

# Electrical Work Plan Instructions – Construction CESH-EWP-Form-01

## A.1 General Information

The document number will be the electronic service request (ESR) or work order number. If there are multiple EWPs per JSA or work order, add a dash to the end of the service request number followed by 01, 02, etc. (SXXXXXXX-01, SXXXXXXX-02, WOXXXXXXX-01).

Each time the EWP is modified (including extension of the expiration date), the revision number will be increased by one.

The effective date is the date the EWP is approved.

**NOTE:** The expiration date provides a speculated duration of use of the EWP for up to one year.

The expiration date is the date the EWP is no longer valid. The expiration date is permitted to be up to one year beyond the effective date assuming the scope/task controls are validated and remain unchanged.

Enter the location where the work will be performed. This can be a building and room number, or a brief description of work location.

The author shall be a qualified electrical worker (QEW). The author is responsible for initiating and filling out the EWP and assuring the EWP is accurate.

The document title is a short descriptive phrase that identifies the equipment and work scope specific to the EWP.

## A.2 Approvals

Construction Manager (CM) and Construction Safety WH&S. The CM and CS WH&S are responsible to verify the EWP is fully complete, accurate, and that proper mitigation controls are included.

Electrical safety subject matter expert (SME) approval is required when “other” is selected in section 7.1 Shock Hazard Risk Assessment of the EWP form; a selection of “Temporary Engineering Calculations” or “Arc-Flash PPE Category Method” is selected in section 7.3.

## A.3 Work Scope

**NOTE:** Diagnostic and testing plans can be written quite broadly and may encompass a wide variety of equipment and parameters.

Provide a clear description of the work to be performed, including the equipment, location, and task(s).

Select all boxes that are applicable to the work being performed. If more than one box is selected, the work scope must detail the sequence in which they are performed.

**NOTE:** Repairing, replacing, or removing energized exposed parts or making physical alterations to the equipment other than adjustments needed to get equipment into desired specifications/tolerances, tweaking potentiometers, resetting electronic equipment (i.e., buttons, toggles), or replacing hot swappable batteries without tools is considered energized electrical work, and will require an energized electrical work permit.

#### **A.4 Engineered Controls and Work Considerations**

This section is pre-populated with potential hazards for the QEW(s) to consider while the work is being performed.

#### **A.5 Pre-Job Briefing**

Conduct a pre-job briefing in accordance with Construction Environment Safety & Health Manual (CESH). CM sign and date after completion.

During the pre-job briefing, discuss each section of the EWP, the risk assessment of the work area, emergency response, and additional factors that may affect risk, including but not limited to the environment, equipment, worker(s), and human performance.

##### **A.5.1 Power Shut Off Location**

Enter the equipment identification number and/or equipment description and device to be shut down in the event of an emergency. Provide specific location (room number and where found). Include access requirements (i.e., proxy card, LAI, escorts, etc.). Perform walk downs and attach pictures to EWP as necessary.

#### **A.6 Worker Qualification**

The QEW(s) performing the scope of work covered by the EWP shall have the experience and training qualifications necessary to safely execute the work.

##### **Training Qualifications**

The QEW(s) 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 that equipment or work method.

- Such persons shall also 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.
- A person can be considered qualified with respect to certain equipment and tasks but still be unqualified for others.

The QEW(s) shall be verified by submitting the activity specific electrical worker qualification form (2024).

The QEW(s) shall be verified current in the following training course if lockout/tagout is applicable:

- Course 000692 – Lock & Tag for Authorized Workers

##### **Experience Qualifications**

The QEW(s) 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 that equipment or work method.

- Such persons shall also 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.
- A person can be considered qualified with respect to certain equipment and tasks but still be unqualified for others.
- Such persons permitted to work within the limited approach boundary shall, at a minimum, be additionally trained in all of the following:
  - Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment.
  - Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts.
  - Approach distances specified on the EWP and associated requirements for each or the corresponding voltages to which the qualified person will be exposed.

## **A.7 Shock and Arc-Flash Hazard/Risk Assessment**

Complete subsections 7.1 through 7.4.

### **A.7.1 Shock Hazard / Risk Assessment**

Enter the maximum exposure AC/DC voltage that will be encountered while performing the work. Select the corresponding voltage with respective shock boundaries in the table in the EWP. Select a shock voltage range from the selection in the table in the EWP.

