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Subcontractors	Program Requirements Document	For Additional Info: http://EDMS	Effective Date: 11/26/19
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Manual: Subcontractors Requirements

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1. PURPOSE

This document describes electrical safety requirements for subcontractors at the Idaho Cleanup Project (ICP) to ensure compliance with National Fire Protection Code (NFPA) 70E, “Standard for Electrical Safety in the Workplace” (2018 Edition); NFPA 70, “National Electrical Code” (2017 Edition); 10 Code of Federal Regulations (CFR) 851, “Worker Safety and Health Program”; and other codes and standards along with *contractor* (see def.) requirements. Any applicable regulatory or contractor requirements must be followed, with the most stringent requirement being met.

2. APPLICABILITY

This document applies to all subcontractors performing electrical work at the ICP, as specified in their contract with the contractor. Stricter requirements may be imposed by subcontractors upon their employees or subtier contractors. The requirements of this document must be followed by subcontractors.

3. REQUIREMENTS

NOTE: *The electrical safety training categories described in this section are NOT position descriptions. ANY personnel who perform work associated with the following training categories are required to have the described training BEFORE performing associated tasks.*

3.1 Worker Safety

The subcontractor shall establish for employees a worker safety and health program that complies with 10 CFR 851. The subcontractor shall post the worker protection poster designated by the Department of Energy (DOE) in a workplace where it is accessible to all workers. (10 CFR 851.20[10])

3.2 Electrical Safety Training

3.2.1 ALL personnel performing work for the ICP shall receive documented electrical safety training that is commensurate with the level of risk for their individual work assignments. (29 CFR 1910.332[c])

3.2.2 The training requirements contained in this section shall apply to personnel who face a risk of electrical hazard that is not reduced to a safe level. (NFPA 70E 110.2)

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- 3.2.3 All training will meet the requirements of NFPA 70E; 29 CFR 1910.331, “Occupational Safety and Health Standards, Scope.” (NFPA 70E, Article 110.2) (29 CFR 1910.332)
- 3.2.4 Personnel who perform work involving power transmission devices must meet the training requirements contained in NFPA 70E and 29 CFR 1910.269. (29 CFR 1910.269[a][2]) (NFPA 70E 110.2)
- 3.2.5 Personnel who work on telecommunication equipment must be trained to the requirements of 29 CFR 1910.268. (29 CFR 1910.228[c])
- 3.2.6 All employees shall be trained to implement 10 CFR 851 in accordance with training completion and documentation requirements in PRD-5001, “Training and Indoctrination.” (10 CFR 851.25)
- 3.2.7 All electrical workers who perform work on live circuits will be trained in first aid and cardiopulmonary resuscitation, provided and renewed as prescribed by the American Red Cross or recognized equivalent agencies. (NFPA 70E 110.2 [C])
- 3.2.8 *Qualified backup personnel* (see def.) shall receive training that includes the following minimum elements: (NFPA 70E 110.2[C])
- A. Responsibilities of an electrical backup person
 - B. Use of appropriate circuit disconnect devices
 - C. Specific working procedures to be followed and the work to be done
 - D. First aid and cardiopulmonary resuscitation
 - E. Use of rescue equipment
 - F. How to contact emergency personnel.
- 3.2.9 Electrical workers who maintain and test batteries exceeding 50 volts shall receive training that includes, as a minimum, emergency procedures associated with accidental acid spills, including procedures for flushing. (10 CFR 851.25)
- 3.2.10 Direct job supervisors/foremen (JS/Fs) shall receive the same level of training as that required for workers being supervised. (DOE M 450.4-1)

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3.3 Identifying and Complying with Electrical Safety Requirements

- 3.3.1 Job hazards associated with electrical work shall be evaluated, mitigated, and communicated. (NFPA 70E 110.7)
- 3.3.2 The risk assessment approach in NFPA 70E, Annex F, “Risk Assessment and Risk Control,” the electrical job safety analysis (JSA) (see the example in Appendix A), and the hazard control set (HCS) in compliance with PRD-1501, “Work Control,” shall be used to determine required hazards control. (NFPA 70E 110.7[F])
- 3.3.3 Electrical safety practices shall comply with the requirements in this document and with all applicable requirements of NFPA 70E, 2018 Edition, including the following:
- A. Chapter 1, “Safety Related Work Practices”
 - B. Chapter 2, “Safety-Related Maintenance Requirements”
 - C. Chapter 3, “Safety Requirements for Special Equipment”
- 3.3.4 29 CFR 1910.269, “Electrical Power Generation, Transmission, and Distribution,” shall apply to work on generation, transmission, or distribution systems.
- 3.3.5 PRD-2012, “Lockouts and Tagouts,” shall be used to satisfy requirements in NFPA 70E 120, “Establishing an Electrically Safe Work Condition.”
- 3.3.6 Radio Frequency (RF) Equipment: A job safety analysis is required (a sample is provided in Appendix B) for work involving RF equipment.
- 3.3.7 Electrical parts or conductors that have been placed into an *electrically safe work condition* (see def.) by being locked out and tagged out (LO/TO) are considered to be attended and, therefore, do not require retesting for absence of voltage until the LO/TO at issue has been removed.
- 3.3.8 Electrical equipment shall be suitable for installation and use in conformity with the provisions of NFPA 70 (National Electrical Code). (NFPA 70 110.3[A])
- 3.3.9 If possible, electrical equipment shall be listed and labeled by a nationally recognized testing laboratory (NRTL) as identified on the following web site: <http://www.osha.gov/dts/otpca/nrtl>. (NFPA 70 110.3[C])

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3.3.10 Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling. (NFPA 70 110.3[B])

3.3.11 Non-NRTL listed/labeled equipment shall be approved for use by the authority having jurisdiction (AHJ) process prior to use.

NOTE: *Approval of non-listed equipment by the AHJ is contingent upon evidence of compliance.*

3.3.12 The installation and protection of temporary electrical service installations shall be per NFPA 70.

3.3.13 The person in charge shall remain at the jobsite while electrical work is being conducted.

3.3.13.1 The person in charge may ONLY leave the work location (the specific location where work can be observed) IF an alternate person in charge is appointed and the work crew is notified of the change. This change shall be documented.

3.3.14 Where work is performed on equipment that is de-energized and placed in an electrically safe work condition but is in a work area with other *look-alike equipment* (see def.) that is energized, the energized look-alike equipment must be identified using one of the following methods: safety signs and tags, barricades, or attendants. (NFPA 70E 130.7[F]; 2018 Edition)

3.4 Authority Having Jurisdiction

3.4.1 All personnel shall use FRM-3100, “Authority Having Jurisdiction (AHJ) Record,” to address questions, equivalencies, exemptions, and authorizations to the company, and shall forward the completed form to the designated interpretive authority. DOE O 420.1C, “Facility Safety”; NFPA 70-110-I; PDD-219, “Industrial Safety and Health Functions, Roles, Responsibilities, and Interfaces.”

3.4.2 The ICP Fire Marshal shall serve as the U.S. Department of Energy Idaho Operations Office (DOE-ID) AHJ representative for the ICP and direct requests for authorizations to the AHJ to use alternative methods from those defined in codes and regulations. (DOE O 420.1C; NFPA 70-110-I; PDD-219)

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- 3.4.3 The Designated Interpretive Authority shall: (DOE O 420.1B; NFPA 70-110-I; PDD-219)
- 3.4.3.1 Provide interpretations of electrical codes and regulations.
- 3.4.3.2 Resolve questions that cannot be resolved at a lower level.
- 3.4.3.3 Direct requests to the DOE-ID AHJ representative for the ICP.

