Contractors must rely on information obtained from EU and from the communications utility regarding the required separation to avoid any induced charge when planning this type of work.

23. If arrangements are made to use protective measures, such as guarding, isolating, or insulating, these precautions shall prevent each employee from contacting overhead lines directly with any part of his or her body, or indirectly through conductive materials, tools, or equipment.

24. For a crane having the potential to encroach upon the Cranes Performing Work LAB of high voltage power lines (115 kV and higher), EU or the utility owner shall determine during the site visit, the grounding requirements necessary to eliminate the potential hazards associated with electrostatic charge or induced voltage. Workers shall be advised of potential shock hazards. Contractors must

rely on information obtained from EU regarding the required separation to avoid any induced charge when planning this type of work.

25. For work that is performed within the vicinity of high voltage power lines (115 kV and higher), workers shall be advised of potential shock hazards where an electrostatic charge or induced voltage may build up on conductive and nonconductive equipment and personnel. The associated job planning for this work shall ensure adequate controls are in place to protect workers from secondary injury (e.g., falls, contusions) in the event primary controls fail. Contractors must rely on information obtained from EU regarding the required separation to avoid any induced charge when planning this type of work.

## 6.2 Performing Work within 20 Feet of Overhead Lines

### 6.2.1 Mobile Equipment (Excluding Cranes) or Personnel Working near Energized Overhead Lines

If insulated barriers, rated for the voltages involved, are installed and they are not part of an attachment to the vehicle, the Equipment Performing Work LAB is permitted to be reduced to the design working dimensions of the insulating barrier.

#### 6.2.1.1 Working near Communication Lines

Where any mobile equipment structure will be elevated near communication lines, they shall be operated to avoid contact.

#### 6.2.1.2 Mobile Equipment with the Potential to Enter the Equipment Performing Work LAB

##### 6.2.1.2.1 General

1. Where any mobile equipment structure will be elevated near energized overhead lines, they shall be operated so that the Equipment Performing Work LAB of Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*, is not encroached upon.
2. Contractors are required to utilize the mandatory barrier control below and at least one of the secondary barrier controls listed below.
3. In the event that the mobile equipment becomes electrified, the operator shall make an attempt to immediately move the equipment away, if possible, without compromising their safety.

6.2.1.2.2 **Mandatory Barrier Control**

Trained Operators and Spotters shall be used and shall meet the following requirements:

1. Operators of mobile equipment and spotters who work near energized overhead lines shall be trained to visually determine when equipment is nearing the Equipment Performing Work LAB for overhead lines and to establish and maintain effective communications between the operator and spotter.
2. The spotter shall be in place prior to movement of the mobile equipment and be positioned to effectively gauge the Equipment Performing Work LAB.
3. The spotter shall have no duties other than being a spotter for a single specific operation.
4. Spotters shall have direct communication with the equipment operator. The method of communication must take into account potentially high noise levels common with heavy equipment operation.
5. Spotters shall be easily identifiable by the equipment operators.

6.2.1.2.3 **Secondary Barrier Controls**

At a minimum, one of the following secondary barrier controls shall be used in addition to a trained spotter:

1. Install physical barriers to prevent encroachment into the Equipment Performing Work LAB.
2. Use stakes/cones or elevated lines to provide constant reminders to operators and spotters of the proximity to energized overhead lines.
3. Use materials to enhance visibility of energized overhead lines for spotters.
4. Signs shall be posted to indicate overhead line height to warn of energized overhead lines and enable the spotter to accurately determine the Equipment Performing Work LAB.
5. Have EU personnel raise or relocate energized overhead lines to reduce the possibility of an inadvertent contact.

#### 6.2.1.3 Mobile Equipment Working Inside the Equipment Performing Work LAB of Energized Overhead Lines

1. In addition to the barrier controls listed in Sections 6.2.1.2.2, *Mandatory Barrier Control*, and 6.2.1.2.3, *Secondary Barrier Controls*, an EU representative shall be on site while work is being performed. EU may require the following:

    a. Block or disengage electrical system protective devices that automatically re-energize the circuit after a fault.

    b. Install nonconductive barricades to restrict access to the work area.

    c. Only allow essential personnel within the work area; all ground personnel are discouraged from touching the equipment.

#### 6.2.1.4 Personnel with the Physical Capability to Enter the Equipment Performing Work LAB

**WARNING:** *Conductive articles of jewelry and clothing (e.g., watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn where they present an electrical contact hazard with energized overhead lines.*

1. If the work being performed presents a hazard of contact with uninsulated energized overhead lines, outdoor premise wiring, overhead communication lines, or crossing the Equipment Performing Work LAB of energized overhead lines, then all energized overhead lines to which an employee may be exposed shall be put into an electrically safe work condition in accordance with DOE-0336, *Hanford Site Lockout/Tagout Procedure*, and/or MSC-PRO-EU-066, *Electrical Utilities Lock and Tag Program*, as applicable. Examples of this type of work include, but are not limited to, work involving ladders, scaffolds, painting equipment, irrigation pipe, poles, or reach tools.

2. For overhead lines (600 volts or less), EU or an individual qualified under Section 3.6 may determine that de-energization is not required as long as the work scope does not involve contact with the line. Protective sleeves may be installed to protect the worker from inadvertent contact.

3. When personnel are performing work within the Equipment Performing Work LAB of energized overhead lines one of the following shall apply:

- Qualified person(s) are performing work near aerial lines using appropriate PPE
- Unqualified person(s) are performing work near facility-owned aerial lines; they will be continuously escorted by individual(s) qualified under Section 3.6 and all will wear the appropriate PPE
- Unqualified person(s) are performing work near aerial lines owned by EU; they will be continuously escorted by EU, and all will wear the appropriate PPE

4. An ERA (A-6007-595) shall be completed and documented to determine the voltage to which personnel will be exposed, boundary requirements, and the PPE necessary to minimize the possibility of electric shock to personnel.
5. Unqualified persons shall not be permitted to enter the Equipment Performing Work LAB unless continuously escorted by individual(s) qualified under Section 3.6, unless the electric conductors and equipment involved are in an electrically safe work condition, in accordance with DOE-0336, *Hanford Site Lockout/Tagout Procedure,* and/or MSC-PRO-EU-066, *Electrical Utilities Lock and Tag Program,* as applicable.
6. A Supervisor/Foreman shall be required to conduct an electrical hazards brief when the ERA (A-6007-595) is used.

## 6.3 Mobile Cranes Operating within 20 Feet of Overhead Lines

### 6.3.1 General

1. Where any cranes will be elevated near communication lines, they shall be operated to avoid contact.
2. Work shall be performed in a manner to prevent the possibility of a crane, load line, or load becoming a conductive path.
3. Cranes shall not be used to handle materials under or over energized overhead lines if any combination of boom, load, load line, or machine component can enter the Prohibited Zone or the No Work Zone (see Appendix F, Figure F-1, *Operating Cranes Near Energized Lines*). The Prohibited Zone for cranes is the Cranes Performing Work LAB as defined in Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*.
4. Durable signs shall be installed at the crane operator's station and on the outside of the crane to warn that electrocution or serious bodily injury may occur unless the Cranes Performing Work LAB, as specified in Appendix F, Table F-1, *Limited Approach Boundaries for Overhead*

*Lines*, is maintained between the crane or the load being handled and energized overhead lines.

5. If cage-type boom guards, insulating links, or proximity warning devices are used on cranes, such devices shall not be a substitute for de-energizing and grounding the overhead lines, even if such devices are required by law or regulation. In view of the complex, invisible, and lethal nature of the electrical hazard involved, and to lessen the potential of false security, instructions on the electrical hazard involved, operating conditions for the devices, limitations of such devices, and testing requirements prescribed by the device manufacturer, if used, shall be understood by the crane operator, crew, and load-handling personnel. The required Cranes Performing Work LAB to energized overhead lines, established in Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*, shall be maintained regardless of any devices used on the crane.
6. In the event that the crane becomes electrified, the operator shall make an attempt to immediately move the equipment away, if possible, without compromising their safety.
7. Devices originally designed by the manufacturer for use as a safety device, operational aid, or a means to prevent power line contact or electrocution, when used to comply with this section, must comply with the manufacturer's procedures for use and conditions of use.
8. A mobile crane activity having the potential to encroach upon the Cranes Performing Work LAB of energized overhead lines shall be conducted in accordance with one of the following conditions:
    a. Overhead lines energized, crane operating less than the erected/fully extended boom length away (has the physical capability to enter the Prohibited Zone or No Work Zone) (See Section 6.3.2 and Appendix F, Figure F-1, *Operating Cranes Near Energized Overhead Lines*)
    b. Overhead lines energized, crane within Prohibited Zone or No Work Zone (See Section 6.3.3)
    c. Crane in transit, no load, and boom lowered (See Section 6.1.5 through 6.1.7)

### 6.3.2 Overhead Lines Energized, Crane Operating Less than the Erected/Fully Extended Boom Length Away (has the Physical Capability to Enter the Prohibited Zone or No Work Zone)

The following steps shall be taken to minimize the hazard of electrocution or serious injury as a result of contact between the energized overhead lines and the crane, load line, or load.

1. The specified Cranes Performing Work LAB between the overhead lines and the crane, load line, and load shall be maintained at all times (see Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*).