If “other” is selected, enter the voltage, and contact electrical safety SME for shock boundaries of voltage ranges not included on this form. Enter the voltage range and approach boundaries as provided by the SME on the EWP.

### **A.7.2 Arc-Flash Hazard/Risk Assessment and Method**

Determine if an arc-flash hazard is present.

Select “No arc-flash hazard,” if the bulleted criteria following the selection are met. Otherwise, select “Arc-flash hazard present.”

### **A.7.3 Method of Determining Incident Energy and Arc-Flash Boundary**

If “No arc-flash hazard,” was selected in section 7.2, then select “Not Applicable.”

Select “Incident energy analysis (e.g., PSSR; arc-flash label),” “Temporary Engineering Calculation,” or “Arc-Flash PPE Category Method” for the method of determining incident energy and arc-flash boundary.

**Note:** Use of “Temporary engineering calculations” and “Arc-Flash PPE Category Method” require approval and signature in section 2 of the EWP by an electrical safety SME.

For “Incident energy analysis (arc-flash label),” the values are found posted on the equipment or located in the facility power systems study report (PSSR). If the information on the label is found to be

inaccurate, enter a service request to replace the label. Enter the following values from the label on the EWP.

- Voltage
- Incident energy cal/cm<sup>2</sup>
- Working distance
- Arc-flash boundary

For “Temporary Engineering Calculations,” a documented calculation in process of becoming a record identified, verified, and provided by Electrical Engineering followed by a review and concurrence by an Electrical Safety SME. Enter the following values from the approved temporary calculation on the EWP.

- Voltage
- Incident energy cal/cm<sup>2</sup>
- Working distance
- Arc-flash boundary

For “Arc-Flash PPE Category Method,” NFPA 70E allows determination of arc-flash PPE categories in lieu of an arc-flash calculation pending all the parameters identified within *Table 5 Arc Flash PPE Categories for AC and DC Systems*.

Enter the following parameters on the EWP. (Parameters must be identified, verified, and provided by Electrical Engineering, followed by a review and concurrence by an Electrical Safety SME and filled out prior to application):

- Voltage
- Maximum available fault current
- Clearing time of the overcurrent protection device
- Working distance
- Arc-flash boundary
- Arc-flash PPE category

#### **A.7.4 Shock & Arc-Flash Considerations**

Select all applicable shock & arc-flash considerations that affect risk.

- Enter the location of nearest AED following the “AED location” selection.
- Enter the communication method(s) available at the work location following the “Communication” selection (e.g., radio, cell phone, land line).
- If “Other” is selected, enter applicable arc-flash considerations (e.g., confined space, elevated work, excavation, noisy work location).
- Enter the associated risk using the risk matrix. (*Table 20-1 Risk Matrix for Electrical Work*)

Estimate the Likelihood and Severity Based on the Work Scope and Identified Hazards.

Risk determination can be evaluated for electrical work based on the source of energy hazard class (severity), how the worker is interacting with the equipment (types of work), conditions that increase risk and impact from environmental conditions. Initial risk determination is to be performed by QEW's. The following risk matrix (*Table 20-1 Risk Matrix for Electrical Work* from the CESH) can be used in conjunction with evaluating equipment, environmental, and work/worker conditions. The result of this evaluation will provide the risk determination.

Notes:

1. Likelihood of occurrence can either increase or decrease based on equipment, work, worker, and environmental conditions.
2. Severity can increase based on environmental conditions. The exception is Negligible  $\leq 50V$ , where only extreme environmental conditions could increase the severity of the injury.
3. All Hazard Classes in an electrically safe work condition are considered to be Low Risk.

**Table 20.1 Risk Matrix for Electrical Work**

Severity / Class	Likelihood of Occurrence				
	Frequent	Probable Energized Work	Occasional Energized Diagnostics & Testing	Improbable Establishing an Electrically Safe Work Condition and Equipment Operation	Remote
<b>Catastrophic</b> >151V to $\leq 1000V$ >1.2 to <40 cal/cm <sup>2</sup>	HIGH	HIGH	HIGH	MODERATE	MODERATE
<b>Critical</b> >50V to $\leq 1000V$ <1.2cal/cm <sup>2</sup>	HIGH	HIGH	MODERATE	MODERATE	LOW
<b>Moderate</b> >50V to $\leq 150V$	HIGH	MODERATE	MODERATE	LOW	LOW
<b>Negligible</b> $\leq 50V$	MODERATE	LOW	LOW	LOW	LOW

Enter additional information; explanatory material or clarifications in the “Additional information” section on the EWP.