3.5 Ground Fault Current Interrupters (GFCI)

- 3.5.1 *Ground-fault circuit protection* (see def.) for personnel for all temporary wiring installations shall be provided. This applies only to temporary wiring installations used to supply temporary power to equipment used by personnel during construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities. (NFPA 70 590.6)
- 3.5.2 All 125-volt, single phase, 15-, 20-, and 30-ampere receptacles that are not part of the permanent wiring of the building or structure and that are in use by personnel shall have ground-fault interrupter protection for personnel. (NFPA 70 590.6[A])
- NOTE:** *The above requirement does NOT apply IF a greater hazard is introduced by interrupting power or if the equipment design is not compatible with GFCI protection.*
- 3.5.3 If a receptacle(s) is installed or exists as permanent wiring of the building or structure and is used for temporary electrical power, provide GFCI protection for personnel. (NFPA 70 590.6[A])
- 3.5.4 GFCI protection shall be provided where an employee is operating or using cord sets (extension cords) or cord- and plug-connected tools related to maintenance and construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or the assured equipment grounding conductor program shall be implemented. (NFPA 70E 110.6[B])
- 3.5.5 Conduct a pre-test of the GFCI used for construction, maintenance, repair, remodeling, demolition of structures and similar activities involving the use of temporary wiring. (AHJ-05-04)
- 3.5.6 A ground fault equipment protector (GFEP) may be used for higher-energy electrical such as electrical heat tape equipment used for deicing or snow melting. (NFPA 70 426.28)

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- 3.5.7 A GFCI that trips may not be reset more than one time. If the GFCI trips a second time, immediately discontinue the use of the GFCI and notify supervision. (Lessons Learned 2000-148)

3.6 Assured Equipment Grounding Conductor Program

- 3.6.1 The subcontractor shall have a written assured grounding program continuously enforced at the site by one or more designated persons to ensure that equipment grounding conductors for all cord sets, receptacles that are not a part of the permanent wiring of the building or structure, and equipment connected by cord and plug are installed and maintained in accordance with the applicable requirements of NFPA 70 250.114, 250.138, 406.3(C), and 590.4(D). (NFPA 70 590.6[B][2])
- 3.6.2 Receptacles other than 125-volt, single phase, 15-, 20-, or 30-ampere receptacles (such as 240 V or 480 V) shall have the following protection: (NFPA 70 590.6[B])
- A. GFCI protection for personnel
- OR
- B. Assured Equipment Grounding Conductor Program (AEGCP).
- 3.6.3 If the decision is made to implement the AEGCP, continue to Step 3.6.4.
- 3.6.4 The following tests shall be performed and recorded for cord sets, receptacles not part of the permanent wiring of the building or structure, and cord-and-plug equipment: (NFPA 70 590.6[B][2][a])
- 3.6.4.1 Equipment-grounding conductors shall be tested for continuity and make sure they are electrically continuous.
- 3.6.4.2 Each receptacle and attachment plug shall be tested for correct attachment of the equipment-grounding conductor.
- 3.6.4.2.1 The equipment-grounding conductor shall be connected to its proper terminal.
- 3.6.4.2.2 The date of test shall be recorded on tag attached to the equipment.
- 3.6.4.2.3 Record all data generated from testing as directed by the responsible manager.

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3.7 Bang Boards

- 3.7.1 *Bang boards* (see def.) shall be constructed per NFPA 70, 2017 edition.
- 3.7.2 Bang boards shall be NRTL approved or are field evaluated and approved by the AHJ.
- 3.7.3 Inspection of bang boards must be performed as follows:
- A. Before being placed into use for the first time
 - B. When modifications have been made
 - C. When moved from one area to another area.
- 3.7.4 Inspection of bang boards must be performed per Appendix D, “Bang Board Inspection Checklist.”
- 3.7.4.1 Appendix D used to document inspection results.
- 3.7.4.2 Upon satisfactory completion of the inspection, a tag/sticker is affixed.

NOTE: *Inspection of bang boards may be performed by Quality Assurance, if requested, using Form 414.81, “Inspection Planning Package.”*

3.8 Personal Protective Equipment (PPE)

- 3.8.1 Electrical workers, persons in charge, and employees exposed to electrical hazards when the risk associated with that hazard is not adequately reduced by the applicable installation requirements shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed. (NFPA 70E 130.7[A])
- 3.8.2 Protective equipment shall be maintained in a safe, clean, and reliable condition and in accordance with manufacturers’ instructions. The protective equipment shall be visually inspected before each use. Protective equipment shall be stored in a manner to prevent damage from physically damaging conditions and from moisture, dust, or other deteriorating agents. (NFPA 70E 130.7[B])
- 3.8.3 Arc-rated apparel shall be inspected before each use. Work clothing or arc flash suits that are contaminated or damaged to the extent that their protective qualities are impaired shall not be used. Protective items that become contaminated with grease, oil, or flammable liquids or combustible materials shall not be used. (NFPA 70E 130.7[C][13])
- 3.8.4 The garment manufacturer’s instructions for care and maintenance of arc-rated apparel shall be followed. (NFPA 70E 130.7[C][13])

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3.8.5 Before each day’s use, and immediately following any incident that can reasonably be suspected of having caused damage, personnel must ensure that the user inspects rubber-insulating PPE visually for holes, tears, punctures, cuts, or other defects or damage and verify that the end of life service date has not expired. (29 CFR 1910.137[b][2][ii])

3.8.5.1 Rubber-insulating gloves must be tested as follows:

- A. Inflate test either manually OR mechanically with an approved glove inflator device.
- B. Roll-test to highlight cracks, cuts, or irregularities.

3.8.6 If defective, or if the end-of-service date has expired, rubber-insulating, voltage-rated PPE must be returned for inspection and voltage retesting.

3.8.7 Glove Class/Voltage Specifications

3.8.7.1 The appropriate class of rubber insulating gloves shall be used for the maximum use voltage (phase-to-phase or phase-to-ground) per Table 1. (DOE-HDBK-1092-2004 2.12.5) (ASTM D120-09, “Std Spec for Rubber Insulating Gloves”)

Table 1. Rubber insulating glove guidelines.

Class	Voltage	Label
Class 00	500 V	Beige
Class 0	1000 V	Red
Class 1	7.5 KV	White
Class 2	17 KV	Yellow
Class 3	26.5 KV	Green
Class 4	36 KV	Orange

Source: DOE-HDBK-1092-2004 2.12.5 (ASTM D120-09)

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3.8.8 Rubber-insulating PPE Testing Requirements and Issue Requirements

- 3.8.8.1 Rubber-insulating PPE must be electrically tested by a certified testing laboratory at the frequencies listed in Table 2. (29 CFR 1910.137, Table I-6)

Table 2. Testing frequencies for rubber-insulating PPE.

Personal Protective Equipment Item	Voltage Test Frequency
Rubber-insulating gloves (in storage)	Every 12 months
Rubber insulating gloves (in use)	Before issue, and every 6 months, not to exceed the 12-month interval stated above
Rubber-insulating sleeves	Every 12 months
Rubber blankets	Every 12 months
Source: 29 CFR 1910.137, Table I-6.	

- 3.8.8.2 Rubber-insulating PPE rated Class 00 or higher shall be used for electrical work at ICP. The PPE must be stored in individual sealed bags in a centralized location for each user group.

- 3.8.8.3 Rubber-insulating, voltage-rated PPE shall be issued on a checkout basis to individual users using Form 442.38, “Issue and Log Sheet for Rubber-Insulating, Voltage-Rated PPE,” or equivalent documentation.

- 3.8.8.3.1 Prior to checkout, the issuer must stamp the end-of-service date on the cuff of the glove with nonconductive marking. (29 CFR 1910.137[a][1][iii])

NOTE: *The end-of-service date is based on either 12 months from the voltage-test date or 6 months from breaking the seal of the bag, whichever is earlier.*

- 3.8.8.3.2 Prior to checkout, the issuer must stamp the end-of-service date on sleeves or blankets with nonconductive marking in an area that will not affect the voltage rating.