   **WARNING:** *Synthetic materials such as ropes or slings may be contaminated by moisture, dirt, etc., and may become conductive and not provide shock protection as intended.*

2. Load control, when required, shall use non-conductive tag lines.
3. A dedicated spotter, who is a qualified signal person per DOE-RL-92-36, *Hanford Hoisting and Rigging Manual*, shall be used. The dedicated spotter shall be in constant contact with the crane operator and shall have the sole responsibility of verifying that the required Cranes Performing Work LAB is maintained and be positioned to effectively gauge the Cranes Performing Work LAB.
4. No one shall be permitted to approach or touch the crane or the load unless the signal person indicates it is safe to do so.
5. Operation of a boom and/or load above energized overhead lines is prohibited.
6. The horizontal and vertical conductor movement due to wind and temperature shall be added to the Cranes Performing Work LAB as specified in Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*. A qualified representative of the owner of the lines or a designated representative of EU shall be consulted for the specific distance to be added.
7. Erect and maintain an elevated warning line, barricade, or line of signs, in view of the operator, equipped with flags or similar high-visibility markings, at 20 feet from the power line or at the Cranes Performing Work LAB from Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*.

### 6.3.3 Overhead Lines Energized, Crane within the Prohibited Zone or No Work Zone

1. Before operating a mobile crane within the Prohibited Zone, a qualified person, together with a qualified representative of EU, shall visit the site to determine if this is the most feasible way to complete the operation and establish the new minimum required clearances to be maintained (less than the Cranes Performing Work LAB). The factors that must be considered in making this determination include, but are not limited to: conditions affecting atmospheric conductivity; time necessary to bring the equipment, load line, and load (including rigging and lifting accessories) to a complete stop; wind conditions; degree of sway in the power line; lighting conditions, and other conditions affecting the ability

to prevent electrical contact. These operations shall be under the supervision of the qualified person and the qualified representative of EU. The Cranes Performing Work LAB may be reduced from Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines,* provided that insulated barriers are used and are rated for the voltage of the overhead line that it will be used on. Apply the mandatory control listed in Section 6.2.1.2.2, *Mandatory Barrier Control.*

The following controls shall be required in addition to the mandatory control:

a. Insulated barriers shall not be a part of, or an attachment to, the crane and shall not allow contact between the energized overhead lines and the crane, load lines, or load.

b. The crane/load shall be grounded by EU or the utility owner.

c. Automatic re-closers shall be blocked or disabled.

d. Nonconductive barricades to restrict access to the crane work area shall be used.

e. Erect and maintain an elevated warning line, barricade, or line of signs, in view of the operator, equipped with flags or similar high-visibility markings, at 20 feet from the power line or at the new minimum required clearance distance (less than the Crane Performing Work LAB from Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*).

f. An insulating link/device shall be installed at a point between the end of the load line (or below) and the load

g. Nonconductive rigging, if the rigging may be within the LAB (see Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines*) during the operation

h. If the crane is equipped with a device that automatically limits range of movement, it must be used and set to prevent any part of the equipment, load line, or load (including rigging and lifting accessories) from breaching the new minimum required clearance distance (less than the Crane Performing Work LAB from Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines,*).

i. Barricades forming a perimeter at least 10 feet away from the crane to prevent unauthorized personnel from entering the work area. In areas where obstacles prevent the barricade from being at least 10 feet away, the barricade must be as far from the crane as feasible.

j. Workers other than the operator shall be prohibited from touching the load line above the insulating link/device and crane. Operators remotely operating the crane from the ground shall use either wireless controls that isolate the operator from the crane or insulating mats that insulate the operator from the ground.

k. Only personnel essential to the operation are permitted to be in the area of the crane and load.

l. Insulating line hose or cover-up shall be installed by the utility owner/operator except where such devices are unavailable for the line voltages involved.

m. The utility owner/operator (or registered professional engineer) and all employers of employees involved in the work must identify one person who will direct the implementation of the procedures. The person identified in accordance with this paragraph must direct the implementation of the procedures and must have the authority to stop work at any time to ensure safety. In most cases this person will be the Designated Lead (DL/Lift Director), as defined in the DOE-RL-92-36, *Hanford Hoisting and Rigging Manual.*

**WARNING:** *Synthetic materials such as ropes or slings may be contaminated by moisture, dirt, etc., and may become conductive and not provide shock protection as intended.*

2. Load control, when required, shall use nonconductive tag lines.

3. A dedicated spotter, who is a qualified signal person per DOE-RL-92-36, *Hanford Hoisting and Rigging Manual*, shall be used. The dedicated spotter shall be in constant contact with the crane operator and shall have the sole responsibility of verifying that the new minimum required clearance (less than the Cranes Performing Work LAB) is maintained and be positioned to effectively gauge the new minimum required clearance distance. The dedicated spotter shall also be equipped with a visual aid to assist in identifying the new minimum required clearance distance. Examples of a visual aid include, but are not limited to: an elevated line; a clearly visible line of stanchions; a set of clearly visible line-of-sight landmarks (such as a fence post behind the dedicated spotter and a building corner ahead of the dedicated spotter). This visual aid may be the same as that referred to in Section 6.3.3.1.e.

4. The person(s) responsible for the operation shall alert and warn the crane operator and all persons working around or near the crane about the hazard of electrocution or serious injury and instruct them on how to avoid the hazard.

5. All nonessential personnel shall be removed from the crane work area.

6. No one shall be permitted to approach or touch the crane or the load unless the dedicated spotter or signal person indicates that it is safe to do so.

### 6.3.4 Crane Assembly and Disassembly near Overhead Lines

Crane assembly or disassembly within 20 feet of overhead lines is classified as performing work, see Section 6.3.2, *Overhead Lines Energized, Crane Operating Less than the Erected/Fully Extended Boom Length Away (has the Physical Capability to Enter the Prohibited Zone or No Work Zone)*, for applicable controls. For additional assembly and disassembly requirements see DOE-RL-92-36, the *Hanford Site Hoisting and Rigging Manual*.

## 7.0 ADMINISTRATIVE REQUIREMENTS

### 7.1 Program Audits

The HSESP shall be assessed to help ensure that the principles and procedures of the Program are being followed. Program audits shall be conducted and documented every three years at a minimum. Field audits shall be conducted and documented at least once a year to ensure the HSESP requirements are being followed. Where the audit determines that the principles and procedures of the Program are not being followed, contractors shall take actions to correct any observations or findings. Deficiencies and findings shall be documented in accordance with the contractors' corrective action management system.

Issues concerning the HSESP that are identified through assessments and surveillance reports shall be forwarded to the HSESP Committee.

**NOTE**: *Electrical Safety Program lockout/tagout activities are audited under DOE-0336, Hanford Site Lockout/Tagout Procedure*.

### 7.2 Incident Investigations

Hanford contractors shall accomplish incident investigation requirements of NFPA 70E Section 110.1(J) through their occurrence reporting and corrective action management systems.

### 7.3 Recordkeeping

Records and documentation generated by the Program shall be processed and maintained in accordance with appropriate contractor policies.

## 8.0 REFERENCES

10 CFR 851, *Worker Safety and Health Program*

29 CFR 1910, Subpart S, *Electrical*

29 CFR 1926, Subpart K, *Electrical*

29 CFR 1926, Subpart CC, *Cranes & Derricks in Construction*

29 CFR 1926, Subpart O, *Motor Vehicles, Motorized Equipment, and Marine Operations*

American Society of Mechanical Engineers (ASME) B30.5, *Mobile and Locomotive Cranes*

American National Standards Institute (ANSI) Z358.1, *Emergency Shower and Eye Wash Station Requirements*.

American National Standards Institute (ANSI) Z535, *Series of Standards for Safety Signs and Tags*.

DOE-0336, *Hanford Site Lockout/Tagout Procedure*

DOE-HDBK-1092, DOE Handbook, *Electrical Safety*

DOE-RL-92-36, *Hanford Site Hoisting and Rigging Manual*

DOE-0344, *Hanford Site Excavating, Trenching, and Shoring Procedure*

DOE O 414.1, *Quality Assurance*, as amended

IEEE 1584, *Guide for Performing Arc Flash Hazard Calculations*

MSC-PRO-EU-066, *Electrical Utilities Lock and Tag Program*

MSC-STD-TQ-61018, *Electrical Safety Training Program Description*

NFPA 70-2017, *National Electrical Code (NEC)*

NFPA 70E-2018, *Standard for Electrical Safety in the Workplace*

Revised Code of Washington (RCW) 19.28, *Electricians and Electrical Installations*