### A.8 Personal Protective Equipment (PPE)

Identify the PPE required to perform the work using the values provided within the shock and arc hazard/risk assessment.

All arc-rated PPE must be worn/used for all parts of the body inside the arc-flash boundary and voltage-rated PPE inside the restricted approach boundary. Arc protective clothing must have an arc thermal protective value (ATPV) or energy breakopen threshold (EBT) rating greater than the calculated arc incident energy.

The PPE must be the proper rating, size, and fit.

- All voltage-rated PPE shall be adequately rated for the highest voltage to be encountered.

- All meters and accessories must be CAT III or IV rated, listed by a nationally recognized testing laboratory(NRTL), and be of the right size and application for the task to be performed. See Table 1, “Portable Electrical Test Instrument Ratings.”
- All PPE must be visually inspected prior to use and used in accordance with manufacturer’s instructions.

**Table 1 – Portable Electrical Test Instrument Ratings**

Measurement Category	Description	Examples
CAT III	Three-phase distribution, including single-phase commercial lighting  <50 kA short circuit current	<ul style="list-style-type: none"> <li>• Equipment in fixed installations, such as switchgear and polyphase motors.</li> <li>• Bus and feeders in industrial plants.</li> <li>• Feeders and short branch circuits, devices fed directly from distribution panels.</li> <li>• Lighting systems in larger buildings.</li> <li>• Appliance outlets with short connections to service entrance</li> </ul>
CAT IV	Three-phase at utility connection, any outdoor conductors  Limited only by the utility transformer feeding the circuit  >>50 kA short circuit current	<ul style="list-style-type: none"> <li>• The "origin of installation"—where low-voltage connection (service entrance cables) is made to utility power.</li> <li>• Electricity meters, primary overcurrent protection equipment.</li> <li>• Outside and service entrance, service drop from pole to building, run between meter and panel</li> <li>• Overhead line to detached building, underground line to well pump.</li> </ul>

**A.8.1 PPE Selection for Shock Hazard**

Voltage-rated PPE must be maintained in a safe, reliable condition. The class of insulating goods shall be selected based on the highest voltage to be encountered AC or DC. Insulating equipment shall be inspected for damage before each day’s use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection.

Electrical protective equipment shall be subjected to periodic electrical tests at intervals not to exceed that specified in *Appendix C, “Shock PPE Testing Requirements and Use Voltage,” Table 3, “Rubber Insulated Testing Table.”* Verify all PPE is rated for highest voltage to be encountered.

Select voltage-rated insulated gloves with external leather protectors per the voltages specified in section 7.1 of this EWP from the drop-down menu. Maximum VAC/VDC use voltages for voltage-rated insulated gloves is specified in Appendix C. (The drop-down menu selection can be changed by clicking anywhere in the voltage-rated glove selection area or cell on the EWP).

Note: A heavy-duty leather glove selection is available for scenarios where voltage-rated PPE is not required for voltage measurements performed on a permanently installed test port or a receptacle with guards in place.

Select the check boxes corresponding to the “Other shock hazard PPE” (PPE must be rated for voltages specified in section 7.1 selection(s) of the EWP).

### **A.8.2 PPE Selection for Arc-Flash Protection (Minimum Rating)**

Select PPE per arc-flash method selected in section 7.2 or 7.3 using the drop-down menu on the EWP. (The drop-down menu selection can be changed by clicking anywhere in the arc-flash PPE selection area or cell on the EWP).

The arc-flash PPE requirements for the following are located in *Appendix D, “Arc-Flash PPE Selections by Method”*:

- No arc-flash hazard present
- Incident energy analysis
- Temporary engineering calculation
- Arc-Flash PPE Category Method (*D.3 Table 5, “Arc-Flash PPE Categories for AC and DC Systems”*)

### **A.8.3 Other Protective Equipment**

IF other test instruments, temporary protective grounds, or other protective equipment (e.g., adequately rated high voltage extension probes, detection devices, ground sticks, and other assorted test equipment when increased distance is required, or sources (capacitors) are greater than 1,000V) will be used, THEN select the corresponding boxes in this EWP section.

