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REVISION LOG

Revision 8

☒ Intent ☐ Non-Intent Implements PRMS Requirements: ☒ Yes ☐ No

- This revision incorporates the changes identified in and supersedes PRCN-UPF-MANUAL-CM-001-R06-01, PRCN-UPF-MANUAL-CM-001-R06-02 and PRCN-UPF-MANUAL-CM-001-R06-03
- The following form has been obsoleted as a result of this document:
  - CFN-1339, *Temporary Electrical Work Practices and Plan Construction Power Generator Installation Record*
- Removed CFN-1339 reference in Section 4.7
- Added Note to Section 4.7, clarifying use of CFN-1325 and CFN-1326 as tools only
- Updated 12th bullet in Section 4.7.1 to remove reference to CFN-1073, *UPF Megger Test Inspection Record* and Y17-95-64-842, *UPF Construction Electrical Testing*
- Removed CFN-1339 from Section 5.0, Document Specific row
- Removed CFN-1339 from Section 6.0
- Removed CFN-1325 and CFN-1326 from Records Table, Section 5.0
- Other changes include:
  - Updated references and acronyms
  - Editorial changes

Revision 7

☒ Intent ☐ Non-Intent Implements PRMS Requirements: ☒ Yes ☐ No

- The following form has been created as a result of this document:
  - CFN-1359, *UPF Electrical Event Investigation Report*
- Updated Section 2.2, *UPF Responsible Superintendent and Startup Test Engineer*, to change title from UPF Lead Electrical Superintendent/Test Lead to UPF Responsible Superintendent and Startup Test Engineer
- Deleted what was Section 2.7, *UPF Electrical Inspector*
- Deleted what was Section 2.9, *Startup Supervisors/Test Engineer*
- Updated Section 2.8, *BNI Environmental, Safety, and Health Manager*
- Deleted what was Section 3.1, *UPF Electrical Safety Committee*
- Deleted what were Sections 3.3-3.36:
  - Section 3.3, *UPF Unqualified Electrical Person*
  - Section 3.4, *UPF Qualified Electrical Person*
  - Section 3.5, *UPF Low Voltage Qualified Electrical Person*
  - Section 3.6, *UPF Medium Voltage Qualified Electrical Person*
  - Deleted pages 14-29 involving General Electrical Safety to refer to Y17-95-64-880, *Electrical Safety in the Workplace*, where all the information can now be found

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- Other changes include:
  - Updated references and acronyms
  - Editorial changes
- This revision is a total rewrite; due to the extent of changes, revision bars are not shown

Previous revisions on record

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TABLES

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1.0 INTRODUCTION

The Uranium Processing Facility (UPF) Construction Electrical Safety Manual describes the responsibilities and practices of UPF's Electrical Safety Program and applies to any work where there is potential for personnel to be exposed to voltages equal to or greater than 50 V.

Y17-95-64-880, *UPF Electrical Safety in the Workplace*, referenced throughout, centralizes the implementing requirements for ease of use by workers and their supervisors when working on or near temporary or permanent energized electrical energy sources.

1.1 Purpose

The purpose of this Manual is to ensure all electrical-related hazards are identified, controlled, and communicated to personnel—including authorized and affected employees/personnel—prior to beginning any job/task evolution on electrical energy sources.

Y-12 National Security Complex (Y-12) employees, sub-contractors, and vendors working on Y-12 Management and Operations are to perform work to the requirements of Y73-528, *Electrical Safety Manual*; and the Y-12 Electrical Safety Program (or an approved equivalent).

Y-12 employees, sub-contractors, and vendors working on the UPF Project are to perform work to the requirements of Y73-528 and the Y-12 Electrical Safety Program (or an approved equivalent).

UPF Construction employees, sub-contractors, and vendors working on the UPF Project will perform work to the requirements of UPF-MANUAL-CM-001, *UPF Construction Electrical Safety Manual*; Y17-95-64-880; and UPF Electrical Safety Program (or an approved equivalent).

This Manual ensures all UPF Project-related work on electrical energy sources is performed in accordance with applicable electrical safety code requirements, including National Fire Protection Association (NFPA), Institute of Electrical and Electronics Engineers (IEEE), Occupational Safety and Health Administration (OSHA), and the Code of Federal Regulations (CFR), including:

- IEEE C2-2012, *National Electric Safety Code* (Code of Record 2012)
- NFPA 70, *National Electrical Code* (Code of Record 2014)
- NFPA 70E®, *Standard for Electrical Safety in the Workplace* (Code of Record 2015)
- 29 CFR 1926, *Safety and Health Regulations for Construction, Subpart K, "Electrical"* (Code of Record 2013)
- 10 CFR 851, *Worker Safety and Health Program* (Code of Record 2009)
- 29 CFR 1910, *Occupational Safety and Health Standards* (Code of Record 2017)
  - 29 CFR 1910.137, *Electrical Protective Equipment*
  - 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*
  - 29 CFR 1910.269, *Electric Power Generation, Transmission, and Distribution*
  - 29 CFR 1910.302, *Electric Utilization Systems*

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- 29 CFR 1910.303, *General*
- 29 CFR 1910.304, *Wiring Design and Protection*
- 29 CFR 1910.305, *Wiring Methods, Components, and Equipment for General Use*
- 29 CFR 1910.308, *Special Systems*
- 29 CFR 1910.331, *Scope*
- 29 CFR 1910.332, *Training*
- 29 CFR 1910.333, *Selection and Use of Work Practices*
- 29 CFR 1910.335, *Safeguards for Personnel Protection*

1.2 Scope

This Manual applies to all UPF Project personnel (e.g., contractors, subcontractors) and any job or task performed during Construction and Startup activities for the UPF Project.

2.0 RESPONSIBILITIES

2.1 UPF Electrical Safety Manager

The UPF Electrical Safety Manager is responsible for:

- Supporting the UPF Construction Project with the NFPA 70E requirements
- Providing auditing requirements as the qualifying agent to Responsible Superintendent (RS) and business units for UPF Annual Field Work Audits (FWAs), UPF Triennial Electrical Program Audit, and the UPF Annual Lockout/Tagout (LOTO) Audits
- Performing and documenting electrical incident investigations with the assistance of the Electrical Incident Management Team

2.2 UPF Responsible Superintendent and Startup Test Engineer

The UPF RS and Startup Test Engineer (STE) are Qualified Electrical Persons (QEP) responsible for the following tasks in their respective organizations:

- Verifying personnel who work with energized electrical equipment understand the guidance and requirements in UPF-MANUAL-CM-001 and Y17-95-64-880
- Verifying personnel who work with energized electrical equipment are properly trained and qualified
- Ensuring (before the start of work) relevant Job Hazard Analysis (JHA) is reviewed with appropriate workers, and crews review and discuss hazards at work fronts in accordance with Y17-95-64-823, *UPF Field Level Hazard Assessment/Job Hazard Analysis Program (FLHA/JHA) Process*
- Maintaining the list of QEPs and making assignments based on QEP designation
- Completing CFN-1317, *UPF Electrical Hazard Risk Assessment & Testing Form* (ERAT), and CFN-1232, *Energized Electrical Work Permit (EEWP)*
- Establishing Electrically Safe Work Conditions (ESWC)

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NOTE: *Additional details for these positions are found in Y17-95-64-880.*

2.3 UPF Training Manager

The UPF Training Manager is responsible for tracking and maintaining all electrical safety training records for the duration of the employee's employment, and the maintenance of the training databases. These records should contain the training, the employee's name, and the dates in which the training was performed. This training will be performed at intervals not to exceed three years and will consist of classroom, on-the-job, or a combination of the two.

2.4 UPF Temporary Power Supervisors

The UPF Temporary Power (TP) Supervisors are responsible for establishing the training requirements, performing the initial assessment for Temporary Power Qualified Electrical Person (TPQEP) qualification for their employees using CFN-1345, *UPF Initial Qualified Person Checklist*, and then verifying certifications, training, and qualifications have been met prior to release to work as a TPQEP. The UPF TP Supervisors are also responsible for performing FWAs to maintain their employees TPQEP qualifications using the CFN-1344, *UPF Annual Field Work Audit*.