# APPENDIX A: DEFINITIONS & ACRONYMS

## DEFINITIONS

| Term | Definition |
|---|---|
| Arc Flash Hazard | A source of possible injury or damage to health associated with the release of energy caused by an electric arc. |
| Arc Flash Boundary (AFB) | When an arc flash hazard exists, an approach limit from an arc source at which incident energy equals 1.2 cal/cm$^2$ (5 J/cm$^2$). |
| Battery System | Interconnected battery subsystems consisting of one or more storage batteries and battery chargers, and can include inverters, converters, and associated electrical equipment. |
| Blind Penetration | Activities including drilling, saw cutting greater than 1 ½ inches, and excavations into surfaces containing concealed electrical conduits and cables which may be accidentally contacted. |
| Charted Working Radius | For mobile equipment, the horizontal distance from the theoretical intersection of the axis of rotation and the vertical center of the hoist line(s). |
| Construction Worksite | As defined by 10 CFR 851.3, *Definitions*, the area within the limits necessary to perform the work described in the construction, procurement, or authorization document. It includes the facility being constructed or renovated along with all necessary staging and storage areas as well as adjacent areas subject to project hazards. |
| Cord Set (Extension Cord) | An insulated, flexible electric wire fitted with a plug at one end and one or more outlets on the other, typically used to plug in devices whose cords are not long enough to reach a wall outlet. |
| Electrical Hazard | A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, or arc blast injury.<br>**NOTE:** *Class 2 power supplies, listed low voltage lighting systems, and similar sources operating at less than 50 volts are examples of circuits or systems that are not considered an electrical hazard.* |
| 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 (applicable verification of isolation checks and safe to work checks complete), and, if necessary, temporarily grounded for personnel protection. |

| Term | Definition |
|---|---|
| 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. |
| 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. |
| Maintenance, Condition of | The state of the electrical equipment considering the manufacturer's instructions, manufacturer's recommendations, applicable industry codes and standards, and recommended practices. |
| Mobile Equipment Operation | Mobile equipment operation is outdoor work that potentially presents a hazard of contact with power lines, outdoor premise wiring, overhead communication lines, or crossing the Equipment in Transit or Equipment Performing Work LAB of energized overhead lines. Mobile equipment operation is work involving track hoes, excavators, dump trucks, elevating work platforms, and all other mobile equipment (this excludes cranes). |
| Modification | Making any physical change to the electrical equipment installation, not to include like-for-like replacement. |
| Multi-Tap Adapter | Typically a 3-outlet adapter used on the end of an extension cord. |
| Multiple Outlet Power Strips | Re-locatable Power Taps (RPTs) and Surge Protection Devices (SPDs). |
| Non-Electrical Workers | Non-Electrical Workers are employees who face a higher than normal risk of exposure to electrical hazards. This includes but is not limited to workers who may operate electrical disconnects or circuit breakers. |
| Normal Operating Condition | A normal operating condition exists where all of the following are satisfied: The equipment is properly installed, maintained, used in accordance with manufacturer's listing and labeling, doors are closed and secured, equipment covers are in place and secured, and there is no evidence of impending failure. |
| Overhead Line(s) | A wire, cable, or bundled conductors supported by messenger cables, with or without insulation, supported by insulators mounted on or hung from crossarms located near the tops of poles, towers, or other structures. |
| Prohibited Zone | The LAB for Cranes Performing Work as defined in Appendix F, Table F-1, *Limited Approach Boundaries for Overhead Lines,* and shown in Appendix F, Figure F-1, *Operating Cranes Near Energized Overhead Lines*. |

| Term | Definition |
|---|---|
| Qualified Person | One who has demonstrated skills and knowledge related to construction and operation of the electrical equipment and installations and has received the applicable safety training to identify the hazards and reduce the associated risk. |
| 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. |
| Risk | A combination of the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard. |
| Risk Assessment | An overall process that identifies hazards, estimates the likelihood of occurrence of injury or damage to health, estimates the potential severity of injury or damage to health, and determines if protective measures are required. |
| Spotter | Trained for (Mobile Equipment) and Dedicated Spotter (Trained for Mobile Cranes) |
| Supervised Industrial Installation | Complex distribution systems with multiple energy sources resulting in differing incident energy values during operation. Conditions of maintenance and engineering supervision ensure that only qualified persons monitor and service the system. Normally, offices, warehouses, garages, and recreational facilities are not considered to be part of Supervised Industrial Installations. |
| Transit | The moving or transporting of a mobile crane or mobile equipment from one jobsite to another. |
| Travel | The function of a mobile crane moving under its own power from one location to another on a jobsite. |
| Vendor | An offsite supplier of a product or service having specialized training and experience for a specific piece of equipment. |
| Working Distance | The distance between a person’s face and chest area and a prospective arc source. |

## ACRONYMS

| | |
|---|---|
| AED | Automated External Defibrillator |
| AEGCP | Assured Equipment Grounding Conductor Program |
| AFB | Arc Flash Boundary |
| AHJ | Authority Having Jurisdiction |
| ANSI | American National Standards Institute |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| AWG | American Wire Gauge |
| BPA | Bonneville Power Administration |
| CEU | Continuing Education Units |
| CFR | Code of Federal Regulations |
| CPR | Cardiopulmonary Resuscitation |
| DOE | U.S. Department of Energy |
| DL | Designated Lead |
| EEWP | Energized Electrical Work Permit |
| EU | Electrical Utilities |
| EIP | Electrical Installation Permits |
| ERA | Electrical Risk Assessment |
| ERDF | Environmental Restoration Disposal Facility |
| GFCI | Ground Fault Circuit Interrupter |
| HAMMER | Volpentest HAMMER Federal Training Center |
| HECB | Hanford Electrical Codes Board |
| HGET | Hanford General Employee Training |
| HSESP | Hanford Site Electrical Safety Program |
| HSSA | Hanford Site Stabilization Agreement |
| HWESB | Hanford Workplace Electrical Safety Board |

| | |
|---|---|
| IAEI | International Association of Electrical Inspectors |
| ICC | International Code Council |
| JHA | Job Hazard Analysis |
| KSAs | Knowledge, Skills, and Abilities |
| LAB | Limited Approach Boundary |
| MSC | Mission Support Contractor |
| NEC | National Electrical Code |
| NESC | National Electrical Safety Code |
| NFPA | National Fire Protection Association |
| NRTL | Nationally Recognized Testing Laboratory |
| OSHA | Occupational Safety and Health Administration |
| PPE | Personal Protective Equipment |
| RAB | Restricted Approach Boundary |
| RCW | Revised Code of Washington |
| RPT | Relocatable Power Tap |
| SME | Subject Matter Expert |
| SPD | Surge Protection Device |
| UL | Underwriters Laboratories |
| WAC | Washington Administrative Code |

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## APPENDIX B: BASIC KNOWLEDGE, SKILLS, AND ABILITIES (KSAs) FOR INSTRUMENT SPECIALISTS

An Instrument Specialist is a qualified person who installs, repairs, maintains, and adjusts indicating, recording, telemetering, and controlling instruments. They test equipment used to control and measure variables, such as pressure, flow, temperature, motion, force, and chemical composition while using precision instruments and hand tools where they may be exposed to unguarded electrical hazards. Instrument Specialists meeting the Basic Experience Requirements (below) are considered to have the following knowledge, skills and abilities (KSAs):

Knowledge Requirements as applicable for assigned tasks:

1. Knowledge of machines and tools, including their designs, uses, benefits, repair, and maintenance.
2. Knowledge of electric circuit boards, processors, chips, and computer hardware and software, including applications and programming.
3. Knowledge of equipment, tools, mechanical devices, and their uses to produce motion, light, power, technology, and other applications.
4. Knowledge of numbers, their operations, and interrelationships including arithmetic, algebra, geometry, calculus, statistics, and their applications.
5. Knowledge of design techniques, principles, tools and instruments involved in the production and use of precision technical plans, blueprints, drawings, and models.
6. Knowledge of electric theory and applications.

Skills Requirements as applicable for assigned tasks:

1. Repairing machines or systems using the needed tools.
2. Using scientific methods to solve problems.
3. Conducting tests to determine whether equipment, software, or procedures are operating as expected.
4. Determining what is causing an operating error and deciding what to do about it.
5. Watching gauges, dials, or other indicators to make sure a machine is working properly.
6. Determining the kind of tools and equipment needed to do a job.
7. Using mathematics to solve problems.
8. Installing equipment, machines, wiring, or programs to meet specifications.
9. Identifying the nature of problems.
10. Generating or adapting equipment and technology to serve user needs.
11. Inspecting and evaluating the quality of products.

12. Controlling operations of equipment or systems.
13. Using logic and analysis to identify the strengths and weaknesses of different approaches.
14. Performing routine maintenance and determining when and what kind of maintenance is needed.
15. Understanding written sentences and paragraphs in work related documents.

Ability Requirements as applicable for assigned tasks:

1. Inspect gauges, meters, and indicators to detect abnormal fluctuations or defects.
2. Test accuracy of meters, gauges, indicators, or other recording or controlling instruments to locate defective components and for conformance to standards.
3. Calculate adjust and calibrate instruments or scales, using hand tools, computer, or electronic devices.
4. Trace out and test electronic solid state components to locate defective parts, using test equipment, schematics, and manuals.
5. Install scales, equipment, or instruments, using blueprints and diagrams.
6. Adjust scales, gears, equipment, or fit of parts.
7. Disassemble malfunctioning instrument and repair or replace damaged or worn parts, using hand tools and power tools
8. Reassemble instrument or equipment, adjust parts, and replace components in the system.
9. Clean and lubricate part and instrument.
10. Cut or fabricate replacement parts for instruments.
11. Maintain record of repairs, calibration, test results, parts and components used, and inventory.
12. Prepare schematic drawings, sketches, or reports to demonstrate changes or alterations made in instruments or system.

Basic Experience Requirements:

The responsible company shall document and ensure that all Instrument Specialists are trained and qualified. Instrument Specialists shall meet one of the following criteria:

1. Completion of a technical school and a minimum of three years of industry experience.
2. Completion of an apprenticeship program with 8,100 documented hours in a recognized apprentice program and a minimum of three years of industry experience.
3. Five Years Industry experience in related responsibilities/job requirements.

4. Equivalent experience (e.g., military, industry) may be substituted for the 8,100 documented hours or any other industry experience requirements.
5. Hanford instrument specialists who are not trained and qualified via a trade school program or equivalent military experience are qualified to perform specific tasks through demonstrating knowledge, skills, and abilities relevant to their assigned duties.