Enter the type(s) of other protective equipment when other is selected.

This section may be completed in the field, as applicable.

### **A.9 Special Instructions**

Information applicable to the job tasks but not captured in the EWP. Examples such as but are not limited to include access restrictions, notifications, coordination of other work at or near the work location, etc.

This section may be completed in the field, as applicable.

**SEND completed EWP to MSIN J2-38 or send a scanned copy to Worker Safety and Health Records at [ih.os.records@pnnl.gov](mailto:ih.os.records@pnnl.gov) (Ctrl and Click).**

## Appendix B – PPE for Electrical Work Inspection and Storage Criteria

**Table 2 – PPE for Electrical Work Inspection and Storage Criteria**

Body Part	Type of Electrical PPE	Inspection Criteria
Head, face, neck, and chin	Ear canal inserts Earmuffs – Suitably rated for arc-flash when worn externally.	Right type size and fit Free from oils or other substances Insert earplugs are not required to be Arc Rated Earmuffs cover potentially exposed areas Arc-Rated
	Class G hard hat (2,200 V) Class E hard hat (20,000 V)	Class G or E identification (nonconductive flame-resistant; corresponding voltage) Used in accordance with the manufacturer’s recommendations and instructions (e.g., expiration, replacement of suspension) Free from visible breaks, cracks, or damage
	Arc-rated face shield	Impact-resistant Z87+ Free from visible breaks, cracks, or damage other than surface scratches
Eye	Safety glasses Z87+ with side shields and safety goggles	Free from breaks, cracks, or damage
Torso	Suitably rated arc-flash clothing (a blast blanket or blast suppression blanket may be used instead)	Free from damage (e.g., holes, tears, burns, or other damaging substances) Covers potentially exposed areas
	Clothing of natural fiber (e.g., cotton, silk, wool, leather)	Free from damage (e.g., holes, tears, punctures, oil, grease, other damaging substances)
Hands and arms	Insulating rubber gloves	Correct voltage rating marking Correct type and style Within 6 months of date stamp (last testing date) Free from damage (e.g., holes, tears, punctures, cracks, softening, hardening) Free of foreign substances (oil, grease, dirt) Perform air leakage test—listen/feel for pinhole leaks Periodically examine gloves during work—if they become damaged or dirty, discontinue use
	Rubber insulating sleeves	Free from cuts, burn marks, holes, tears, punctures, cracks, scratches, abrasions, aging, oil markings, softening, or hardening Correct type and style Correct voltage rating marking Tested and inspected by a nationally recognized testing laboratory (NRTL) within the last 12 months



<b>Body Part</b>	<b>Type of Electrical PPE</b>	<b>Inspection Criteria</b>
	Leather protectors	Proper reveal for voltage class gloves Heavy duty (.03 in min thickness) or arc rated where required for arc-flash protection Free from damage (e.g., holes, tears, punctures, oil, grease, other damaging substances)
Legs	Suitably rated arc-flash clothing (a flash blanket or blast suppression blanket may be used instead)	Used in accordance with manufacturer's recommendations and instructions Free from damage (e.g., holes, tears, burns, other damaging substances) Covers potentially exposed areas
Feet	Leather footwear, insulated footwear, or dielectric overshoes	Free from damage (e.g., holes, tears, punctures)
<b>Other Protective Equipment</b>		<b>Inspection Criteria</b>
Insulating rubber mats		Free from damage (e.g., holes, tears, punctures) Correct type and style Correct voltage rating marking Tested and inspected by an NRTL within the last 12 months
Insulating shielding (e.g., Electro-Shield)		Free from damage (e.g., holes, tears, punctures) Correct type and style Correct voltage rating marking (i.e., rating must be visible)
Voltage-rated insulated hand tools		Free from damage (e.g., cracks, damaged insulation) 1,000-volt marking
Rubber insulating blankets		Manufactured via a seamless process. Free from breaks, cracks, and damage Correct type and style Correct voltage rating marking Tested and inspected by an NRTL within the last 12 months
Nonconductive side rail ladders		Free from damage Inspect before using for grease, oil, and other slippery conductive substances
Test instruments (used to verify the presence of energy or to test, troubleshoot, and identify energized from de-energized equipment or systems)		Test lead rating, case, and other mechanical assemblies to confirm that they are free from cracks or damage. Correct voltage rating marking For multimeters, CAT III rating (CAT IV for outdoor) NRTL-listed. See the <a href="#">Calibrate Measuring and Test Equipment for Use</a> workflow for information on calibrated test instruments Perform operational test on known-like source before and after use
Portable GFCI (ground fault circuit interrupter)		Works as expected using the test button per the manufacturer's instructions. Insulation and case free from damage