2.5 UPF Lockout/Tagout Coordinator

The UPF LOTO Coordinator is responsible for the program and procedure Y17-95-64-801, *UPF Energy Isolation Management (EIM) – Lockout/Tagout (LOTO)*. The UPF LOTO Coordinator is also responsible to ensure the LOTO Audits are performed at intervals not to exceed one year. The audit covers at least one LOTO in progress to identify and correct deficiencies in the program/procedures, LOTO training, and worker performance of the LOTO procedure.

2.6 UPF Site Manager/Project Startup Manager

The UPF Site Manager has the overall responsibility for ensuring the implementation of this Manual. The Project Startup Manager (PSUM) has the overall responsibility for the implementation of this Manual as it pertains to systems that have been turned over to Startup. In coordination with the Environmental, Safety, and Health (ES&H) Manager, the Site Manager/PSUM is also responsible for ensuring all UPF construction site personnel actively comply with Ground Fault Circuit Interrupter (GFCI) requirements; and providing worker support, facilities, and other resources necessary to effectively conduct required safe work practices.

2.7 BNI Environmental, Safety, and Health Representative

Bechtel National, Inc. (BNI) ES&H Representatives are responsible for reviewing, approving (if applicable), and assisting in the development of JHAs and EEWPs (when requested). The BNI ES&H Representatives also review assigned electrical Personal Protective Equipment (PPE) (when requested) and provide field electrical safety assistance.

The ES&H Representative will retain final electrical incident investigation reports and ensure Lessons Learned are discussed and reviewed, to include tracking and

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trending Energy Facility Contractors Group report information to evaluate performance in accordance with the Electrical Safety Program.

2.8 BNI Environmental, Safety, and Health Manager

The BNI ES&H Manager is responsible for ensuring new-hire orientation includes appropriate information about electrical safety, and coordinates with the Site Manager, PSUM, and Electrical Safety Manager as appropriate to ensure compliance with guidance and requirements in this Manual and Y17-95-64-880.

2.9 Y-12 Electrical Contractor Authority Having Jurisdiction

The Y-12 Electrical Contractor Authority Having Jurisdiction (ECAHJ), or their delegate, will have access to any area where electrical work is being performed. The Y-12 ECAHJ is responsible for ensuring electrical codes and standards are followed, confirming assignment of electrical inspectors, reviewing/approval of electrical inspection documentation, and participation for the review of accidents/incidents (as requested). The Y-12 ECAHJ approves equipment and materials installations, as well as delegates personnel responsible for interpreting NFPA 70. The Y-12 ECAHJ ensures electrical inspectors are trained and qualified in accordance with NFPA 70 requirements.

3.0 ROLES

3.1 UPF Electrical Incident Investigation Team

The UPF Electrical Incident Investigation Team is established by the Electrical Safety Manager to conduct investigations in accordance with OT-SH-801768-A038, *UPF Electrical Hazard and Incident Investigations*, for any electrical events and incidents from Electrical Arc Flash or Shock. Investigations will be documented on CFN-1359, *UPF Electrical Event Investigation Report*. The Electrical Safety Manager will distribute the investigation findings and report to the necessary stakeholders.

NOTE: *Refer to Y17-95-64-880 for definitions, training requirements, and verification of competency for Unqualified Electrical Person, QEP, LQEP, and MQEP.*

3.2 UPF Construction Site Electricians

The UPF Construction Site Electricians receive training (i.e., classroom, on-the-job, or a combination of the two) to meet and exceed client, employer, and Project electrical safe work practice requirements. The UPF Construction Site Electricians are responsible for ensuring their training qualifications are up-to-date and applicable to the specific hazards for the electrical energy (i.e., Low-Voltage Qualified Electrical Person [LQEP], Medium-Voltage Qualified Electrical Person [MQEP], Startup Qualified Electrical Person [SUQEP], TPQEP) associated with the job or task assignment.

The UPF Construction Site Electricians are trained to work with a variety of electrical equipment, including the safe operation and application of GFCIs while using human performance tools (i.e., situational awareness, questioning attitude, peer-check, self-

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check, stop work authority) to keep themselves and others safe from Electrical Hazards (EHs).

3.3 UPF Startup Qualified Electrical Person

The UPF SUQEP receives training from the classroom, on-the-job, or a combination of the two, to qualify to work as a SUQEP. The UPF SUQEP will also receive training as LQEP and MQEP. Competency is reached and the SUQEP is considered qualified after the successful completion of CFN-1345. The UPF SUQEP operates electrical equipment at the direction of the STE. The UPF SUQEP will be required to complete an additional annual CFN-1344 assessment to maintain the LQEP and MQEP qualifications. The UPF SUQEP performs all Zero-Energy Checks for voltage levels equal to or greater than 1000 V.

3.4 UPF Temporary Power Qualified Electrical Person

The UPF TPQEP receive training from the classroom, on-the-job or a combination of the two to qualify to work as a TPQEP. The UPF TPQEP will also receive training as an LQEP and once competency is reached will be assessed using the CFN-1345 for qualification. The UPF TPQEP will be required to complete an additional annual CFN-1344 assessment to maintain the LQEP qualification.

4.0 PROCESS/GUIDANCE

NOTE: *Refer to Y17-95-64-880 for implementation requirements.*

4.1 General Electrical Safety

This section applies to all personnel who could potentially be exposed to electrical shock hazards that are not reduced to an ESWC by the applicable electrical installation requirements.

ENSURE ONLY the Startup Organization operates or performs any work on Startup-controlled electrical equipment unless an appropriate work authorization has been obtained in accordance with Y15-95-926, *UPF Work Authorization.*

Refer to Y17-95-64-880 for the ERAT process involving:

- Defining the work scope
- Assessing shock and arc hazards
- Describing switching order including modes of electrical equipment operation
- Zero energy verification
- Energized electrical testing
- Electrically Safe Work Condition
- Energized Electrical Work Permit

WARNING

Under no circumstances shall work inside the Restricted Approach Boundary (RAB) or Arc Flash Boundary (AFB) be performed if the incident energy is >40 Cal/cm2

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4.2 Approach Boundaries for Overhead and Underground Utilities

4.2.1 Overhead Transmission Power Lines

ENSURE when heavy equipment must be moved or operated near overhead power transmission lines on or adjacent to the UPF construction site or site road, comply with applicable requirements in **Section 4.2.2, *Reviewing Transport Routes with Overhead Utilities***.

As a general rule, the following controls will be implemented:

- A risk assessment must be conducted (e.g., JHA or similar method)
- The job safety planning performed will work to avoid the close proximity to overhead lines to avoid accidental/unintentional contact where practical to do so

In addition to the use of heavy equipment, the following activities must be controlled in areas where overhead power lines are present (e.g., cranes):

- Erecting scaffolding and handling scaffold tubes
- Handling long ladders
- Operating mobile-elevated work platforms
- Elevating dump truck or front-end loader

4.2.2 Reviewing Transport Routes with Overhead Utilities

PRIOR TO moving heavy equipment across the UPF construction site and support areas, the discipline RS, with support from Field Engineering, will review the travel route. As part of the review and in accordance with Y17-95-64-871, *UPF Construction Hoisting and Rigging Work Operations*, overhead obstructions or energized utilities are identified and evaluated to determine if a haul plan needs to be developed for the movement of the heavy equipment.

4.2.3 Transporting Heavy Equipment Over Routes with Overhead Utilities

This section establishes criteria that must be met for heavy equipment (e.g., cranes, elevated dump truck, front-end loader) traveling under or near power lines. The discipline RS must **ENSURE** the following apply:

- All parts of the equipment are lowered/stowed sufficiently to meet height restrictions
- Clearances specified in **Table 1** are maintained
- Effects of speed and terrain on equipment movement (including movement of the boom/mast) are considered to **ENSURE** the minimum clearance distances specified in **Table 1** are not breached
- When traveling at night or in conditions of poor visibility (in addition to the measures specified previously), make plans to **ENSURE** the power lines are illuminated or another means of identifying the location of the lines is used

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Table 1. Power Line Clearance Minimums during Transport

Normal Voltage	Limited Approach Boundary (LAB) *(Minimum)*	Y17-95-64-871 *(Transport Criteria)*
< 600 V	4 ft.	7 ft.
13.8 kV	6 ft.	9 ft.
161 kV	10 ft.	13 ft.