## APPENDIX C: BASIC KNOWLEDGE, SKILLS, AND ABILITIES (KSAs) FOR ELECTRICIANS

A general journey-level electrician is a qualified person who installs and repairs electrical systems, apparatus, electronic, and electrical components of industrial machinery and equipment. They follow electrical code, manuals, schematic diagrams, blueprints, and other specifications while using hand tools, power tools, electrical and electronic test equipment to perform maintenance and repair on electrical equipment where they are exposed to unguarded electrical hazards. Through training and experience, the general journey-level electrician is considered to have the following knowledge, skills and abilities (KSAs):

Knowledge Requirements as applicable for assigned tasks:

1. Knowledge of design techniques, principles, tools and instruments involved in the production and use of precision technical plans, blueprints, drawings, and models.
2. Knowledge of equipment, tools, mechanical devices, and their uses to produce motion, light, power, technology, and other applications.
3. Knowledge of electric circuit boards, processors, chips, and computer hardware and software, including applications and programming.
4. Knowledge of materials, methods, and the appropriate tools to construct objects, structures, and buildings.
5. Knowledge of electric theory and applications.
6. Knowledge of machines and tools, including their designs, uses, benefits, repair, and maintenance.

Skills Requirements as applicable for assigned tasks:

1. Repairing machines or systems using the needed tools
2. Determining what is causing an operating error and deciding what to do about it
3. Installing equipment, machines, wiring, or programs to meet specifications
4. Performing routine maintenance and determining when and what kind of maintenance is needed
5. Inspecting and evaluating the quality of products
6. Conducting tests to determine whether equipment, software, or procedures are operating as expected
7. Determining the kind of tools and equipment needed to do a job
8. Identifying the nature of problems
9. Using mathematics to solve problems

10. Understanding written sentences and paragraphs in work related documents

Ability Requirements as applicable for assigned tasks:

1. Install electrical wiring, equipment, apparatus, and fixtures, using hand tools and power tools.
2. Maintain and repair or replace wiring, equipment and fixtures, using hand tools.
3. Plan layout and install electrical wiring, equipment and fixtures consistent with specifications and applicable electrical and construction codes.
4. Inspect systems and electrical parts to detect hazards, defects, and need for adjustments or repair.
5. Tests electrical systems and continuity of circuits in electrical wiring, equipment, and fixtures, using testing devices.
6. Diagnose malfunctioning systems, apparatus, and components, using test equipment and hand tools.
7. Ready and assemble electrical wiring, equipment and fixtures, using specifications and hand tools.
8. Prepare sketches of location of wiring and equipment or follows blueprints to determine location of equipment and conformance to safety codes.
9. Climb ladder to install, maintain or repair electrical wiring, equipment and fixtures.
10. Construct and fabricate parts, using hand tools and specifications.

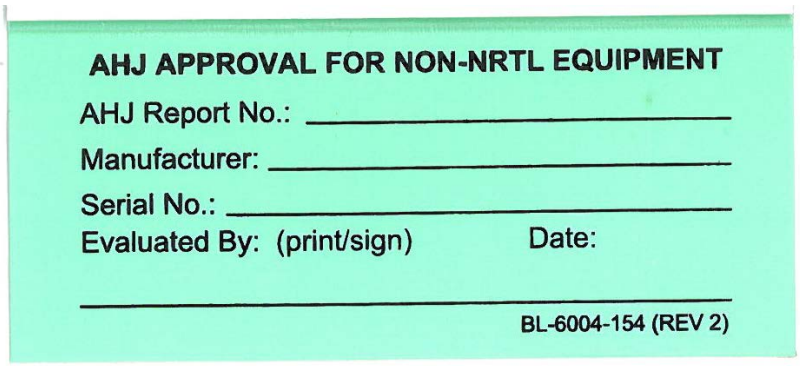
Basic Experience Requirements:

The responsible company shall document and ensure that all Electricians are trained and qualified. Electricians shall meet one of the following criteria:

1. Possession of a general journey-level license
2. Completed 8,000 documented hours of electrical on-the-job training under the supervision of a journey-level electrician in light industrial, commercial, or construction and a minimum of 2,150 hours of classroom training.
3. Verified electrical experience (e.g., military, other State) may be substituted for a portion of the 8,000 documented hours and 2,150 hours of classroom training requirements.

# APPENDIX D: LABELS AND TAGS

## FIGURE D-1: AHJ APPROVAL FOR NON-NRTL EQUIPMENT LABELS




## FIGURE D-2: FIELD-ASSEMBLED EXTENSION CORD LABEL

Company_____

Max _____ Amps Max _____ Watts

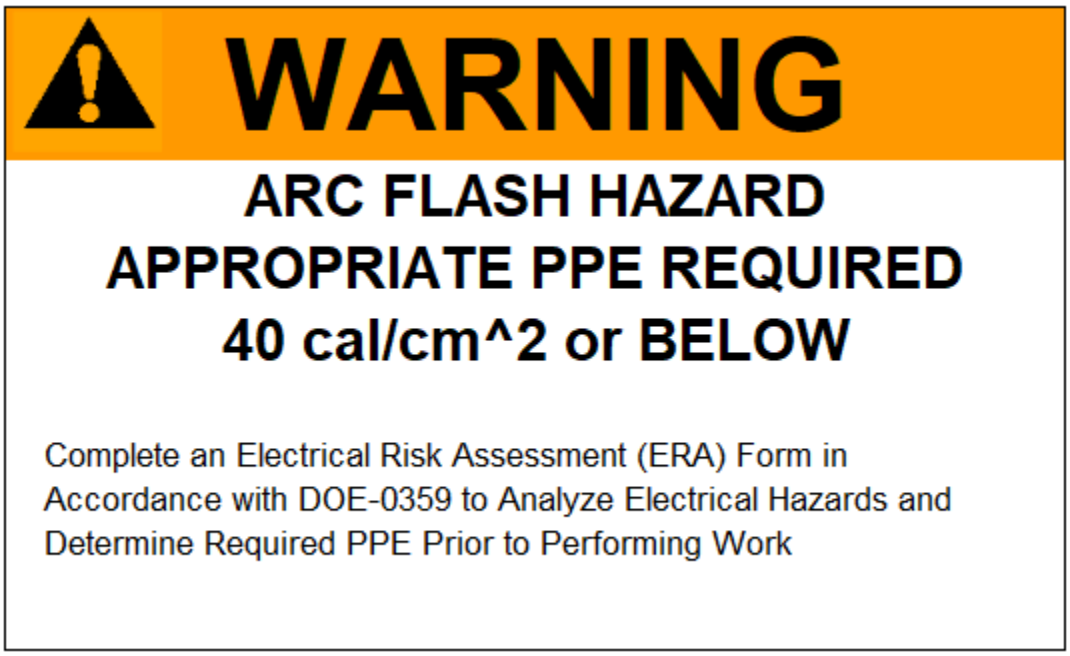
Suitable for outdoor use Yes No

**FIGURE D-3: QUARTERLY INSPECTION TAG**

**TABLE D-1: QUARTERLY INSPECTION TAG G605911**

| Quarter | Months |
|---|---|
| First | January, February, March |
| Second | April, May, June |
| Third | July, August, September |
| Fourth | October, November, December |

**FIGURE D-4: INCIDENT ENERGY LABEL SAMPLES**



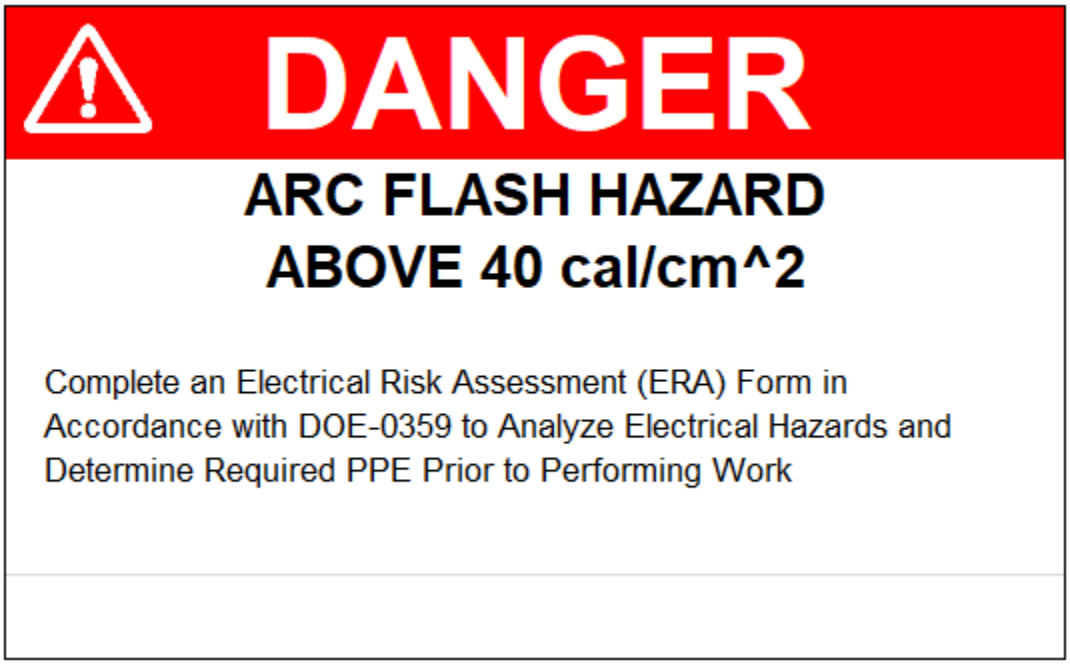



**FIGURE D-4: INCIDENT ENERGY LABEL SAMPLES**

**(CONTINUED)**

**WARNING**

**ARC FLASH HAZARD**

**APPROPRIATE PPE REQUIRED**

1. Voltage:
2. Arc Flash Boundary:
3. At least one of the following:
   - Available incident energy and working distance, or the Arc Flash PPE Category for the equipment
   - Minimum arc rating of clothing
   - Site-specific level of PPE