### Care and Storage of Electrical PPE

- Visually inspect for damage before storing.

- Do not store in extreme temperatures or in areas with increased ozone.
- Pay special attention to the working area of gloves: palm, fingers, and thumbs. Do not store damaged gloves or other PPE; return damaged gloves for service and repair.
- Do not store if wet, dirty, or in a distorted condition (e.g., inside-out).
- Store in an appropriate container.
- Do not store other items, such as tools, in the glove or protective face shield container.
- When cleaning or laundering electrical PPE, workers should use only cleaning materials specifically suited for the item in accordance with the manufacturer's instructions.

#### **Tool and Electrical Testing Device Considerations**

- Adequately rated high voltage extension probes, detection devices, ground sticks, and test equipment when sources (capacitors) are greater than 1,000 V.
- Ladders with nonconductive side rails.
- Voltage-rated hand tools within the restricted approach boundary.
- Voltage-rated blankets, covers, and other approved shock protection.

## Appendix C – Shock PPE Testing Requirements and Use Voltage

Rubber insulating equipment that has been previously issued for service, is not new, and is required to be retested in accordance with the intervals in *Table 3, “Insulated Rubber Testing Table”* below.

**Table 3 – Insulated Rubber Testing Table**

Rubber Insulating Equipment	When to Test
Blankets	Before the first issue; every 12 months thereafter*
Covers	If the insulating value is suspect
Gloves	Before the first issue; every 6 months thereafter*
Line Hose	Line hose if the insulating value is suspect
Sleeves	Before the first issue; every 12 months thereafter*

*\*New insulating equipment (direct from a manufacturer) is not permitted to be placed into service unless it has been electrically tested within the previous 12 months and must be marked with the issue date to begin the testing periodicity as it relates to the specific type of insulating PPE*

Insulating blankets, gloves, mats, hard hats, and sleeves must meet voltage phase-to-phase or phase-to-ground (whichever is greater) maximum use levels in *Table 4, “Maximum Use Voltage for Insulated Gloves”* below.

**Table 4 – Maximum Use Voltage for Insulated Gloves**

Class	Maximum Use Voltage VAC/VDC	Label Color
00	500/750	Beige
0	1,000/1,500	Red
1	7,500/11,250	White
2	17,500/25,500	Yellow
3	26,500/39,750	Green
4	36,000/54,000	Orange

## Appendix D – Arc-Flash PPE Selections by Method

### D.1 Arc-flash PPE when no arc-flash is present.

For work where there is no arc-flash label or study but the short circuit current and clearing time are known, use the following Arc-Flash PPE Categories for AC and DC Systems (as long as equipment matches equipment specification and parameters identified in table; if unable to meet the equipment specifications and identified parameters, an arc-flash study shall be required).

#### **No Arc-Flash Hazard ( $I_E < 1.2 \text{ cal/cm}^2$ )**

- Non-melting, natural occurring fiber clothing or arc-rated/flame-resistant clothing (long sleeve shirt, pants)
- Leather footwear
- Safety glasses
- Leather gloves

Above PPE shall be worn until an electrically safe work condition has been established.

### D.2 Arc-Flash PPE Selection - Systems with an (Arc-Flash Label) or Incident Energy Analysis Method (Label or Temporary Calculation)

When the incident energy ( $I_E$ ) exposure is determined and calculation data is available, use NFPA 70E 130.5(G) for the selection of arc-related clothing and other PPE.