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- 3.8.8.3.3 The end-of-service date for sleeves and blankets shall be based on 12 months from the voltage-test date.
(29 CFR 1910.137[b][2][viii])

3.8.9 Leather Protectors

- 3.8.9.1 Leather protectors may be omitted for the following classes of rubber-insulating gloves ONLY when small equipment and parts manipulation require unusually good finger dexterity, as follows: (29 CFR 1910.137[b][2][vii])
- A. Class 0
 - B. Class 00 but only at voltages up to 250 V
 - C. Classes 1 and higher ONLY when the following conditions are met:
 - (1) If physical damage to the gloves is unlikely AND if the voltage rating of the gloves is one class higher, than the voltage exposure.
- 3.8.9.2 Rubber-insulating gloves of any class that have been used without leather protectors must NOT be used again until they have been retested per ASTM F 496-08 Section 7.
- 3.8.9.3 When arc-rated clothing is worn to protect an employee, it shall cover all ignitable clothing and shall allow for movement and visibility. (NFPA 70E 130.7[C][2])
- 3.8.9.4 Employees shall wear nonconductive head protection whenever there is a danger of head injury from electrical shock or burns due to contact with live parts or from flying objects resulting from an electrical explosion.
(NFPA 70E 130.7[C][3])
- 3.8.9.5 When insulated footwear is used to protect against step and touch potential, dielectric overshoes shall be required.
(NFPA 70E 130.7[C][8])
- 3.8.9.6 When an employee is working within the restricted approach boundary, the worker shall wear PPE appropriate for the shock hazard. When an employee is working within the arc flash boundary, he or she shall wear protective clothing and other PPE appropriate for the arc flash hazard. All parts of the body inside the arc flash boundary shall be protected. (NFPA 70E 130.7[C][1])

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3.9.1 Generators shall be installed and operated in accordance with the manufacturer's instructions, labeling, or recommendations. (NFPA 110.3[B])

NOTE: *Approval of nonlisted equipment by the AHJ is contingent upon evidence of compliance via an approved AHJ record.*

3.9.2 A pre-use inspection (Appendix E) shall be completed before using generator.

3.9.3 Before refueling generator, generators shall be allowed to cool down for at least 10 minutes.

3.9.4 Generators shall be refueled outdoors or in well ventilated area.

3.9.5 Generators shall be of the type suitable for the location in which it is used. (NFPA 70 445.10)

3.9.6 If using generator in rain or wet environment, the generator shall be covered or protected to prevent electric shock or electrocution.

3.9.7 The generator shall not be operated with wet hands or wet gloves.

3.9.8 Adequate ventilation shall be provided for engine generator sets to prevent carbon monoxide exposure or overheating.

3.9.9 At the initial startup and before operating generator, two-wire generators rated at 5 kW or less that have insulated circuit conductors shall be tested.

3.9.10 Test that the two circuit conductors are insulated by testing to ensure that no continuity exists between each blade of the receptacle (not the ground pin) to the frame.

3.9.11 For receptacles on a 2-wire, single-phase generator rated less than 5kW, where the circuit conductors of the generator are insulated from the generator frame and all other grounded surfaces, the receptacles are not required to be protected with GFCIs. (29 CFR 1926.404[b][1][ii])

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- 3.9.12 Unless otherwise specified by the equipment manufacturer, the frame of the portable generator is not required to be connected to a grounding electrode if:
- A. The generator supplies only equipment mounted on the generator
- OR
- B. The generator supplies only cord-and-plug-connected equipment through receptacles mounted on the generator
- AND
- C. The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame. (NFPA 70 250.34[A], [A][1], [A][2])
- 3.9.13 For a vehicle-mounted generator, unless otherwise specified by the equipment manufacturer, the frame of a vehicle is not required to be connected to a grounding electrode for a system supplied by the generator on the vehicle if:
- A. The frame of the vehicle-mounted generator is bonded to a vehicle frame.
- AND
- B. The generator supplies only equipment located on the vehicle or cord-and-plug-connected equipment through receptacles mounted on the vehicle.
- OR
- C. Both equipment located on the vehicle and cord-and-plug-connected equipment are supplied through receptacles mounted on the vehicle or on the generator
- AND
- D. The noncurrent-carrying metal parts of the equipment and equipment grounding conductor terminals of the receptacles are bonded to the generator frame. (NFPA 70 250.34[B], [B][1], [B][2], [B][3])
- 3.9.14 Portable generators supplying fixed wiring systems shall be grounded in accordance with NFPA 70 250.20(D), “Separately Derived Systems.” If generator is part of a separately derived system, the neutral conductor shall be bonded to the generator frame. (NFPA 70 250.34[C])

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3.10 Working On or Near Live Parts

3.10.1 Prior to working on or near any exposed, energized components rated higher than 50 volts, other than to perform exempted work, the subcontractor must obtain an approved “Energized Electrical Work Permit” (see Appendix C, Contractor Form 442.35, “Energized Electrical Work Permit,” [EEWP]) from the Point Of Contact (POC). The subcontractor must verify that the EEWP form to be used is current through verification that it is the version on the Electronic Document Management System (EDMS) or by the subcontract technical representative.

3.10.1.1 Exempted work includes tasks such as:

- A. Testing, troubleshooting, voltage measuring, or instrument calibrations (NFPA 70E 130.2[B][3])
- B. Thermography, ultrasound, or visual inspections, if the restricted approach boundary is not crossed (NFPA 70E 130.2[B][3])
- C. Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed (NFPA 70E 130.2[B][3])
- D. General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed. (NFPA 70E 130.2[B][3])

3.10.1.2 Exempted tasks must be performed by *qualified workers* (see def.) and the designated level of PPE worn is determined by shock risk assessment and arc flash risk assessment, and appropriate safe work practices are followed.

3.10.2 To perform electrical work on cables or circuit parts accessed through maintenance holes/manholes, the following applies:

3.10.2.1 Wiring and cables that could be moved or touched during the work evolution must be *visually inspected* (see def.) for breaks in the insulation.

3.10.2.1.1 PPE is NOT required to perform visual inspection IF the cables are rated 600 volts and lower and the restricted approach boundary is not crossed.

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- 3.10.2.1.2 PPE meeting NFPA 70E 130.7 AND company requirements must be worn to perform visual inspection if the cables are higher than 600 volts.
- 3.10.2.2 If breaks are identified during the visual inspection, a Step Back or Stop Work should be invoked.
 - 3.10.2.2.1 Work will be allowed to resume when insulation issues have been resolved and management approval has been obtained.
- 3.10.3 When possible, work evolutions must be performed in an electrically safe work condition.
 - 3.10.3.1 When performing zero energy verifications on deenergized cables or deenergized circuit parts, PPE meeting NFPA 70E 130.7 AND company requirements for energized electrical work must be worn.
 - 3.10.3.1.1 To manipulate cables rated higher than 600 volts that have been deenergized, and verified as such, PPE is NOT required if the cables are NOT located in the same conduit or duct bank as, or in close proximity to, energized conductors.
- 3.10.4 When electrical work is performed on an energized insulated cable, an EEWP is required because of the possibility of breaks in the insulation.
 - 3.10.4.1 PPE meeting NFPA 70E 130.7 AND company requirements for energized electrical work must be worn.
- 3.10.5 *Unqualified personnel* (see def.) shall be advised of the electrical hazards and warn them to stay outside of the Limited Approach Boundary unless escorted by a qualified person. (NFPA 70E 130.4[E][3])
- 3.10.6 Where there is a need for unqualified personnel to cross the Limited Approach Boundary, a qualified person shall advise the unqualified personnel of the possible hazards and continuously escort the unqualified personnel while inside the Limited Approach Boundary. (see NFPA 70E, Tables 130.4(D)(a) and 130.4(D)(b), Columns 2 and 3). (NFPA 70E 130.4[E][3])
- 3.10.7 An escorted unqualified person shall NOT be allowed to cross the Restricted Approach Boundary. (NFPA 70E 130.4[E][3])

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- 3.10.8 To cross the Restricted Approach Boundary, qualified persons must do the following: (NFPA 70E, Annex C.1.2.3)
- 3.10.8.1 A documented plan shall be approved by authorized management and used. (NFPA 70E, Annex C.1.2.3)
 - 3.10.8.2 Personal protective equipment shall be used that is rated for the voltage and energy level involved. (NFPA 70E, Annex C.1.2.3)
 - 3.10.8.3 Risk due to inadvertent movement shall be minimized by: (NFPA 70E, Annex C.1.2.3)
 - A. Keeping as much of the worker's body out of the restricted space as practical
 - B. Using ONLY protected body parts in the restricted space as necessary to accomplish the work.
- 3.10.9 Where work performed on equipment that is de-energized and placed in an electrically safe condition exists in a work area with other energized equipment that is similar in size, shape, and construction, one of the following alerting methods shall be employed to prevent the employee from entering look-alike equipment: (NFPA 70E 130.7[F]; 2018 Edition)
- 3.10.9.1 Safety signs, safety symbols, or tags must be used where necessary to warn employees about electrical hazards that might endanger them.
 - 3.10.9.2 Barricades
 - 3.10.9.2.1 Barricades must be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas containing energized conductors or circuit parts.
 - 3.10.9.2.2 Conductive barricades must not be used where they might cause an electrical hazard.
 - 3.10.9.2.3 Barricades must be placed no closer than the Limited Approach Boundary or no closer than the Flash Protection Boundary, if it is larger.