NOTE 1: *Normal voltage is the standard installation found on the Y-12 facility and expected to be encountered by UPF work operations.*

NOTE 2: *All work performed at UPF support areas (offsite) will be evaluated to identify the power line voltage and required clearances.*

4.2.4 Heavy Equipment Assembly/Disassembly Near Overhead Utilities

Assembly/disassembly of heavy equipment below power lines is prohibited. No part of the equipment, load line, or load (including rigging and lifting accessories), whether partially or fully assembled, is allowed below a power line unless it has been confirmed that the utility owner/operator has de-energized and (at the worksite) visibly grounded the power line.

4.2.5 Heavy Equipment Operations Near Overhead Utilities

Except when heavy equipment is in transit, it is strictly forbidden to park, place, or move any crane boom, load line, or heavy equipment into the Minimum Safe Approach Distance (MSAD) to conduct work.

NOTE 1: *Clearances defined in this Manual are more stringent than IEEE C2 National Electrical Safety Code NESC requirements.*

The area surrounding each power line will be established as an MSAD boundary. Work is prohibited beyond the boundary unless the line has been de-energized or insulated.

The MSAD varies as depicted in **Table 2**.

Table 2. Power Line MSAD

Line Voltage (nominal, kV)	MSAD
Up to 25 kV	30 ft.
Over 25 kV	50 ft.

When working in close proximity to power lines, contact the utility system owner to determine the line voltage and if the lines can be de-energized or insulated.

NOTE 2: *All overhead lines are considered energized unless, and until, the person owning the line or the electric utility authorities indicate that it is not an energized line and that it has been visibly grounded.*

4.2.6 Establishing Exclusion Zones/Warnings

For overhead power lines on the UPF construction site or support areas, erect and maintain an elevated warning line, barricade, line of signs, or equivalent along the

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MSAD boundary, in view of an equipment operator, equipped with flags or similar high-visibility markings.

During movement and/or operation of heavy equipment, if the equipment operator is unable to see the warning line while operating the heavy equipment, establish the following:

- An additional spotter should be added to provide warning of boundary encroachment to assist the initial spotter, flagger, or signal person
- A boom range control warning device set to give the operator sufficient warning when approaching the boundary
- Clearance heights should be identified and posted for all overhead utilities located over established haul routes on the UPF construction site and support areas

4.2.7 Underground Utilities and Anomalies

PRIOR TO traveling an identified route or working in an area, Engineering should perform an evaluation and characterization of the areas for underground utilities or subsurface anomalies (e.g., cavities, soft soil). **DO NOT** perform heavy equipment operations **UNTIL** it has been determined that ground conditions are firm, drained, and graded to a sufficient extent so that, in conjunction (if necessary) with the use of supporting materials (e.g., crane mats), the equipment manufacturer's specifications are met.

Establish precautionary requirements based on the following:

- Type of the utility system
- Whether the utility system is allegedly in service or out of service
- Age of the utility system installation, etc.

Perform excavating activities and underground utility clearance/avoidance in accordance with Y17-95-64-822, *UPF Site Excavation and Backfill*.

ENSURE ALL necessary steps to contact the appropriate owners or authorities to identify and mark the location of the electrical lines, utilities, or equipment.

If it is determined there is a reasonable possibility of contacting electrical lines or equipment, **ENSURE** appropriate safe work practices and PPE will be used during excavation, which also includes the use of Hand-Digging, Hydro Excavation, or Potholing.

NOTE 1: *Using appropriate "Safe Work Practices" includes performing a Risk Assessment using CFN-1317 in accordance with Y17-95-64-880*

NOTE 2: *Using appropriate PPE includes following the necessary information provided from a risk assessment, arc flash/shock hazard analysis labeling, and using either the incident energy analysis method or arc flash category method in accordance with* ***NFPA 70E****.*

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4.3 Electrical Equipment

All 120 V or 208 V, single-phase receptacles and portable power tool equipment must comply with the GFCI requirements, as specified in **Section 4.3.1, *GFCI Requirements***.

4.3.1 GFCI Requirements

GFCIs must be used for electrical equipment when the Assured Equipment Grounding Conductor Program (AEGCP) is **NOT** used in accordance with **Section 4.4.2, AEGCP – Powered Hand Tool Cords and Extension Cords; Section 4.4.3, AEGCP – Inspection of Powered Hand Tools;** and **Section 4.4.4, AEGCP – Non-Permanent Plant GFCI**. Plug in the GFCIs at the source of electricity and then attach the cord in line after.

A GFCI must be tested by the "USER" for correct operation **PRIOR TO** use. In order to test a GFCI, follow **Steps 1** through **5**.

Step 1 **PLUG** the GFCI into the outlet.

Step 2 **ACTIVATE** the GFCI by pressing the reset button.

Step 3 **VERIFY** the GFCI is operational by viewing the light at the switch or by the verifying reset button on GFI outlet has not been tripped (some GFCIs do not have indication lights).

Step 4 **PRESS** the test button.

Step 5 **ENSURE** the light goes out, signifying the unit is off.

NOTE 1: *If a GFCI is visually inaccurate, defective, or non-conforming for S/CI determination, refer to Y15-95-813,* Suspect/Counterfeit Item Prevention and Detection.

If the GFCI fails any part of the test, there is something wrong with the installation and TP must be contacted.

If the GFCI is damaged, return it to TP for disposal and replacement.

GFCIs must be free from any defects. A GFCI will not be used if it has sustained damage to the insulation plugs or switches.

NOTE 2: *GFCI is the UPF project-preferred method.*

4.3.2 Electrical Power and Lighting Circuits

ENSURE switches and breakers used for the routine opening and closing of circuits under loads are properly load-rated.

ENSURE the personnel who use test instruments, equipment, and accessories to test energized electrical circuits, circuit parts, or equipment are QEPs who have the proper training, qualifications, and expertise to do so for the applicable/associated voltages for the job/task.

VERIFY the QEPs are currently trained and qualified as a QEP who can test energized electrical circuits, circuit parts, conductors, or electrical equipment for the applicable/associated voltages **PRIOR TO** allowing them to use test instruments, equipment, and accessories.

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ENSURE after a circuit breaker has been de-energized by the operation of an over-current device (e.g., circuit breaker trip), that the circuit is **NOT** manually energized or reset **UNTIL** it has been determined by a QEP that the circuit can be safely reenergized.

ENSURE a QEP is used to reset circuit breakers that are de-energized by the operation of an over-current device and **ONLY** a QEP can manually reenergize.

VERIFY all circuit breaker panels, transformers, and switchgears are labeled to show the voltage involved.

VERIFY all panelboards, disconnects, and major electrical equipment have their upstream power sources clearly identified on the equipment with legible, applicable, and up-to-date labeling. **ENSURE** circuit Breaker Panels are labeled specifically to show what each breaker energizes (i.e., feeding from, supplying to).

VERIFY all Test Instruments, equipment, and accessories are rated for the circuits, equipment, and job/task for which they will be used.

NOTE: *Electrical panel boxes are permitted to stay open (usually kept closed) when a LOTO device attached to a circuit breaker holds a door open, preventing it from closing.*

4.3.3 Extension Cord Requirements

The use of extension cords will **NOT** be permitted for the fixed wiring of a structure however, they may be permitted for TP usage under the following conditions:

- **ENSURE ALL** 110 V extension cords are visually inspected for damage or missing components by the personnel using the extension cord **PRIOR TO** each use. Any damaged extension cords are to be removed from service, tagged, and returned to the TP Group for disposal or repair
- **ENSURE ALL** extension cords, regardless of whether they are used indoors or outdoors, will be protected by a GFCI
- **ENSURE** extension cords are routed overhead at **NO LESS** than 7 feet 0 inches above finished floors and placed on manufactured safety hooks (i.e., “S” Hooks), when applicable
- **ENSURE** extension cords **DO NOT** pass through walls, doors, partitions, or other pinch points **UNLESS** manufactured or field-fabricated protective devices are put into place to avoid environmental or physical damage
- **ENSURE** extension cords routed at grade are protected by cable ramps or cable protective devices, which are manufactured or field fabricated to provide the appropriate protection to avoid damage (i.e., Yellow Jacket Cable Protectors)
- **ENSURE ALL** extension cords are routed in such a way to **NOT** impede the flow of traffic and personnel
- **PRIOR** TO use or plugging into a receptacle, **VERIFY** the extension cord is equipped with both a male and female plug end, that the plug pins and prongs are present, and that the extension cord is going to be energized directly from a receptacle outlet
- **ENSURE** the rear/base of the plug-end is used when inserting the plug into a receptacle to prevent fingers from contact with exposed energized prongs