#### **$I_E$ Exposures Equal to $1.2 \text{ cal/cm}^2$ up to $12 \text{ cal/cm}^2$**

- Arc-rated clothing rated equal to or greater than the estimated incident energy<sup>a</sup>
- Long-sleeved shirt and pants or coverall or arc-flash suit; selection of one in group is needed (SR)
- Arc-rated face shield and arc-rated balaclava or arc-flash suit hood (SR)<sup>b</sup>
- Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) as needed (AN)
- Heavy duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors (SR)<sup>c</sup>
- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection
- Leather footwear

#### **$I_E$ Exposures Greater than $12 \text{ cal/cm}^2$**

- Arc-rated clothing rated equal to or greater than the estimated incident energy<sup>a</sup>
- Long-sleeved shirt and pants or coverall or arc-flash suit (SR)
- Arc-rated flash suit hood

- Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN)
- Arc-rated gloves or rubber insulating gloves with leather protectors (SR)<sup>c</sup>
- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection
- Leather footwear

<sup>a</sup>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.

<sup>b</sup>Face shields with a wraparound guard to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). 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.

<sup>c</sup>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.

<sup>d</sup>Footwear other than leather or dielectric shall be permitted to be used, provided it has been tested to demonstrate no ignition, melting, or dripping at the estimated IE exposure.

<sup>e</sup>The arc rating of outer layers worn over arc-rated clothing as protection from the elements for other safety purposes, and that are not used as part of a layered system, shall not be required to be equal to or greater than the estimated IE exposure.

### D.3 Arc-Flash PPE Categories for AC and DC Systems

**Table 5 – Arc-Flash PPE Categories for AC and DC Systems**

Equipment	Condition	Arc-Flash PPE Category	Arc-Flash Boundary (Feet)	PPE NFPA 70E Table 130.7(C)(15)(c)
Panelboards or other equipment rated 240 V and below	<p><b>Parameters:</b></p> <p>Maximum of 25 kA short circuit current available;</p> <p>Maximum of 0.03 sec (2 cycle) fault clearing time;</p> <p>Minimum 18 in. working distance.</p>	1	2	<p>1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls</p> <p>2. Arc-rated arc-flash suit hood <b>OR</b> arc-rated face shield with a wrap-around guard to protect face, forehead, ears, and neck</p> <p>3. Arc-rated jacket, parka, or rain wear (optional)</p> <p><i>All required PPE shall have a minimum arc rating of 4 cal/cm<sup>2</sup> or be tested as total arc rated system. (See Note 1)</i></p> <p>4. Arc-rated hard hat</p> <p>5. Safety glasses or safety goggles</p> <p>6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors</p> <p>7. Hearing protection</p> <p>8. Leather work shoes</p>

Equipment	Condition	Arc-Flash PPE Category	Arc-Flash Boundary (Feet)	PPE NFPA 70E Table 130.7(C)(15)(c)
Panelboards or other equipment rated > 240 V and up to 600 V	<b>Parameters:</b> Maximum of 25 kA short circuit current available;  Maximum of 0.03 sec (2 cycle) fault clearing time  Minimum 18 in. working distance	2	3	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls 2. Arc-rated arc-flash suit hood <b>OR</b> arc-rated face shield with a wrap-around guard to protect face, forehead, ears, and neck 3. Arc-rated jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 8 cal/cm<sup>2</sup> or be tested as total arc rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves <b>OR</b> voltage rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes
600 V class motor control centers (MCCs)	<b>Parameters:</b> Maximum of 65 kA short circuit current available;  Maximum of 0.03 sec (2 cycle) fault clearing time;  Minimum 18 in. working distance.	2	5	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls 2. Arc-rated arc-flash suit hood <b>OR</b> arc-rated face shield with a wrap-around guard to protect face, forehead, ears, and neck 3. Arc-rated jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 8 cal/cm<sup>2</sup> or be tested as total arc rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves OR voltage-rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes
600 V class motor control centers (MCCs)	<b>Parameters:</b> Maximum of 42 kA short circuit current available;  Maximum of 0.33 sec (20 cycle) fault clearing time;  Minimum 18 in. working distance.	4	14	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls 2. Arc-rated arc-flash suit hood 3. Arc-rated arc-flash jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 40 cal/cm<sup>2</sup> or be tested as total arc rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes

Equipment	Condition	Arc-Flash PPE Category	Arc-Flash Boundary (Feet)	PPE NFPA 70E Table 130.7(C)(15)(c)
600 V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards	<b>Parameters:</b> Maximum of 35 kA short circuit current available;  Maximum of up to 0.5 sec (30 cycle) fault clearing time;  Minimum 18 in. working distance.	4	20	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls 2. Arc-rated arc-flash suit hood 3. Arc-rated arc-flash jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 40 cal/cm<sup>2</sup> or be tested as total arc-rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes
Other 600 V class (277 V through 600 V, nominal) equipment	<b>Parameters:</b> Maximum of 65 kA short circuit current available;  Maximum of 0.03 sec (2 cycle) fault clearing time;  Minimum 18 in. working distance (except as indicated).	2	5	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls 2. Arc-rated arc-flash suit hood <b>OR</b> arc-rated face shield with a wrap-around guard to protect face, forehead, ears, and neck 3. Arc-rated jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 8 cal/cm<sup>2</sup> or be tested as total arc rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes
Storage Batteries, DC Switchboards, and other DC Supply Sources  100V > Voltage ≤ 250V	<b>Parameters:</b> Voltage 250V  Short circuit current < 4kA  Maximum arc duration 2 seconds  Minimum 18 in. working distance	1	3	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls 2. Arc-rated arc-flash suit hood <b>OR</b> arc-rated face shield with a wrap-around guard to protect face, forehead, ears, and neck 3. Arc-rated jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 4 cal/cm<sup>2</sup> or be tested as total arc-rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes

Equipment	Condition	Arc-Flash PPE Category	Arc-Flash Boundary (Feet)	PPE NFPA 70E Table 130.7(C)(15)(c)
Storage Batteries, DC Switchboards, and other DC Supply Sources  100V > Voltage ≤250V	<b>Parameters:</b>  Voltage 250V  4kA ≤ short circuit current < 7kA  Maximum arc duration 2 seconds  Minimum 18 in. working distance	2	4	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls 2. Arc-rated arc-flash suit hood <b>OR</b> arc-rated face shield with a wrap-around guard to protect face, forehead, ears, and neck 3. Arc-rated jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 8 cal/cm<sup>2</sup> or be tested as total arc-rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes
Storage Batteries, DC Switchboards, and other DC Supply Sources  100V > Voltage ≤250V	<b>Parameters:</b>  Voltage: 250V  7kA ≤ short circuit current < 15kA  Maximum arc duration 2 seconds  Minimum 18 in. working distance	3	6	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> Arc-rated coveralls 2. Arc-rated arc-flash suit hood 3. Arc-rated arc-flash jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 25 cal/cm<sup>2</sup> or be tested as total arc-rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes
Storage Batteries, DC Switchboards, and other DC Supply Sources  250V > Voltage ≤600V	<b>Parameters:</b>  Voltage: 600V  Short circuit current <1.5kA  Maximum arc duration 2 seconds  Minimum 18 in. working distance	1	3	1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> Arc-rated coveralls 2. Arc-rated arc-flash suit hood <b>OR</b> arc-rated face shield with a wrap-around guard to protect face, forehead, ears, and neck 3. Arc-rated jacket, parka, or rain wear (optional)  <i>All required PPE shall have a minimum arc rating of 4 cal/cm<sup>2</sup> or be tested as total arc-rated system. (See Note 1)</i>  4. Arc-rated hard hat 5. Safety glasses or safety goggles 6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors 7. Hearing protection 8. Leather work shoes