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3.10.9.3 Attendant(s) must be stationed to warn and protect employees from electrical hazards if signs and barricades are not sufficient.

3.10.9.3.1 The attendant(s)'s primary duty and responsibility must be to keep unqualified employees outside a work area where the unqualified employee might be exposed to electrical hazards.

3.10.9.3.2 An attendant(s) must remain in the area as long as there is a potential for the employees to be exposed to the electrical hazards.

NOTE: *The PIC can serve as the attendant where needed.*

3.10.10 Ensure that the energized look-alike equipment is identified using the unique ID number and that the ID number on the de-energized equipment to be worked on matches the ID number in the work documents.

3.10.10.1 Equipment is identified by assigning unique ID numbers to it and embossing these ID numbers on the equipment using lamicoid labels or stencils.

3.11 Electrical Backup Worker for Working On or Near Energized Electrical Equipment

3.11.1 Before commencing work, a qualified electrical backup worker shall be at the work site if the planned work is to be performed on equipment rated higher than 300 V or 1.2 cal/cm² (at the working distance) calculated incident energy level, except under the following conditions:

- A. Routine switching of circuits, if conditions at the site allow this work to be performed safely
- B. Work performed with live-line tools if the position of the employee will not be within reach of or otherwise exposed to contact with energized parts
- C. Emergency repairs to the extent necessary to safeguard the general public.

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- 3.11.2 A qualified electrical backup worker shall be present when working on or near exposed, energized equipment, components, or wiring with the following voltage and incident energy level:
1. 300 V or greater
- OR
2. Incident energy levels at 1.2 cal/cm² calculated or greater at the working distance.
- 3.11.3 A qualified electrical backup worker is not required when working on or near exposed, energized equipment, components, or wiring with the following voltage and incident energy levels:
- A. Less than 300 V
 - B. Less than 1.2 cal/cm² calculated incident energy level at the working distance
 - C. Power and current safety limited electronics and communication equipment.
- 3.11.4 A qualified electrical backup worker shall accompany a *qualified electrical worker* (see def.) at the job site and don the PPE indicated on Form 442.35 or the applicable JSA.
- 3.11.5 All involved qualified electrical workers and qualified electrical backup workers must be in 100% agreement to meet the *100% Safety Rule* (see def.) of the work that is to be performed and the sequence in which it should be done.
- 3.11.6 If qualified electrical workers and qualified electrical backup workers cannot reach 100% agreement, work must be stopped until 100% agreement has been reached.

3.12 Person In Charge (PIC) for Work On or Near Energized Electrical Systems

- 3.12.1 A qualified electrical worker shall be assigned to assume the responsibilities of the PIC when working on or near energized electrical systems.

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NOTE: *The PIC will be a qualified electrical worker, but may be the job supervisor, foreman, or qualified electrical worker.*

3.12.2 The PIC shall conduct the pre-job briefing. (NFPA 70E 110.1[I])

3.12.2.1 The PIC may conduct the briefing as a partnership with the job supervisor/foreman assisting with the electrical portion of the pre-job briefing. The PIC will ensure that all personnel involved, including unqualified personnel attend the pre-job briefing.

3.12.3 If energized electrical work is to be performed, the PIC shall ensure that Form 442.35, “Energized Electrical Work Permit,” is completed and signed.

NOTE: *Tasks such as testing, troubleshooting, voltage measuring, or instrument calibration may be performed without Form 442.35.*

3.12.4 The PIC shall be physically at the job site during the following activities:

- A. Energized work where the calculated incident energy 1.2 cal/cm² or greater at the working distance
- B. Working on exposed energized part(s) OR within the Restricted Approach Boundary of 240 Volts or greater.

3.13 Pre-job Briefing

3.13.1 A pre-job briefing shall be performed. (NFPA 131.1[I])

3.13.2 Include discussion of hazards and controls indicated on Form 420.16B, “Arc Flash Hazard Analysis Worksheet for AC Systems (Arc Flash PPE Categories Method),” and attach to Form 442.35, “Energized Electrical Work Permit.”

3.13.3 When the work requires an EEWP, document completion of the pre-job briefing with Form 434.14, “Pre-Job Briefing Checklist,” and attach it to the EEWP.

3.14 Working Near Overhead Electrical Lines

3.14.1 Before work is performed near overhead electrical lines, the contractor POC shall be notified in order to obtain the required approvals and clearances.

3.14.1.1 When lines must be deenergized, the contractor POC shall be notified 72 hours in advance. (29 CFR 1910.269[m][3])

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- 3.14.1.2 Before performing work where personnel or equipment can make contact with distribution system equipment while working within 50 ft of overhead power lines, a high-voltage work permit and/or high-voltage work clearance shall be obtained. (29 CFR 1910.269[m][3])
- 3.14.1.3 Except in emergencies, all outages on Idaho National Laboratory (INL) power lines shall be coordinated by the area outage coordinator.
- 3.14.2 Ensure that equipment stays outside the Limited Approach Boundary. Use the following barrier control methods to ensure that the equipment comes no closer than NFPA 70E Tables 130.4(D)(a) and 130.4(D)(b)
 - 3.14.2.1 Use trained spotters during work performance.
 - 3.14.2.2 Require spotters to wear reflective materials such as fluorescent vests.
 - 3.14.2.3 Use demarcation lines to ensure that safe approach distances are maintained. Stakes, cones, painted lines, or physical barriers must be used to provide constant reminders to equipment operators of the proximity to the overhead lines.
- 3.14.3 The following safety-related work practices shall be used when working on or near energized, uninsulated, movable overhead lines. (NFPA 70E 130.8)
 - 3.14.3.1 Where work is performed in locations containing energized overhead lines that are not guarded or isolated, precautions must be taken to prevent employees from contacting such lines directly with any unguarded parts of their body or indirectly through conductive materials, tools, or equipment.
 - 3.14.3.2 Where work and working conditions make contact with energized overhead lines a possibility, the lines must be deenergized and visibly grounded at the point of work, or suitably guarded.
 - 3.14.3.3 Personnel protective grounds must be applied to deenergized overhead lines exceeding 600 V when contact is possible.

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WARNING

Overhead lines may be encased within a material of composition or thickness that is not recognized as insulation or deteriorated due to aging systems, thereby increasing the danger of electrical shock upon contact.

- 3.14.3.4 The insulation on overhead lines must not be relied upon for personnel protection. Ensure that precautions for working on live parts are used and the approach boundaries of NFPA 70E 130.4(D)(a) and 130.4(D)(b) (Appendix A) are followed.
- 3.14.4 When work is performed within 50 ft of the centerline of energized overhead electrical wires, the possibility of induced voltages may produce induced voltage shocks. Ensure that work planning and hazards controls are applied to reduce or eliminate the collection of induced voltages, including (but not limited to) the following: (NFPA 70E 120.5[8])
- 3.14.4.1 Ground or bond equipment and materials using conductive straps or jumpers (request Engineering to evaluate the need for a driven ground).
- 3.14.4.2 Use conductive rigging in lieu of synthetics or jumpers to bond hoisted materials to the lifting apparatus.
- 3.14.4.3 Stay alert to the possibility of a voltage discharge when handling materials or contacting equipment when working within the influence of nearby high voltage electrical lines.
- 3.14.4.4 Use metal dunnage, sawhorses, or pipe racks to store pipes or steel off the ground.
- 3.14.5 Approach distances for unqualified persons**
- 3.14.5.1 Ensure that when employees without electrical training are working on the ground or in an elevated position near overhead lines, the location is such that the employee and the longest conductive object the employee might contact will NOT come closer to any unguarded, energized overhead line than the Limited Approach Boundary identified in Tables 130.4(D)(a) and 130.4(D)(b) (Appendix A) of NFPA 70E. (NFPA 70E 130.8[E])

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3.14.5.2 If the voltage on the line exceeds 50 kV, the distance must be 10 ft plus 4 in. for every 10 kV over 50 kV.