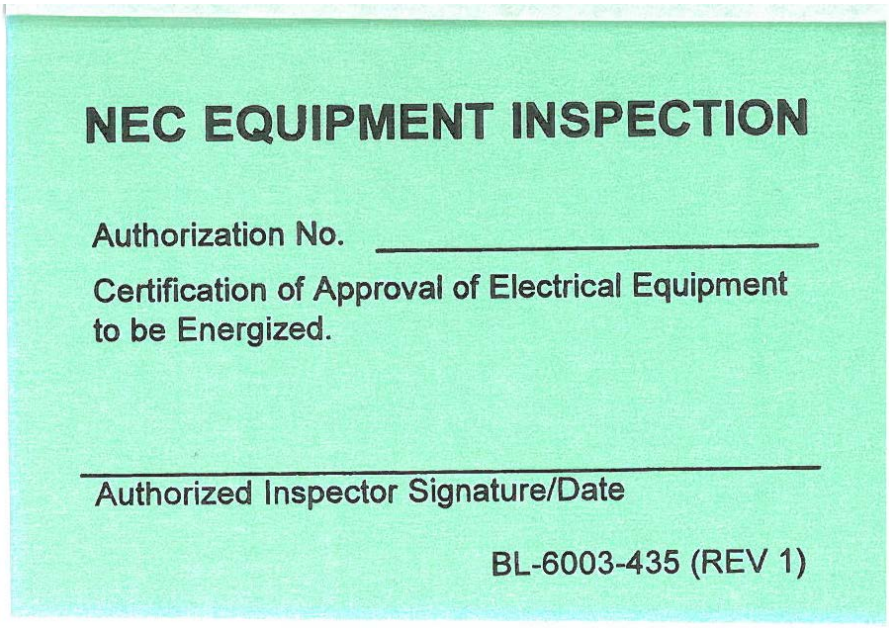
**DANGER**

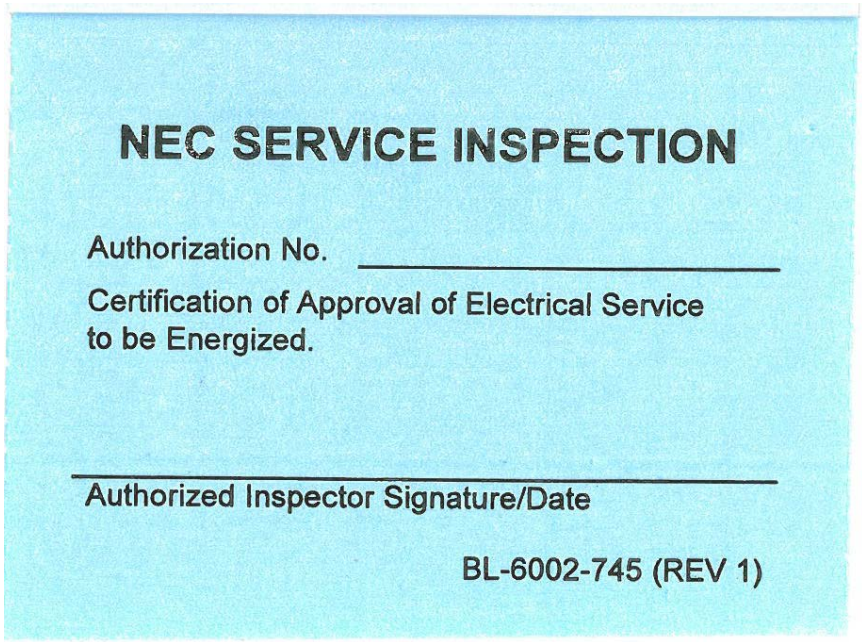
**ARC FLASH HAZARD**

**ABOVE 40 cal/cm^2**

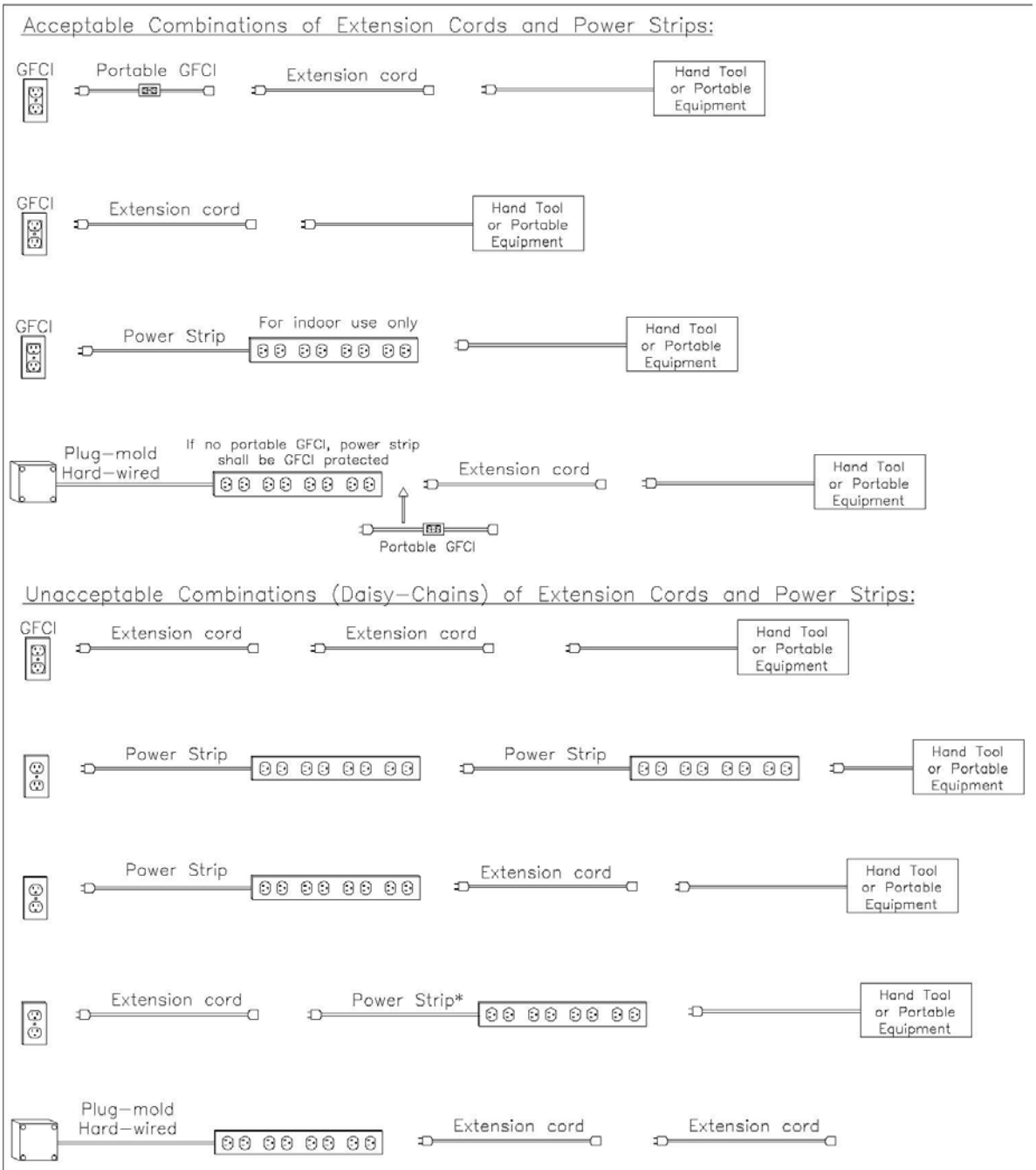
1. Voltage:
2. Arc Flash Boundary:
3. At least one of the following:
   - Available incident energy and working distance, or the Arc Flash PPE Category for the equipment
   - Minimum arc rating of clothing
   - Site-specific level of PPE

**FIGURE D-5: NATIONAL ELECTRICAL CODE (NEC) INSPECTION LABELS**



## APPENDIX E: ACCEPTABLE AND UNACCEPTABLE COMBINATIONS OF EXTENSION CORDS AND POWER STRIPS




***EXCEPTIONS**: A power strip may be connected to a single extension cord temporarily for testing, training, and similar purposes. This temporary configuration may not extend beyond one shift.*

***NOTE**: GFCI devices are not required where GFCI operation could interrupt power to critical systems (i.e. air monitoring equipment, egress lighting).*

## APPENDIX F: WORK OR TRAVEL/TRANSIT NEAR OVERHEAD LINES

### TABLE F-1: LIMITED APPROACH BOUNDARIES FOR OVERHEAD LINES

| | Equipment in Transit | Equipment Performing Work | Cranes in Transit | Cranes Performing Work/Travel |
|---|---|---|---|---|
| Communication Wire | Avoid contact | Avoid contact | Avoid contact | Avoid contact |
| 50-750 V | 4 feet | 10 feet | 4 feet | 10 feet (See Section 6.3) |
| 2.4-13.8 kV | 4 feet | 10 feet | 6 feet | 10 feet (See Section 6.3) |
| 115 kV | 6 feet, 2 inches | 12 feet, 2 inches | 10 feet | 15 feet (See Section 6.3) |
| 230 kV | 10 feet | 16 feet | 10 feet | 20 feet (See Section 6.3) |
| 500 kV | 19 feet | 25 feet | 19 feet | 50 feet (See Section 6.3) |

[1] The limited approach boundary for cranes is the "Prohibited Zone" as defined in American Society of Mechanical Engineers (ASME) B30.5 and OSHA 1926.1400 Subpart CC, *Cranes and Derricks*.