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- **ENSURE** the plug-end is installed into a receptacle with a reasonable amount of force to ensure the extension cord is fully inserted, protecting personnel from exposed energized electrical circuit parts
- **ENSURE** extension cords are **NOT** "daisy-chained" or interconnected together as this can cause the circuit to overload and create a potential fire hazard
- **ENSURE** extension cords are **NOT** fastened with staples or otherwise suspended in a manner that damage can occur to the outer jacket or insulation
- **ENSURE** the maximum electrical load attached to the extension cord will NOT exceed the circuit or the extension cord listed capacity
- **ENSURE** cable assemblies, extension cords, flexible cords, and cabling are properly run and supported throughout the run while using VELCRO®, cable ties, straps, or similar type fittings to secure and protect them from physical damage
- **ENSURE** all extension cords and cabling will be installed and maintained to prevent force from a pull transferring directly to joints or terminals preserving integrity of insulation and terminations
- **ENSURE** when handrails/stair rails, scaffolds, steel bollards/stanchions are used as barriers/barricades and are used to support extension cords and cabling, they must attach manufactured safety hooks (i.e., "S" Hooks) or other equivalent safety prevention methods to prevent accidental/incidental contact with energized electrical equipment or conductors
- **ENSURE** extension cords are **NOT** used to carry, raise, or lower any portable cord and plug-connected electrical equipment
- **ENSURE** electrically powered industrial lifts/trucks (e.g., aerial lift, scissor lift, boom lift, telehandlers) are **NOT** operated, raised, or lowered while being charged with an extension cord or receptacle. **VERIFY** extension cords are UL Solutions (UL) or Factory Mutual listed, which are properly rated and equipped, including a grounding conductor and ground prong

NOTE: *Extension cord connected to a UL-listed appliance or used in a UL-listed extension cord set is considered protected as long as the appliance or extension cord is used in accordance with its UL requirements.*

4.3.4 Flexible Cord Sets (Extension Cords)

120 Volt

- The factory manufactured 120 V Flexible Cord Sets will no longer be repaired (project preferred method) and will be exchanged/replaced with new Flexible Cord Sets
- Any newly field fabricated or associated repairs to 120-V Flexible Cord Sets (specialty extension cords, heavy duty, end-of-line/equipment specific) will be performed by a LQEP from Temporary Power, and will receive a unique identifier, National Electric Code (NEC) Inspection, and the applicable labeling

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208 Volt

- All newly field fabricated and any associated repairs to 208-V Flexible Cord Sets will be performed by a LQEP from Temporary Power and will receive a unique identifier, NEC Inspection, and the applicable labeling (which will be done prior to going into/returning to service)
- All newly field fabricated and any associated repairs to 208-V Flexible Cord Sets will also have strain relief (Kellems Grips) installed by an LQEP from Temporary Power

480 Volt

- All newly field fabricated and any associated repairs to 480-V Flexible Cord Sets will be will be performed by an LQEP from Temporary Power and will receive a unique identifier, NEC Inspection, and the applicable labeling (which will be done prior to going into/returning to service)
- All newly field fabricated and any associated repairs to 480-V Flexible Cord Sets will also have strain relief (Kellems Grips) installed by an LQEP from Temporary Power. All currently placed 480-V Flexible Cord Sets currently have Meltric Plugs and Kellems Grips installed by an LQEP from Temporary Power

4.3.5 Power Strips/Relocatable Power Taps/Multi-Port Adapters

ENSURE all Power Strips, Relocatable Power Taps (RPTs), and Multi-Port Adapters are attached directly to a permanent receptacle.

ENSURE all Power Strips, RPTs, and Multi-Port Adapters are properly rated or listed for the application, environment, and used in accordance with manufacturer instructions.

ENSURE Power Strips, RPTs, and Multi-Port Adapters are not used in construction activities.

ENSURE Power Strips, RPTs, and Multi-Port Adapters are NOT “daisy-chained” or interconnected together as this can cause the circuit to overload and create a potential fire hazard.

4.4 Assured Equipment Grounding Conductor Program

The site uses the AEGCP to protect personnel from electrical shock hazards equal to or greater than 208-V and 120-V circuits that are approved to not be on a GFCI device. GFCI breakers and receptacles will be checked in accordance with manufacturer recommendations on a quarterly basis. Standard 120-V extension cords that plug into a GFCI device are exempt from quarterly cord check programs.

ALL construction power circuits on the UPF construction site will be protected by a GFCI breaker, GFCI in-line device, or the AEGCP.

The AEGCP is intended to ensure a continuous grounding conductor for all non-permanent power circuits not protected by a GFCI component. This AEGCP will include all voltage service levels 120 V to 480 V. By adhering to this Procedure, all construction power systems not protected by a GFCI component will meet the criteria

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for a successful AEGC which includes ALL non-GFCI cords sets from 120 V to 480 V.

4.4.1 AEGCP – Cord Sets, Equipment, Receptacles (Non-Permanent), and Powered Hand Tool Exemptions

The following is a list of tools and equipment that typically will not be protected by GFCI. The protection for these items will be provided by the AEGCP. **ALL** double-insulated tools are exempt from the AEGCP as they are inspected **PRIOR TO** each use by the tool user (if additional items are requested to be added to the list, written approval is needed from the Electrical Safety Manager, with concurrence from the BNI ES&H Manager, or designee):

1. All 208-V to 480-V tools and equipment
2. TP used for Permanent Plant Equipment does not require GFCI breaker protection
3. The following 120-V tools and equipment (included but not limited to):
    - Welders
    - Magnetic drills
    - Rod ovens

The cord sets and all receptacles that are **NOT** part of the permanent wiring of a building or structure that not protected by GFCI, and all tools and equipment connected by cord and plug will be physically inspected and tested as follows by the user:

- Daily visual inspections will be conducted on **ALL** tools and equipment subject to this AEGCP
- Daily visual inspections by the user will also be conducted on **ALL** cord sets used to extend circuits, for tools and equipment subject to this AEGCP, from the power receptacle to the work location
- Visual Inspection, for the list of inspection requirements
- Ground conductor continuity and terminal connector testing will be conducted at the appropriate intervals indicated in the AEGCP

The visual inspections of the cord sets, equipment, receptacles (non-permanent), and powered hand tools not protected by GFCI will be performed **PRIOR TO** use by the user to **VERIFY** there are no pre-existing external defects (e.g., damaged or missing pins, insulation damage, cuts) on the following:

- The cord sets
- The attachment caps
- The plugs and receptacles of cord sets
- The equipment connected by cord and plug (e.g., powered hand tools)

The continuity testing for equipment grounding conductors will be tested for continuity and documented on CFN-1326, *Temporary Power – Grounding Assurance Test Record*. These conductors will be electrically continuous on the following:

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- **ALL** non-GFCI cord sets – The ground conductor continuity test shall consist of a continuity check from the ground conductor at one end of the cord to the ground conductor at the opposite end of the cord
- Receptacles that are not part of the permanent power system – The ground conductor continuity test will consist of a continuity check from each receptacle's grounded conductor to the in-coming service receptacle's grounded conductor. and the unit's grounding electrode conductor
- **ALL** non-GFCI Tools and equipment – The ground conductor continuity test will consist of a continuity check from the grounded electrode conductor on the tool/equipment power cord and the metal housing (if applicable) of the tool/equipment

ENSURE a terminal connection test is performed to **VERIFY** the ground connection is connected to the appropriate terminal and terminated properly.