NOTE: *Objects that are not insulated for the voltage involved are considered to be conductive.*

3.14.6 Vehicular and Mechanical Equipment Near Energized Overhead Lines

3.14.6.1 Where any vehicle or mechanical equipment structure will be elevated near energized overhead lines, they shall be operated so that the Limited Approach Boundary distance of NFPA 70E, Tables 130.4(D)(a) and 130.4(D)(b), are maintained. However, under any of the following conditions, the clearances shall be permitted to be reduced: (NFPA 70E 130.8[F])

- A. If the vehicle is in transit with its structure lowered, the limited approach boundary to overhead lines in NFPA 70E, Table 130.4(D)(a), Column 2 and 130.4(D)(b), Column 2, shall be permitted to be reduced by 6 ft (1.83 m)
- B. If insulated barriers, rated for the voltages involved, are installed, AND they are NOT part of an attachment to the vehicle, the clearance shall be permitted to be reduced to the design working dimensions of the insulating barrier
- C. If the equipment is an aerial lift insulated for the voltage involved, AND if the work is performed by a qualified person, the clearance (between the uninsulated portion of the aerial lift and the power line) shall be permitted to be reduced to the restricted approach boundary given in NFPA 70E, Tables 130.4(D)(a), Column 4 and 130.4(D)(b), Column 4.

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3.14.6.2 Employees standing on the ground shall NOT contact the vehicle or mechanical equipment or any of its attachments, UNLESS:

A. The employee is using protective equipment rated for the voltage

OR

B. The equipment is located so that no uninsulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in NFPA 70E 130.8(F)(2).

3.14.6.3 If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may NOT stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from hazardous ground potentials (step and touch potential). (NFPA 70E 130.8[F][3])

3.15 Service Drop Conductors and Feeders 600 Volts and Below

3.15.1 Where work is performed in locations containing insulated or covered service drop conductors or feeders, precautions shall be taken to prevent contact. (Lessons Learned)

3.15.1.1 Unqualified persons shall NOT approach or bring any conductive object or equipment any closer than 3 ft to a service drop conductor or feeder.

3.15.1.2 Where contact is possible, the conductors shall be deenergized or precautions followed for working on or near exposed energized conductors.

3.16 Batteries in Battery Rooms

3.16.1 When forced or natural ventilation systems are required by the battery system design and are present, they shall be examined and maintained to prevent buildup of explosive mixtures per the equipment manufacturer's requirements. (NFPA 70E, 240.1)

3.16.2 Eye and body wash apparatus shall be maintained in operable condition. (NFPA 70E, 240.2)

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- 3.16.3 Provisions appropriate to the battery technology shall be made for sufficient diffusion and ventilation of gases from the battery, if present, to prevent the accumulation of an explosive mixture. (NFPA 70E 240.1; NEC 2017, Article 480.10[A])
- 3.16.4 Ventilation for sealed gelled electrolyte type batteries shall be provided to ensure the design temperature is maintained to prevent thermal runaway leading to cell meltdown resulting in fire or explosion.
- 3.16.5 Tools and equipment for work on batteries shall be equipped with handles listed as insulated for the maximum working voltage.
- 3.16.5.1 Battery terminals and all electrical conductors shall be kept clear of unintended contact with tools, test equipment, liquid containers, and other foreign objects.
- 3.16.5.2 Nonsparking tools shall be required when the risk assessment justifies their use or if the hydrogen gas level can be determined to . (NFPA 70E, 320.3[C][2])
- 3.16.6 All personnel working with batteries shall don the appropriate PPE. (NFPA 70E 320.8)
- 3.16.7 To work on batteries, person must be a qualified electrical worker with additional training for working on battery system.

3.17 Emergency Situations

- 3.17.1 All personnel shall respond immediately to emergency situations by contacting the INL power dispatcher by phone (526-2300) or by contacting the Warning Communications Center (WCC) at 526-1515 or by radio, channel WCC/TRF.

NOTE: *Examples of an emergency situation are power lines on the ground, power poles on fire, damage to a power pole causing power lines to fall, vehicles or equipment coming into contact with lines, and danger to people and/or property.*

- 3.17.2 If a line has fallen on an occupied vehicle, occupants shall stay in the vehicle until help arrives from Power Management, UNLESS it is necessary to leave the vehicle to obtain assistance or because of other hazards such as fire.
- 3.17.3 When a line is on the ground, on a vehicle, or touching a piece of machinery such as a crane, the following precautions shall be taken:
- 3.17.3.1 Do not approach a downed line.

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- 3.17.3.2 If it is necessary to leave a vehicle or the area of a downed line, take the following protective actions.
- 3.17.3.2.1 Do NOT touch the vehicle and the earth at the same time.
- 3.17.3.2.2 Avoid step potentials in the earth that result when energized lines come in contact with the earth by either hopping away from the vehicle and the lines with both feet together OR taking small shuffling steps.
- 3.17.3.2.3 NEVER, under any circumstance, touch the vehicle involved while standing on the ground.

4. DEFINITIONS

100% safety rule. All participating qualified electrical workers are in agreement of the work to be completed and the work sequence in which it should be performed before switching, isolating, testing, or working on energized circuits.

Bang Board. Portable electrical distribution equipment that supplies temporary power to equipment used by personnel during construction, maintenance, remodeling, repair, or demolition of buildings or structures. A bang board may consist of a transformer, disconnects switches that supply 480 volts, and power panel that supplies various voltages to GFCI protected receptacles.

Contractor. All duly authorized Idaho Cleanup Project (ICP) contractor representatives acting in their professional capacity, in the performance of work at the ICP at the Idaho National Lab (INL).

Electrically safe work condition. A state in which the conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to verify the absence of voltage, and, if necessary, temporarily grounded for personnel protection.

Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to de-energize a circuit or a portion thereof within an established period of time when a current exceeds the values established for the device being used.

Look-alike equipment. Equipment that is similar in size and shape, and construction, essentially looks like the other equipment in the same general vicinity.

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Qualified electrical worker. An employee who is fully qualified to perform work through training, education, and experience and may be required to cross the limited approach boundary to perform certain assigned duties on or near exposed, energized electrical equipment, components, or wiring operating at 50 V or more to ground. The qualified electrical worker is also trained and knowledgeable of the construction of the equipment or specific work method and is trained to recognize and avoid the electrical hazards that might be present with respect to the equipment or work method and has been trained in CPR and first aid. The training includes those listed in PLN-3425, “ICP Electrical Safety Training Plan,” for a qualified electrical worker. A qualified electrical worker may meet the definition for a “Qualified Worker,” depending on the task performed. The company qualified electrical worker maintains qualification QCICPELE, ICP Electrical Worker.

Qualified backup personnel (buddy). A person who is trained and knowledgeable of the construction of the equipment or specific work method and is trained to recognize and avoid the electrical hazards that might be present with respect to the equipment or work method, trained in CPR and first aid, and who has no other duties than protecting the person performing the work from the hazards associated with electrical shock. The backup may assist the worker on minor tasks that do not subject the backup to an electrical hazard (shock and flash).

Qualified worker. A qualified worker is trained and knowledgeable in the construction and operation of equipment or a specific work method and has been trained to identify and avoid the electrical hazard that might be present with respect to that equipment or work method.

Unqualified personnel. A person that is not familiar with the construction and operation of the electrical equipment and the hazards involved. An unqualified person is not authorized to cross the limited approach boundary unless escorted by a qualified person.

Visual inspection. An inspection that is visual ONLY and does NOT include hands-on manipulation of conductors, wiring, or other electrical components.