[2] The 500kV lines on the Hanford Site are owned by the Bonneville Power Administration (BPA). Any work near these lines requires prior contact with BPA.

**NOTE**: *All numbers are based on the most conservative requirements from the National Fire Protection Association (NFPA) 70E, Code of Federal Regulations, Title 29, Occupational Safety and Health Administration 29 CFR 1910.333 (c)(3)(iii)(A), and ASME B30.5 (for cranes).*

## FIGURE F-1: OPERATING CRANES NEAR ENERGIZED OVERHEAD LINES

Figure A

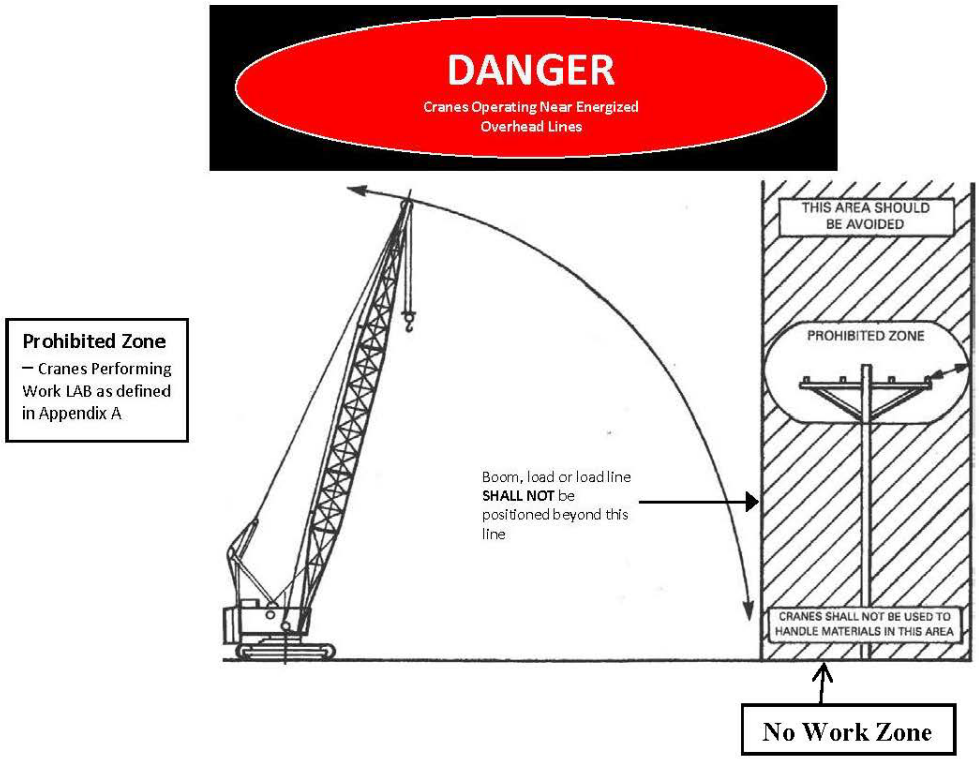



Figure B

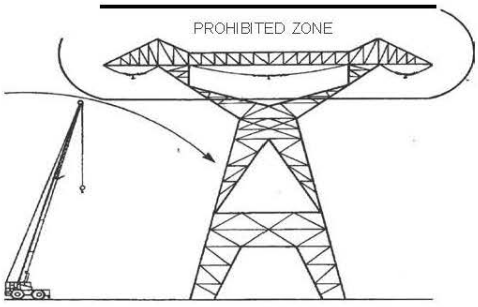


**FIGURE F-2: MOBILE EQUIPMENT IN TRANSIT THAT HAS THE POTENTIAL TO BE WITHIN 20 FEET OF OVERHEAD LINES**

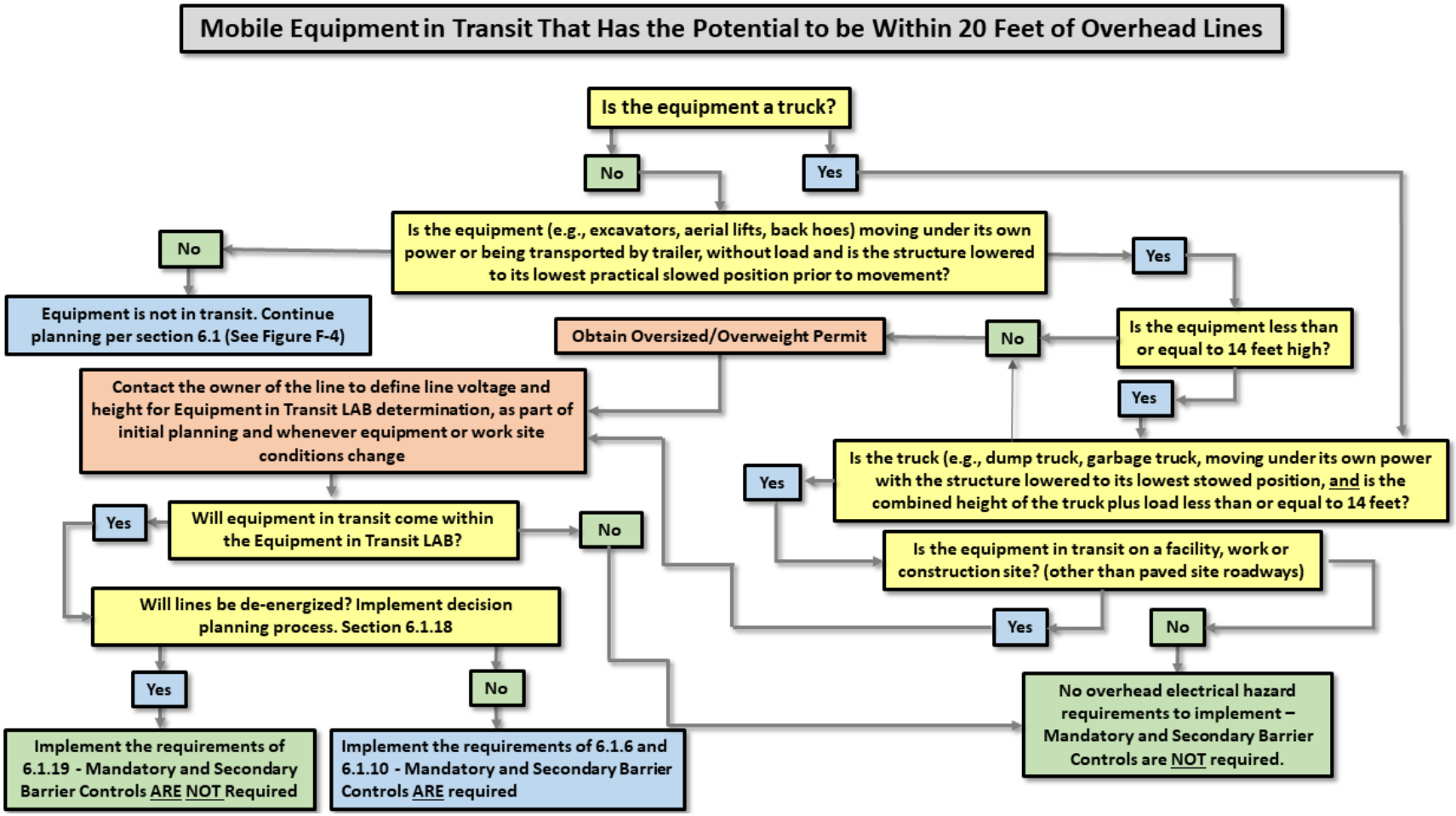