Equipment	Condition	Arc-Flash PPE Category	Arc-Flash Boundary (Feet)	PPE NFPA 70E Table 130.7(C)(15)(c)
Storage Batteries, DC Switchboards, and other DC Supply Sources 250V > Voltage ≤600V	<b>Parameters:</b> Voltage: 600V Short circuit current 1.5kA ≤ short circuit current < 3kA Maximum arc duration 2 seconds Minimum 18 in. working distance	2	4	<ol style="list-style-type: none"> <li>1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls</li> <li>2. Arc-rated arc-flash suit hood <b>OR</b> arc-rated face shield with a wrap-around guarding to protect face, forehead, ears, and neck</li> <li>3. Arc-rated jacket, parka, or rain wear (optional)</li> </ol> <p><i>All required PPE shall have a minimum arc rating of 8 cal/cm<sup>2</sup> or be tested as total arc rated system. (See Note 1)</i></p> <ol style="list-style-type: none"> <li>4. Arc-rated hard hat</li> <li>5. Safety glasses or safety goggles</li> <li>6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors</li> <li>7. Hearing protection</li> <li>8. Leather work shoes</li> </ol>
Storage Batteries, DC Switchboards, and other DC Supply Sources 250V > Voltage ≤600V	<b>Parameters:</b> Voltage: 600V 3kA ≤ short circuit current < 7kA Maximum arc duration 2 seconds Minimum 18 in. working distance	3	6	<ol style="list-style-type: none"> <li>1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> arc-rated coveralls</li> <li>2. Arc-rated arc-flash suit hood</li> <li>3. Arc-rated arc-flash jacket, parka, or rain wear (optional)</li> </ol> <p><i>All required PPE shall have a minimum arc rating of 25 cal/cm<sup>2</sup> or be tested as total arc rated system. (See Note 1)</i></p> <ol style="list-style-type: none"> <li>4. Arc-rated hard hat</li> <li>5. Safety glasses or safety goggles</li> <li>6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors</li> <li>7. Hearing protection</li> <li>8. Leather work shoes</li> </ol>
Storage Batteries, DC Switchboards, and other DC Supply Sources 250V > Voltage ≤600V	<b>Parameters:</b> Voltage: 600V 7kA ≤ short circuit current < 10kA Maximum arc duration 2 seconds Minimum 18 in. working distance	4	8	<ol style="list-style-type: none"> <li>1. Arc-rated long sleeve shirt and arc-rated long pants <b>OR</b> Arc-rated coveralls</li> <li>2. Arc-rated arc-flash suit hood</li> <li>3. Arc-rated arc-flash jacket, parka, or rain wear (optional)</li> </ol> <p><i>All required PPE shall have a minimum arc rating of 40 cal/cm<sup>2</sup> or be tested as total arc rated system. (See Note 1)</i></p> <ol style="list-style-type: none"> <li>4. Arc-rated hard hat</li> <li>5. Safety glasses or safety goggles</li> <li>6. Arc-rated gloves <b>OR</b> voltage-rated insulated gloves with heavy duty leather protectors</li> <li>7. Hearing protection</li> <li>8. Leather work shoes</li> </ol>

*Table 5, Note 1 - The total system arc rating is the arc rating obtained when all clothing layers worn by a worker are tested as a multi-layer test sample. (A total system arc rating cannot be determined by adding the arc ratings of individual layers.)*

**Approval History for: CESH-EWP-Form-01, R0 - Electrical Work Plan - Construction and CESH-EWP-Form-01-Instruction, R0 - Electrical Work Plan Instructions**

**Final Process State: APPROVED**

<b>Name</b>	<b>Activity Name</b>	<b>Date</b>
✔ Sweesy, Jason J	Review Concurrence 2	9/22/2023 9:14:18 AM
✔ Kirkpatrick, Evan	Review Concurrence 4	9/22/2023 10:01:55 AM
✔ Thompson, Hunter	Review Concurrence 3	9/25/2023 8:42:55 AM
✔ Madison, Michael D	Review Concurrence 1	9/26/2023 9:59:41 AM
✔ Deichman, Mark L	Review Approval 3	9/26/2023 11:48:01 AM
✔ Morris-Benavides, Sarah	Review Approval 8	9/26/2023 12:50:30 PM
✔ Grover, Sam B	Review Approval 4	9/27/2023 8:12:59 AM
✔ Herman, Greg A	Review Approval 6	9/27/2023 11:55:39 AM
✔ Jivelekas, Adam P	Review Approval 7	9/27/2023 1:32:27 PM
✔ Buchanan, Clint R	Review Approval 2	9/28/2023 1:56:56 PM
✔ Brooks, Mike	Review Approval 1	9/29/2023 10:55:40 AM
✔ Henderson, Jennifer	Review Approval 5	10/2/2023 7:08:01 AM

\* All actions are stored digitally and viewable at <https://approvals.pnl.gov/ProcessView.aspx?pid=5563665>