See LST-27, “Glossary”

Also see NFPA 70E, Article 100, for additional definitions.

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Page: 26 of 40**5. REFERENCES****5.1 Source Documents**

10 CFR 851, “Worker Safety and Health Program”

29 CFR 1910, “Safety and Health Regulations for General Industry”

29 CFR 1926, “Safety and Health Regulations for Construction”

ASTM F 496-02, “Standard Specification for In-Service Care of Insulating Gloves and Sleeves”

ASTM F 1236-01, “Standard Guide for Visual Inspection of Electrical Protective Rubber Products”

DOE O 420.1C, “Facility Safety”

NFPA 70, “National Electrical Code” (2017 ed.)

NFPA 70E, “Standard for Electrical Safety in the Workplace” (2018 ed.)

GDE-436, “Engineering Guide for Temporary Electrical Power Use”

MCP-1525, “Providing Electrical Equipment Acceptable to the Authority Having Jurisdiction”

MCP-1545, “Flash Hazard Analysis and Calculations”

MCP-1563, “Working On or Near Energized Electrical Parts and Conductors”

MCP-2089, “Use of Portable and Vehicle-Mounted Generators”

MCP-2100, “Working Near Overhead Power Lines”

MCP-2261, “Electrical Protective Clothing and Personal Protective Equipment”

MCP-3003, “Performing Pre-Job Briefings and Documenting Feedback”

MCP-3306, “Temporary Electrical Installations”

5.2 Related Requirements

The following documents may also contain requirements that apply to this activity:

Form-420.16B, “Arc Flash Hazard Analysis Worksheet for AC Systems (Arc Flash PPE Categories Method)”

Form 442.35, “Energized Electrical Work Permit”

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LST-27, “Glossary”

MCP-553, “Step Back and Stop Work Authority”

PLN-3425, “ICP Electrical Safety Training Plan”

PRD-1501, “Work Control”

PRD-2012, “Lockouts and Tagouts”

PRD-5001, “Training and Indoctrination”

6. APPENDIXES

Appendix A, Electrical Job Safety Analysis

Appendix B, Radio Frequency Equipment Job Safety Analysis

Appendix C, Energized Electrical Work Permit

Appendix D, Bang Board Inspection Checklist

Appendix E, Generator Pre-Use Inspection

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Appendix A

Electrical Job Safety Analysis

Electrical hazards are evaluated using the appropriate requirements, such as from the following sample job safety analysis (JSA), in conjunction with subcontractor JSAs, subject-matter expert evaluations, and the hazard risk evaluation listed in NFPA 70E, Annex F, “Risk Assessment and Risk Control,” and PRD-1501. An ICP Electrical Safety Committee-approved risk evaluation process may also be used to fulfill the function of the NFPA risk assessment.

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442.17

JOB SAFETY ANALYSIS

JSA No. JSA-XXX

Revision No. DRAFT

Use with MCP-3450

Job/Title Electrical Job Safety Analysis	Effective Date _____
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Facility/Project & Location
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SME APPROVAL (A "Yes" response requires a review by SME.)

<table style="width: 100%;"> <tr> <th style="text-align: left;">No</th> <th style="text-align: left;">Yes</th> <th style="text-align: left;">SME</th> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Industrial Safety</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Industrial Hygiene</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Fire Protection</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>RCT/RAD Eng.</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Other: _____</td> </tr> </table>	No	Yes	SME	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Industrial Safety	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Industrial Hygiene	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Fire Protection	<input checked="" type="checkbox"/>	<input type="checkbox"/>	RCT/RAD Eng.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____	<table style="width: 100%;"> <tr> <th style="text-align: left;">No</th> <th style="text-align: left;">Yes</th> <th style="text-align: left;">SME</th> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Env. Protection</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Quality Assurance</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Engineering</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Other: _____</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Other: _____</td> </tr> </table>	No	Yes	SME	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Env. Protection	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Quality Assurance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engineering	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____
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S a m p l e

Briefly Describe The Job and Expected Result

Required Job Training/Required Personal Protective Equipment	Required Job Training/Required Personal Protective Equipment
Training	PPE

Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
1. Work area is prepared	1a. Disabling necessary services or exposure to hazardous processes	1a.1 Drawings and prints are reviewed to identify multiple power sources and critical operations or safety systems affected.
		1a.2 All required forms are processed for outages, lockouts and tagouts, fire systems emergency alarms, hazardous chemicals, etc. Work is coordinated with facility or area management.
	1b. Lack of training or experience	1b.1 All personnel are trained and qualified, and follow procedures.
		1b.2 Workers who are not familiar with area or system(s) are briefed by line management.
		1b.3 A pre-job briefing is conducted per NFPA 70E 110.1(l) and MCP-3003.

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Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE														
2. General requirements common to energized and deenergized work	2a. Using portable power tools	2a. All electrical portable power tools, operating at 110 volts or more are protected by a GFCI.														
	2b. Shock (conductive materials)	2b.1 All conductive materials (such as jewelry and key chains) are removed from the body.														
		2b.2 Electrically safe hard hats are worn whenever there is a danger of head injury from electrical shock or burns due to contact with exposed energized parts.														
	2c. Flash burns	2c. Full cover fire retardant clothing and face shield are worn when there is a possibility of exposure to an electrical arc flash while working inside the flash protection boundary.														
2d. Lack of work coordination	2d. Before performing ANY work, facility management is contacted and facility management authorization is received.															
3. Diagnostic, troubleshooting, and calibration activities	3a. Shock (conductive materials)	3a. Diagnostic, troubleshooting, and calibration activities may be performed with approved test instruments and equipment on exposed energized electrical conductors and circuit parts by qualified personnel without the use of lockout and tagout ONLY after all other possibilities have been eliminated.														
4. Verifying system is deenergized	4a. Electrocution prior to deenergization <table border="1" data-bbox="724 925 1039 1214"> <thead> <tr> <th>Class</th> <th>Voltage</th> </tr> </thead> <tbody> <tr> <td>00</td> <td>500 V</td> </tr> <tr> <td>0</td> <td>1,000 V</td> </tr> <tr> <td>1</td> <td>7.5 kV</td> </tr> <tr> <td>2</td> <td>17 kV</td> </tr> <tr> <td>3</td> <td>26.5 kV</td> </tr> <tr> <td>4</td> <td>36 kV</td> </tr> </tbody> </table>	Class	Voltage	00	500 V	0	1,000 V	1	7.5 kV	2	17 kV	3	26.5 kV	4	36 kV	4a.1 Backup and the 100% safety rule are required for electrical systems over 300 volts. For electrical systems 300 volts or less, the need for backup is determined by the qualified person performing the job. Back up must have the same level of safety training and PPE as the worker performing the work. Backup has no other duties, other than protecting the person performing the work from the hazards associated with electrical shock.
		Class	Voltage													
		00	500 V													
		0	1,000 V													
		1	7.5 kV													
		2	17 kV													
3	26.5 kV															
4	36 kV															
4a.2 The system is deenergized, locked, and tagged out.																
4a.3 The system is tried to verify that the power has been interrupted.																