**FIGURE F-3: MOBILE CRANE IN TRANSIT THAT HAS THE POTENTIAL TO BE WITHIN 20 FEET OF OVERHEAD LINES**

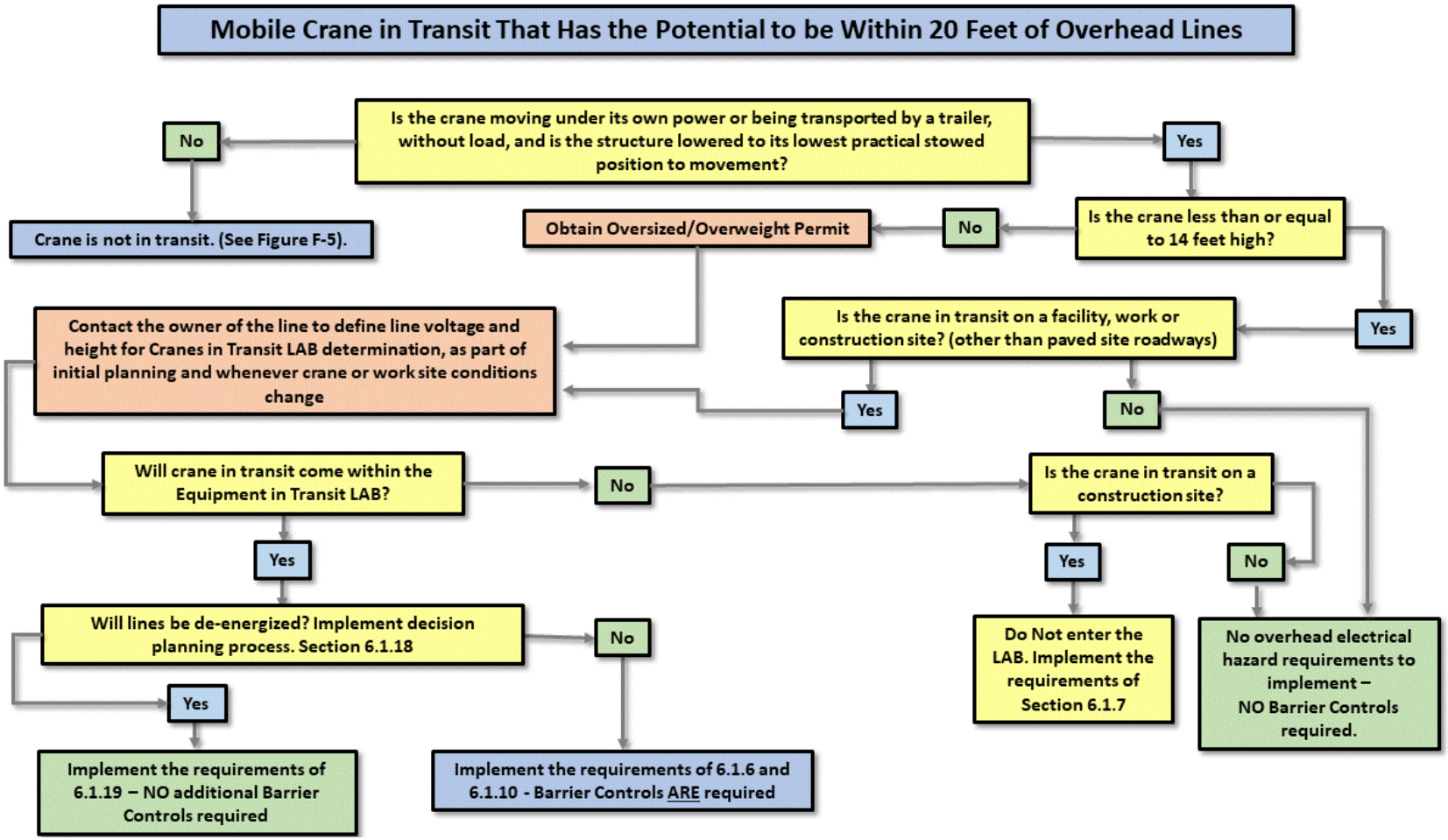


**FIGURE F-4: MOBILE EQUIPMENT PERFORMING WORK WITH THE POTENTIAL TO BE WITHIN 20 FEET OF OVERHEAD LINES**

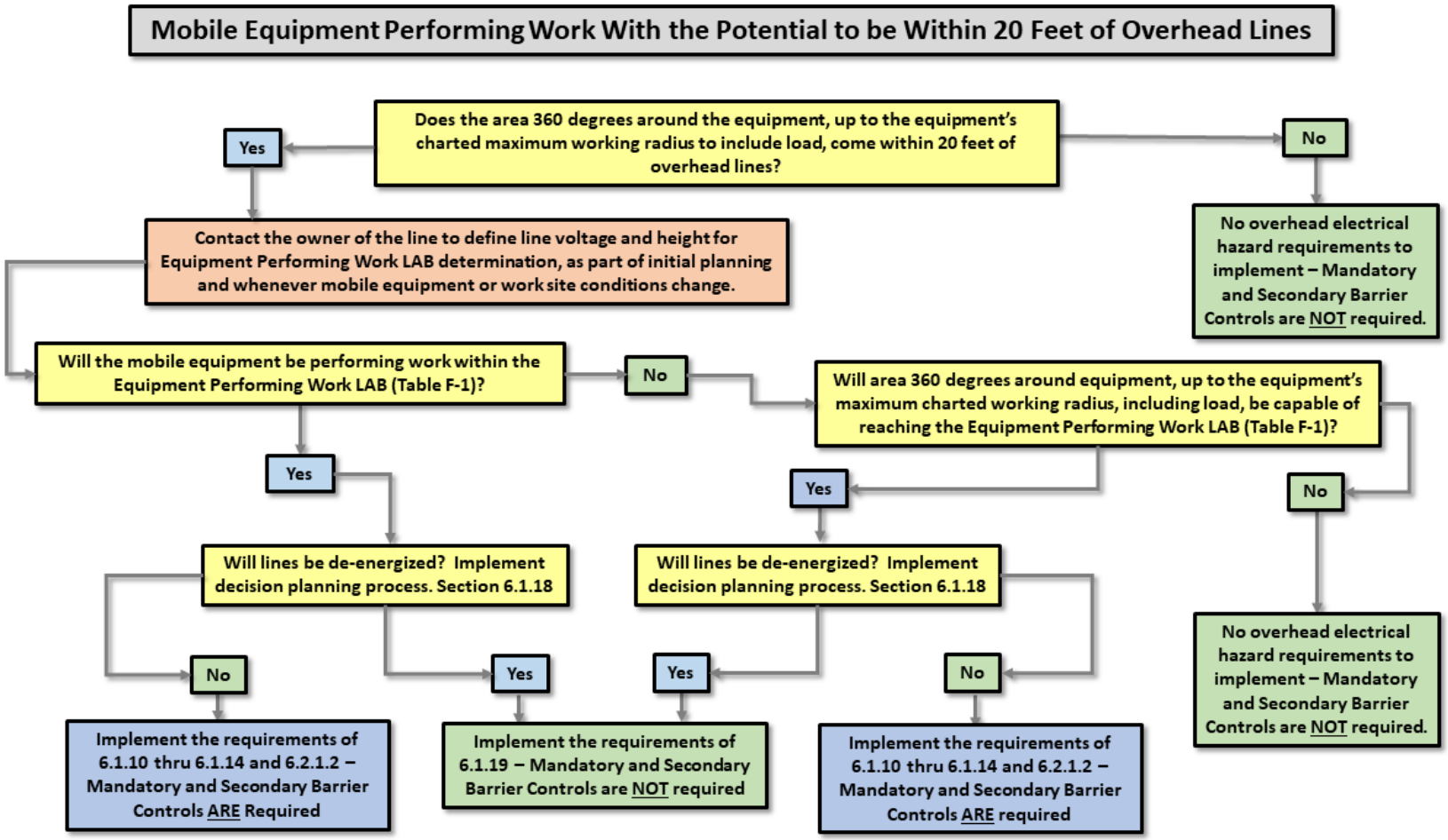
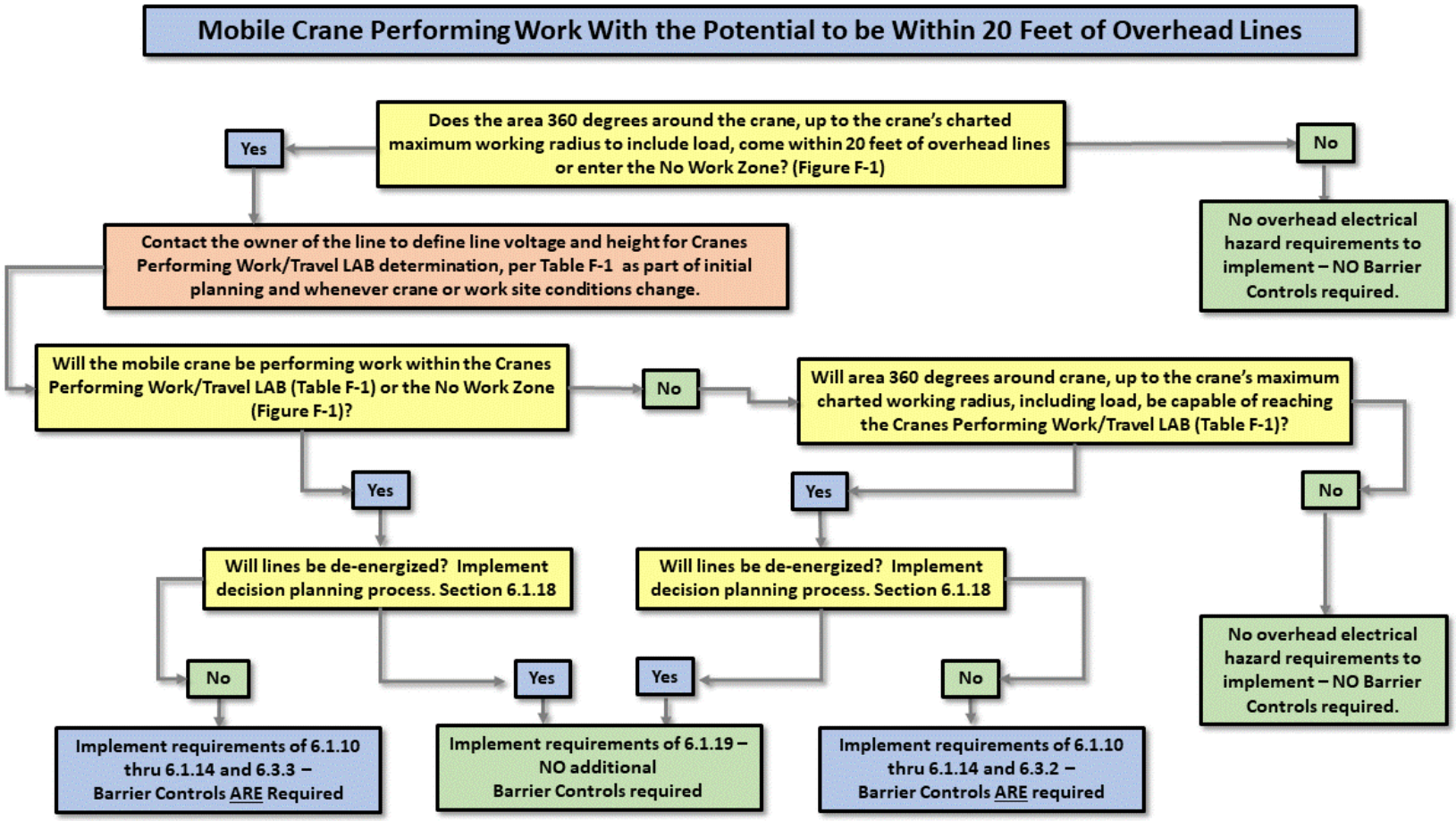


**FIGURE F-5: MOBILE CRANE PERFORMING WORK WITH THE POTENTIAL TO BE WITHIN 20 FEET OF OVERHEAD LINES**



## ATTACHMENT 1: HANFORD SITE ELECTRICAL SAFETY PROGRAM (HSESP) COMMITTEE CHARTER

The Hanford Site Electrical Safety Program (HSESP) Committee is established to serve as the group providing consensus direction for the consistent administration and implementation of the HSESP, herein called the Program. The participating contractors and organizations are responsible for appointing representatives to the committee.