NOTE 1: *ALL double-insulated tools are exempt because they do not have a ground connection.*

The continuity testing for cord sets, equipment, receptacles (non-permanent), and powered hand tools not protected by GFCI will be performed at the following intervals:

- **PRIOR TO** the initial/first use
- **PRIOR TO** the equipment being returned to service following any repairs
- **PRIOR TO** the equipment being returned to service following any modifications and/or the equipment is relocated

The modifications of cord sets, equipment, receptacles (non-permanent), and powered hand tools not protected by GFCI are defined by the following criteria:

1. Any type of wiring change
2. The relocation of a receptacle, rack, panel, or unit supplying construction power
3. The installation or rerouting, in whole or part, of any cord set that supplies power to a receptacle, rack, panel, or unit

NOTE 2: *Testing frequency includes all 480-V construction power racks that have their own ground rod to each end user receptacle not protected by a GFCI device to which they supply power.*

NOTE 3: *Testing frequency includes all distribution units and their corresponding cord sets and receptacles.*

NOTE 4: *All 480-V cords and equipment must be inspected by a general foreman or above prior to energization and documented on construction power electrical equipment.*

4.4.2 AEGCP – Powered Hand Tool Cords and Extension Cords

ENSURE before initial use and prior to each use thereafter, attachment plugs, receptacles, cover plates, and cord connectors are visually inspected by the employee who is assigned to use the equipment. If any of the following conditions exist, the equipment is tagged with a defective tool tag and returned to the tool crib for repair or disposal:

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- Breaks, damage, or cracks exposing live components or loss of insulation on electrical conductors or wiring
- Missing cover plates
- Terminations with stray strands or loose terminals
- Missing, loose, altered, or damaged blades, pins, prongs, or contacts
- Missing grounding conductor or ground prong
- Frayed or damaged cords

ENSURE in addition to the inspection by the assigned employee, a QEP will conduct quarterly inspections on GFCIs in accordance with ML-SH-801768-A001, *UPF Quarterly Inspection Color Codes*.

NOTE 1: *If the cord does not pass inspection, the equipment is tagged with a "Defective Tool/Do Not Use" tag and returned to the tool crib for repair or disposal.*

NOTE 2: *All extension cords, regardless of whether used indoors or outdoors, shall be protected by GFCIs.*

Table 3 describes the colors to use during each quarter of the inspection schedule.

Table 3. Inspection Schedule and Marking Colors

Quarter	Months	Color	
First	January, February, March	Yellow	
Second	April, May, June	Green	
Third	July, August, September	Red	
Fourth	October, November, December	Blue	

ALL non-GFCI pigtail type receptacles and non-GFCI connected cords are marked with colored tape to identify the period in which the inspection and test were conducted, as shown in **Table 3**.

The testing of **ALL** TP non-GFCI receptacles, non-GFCI connected cord sets, and cord/plug connected equipment will occur two weeks prior to the first day of the first month of each quarter and will continue during the first two weeks of the first month in the quarter. During this four-week interval, either quarter color will be deemed acceptable.

NOTE 3: *All double-insulated tools are exempt from this inspection and color marking requirement.*

ENSURE all receptacles are of the grounding type.

ENSURE ALL branch circuits include a separate equipment grounding conductor, and all receptacles are electrically connected to the equipment grounding conductors.

ENSURE receptacles are **NOT** connected to the same ungrounded conductor of multi-wire circuits that supply temporary lighting.

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ENSURE suitable disconnecting switches or plug connectors are installed to permit the disconnection of all ungrounded conductors of each temporary circuit.

VERIFY ALL lighting for general illumination are protected from accidental contact or breakage by a suitable luminaire or lamp holder with appropriate safeguards.

ENSURE cable assemblies, flexible cords, and cables are supported in place at intervals that ensure they will be protected from physical damage.

ENSURE the supports are in the form of cable ties, straps, VELCRO, “S” Hooks, or similar-type fittings installed in a manner not to cause damage.

ENSURE electrical hand tools and equipment meet the following standards:

- Where possible, hand tools will be of 110 V or 120 V
- Where 240-V tools are used, they will be double insulated
- Equipment casing will be intact with no loose fittings or exposed cables
- Plug fittings will be of an approved industrial type
- Hand tools that are battery operated are acceptable for use unless there is damage to the hand tool casing or battery is leaking/bulging
- Tools will be in good condition and will be subject to Preventative Maintenance (PM) schedules recommended by the manufacturer

4.4.3 AEGCP – Inspection of Powered Hand Tools

PRIOR TO each use, the **USER** should **ENSURE** portable cord and plug-connected electrical equipment is visually inspected for external defects (e.g., loose parts, deformed, pinched, crushed outlet jacket, and missing pins/prongs, evidence of possible internal damage).

ENSURE double-insulated tools (tools without a manufacturer ground) have had a visual inspection **PRIOR TO** each use.

ENSURE all required GFCI inspections and testing is performed **PRIOR TO** first use, and **PRIOR TO** the portable cord and plug-connected equipment being returned to service following any repairs, when equipment is used after any incident that can be reasonably suspected to have caused damage and at intervals not to exceed three months.

ENSURE damaged portable cord and plug-connected electrical equipment are tagged with “DO NOT USE” tags and are removed from service until repaired, tested, and re-certified for use.

ENSURE portable cord and plug-connected electrical equipment that are used in outdoor and/or wet locations are protected by GFCIs.

If any of the following conditions exist during GFCI inspection and testing, the GFCI equipment must be tagged with a “Defective Tool/Do Not Use” tag and returned to the tool crib for repair or disposal:

- Breaks, damage, or cracks exposing energized electrical parts
- Missing cover plates
- Terminations with stray strands or loose terminals

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- Missing, loose, altered, or damaged blades, pins, prongs, or contacts
- Frayed or damaged cords
- Incorrect polarity

4.4.4 AEGCP – Non-Permanent Plant GFCI

The following requirements pertain to the location and recommended use of a GFCI:

In accordance with applicable codes/standards, **ENSURE** GFCIs will be provided for all 120 V, single phase (15 A and 20 A) receptacle outlets (or 240 V, single-phase, 30 and 40 A, as applicable) that are not part of the permanent wiring of a building or structure (e.g., temporary wiring during construction).

ENSURE GFCIs are provided for lavatory, washroom, and change room outlets.

ENSURE GFCIs are provided for all areas having a moist or wet atmosphere where electrical equipment or portable electric tools may be used.

There are certain limitations associated with the use of GFCIs. These limitations include the following:

ENSURE all GFCIs operate only on line-to-ground fault currents, such as insulation leakage currents or currents likely to occur during accidental contact with an energized wire of a 120-V circuit and ground, understanding that GFCIs do not protect in the event of line-to-line contact.

ENSURE the polarity of conductors in all cords, plugs, and receptacles supplying single pole portable GFCI units be properly maintained or the unit may not protect personnel against shock.

NOTE 1: *It is recommended to locate portable GFCI units near the equipment being used and to use cords within 10 feet of each tool or lamp; this may minimize nuisance tripping.*

GFCI testing requirements include, but are not limited to, the following:

- **ENSURE** all GFCIs are tested for correct operation before use in accordance with **Section 4.3.1**
- **ENSURE** all GFCIs will be inspected and checked on a quarterly basis, in accordance with ML-SH-801768-A001

NOTE 2: *The GFCI testing documentation will be maintained by the Construction Electrical Field Engineering Group.*

4.5 Capacitors, Generators, and Transformers

4.5.1 Capacitors

Stored Energy in Capacitors

ENSURE the appropriate controls are in place and are applied according to the capacitor's stored energy hazard threshold.

ENSURE appropriate controls for capacitors are applied when hazard thresholds are exceeded:

1. Less than 100 V and greater than 100 joules of stored energy

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2. Greater than or equal to 100 V and greater than 1.0 joule of stored energy
3. Greater than or equal to 400 V and greater than 0.25 joules of stored energy

Appropriate Controls for Capacitors

ENSURE personnel are familiar with and trained on specific hazards and controls to work safely on electrical equipment with capacitors following safety-related work practices.

ENSURE the risk assessment covers electrical equipment with capacitors and has indicated the appropriate PPE to account for capacitor voltage/stored energy, thermal, shock, arc flash and blast, and takes additional protective measures to provide an ESWC.

ENSURE the risk assessment includes a test and grounding method is applied to appropriately ground, bleed, and discharge capacitors in which the appropriate controls are put in place to control the EH.

ENSURE the risk assessment is used to develop a written procedure captures required steps to place equipment with capacitors in ESWC which includes the following:

1. Information about the stored energy available
2. How long to wait after de-energizing before opening enclosure, taking into account the duration of discharge
3. How to test for absence of voltage
4. What to do if there is stored energy potential
5. A sequence of operations to discharge and place in an ESWC
6. How to use grounding sticks to safely discharge capacitors when applicable

ENSURE any work with or on capacitors follows safe work practices, and establishes and verifies ESWC in accordance with NFPA 70E.