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Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
<p>4. (continued).</p>	<p>4a. Electrocution prior to deenergization (continued)</p>	<p>4a.4 In addition to the hazard elimination performed in 2, 3, and 4, verification is made that the system is deenergized using instruments approved for the purpose and the following PPE:</p> <p>Less than 300 volts line to line: minimum requirement is to conduct a hazards evaluation and use electrically insulated tools, PPE, and shields or barriers, as appropriate.</p> <p>300 volts to ground and less than 600 volts line to line: minimum PPE: eye and face protection, gloves rated for the voltage, (see chart at left), and an electrically rated insulated mat when practical.</p> <p>600 volts to ground and less than 13.8 KV line to line: minimum PPE: eye and face protection, gloves rated for the voltage (see chart at left), an electrically insulated mat and sleeves, when practical. In addition to PPE, the system must be grounded with appropriate ground clusters whenever possible; if it is not grounded it is not dead, appropriate PPE must be used.</p> <p>4a.5 Other close proximity conductors are identified and either deenergized, locked and tagged, or insulation barriers are provided. It is ensured that all sources of power have been checked.</p>

sample

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Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE														
<p>5. Electrical work is performed on energized systems over 50 volts ONLY if management has demonstrated that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limits. Reference 29 CFR 1910.333(a)(1)</p> <p>Approval for working on or near energized parts:</p> <p>Signature of immediate supervisor or foreman</p> <p>_____</p> <p>Signature of person in charge of the facility</p> <p>_____</p>	<p>5a. Injury and/or incapacitation</p> <table border="1" data-bbox="724 357 1039 649"> <thead> <tr> <th>Class</th> <th>Voltage</th> </tr> </thead> <tbody> <tr> <td>00</td> <td>500 V</td> </tr> <tr> <td>0</td> <td>1,000 V</td> </tr> <tr> <td>1</td> <td>7.5 kV</td> </tr> <tr> <td>2</td> <td>17 kV</td> </tr> <tr> <td>3</td> <td>26.5 kV</td> </tr> <tr> <td>4</td> <td>36 kV</td> </tr> </tbody> </table>	Class	Voltage	00	500 V	0	1,000 V	1	7.5 kV	2	17 kV	3	26.5 kV	4	36 kV	<p>5a.1 Backup and the 100% safety rule are required for electrical systems over 300 volts. For electrical systems 300 volts or less, the need for backup is determined by the qualified person performing the job. Backup must have the safety training and PPE as the worker performing the work. Backup has no other duties, other than protecting the person performing the work from the hazards associated with electrical shock.</p> <p>5a.2 Voltages involved are identified, including close proximity circuits. Electrical work is performed using the personal protective equipment listed below.</p> <p>less than 300 volts line to line: minimum requirement is to conduct a hazards evaluation and use electrically insulated tools, PPE, and shields or barriers, as appropriate.</p> <p>300 volts to ground and less than 600 volts line to line: minimum PPE: eye and face protection, gloves rated for the voltage, (see chart at left), and an electrically rated insulated mat when practical.</p> <p>600 volts to ground and less than 13.8 kV line to line: minimum PPE: eye and face protection, gloves rated for the voltage (see chart at left), an electrically insulated mat and sleeves, when practical. It is recommended that when working with voltages above 600 volts, two sources of protection are used (such as hot stick and gloves, hot stick and bucket truck, or blanket and gloves).</p>
Class	Voltage															
00	500 V															
0	1,000 V															
1	7.5 kV															
2	17 kV															
3	26.5 kV															
4	36 kV															
Additional Hazards Identified and Methods of Elimination																

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Appendix B

Radio Frequency Equipment Job Safety Analysis

Electrical hazards associated with work on radio frequency equipment are evaluated using the appropriate requirements from the following sample job safety analysis in conjunction with the hazard risk evaluation listed in NFPA 70E, Annex F. An ICP Electrical Safety Committee-approved risk evaluation process may also be used to fulfill the function of the NFPA risk assessment.

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JOB SAFETY ANALYSIS

JSA No. JSA-XXX

Use with MCP-3450

Revision No. DRAFT

Job/Title Radio Frequency Equipment Job Safety Analysis	Effective Date _____
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Facility/Project & Location

SME APPROVAL (A "Yes" response requires a review by SME.)

<table style="width:100%"> <tr> <th>No</th> <th>Yes</th> <th>SME</th> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Industrial Safety</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Industrial Hygiene</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Fire Protection</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>RCT/RAD Eng.</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Other: _____</td> </tr> </table>	No	Yes	SME	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Industrial Safety	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Industrial Hygiene	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Fire Protection	<input checked="" type="checkbox"/>	<input type="checkbox"/>	RCT/RAD Eng.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____	<table style="width:100%"> <tr> <th>No</th> <th>Yes</th> <th>SME</th> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Env. Protection</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>Quality Assurance</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Engineering</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Other: _____</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td>Other: _____</td> </tr> </table>	No	Yes	SME	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Env. Protection	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Quality Assurance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engineering	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____
No	Yes	SME																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Industrial Safety																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Industrial Hygiene																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Fire Protection																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	RCT/RAD Eng.																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____																																			
No	Yes	SME																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Env. Protection																																			
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Quality Assurance																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Engineering																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____																																			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Other: _____																																			

Briefly Describe The Job and Expected Result

Required Job Training/Required Personal Protective Equipment <u>Training</u>	PPE
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Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
1. Working with Radio Frequency (RF) Equipment Barriers, signs, and audible warning devices are used to prevent unauthorized personnel from entering an RF test area NOTE: Devices that may produce RF radiation include telecommunication and radar equipment; industrial equipment, such as RF heaters; and scientific and medical equipment, such as magnetic resonance imageries and klystron tubes.	1a. Shock due to high-voltage power sources NOTE: Induced currents may be present in conductive objects that are not part of the RF structure. Grounding and bonding conductors that are adequate for DC and power frequencies may develop substantial voltage when fast pulses and radio frequency currents are present.	1a.1 All conductive materials (such as jewelry and key chains) are removed from the body.

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Sequence Of Basic Job Steps	Potential Hazards	Hazard Control/PPE
1. (continued)	1a. (continued)	1a.2 Lockout and tagout is provided to prevent operation of RF equipment during installation, maintenance, or modification.
		1a.3 Properly shielded and grounded enclosures are used for RF equipment to minimize radiation leakage. Attention is paid to all openings such as doors, access ports, and viewing windows.
		1a.4 Use-control features (such as a key switch) are used to prevent unauthorized operation of RF equipment.
		1a.5 Use of electrical equipment near induction heating apparatus is avoided to prevent induced energy from interfering with the equipment operation.
	1b. X-rays exposure NOTE: X-rays may exist at voltages above 10 kV.	1b. RF leakage from enclosures and couplings is monitored if personnel must be in the radiation area during operation.
	1c. Burns NOTE: RF currents can cause severe burns.	1c. Lockout and tagout is provided to prevent operation of RF equipment during installation, maintenance, or modification.
1d. Elevated work NOTE: RF burns from antennas can cause falls from towers.	1d. Fall protection is used when an employee is on any structure over 6 ft. of elevation.	
1e. Unintended ignition NOTE: EM fields may cause equipment malfunction and unintended ignition of explosives, fuel, or ordnance.	1e. Properly shielded and grounded enclosures are used for RF power equipment to minimize radiation leakage. Special attention is paid to all openings such as doors, access ports, and viewing windows.	

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Appendix C

Energized Electrical Work Permit

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ELECTRICAL SAFETY

Exemptions to Work Permit: Electrical work shall be permitted without an EEWP if a qualified person is provided with and uses appropriate safe work practices and PPE under the following conditions: (NFPA 70E 130.1[B][3])

1. Testing, troubleshooting, voltage measuring, or instrument calibrations. (See PRD-5099 for description of troubleshooting work activities.)
2. Thermography, ultrasound, or visual inspections if the restricted approach boundary is not crossed.
3. Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed.
4. General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed.

Part I: WORK DESCRIPTION

Site Area: _____ (INTEC, RTC, TAN, RWMC, Misc. Sites) Work Order Number: _____

1. Description of circuit/equipment/job location:

2. Description of work to be performed:

3. Type of Work:
 - Work NEAR, work within the limited approach boundary, no contact with energized parts, with exception of exempted work.
 - Work ON energized electrical, work within the restricted approach boundary, contact with tools, equipment or insulated body.
4. Justification why the circuit(s) or equipment cannot be de-energized (i.e. for reasons of increased or additional hazards or is infeasible due to equipment design or operational limitations).