The Department of Energy (DOE) Richland Operations Office (RL), DOE Office of River Protection (ORP), and affected Contractors acknowledge that a joint committee provides the best approach for implementing a consistent, effective, and compliant interpretation of requirements for the Program. The parties agree to cooperate in a teambuilding manner to ensure that the full intent of the Program is met and will be responsibly carried out by their respective organizations.

### 1.0 MISSION

The mission of the HSESP Committee is to ensure consistent and standard application of the Program to promote and maintain a safe work environment. The Committee will achieve this consistent approach through sharing best practices, lessons learned, and taking advice and receiving input from the Hanford Workplace Electrical Safety Board (HWESB) and the Hanford Electrical Codes Board (HECB).

### 2.0 COMMITTEE STRUCTURE/MEMBERSHIP/QUALIFICATION

The Committee shall be comprised of two primary representatives each from the following prime contractors to the DOE at Hanford:

- Mission Support Contract (MSC)
- Plateau Remediation Contract (PRC)
- River Corridor Contract (RCC)
- Tank Operations Contract (TOC)

One representative shall be the contractor's Technical Representative for the HSESP Program as determined by their contractor; the second representative shall be a Hanford Atomic Metal Trades Council (HAMTC) representative (as appointed by the HAMTC President or delegate).

In addition, one representative each from the following organizations shall be appointed to serve on the Committee:

- Central Washington Building and Construction Trades Council (CWB & CTC) (as approved by the Union President or delegate)
- HAMTC

- Electrical Utilities (EU)

These representatives comprise the consensus decision-making membership. An alternate member shall be identified to serve during any absence of a primary representative. The alternate shall have the same authority as the primary representative in their absence.

A representative from Volpentest HAMMER Training and Education Center, Training Department (HAMMER) shall attend meetings as an advisory member to address matters pertaining to training. A representative of the Hanford Hoisting and Rigging Committee shall be invited to participate at each meeting as an advisory member.

A Committee member's length of duty may be indeterminate.

A chair and co-chair shall be elected by a simple majority of the voting membership of the Committee every two years. The chair and co-chair may be re-elected to their respective positions.

Meetings shall be open to others to observe and to give their organizations' impact, perspectives, and technical advice for consideration of the Committee; however, participation in consensus decisions resides solely with the Committee members described herein. The Committee has the authority to develop sub-committees and invite ad hoc participants as needed.

Representatives of RL and ORP shall be invited to participate at each meeting as advisory members.

The MSC shall provide a recording secretary for the Committee. The recording secretary is a position that provides administrative support to the chairperson. A facilitator shall be provided by the MSC as requested by the Committee.

## 3.0 FUNCTIONS OF THE HSESP COMMITTEE

The functions of the Committee shall be:

- Elect a chair and co-chair
- Assist the MSC with the maintenance of the written Program
- Communicate and submit Program changes to RL and ORP through the MSC
- Maintain the Committee charter and review annually

- Review and verify that training is consistent and appropriately covers the content of the Program
- Develop lines of inquiry for contractor use during independent assessments
- Evaluate trends in performance and recommend actions for improvement
- Review electrical safety related events, issues, and lessons learned as appropriate
- Share electrical events or trends across the DOE Complex; compare Hanford to other sites in the DOE Complex
- Ensure distribution of lessons learned as necessary
- Maintain communication with the contractor working level committees and collaborate to resolve worker level issues, concerns, or events in a way that maintains site-wide consistency
    - Since the core function of a Site-Wide Safety Program is "worker protection," it is imperative to have a structure that fosters and encourages input and feedback from the working level. Affected contractors will convene/attend a working level committee to discuss issues, concerns, or events that occur in the area of electrical safety within their organizations. These working level committees shall include equal representation of bargaining unit (as appointed by the bargaining unit president or delegate) and non-bargaining unit employees and ensure good communication up through each group's representative(s) on the HSESP Committee.
- Evaluate and recommend resolution for issues/disputes pertaining to the Program
    - Issues shall not include any actions regarding applicable Collective Bargaining Agreements
- Recommend topics/information for communication to the workforce
- Provide Program status to the Senior Management Team (SMT) and DOE management when requested
- Maintain a current website on electrical safety for site-wide use
- Review and approve compliance guides developed by the HWESB and HECB

## 4.0 ROLES AND RESPONSIBILITIES

### 4.1 Chair Roles and Responsibilities

- Schedule and conduct meetings
- Facilitate meetings in an orderly fashion
- Limit disruptions

- Ensure meeting agendas are prepared
- Ensure meeting summaries are documented
- Function as a point of contact and spokesperson for the Committee
- Interface with other site-wide safety program committees as necessary
- Ensure an action item list is maintained and members complete their assignments in a timely manner
- Coordinate assignments of sub-committee(s)
- Communicate with the SMT as needed

### 4.2 Co-Chair Roles and Responsibilities

- Act as the Chair when the Chair is absent
- Perform roles and responsibilities as delegated by the Chair

### 4.3 Member Roles and Responsibilities

- Provide the chairperson with the identity of an alternate Committee member who is designated as the organizational representative
- Attend and participate in meetings when scheduled or notify their alternate when unable to attend
  - Alternates are responsible to attend and participate in meetings when the primary cannot attend
  - If the primary and alternate are both unable to attend, the Chair shall be notified
- Foster communication between the Committee and affected organizations relative to issue identification, interpretations, and consensus resolution
- Maintain lines of communications between management, workers, and the HSESP Committee
- Assist management and safety personnel with electrical safety questions, assessments, incident investigations, critiques, fact finding meetings, and other electrical safety issues
- Distribute meeting summaries and other electrical safety information throughout represented project or contractor facilities. Provide printed copies to personnel who may not routinely use e-mail

- Communicate regularly with craft workers, supervisors, safety professionals, and management regarding electrical safety issues, concerns, and lessons learned
- Ensure that electrical safety questions, concerns, and requests for interpretations are brought to the appropriate technical board for discussion and resolution
- Promotes and coordinates electrical safety initiatives within the company
- Maintain a safety and requirements focus when addressing issues; avoid facility, craft, job function, or contractor biases when participating in discussions.
- Maintain current knowledge of the requirements of the Program
- Maintain working knowledge of appropriate electrical safety codes, standards, and procedures
- Attend periodic meetings of the Hanford Electrical Code Board (HECB) and/or Hanford Workplace Electrical Safety Board (HWESB)
- Research agenda topics in preparation for HECB and HWESB meeting discussions
- Participate in issue discussions representing respective organization
- Bring up issues or speak in discussions only after being recognized by the chairperson
- Listen respectfully and refrain from interrupting others
- Refrain from disruptive side conversations

## 5.0 MEETINGS

The Committee shall:

- Meet regularly as necessary, but no less than quarterly, via scheduled meetings
- Hold special meetings to address urgent or emerging issues
- Record and retain meeting minutes and action items, and distribute to the membership, alternates, and DOE
- Document and maintain record copies of decisions

## 6.0 MEETING AGENDA

- The chairperson shall ensure an agenda is prepared for each meeting, using input from the membership, and forward a copy to all members, alternates, and DOE in advance of the meeting time and date
- Action items shall be assigned and tracked

## 7.0 QUORUM

The Committee shall be considered to have a quorum when all Committee members, or their alternates, are present. Failure to reach consensus will be cause for an issue to elevate into a secondary phase of discussion and comment.

## 8.0 SECONDARY PHASE OF DISCUSSION AND ISSUE RESOLUTION

Matters not agreed upon by the Committee through the initial consensus process shall be elevated to the secondary phase of discussion. If consensus cannot be reached by the Committee, the issue may be elevated to the SMT and/or DOE. The SMT shall provide a status of their resolution process to the Committee at scheduled meetings.

John G. Lehew III, President and Chief Executive Officer
CH2M Hill Plateau Remediation Company

J. Frank Armijo, President and General Manager
Mission Support Alliance, LLC

M.N. Brosee, President
Washington Closure Hanford LLC

C.G. Spencer, President and Project Manager
Washington River Protection Solutions LLC

David P. Davis, President
Central Washington Building and
Construction Trades Council

David E. Molnaa, President
Hanford Atomic Metal Trades Council

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