ENSURE capacitors are installed, maintained, and serviced in accordance with NFPA 70, Article 460, *Capacitors*.

4.5.2 Generators

Generator Inspections

ENSURE generators are provided with a nameplate including manufacturer’s name, rated frequency, number of phases, rating in kilowatts or kV amperes, normal volts and amperes corresponding to the rating, the rated revolutions per minute, and the rated ambient temperature/temperature rise.

ENSURE generators that are rated at more than 15 kW provide the power factor, subtransient and transient impedances, insulation system class, and time rating on the nameplate.

ENSURE generators are equipped with disconnects and are lockable in the open position to **ENSURE ALL** protective devices and control apparatus can be

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disconnected entirely from the circuits supplied by the generator, with the exception of the following:

1. They are portable cord and plug connected generators
2. The driving means for the generator can be readily shut down, rendered incapable of restarting, and is lockable in the off position or the generator is not arranged to operate in parallel with another generator/source of voltage

ENSURE any work with or on generators follows safe work practices and establishes and verifies ESWC in accordance with NFPA 70E.

ENSURE generators are installed, maintained, and serviced in accordance with NFPA 70, Article 445, *Generators*.

Portable Power Generators

The following are applicable to Portable Generators:

- **ENSURE** a GFCI is used for ALL 110 V generators whether they are a hard-wired or a portable generator
- **ENSURE** generators and welding transformers are maintained in a serviceable condition
- **ENSURE** generator fuel tanks are located in areas that have provisions for spill containment or are equipped with a secondary containment system rated to hold up to 110% of the total tank contents
- **ENSURE** the area/location around generators will be maintained free of oil and diesel spills
- **ENSURE** all rotating-component equipment is safeguarded by Engineering Controls from incidental or unintentional contact by personnel (e.g., equipment guarding, machine guarding)
- **ENSURE** properly rated grounding (if required) is provided on portable electrical generators to include temporary light plants/systems that function as a generator, along with a lighting plant function, in accordance with the manufacturer's instructions
- **VERIFY** outlets/receptacles are maintained in good condition (e.g., no cracked outlets, outlet cover without damage that exposes conductors)

4.5.3 Transformers

ENSURE transformers are installed, maintained, and serviced in accordance with NFPA 70, Article 450*, Transformers and Transformer Vaults*.

4.6 Startup

The forms, processes, and procedures for all Startup activities for the UPF Project are completed in compliance with this Manual, Y17-95-64-880, and NFPA 70E for establishing electrical safety requirements.

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4.7 Temporary Power

For any job/task that is performed working on TP, the TP/TPQEP personnel are to reference, but are not limited to the following forms, processes, and procedures for ANY TP-related job/task:

- CFN-1232, *Energized Electrical Work Permit (EEWP)*
- CFN-1261, *UPF Electrical Inspector Approval*
- CFN-1317, *UPF Electrical Hazard Risk Assessment & Testing Form*
- CFN-1324, *Temporary Electrical Work Practices and Plan GFCI Inspection and Test Record*
- CFN-1325, *Temporary Power Maintenance Record*
- CFN-1326, *Temporary Power – Grounding Assurance Test Record*

NOTE: *CFN-1325 and CFN-1326 will be used by the TP Organization as tools only (i.e., these forms are not considered records for retention control). Inspections by the TP Organization for Maintenance and Grounding Assurance are governed by quarterly color codes as defined in Table 3.*

- CFN-1327, *Temporary Power Request Form*
- CFN-1344, *UPF Annual Field Work Audit*
- CFN-1345, *UPF Initial Qualified Person Checklist*
- OT-SH-801768-A038, *UPF Electrical Hazard and Incident Investigations*

The UPF Construction TP follow ALL applicable codes, practices, principles, and procedures indicated in NFPA 70E to establish ESWC and follow safe work practices.

ENSURE Electrical Preventative Maintenance (EPM) is performed on TP electrical equipment, tools, and cabling/cords in accordance with manufacturer's requirements and documenting by completing the CFN-1325.

NOTE: *All requests for initial or additional temporary power must be requested using the CFN-1327. This request form is maintained in Process Director and not considered a project record.*

4.7.1 Temporary Power – Construction Power Distribution

The following are requirements that are applicable to Temporary Construction Power Distribution:

- **ENSURE ALL** TP distribution boards have GFCIs or Residual Current Devices (RCDs) fitted
- **ENSURE ALL** TP cabling/cord that is to be connected to permanent plant equipment for Startup Testing is installed and properly maintained in accordance with Y15-95-100, *UPF Control of Temporary Modifications*
- **ENSURE ALL** TP terminal points will be in an enclosure using applicable rubber/plastic grommets
- **ENSURE ALL** TP cabling/cord, which includes grounding, is properly sized and rated for the application/installation, and is provided by Electrical Field Engineering

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- **ENSURE ALL** TP cabling/cord used is sufficient and durable for use in the construction work environment conditions and the location in which it will be used, and that this information is provided by Electrical Field Engineering
- **ENSURE ALL** TP grounding terminations are fitted to distribution boards and metal support frames in accordance with applicable codes and requirements
- **ENSURE ALL** TP splicing of cabling/cords will **ONLY** be permitted accordance with a field sketch in which the cabling will be extended or repaired with the appropriate fittings
- **ENSURE ALL** TP cabling is routed in a manner that **DOES NOT** create an obstruction to enter, egress, or present a trip hazard. **ENSURE** the method routing cabling is done in a manner that **DOES NOT** damage or affect the integrity of the cable (refer to UPF-CP-200, UPF General Safe Work Practices)
- **ENSURE ALL** TP 480-V service cabling, attachments, and equipment are handled, moved/removed, or relocated **ONLY** by TP/TPQEP
- **ENSURE ALL** TP 480-V services are routed off the floor and out of traffic areas
- **ENSURE ALL** TP Meltric plug assemblies use Kellems cable grips
- **ENSURE ALL** 480-V flexible extension cord sets are tested quarterly and marked with appropriate color-coded tape

NOTE: *ALL portable cord-and plug-connected equipment and Flexible Cord Sets (extension cords) shall be visually inspected before use on any shift for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket). All cord-and plug-connected equipment and Flexible Cord Sets which remain connected once they are put in place and are not exposed to damage need not be visually inspected until they are relocated.*

- The following color coding will be used for TP Construction Power Distribution cabling purposes:
  - Flexible Cord Sets will use the "BK" conductor as "A" phase, "RD" conductor as "B" phase, "WH" conductor as "C" phase, and the "GRN" conductor for grounding
  - 208/120 V, three-phase color coding is BK, RD, BL (black, red, blue)
  - 480/277 three-phase color coding is BR, OR, YL (brown, orange, yellow)

4.7.2 Temporary Power – Power Distribution Equipment (PDE)

The TP – Power Distribution Centers are fed from an outside/exterior switchgear, to an Interior Main Panel, and distributed out to Power Distribution Unit (PDU) (cart w/wheels or fork lift inserts) provides 480 V distribution to Heating, Air Conditioning and Ventilation (HVAC), Welders, and any other equipment requiring 480 V. This PDU then provides the 480-V feeders to the Power Distribution Cart (PDC), which then provides lighting, tool power, and 50 A Spider Boxes (in some instances) are distributed out.

The TP – PDCs are powered by 480 V and then supply 120/208 V or 120/240 V (equipped with a transformer) through a National Electrical Manufacturers Association (NEMA)-rated power distribution panel.

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The TP – PDUs are powered by 480 V and supply 480 V (e.g., 100 A/30 A, 200 A/30A) power through a NEMA-related power distribution panel.

ENSURE PDCs are installed with a minimum 36 in. (3 ft.) of clearance and this clearance is maintained.

ENSURE the 480-V side of PDCs and PDUs are installed with a minimum 42 in. (3½ ft.) of clearance.

ENSURE the PDE is **NOT** installed in a manner that would block entry or egress from the facility or electrical switching equipment. **ENSURE** at least one egress has a minimum of 24in. (2 ft.) wide x 78 in. (6½ ft.) high for entrance to and egress from Working Space.

PRIOR TO energizing, the PDE will be grounded using an approved Engineering method using the appropriately rated and sized grounding cable/conductor.

ENSURE the PDE has the appropriate nameplate, safety information, and Identification (ID) labels affixed to it and that they are legible and applicable to the environment to be used. Damaged or worn labels are to be reported to the Temp Power crew for replacement.