Requester: _____ S#: _____ Date: _____

Part II: RISK ASSESSMENT, PPE, AND TOOLS

1. PIC for Job Name: _____ Date: _____ Reassignment of PIC Name: _____ Date: _____
2. a) System Voltage: _____ volts b) Available Fault Current: _____ amperes
3. Fault clearing time select one and enter value: _____ cycles.
 - 2 cycles, molded case circuit breaker or fuse protection
 - 6 cycles, relay operated circuit breaker
 - 40 cycles, protection by utility fuse or circuit breaker
4. Arc Flash Boundary : _____ feet _____ inches.
 - Calculated AFB under engineering supervision, or
 - The AFB determined using NFPA 70E Task Tables (130.7(C)(15)(a) or 130.7(C)(15)(b)).
5. Shock protection boundaries: (select one)

	Boundaries			
	Voltage	Limited Approach		Restricted Approach
		Fixed	Movable	
<input type="checkbox"/>	50 to 150 V	3 ft 6 in.	10 ft 0 in.	avoid contact
<input type="checkbox"/>	151 to 750 V	3 ft 6 in.	10 ft 0 in.	1 ft 0 in.
<input type="checkbox"/>	751 V to 15 kV	5 ft 0 in.	10 ft 0 in.	2 ft 2 in.

6. Physical barriers must be established or access controlled to the limited approach boundary or the AFB whichever is greater.
Minimum distance of barriers: _____ feet _____ inches.
7. Flash Hazard Analysis (FHA): (List the highest hazard/risk category or IEEL that will be encountered.)
 - a) Calculated adjusted IEEL

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- b) Arc Flash PPE Category (NFPA 70E Table 130.7(C)(15)(c)) if NFPA 70E Task Tables (130.7(C)(15)(a) or 130.7(C)(15)(b)) are used.
- a) IEEL Value _____ cal/cm² OR b) Arc Flash PPE Category _____
8. List the appropriate JSA or describe safe work practices that will be employed:
-
-
-

9. List the PPE and tools which will be used to perform job tasks. If IEEL Values known, use the table below. For the table approach method, follow NFPA 70E Tables 130.7(C)(15)(a), 130.7(C)(15)(b), and 130.7(C)(15)(c).

Flash Hazard PPE by Incident Energy Exposure Level (IEEL)	
Incident Energy exposures equal to 1.2 cal/cm² (at the working distance) up to 12 cal/cm²	Incident Energy exposures greater than 12 cal/cm²
<ul style="list-style-type: none"> • Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy^a • Long-sleeve shirt and pants or coverall or arc flash suit • Arc-rated face shield an arc-rated balaclava or arc flash suit hood^b • Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) • Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors^c • Hard hat • Safety glasses or safety goggles • Hearing protection • Leather footwear 	<ul style="list-style-type: none"> • Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy^a • Long-sleeve shirt and pants or coverall or arc flash suit • Arc-rated arc flash suit hood • Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) • Arc-rated gloves, or rubber insulating gloves with leather protectors^c • Hard hat • Safety glasses or safety goggles • Hearing protection • Leather footwear
<p>a. Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system if tested as a combination consisting of an arc-rated shirt and pants, coverall, and arc flash suit.</p> <p>b. Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required. Where the back of the head is inside the arc flash boundary, a balaclava or an arc flash hood shall be required for full head and neck protection.</p> <p>c. Rubber insulating gloves with leather protectors provide arc flash protection in addition to shock protection. Higher class rubber insulating gloves with leather protectors, due to their increased material thickness, provide increased arc flash protection</p>	

PPE Selection (PPE must meet or exceed ATPV/arc rating of hazard.)

Body

Non-melting or untreated natural fiber

- T-shirt (short sleeve) Shirt (long sleeve) Pants (long, untreated, denim cotton blue jeans, 4 cal/cm²)

(AR) Clothing (typical, shirt and pants/overall OR coveralls)

- Other AR long sleeve shirt _____ cal/cm² Other AR pants/bib overall _____ cal/cm² Other AR coveralls _____ cal/cm²
- 8.2 cal/cm² AR long sleeve shirt 16.0 cal/cm² AR pants/bib overall 9.3 cal/cm² AR contractor coveralls
- AR rated jacket (as needed) AR rated parka (as needed) AR rated rainwear (as needed)

(AR) Protective Clothing (Non-typical contamination issues)

- DOE blue modesty scrubs/coveralls (100% cotton)
- Other AR coveralls _____ cal/cm²
- 20.9 cal/cm² AR coveralls Style 801
- AR cloth booties
- Other AR cloth hood _____ cal/cm²
- 20.9 cal/cm² AR cloth hood Style 801

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ELECTRICAL SAFETY

(AR) Protective Equipment

- cal/cm² flash suit jacket cal/cm² flash suit pants

Head and Face

- Safety glasses or safety goggles
- Hardhat (Class E) AR hardhat liner
- Hearing protection (ear canal inserts)
- 8 cal/cm² or greater arc rated face shield with wrap-around guarding to protect forehead, ears, and neck.
- ___ cal/cm² flash suit hood

Hand and Foot Protection

- Leather gloves (leather protectors over voltage rated gloves is acceptable) Voltage rated gloves (within restricted approach boundary)
- Leather work shoes or boots Voltage rated sleeves (within restricted approach boundary)

Meters and Tools

- CAT III meter (inside building except service) CAT IV meter (outdoor, underground and service distribution)
- High voltage meter rated for circuit (listed equipment or approval by the AHJ)
- Voltage rated tools Live line tools (i.e. hot stick, shotgun)

10. Additional comments (or N/A):

11. Perform **documented pre-job brief** per MCP-3003 (Form 434.14) covering the job, applicable JSA, related hazards, 100% rule, work practices, and means of mitigation of hazards.

Pre-job briefing has been completed and work can be done safely:

Electrical Qualified Job Supervisor/Foreman/PIC Print/Type Name	Electrical Qualified Job Supervisor/Foreman/PIC Signature	S Number	Date
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Part III: APPROVALS

1. This permit is valid from Start Date: _____ Expiration Date: _____ Extended: _____ Initials: _____

NOTE: Maximum permit duration is four weeks from original start date, including any extensions.

2. Work is approved for working NEAR exposed energized conductors or parts, work within the limited or restricted approach boundaries. No contact with energized parts, with exception of exempted work.

Electrical Qualified Job Supervisor/Foreman Print/Type Name	Electrical Qualified Job Supervisor/Foreman Signature	S Number	Date
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3. Work is approved for working ON exposed energized conductors or parts, contact with tools, equipment, or insulated body.

Area Project Manager Print/Type Name	Area Project Manager Signature	S Number	Date
---	-----------------------------------	----------	------

UFC: 7150

Disposition Authority: A17-15-b

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Appendix D

Bang Board Inspection Checklist

Bang Board ID:		Date:			
	Requirement	YES	NO	NA	Comment
1	Megger test all circuits with circuit breakers closed				
2	Equipment and receptacle covers labeled				
3	All bang board conductors continuity tested				
4	All equipment/support racks grounded				
5	All electrical components have clear working space				
6	Fasteners are S/CI				
7	Conductor taps completed				
8	Conductor terminations torqued				
9	Bang board configured and wired per drawing				
10	Arc Flash Hazard warning label affixed				
11	Power panel and receptacle labels correspond				
12	Transformer grounded/bonded				
13	All GFCI receptacles tested				
14	Bang board enclosures rated for environment (weather covers)				
15	Assured grounding conducted				
Signed:					

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Appendix E

Generator Pre-Use Checklist

Pre-Use Inspection of Portable and Vehicle-Mounted Generators					
		Yes	No	Frequency	If "No"
1.	Is an operating manual available?			Initial Use	
2.	Does the generator contain a nameplate, or equivalent information provided by the manufacturer, that includes the following information: A. Manufacturer's name B. Rated frequency C. Number of phases if AC D. Rating in kilowatts or kilovolt amperes E. Normal volts and amperes.			Initial Use	
3.	Does portable generator have a Nationally Recognized Testing Laboratory (NRTL) listing or has an Authority Having Jurisdiction (AHJ) tag attached?			Initial Use	Complete Form 440.40A, "Non-NRTL Portable and Vehicle-Mounted Generator Approval," and submit to the AHJ for approval.
4.	Does the generator show any signs of damage or alteration?			Daily	
5.	Is the generator grounded if above 5 kW?			Initial Use	
6.	Does the generator design appear to protect its contents from the environment?			Initial Use	
7.	If the generator has access panels, have inside visual inspections been performed to check for debris; broken, damaged, or altered parts, indications of loose, and/or overheated electrical connections; and overall integrity?			Initial Use	
8.	When operating the generator, will the operator be protected from hazards associated with the generator?			Initial Use	