PRIOR TO initial energization, inspect the PDE for damage, including broken breakers, tripped breakers, or exterior damage to the dry transformer, and document the inspection with a label/sticker to indicate the inspection is complete and indicate in the TP equipment logbook or shared drive.

ENSURE cables/conductors from the PDE are inspected for damage including plug end **PRIOR TO** attaching/installing the plug end. **ENSURE** PDE damaged cables or plug ends are properly tagged as “Defective Tool/Do Not Use” and removed from service **UNTIL** the PDE is repaired or replaced.

ENSURE items are NOT placed or stored on top of the PDE.

ENSURE if a PDE breaker trips on the breaker panel that the operation or reset of these breakers are ONLY performed by a TPQEP.

4.7.3 Temporary Power – Ground Fault Protection

ENSURE a GFCI is used for **ALL** of the 120-V (e.g., 15 A, 20 A, or 30 A) circuit receptacles used for construction purposes.

ENSURE when permanent receptacles are being used to support construction activities (e.g., permanent buildings, trailers, change shacks, butler-type buildings, or similar structures), that GFCI devices are used with each cord set, electrical tool, or piece of electrical equipment. Document the inspection on CFN-1324.

ENSURE a GFCI polarity tester is used when testing satellite receptacles downstream from receptacles containing a GFCI.

ENSURE GFCI breakers/receptacles are tested quarterly by the TPQEP by pushing the "Test" button integral to the device. Pressing the "Test" button should cause the device to trip and open the circuit; if it does not, the GFCI breaker or receptacle will be taken out of service and tagged “DO NOT USE” for repair or disposal.

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ENSURE Standard 120-V, U-ground-type extension cords; and 208-V, single-phase, twist-lock extension cords are tools of the trade, and Craft personnel can plug and unplug these cords after shedding the load (i.e., turning off the welder or heater).

ENSURE the plugging in, unplugging, or routing/rerouting of 480-V cords sets after shedding the load is ONLY performed by a TPQEP.

ENSURE the operation or reset of ANY breakers for temporary electrical equipment, such as panel boards, spider boxes, PDE, and vendor equipment are ONLY performed by a TPQEP.

4.7.4 Temporary Power – Labeling

ENSURE TP equipment labeling is legible and durable to be able to withstand outdoor conditions.

ENSURE the TP Field Engineer/RFE is notified before any new TP equipment are placed into the field or changes are made to device configuration or location in the field.

ENSURE ALL TP related applicable electrical components have proper labeling PRIOR TO leaving fabrication or warehouse areas, which is applied by the TP Electrical Field Engineer for proper ID.

ENSURE TP equipment that has been relocated is relabeled and that the applicable TP drawings and associated documents are also updated.

ENSURE main transformers, disconnect switches, 480-V PDUs, and portable transformer/panel boards will be shown on TP drawings.

ENSURE ALL TP electrical panel and panel schedules are produced at the time of installation and be current at all times.

ENSURE ALL TP-related applicable electrical components are labeled using applicable TP drawings and in accordance with NFPA 70E. The TP equipment labeling will contain the following information:

- The TP Component/Equipment ID as shown on TP drawings
- The TP Component/Equipment approximate location (e.g., Mechanical Electrical Building, Yard, Main Processing Building, or Process Support Facility)

ENSURE TP equipment labeling **ALWAYS** indicates where the TP electrical equipment is feeding **FROM** on the front exposed side of the device and what it supplies **TO** if applicable.

ENSURE TP field installed cabling/cords labeling, excluding 120-V extension cords, **ALWAYS** indicates where the TP electrical equipment is feeding **FROM** and what it supplies **TO** if applicable.

- All TP field installed power cabling/cords (non-120-V extension cords) from panel boards to their end field piece of equipment (e.g., to welders, other power panels, distribution centers, disconnect switches) will have labeling on both ends to identify as follows: The TP field installed cabling/cords are to have the locations for feeding **FROM** and supplied **TO** on each end of the field installed power cabling/cords

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- The TP field installed cabling/cords will have the cable/cords by either being identified the color pink (i.e., pink extension cord, pink electrical tape) or by being labeled as TP
- There may be multiple tags or labels used in some applications to identify these TP cable/cords

NOTE: *Downstream items such as spider boxes and weld machines that constantly change location will not be shown on drawings unless they are located in a semi-permanent location (e.g., in fab shop areas).*

4.8 Batteries and Battery Rooms

ENSURE safety-related work practices are used to protect personnel who might be exposed to the EHs involved with 24-Volts Direct Current (VDC) and 48-VDC Battery Systems.

4.8.1 Safety Requirements Related to Batteries and Battery Rooms

For any job/task that is performed working on batteries, battery rooms, or battery enclosures **ENSURE** a risk assessment (e.g., CFN-1317, JHA) are performed **PRIOR TO** starting job/task to identify the chemical, electric shock, and arc flash hazard risks associated with each of the types of tasks to be performed. For working on battery systems operating at less than 50 V, the batteries, battery rooms, or battery enclosures will not need to be de-energized if there will be no increased exposure to electrical burns or explosion from electrical arcs.

ENSURE the proper PPE is used for the EH.

ENSURE unauthorized personnel are prohibited from access to battery rooms or battery enclosures, access should be granted by the Person in Charge (PIC) of the facility/premises, or other persons appointed to do so by PIC.

ENSURE proper illumination is provided to enable employees to work safely.

ENSURE warning signs or labels are posted for the following: series connections, parallel connections, charging methodology, temperature/thermal, charge status, Direct Current (DC) distribution cable size/length, and arc flash due to the prospective short circuit current.

ENSURE conductive objects are not worn (e.g., jewelry) while working on battery systems.

ENSURE battery terminals and electrical conductors are kept clear of unintended contact from tools, test equipment, containers, or other foreign objects.

ENSURE non-sparking tools are used when Battery Risk Assessment indicates additional hazards associated with the task to be performed.

VERIFY tools and equipment are insulated for maximum working voltage.

ENSURE regular PM is performed (e.g., examinations, maintenance) to prevent explosive mixtures in forced or natural ventilation systems.

ENSURE regular maintenance and functional testing of detection and alarm systems is performed.

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VERIFY battery ventilation system openings are unobstructed.

ENSURE provisions are made for sufficient ventilation of gases from Battery Rooms and Storage Areas to prevent the accumulation of explosive mixtures.

ENSURE cell flame arresters are inspected for proper installation or unobstructed ventilation replaced in accordance with manufacturer's instructions.

NOTE 1: *The UPF Project uses Valve-Regulated Lead Acid (VRLA) cell batteries.*

NOTE 2: *The UPF DC Power 48 VDC system(s) operates at a float voltage > 50 VDC; therefore, the DC Power system is required to be de-energized prior to being worked on.*

4.8.2 Batteries and Battery Room – Electrolyte Hazards

ENSURE the proper PPE is used for the chemical hazard (e.g., safety glasses, goggles).

VERIFY an eye wash and body wash apparatus is readily available, maintained, and in operable condition and for the nearest location **PRIOR TO** starting job/task.

ENSURE NO open flames or smoking are allowed in batteries, battery rooms, or battery enclosures.

NOTE: *Batteries with solid electrolyte (such as most lithium batteries) or immobilized electrolyte (e.g., VRLA) present little or no electrolyte hazard.*

4.9 Other Protective Equipment

When other protective equipment is required, it will conform to all applicable state, federal, or local codes, and standards.

4.9.1 Insulated Tools and Equipment

These insulated tools and equipment prevent accidental/unintentional contact with conducting surfaces of electrical circuit parts, conductors, and equipment.

This includes, but is not limited to, the following:

- Fuse handling equipment
- Ropes and handlines
- Portable ladders

PRIOR TO each use inspect insulated tools and equipment for damage to insulation that could limit the tool from performing the desired function or increase the risk for an incident.

VERIFY insulated tools are constructed, designed, and rated for the voltages and environments in which they are used.

ENSURE Fuse Handling Equipment is rated for circuit voltage and used to remove or install a fuse when terminals are energized.

ENSURE ropes and handlines used within the LAB) are non-conductive.

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VERIFY fiberglass-reinforced plastic rods used for live-line tools meet all applicable codes and standards for electrical installation requirements.

ENSURE Portable Ladders have non-conductive side rails when used inside LAB or when there is potential to contact energized equipment, conductors, or circuit parts.

ENSURE all other protective equipment/insulated tools and equipment is installed, used, and maintained in accordance with applicable NFPA 70E requirements.

4.9.2 Barriers

These physical obstructions are intended to prevent contact with electrical circuit parts, conductors, and equipment while energized.

ENSURE barriers are in place to prevent unintentional contact with exposed energized electrical conductors or circuit parts operating at greater than 50 V when work/task is within the RAB.

ENSURE barriers are supported to remain in place to prevent unintentional contact by a person, tool, or equipment.

ENSURE voltage rated plastic guard equipment is properly rated for the voltage and meets all applicable state, federal, or local codes/standards to prevent unintentional contact with energized conductors, circuit parts, and equipment to protect employees, or to keep material from contact with ground.

ENSURE physical or mechanical barriers are installed no closer than the RAB and that while the barriers are being installed that the approach boundary distances are maintained in accordance to applicable tables or placed into an electrically safe work condition.

ENSURE ALL other protective equipment/barriers are installed, used, and maintained in accordance with applicable NFPA 70E requirements.

4.10 Inspection and Maintenance of Personal Safety and Protective Equipment

4.10.1 Personal Safety and Protective Equipment Maintenance

These personal safety and protective equipment items are to be maintained in accordance with manufacturer's instruction and in a safe working condition, which includes, but is not limited to the following:

- Grounding equipment
- Hot sticks
- Rubber gloves, sleeves, and leather protectors
- Test instruments
- Blanket and similar insulating equipment
- Insulating mats and similar insulating equipment
- Protective barriers
- Electrical circuit breaker rack-out devices
- Portable lighting units
- Temporary protective grounding equipment

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- Dielectric footwear
- Protective clothing
- Bypass jumpers
- Insulated and insulated hand tools

ENSURE personal safety and protective equipment is properly maintained by performing visual inspections prior to use and thereafter not to exceed one year, unless specified otherwise by applicable state, federal, or local codes and standards.

ENSURE personal safety and protective equipment is properly maintained to ensure protection of personnel by ensuring the insulating capability has been retained by performing testing prior to initial use and thereafter not to exceed three years.

4.10.2 Inspection of Protective Equipment

ENSURE insulating equipment is inspected by the assigned employee/personnel for damage **PRIOR TO** each day's use and immediately following any incident that can reasonably be suspected to have caused damage. **ENSURE** rubber-insulating gloves will be given an air test by blowing into the glove and sealing off the top of the glove and inspecting for cuts, tears, holes, or air leakage **PRIOR TO ANY** use.

Insulating equipment with the following defects shall be tagged "Do not use," isolated from non-defective insulating equipment, and reported to a supervisor:

- Holes, tears, punctures, or cuts
- Ozone cutting or ozone checking (the cutting action produced by ozone on rubber under mechanical stress into a series of interlacing cracks)
- Embedded foreign object
- Texture changes (e.g., swelling, softening, hardening, becoming sticky or inelastic)
- Any other defect that damages the insulating properties

ENSURE repaired insulating equipment is properly tested when reused by employees/personnel to **ENSURE** it can withstand the voltage for which it is intended to be used.

ENSURE insulating protective equipment is tested by an approved electrical testing service in accordance with 29 CFR 1910.137. **VERIFY** the insulating protective equipment is stamped/tagged with the date it was tested, the class of the equipment, and the test voltage.

ENSURE test instruments, equipment, and accessories are labeled and rated for the voltages and ANY other limits that apply. **ENSURE** test instruments, equipment, and accessories are tested and certified on a periodic basis in accordance with NFPA 70E.

4.11 Safety Grounding Equipment

ENSURE safety grounding equipment inspections include a visual inspection for damage and are tested for tightness. **ENSURE** safety grounding equipment inspections do not to exceed one year.

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ENSURE safety grounding equipment is inspected for cuts in protective sheath and damage to conductors and that clamp and connector strain relief devices are checked for proper for torque/tightness.

ENSURE if safety grounding equipment is repaired or modified it must be properly tested **PRIOR TO** being returned to service.

ENSURE testing of the temporary protective grounding equipment is performed as service conditions require.

ENSURE grounding and testing devices are stored properly in a clean and dry area and properly inspected and tested **PRIOR TO** being used.

4.12 Test Instruments and Equipment

4.12.1 Testing, Troubleshooting, and Voltage Measurements

The following elements of control considerations, requirements, and information must be established prior to the performance of testing:

1. The voltage detector to be used, the required PPE, and the QEP who will use to verify proper operation of the voltage detector before and after use
2. Define the boundary of the ESWC
3. The requirement to test before touching every exposed circuit part, conductor, or equipment within the defined boundary of the work area of job/task
4. The requirement to retest for absence of voltage (e.g., undocumented zero energy test, lack of nominal voltage) when circuit conditions change or when the job location is left unattended
5. The job planning considerations that include methods of verification where there is no accessible exposed point to take voltage measurements

ENSURE electrical test equipment and accessories are properly rated for circuits and equipment, approved for the purpose, and in accordance with the manufacturer's instructions.

ENSURE electrical test equipment and accessories that are designed for the environment in which they are used, being visually inspected to ensure functional integrity (e.g., damage to outer case, oil or grease removed, leads for nicks and exposed wiring, damage to probes) and properly repaired or replaced **PRIOR TO** each use, and verified on a known source before and after an absence of voltage test.

NOTE 1: *If performing testing, troubleshooting, or voltage measurements, including a zero energy/lack of nominal voltage test, an applicable Risk Assessment using CFN-1317 is required PRIOR TO starting the job/task.*

NOTE 2: *Only QEPs currently trained and qualified for the voltages (e.g., LQEP, MQEP) to be tested may perform testing, troubleshooting, or voltage measurements on electrical circuit parts, conductors, or equipment.*

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4.12.2 Proper Use of Proximity Testers

ENSURE on electrical systems more than 1000 V, that noncontact test instruments (e.g., proximity testers) are permitted to be used to test each phase conductor by SUQEP (i.e., MQEP) for Zero-Energy Checks in electrical switchgear.

PRIOR TO use of proximity testers in these instances, the QEP must meet the training and qualification requirements applicable to the voltages to be tested.

ENSURE for voltages that are less than 1000 Volt Alternating Current, the noncontact tester **WILL NOT** be used as it **DOES NOT** meet the requirements for a Zero-Energy Check or verification under Y17-95-64-801. The proximity tester may be used by a QEP as a personal verification tool only for voltages less than 1000 V.

ENSURE when used for trouble shooting circuits, a digital multimeter/multimeter is used to verify the proximity tester results.

PRIOR TO being issued a proximity tester, QEP will be trained on the proper use and limitations of the proximity tester that will be issued by the tool room. No personal-use proximity testers are authorized on the UPF construction site. The proximity tester will be issued only to a QEP **AFTER** having the appropriate documented training. The authorized trainer sends an email to the Tool Room and ES&H which will add the QEP to the proximity tester “competent person list.”

4.13 Alerting Techniques

4.13.1 Safety Signs and Tags

ENSURE safety signs, safety symbols, and tags are used when necessary to warn employees/personnel of EHs which could put them in danger.

VERIFY ALL signs and tags meet applicable requirements of state, federal, local/regional codes and standards.

4.13.2 Barricades

VERIFY safety signs are used in conjunction with barricades to limit or prevent employee/personnel access to work/task area containing exposed energized electrical circuit parts, conductors, or equipment.

ENSURE if the barricade would increase likelihood of exposure to EHs that they are not used.

ENSURE barricades are no closer than the LAB given for Shock Protection Approach Boundaries to exposed energized electrical conductors or circuit parts for the related voltage.

VERIFY barricades are not placed closer than the AFB, where it is greater than the LAB.

NOTE: *The barricade installation and general requirements can be referenced in UPF-CP-214*, Barricades and Signs.

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4.13.3 Attendants

ENSURE if safety signs and barricades **DO NOT** provide sufficient warning/protection from EHs, an attendant is used to warn/protect employees/personnel.

ENSURE manual signaling and alerting are performed by attendant to keep employees/personnel outside out of work/task areas where they could be exposed to EHs.

4.14 Electrical Equipment Labeling

ENSURE Electrical Equipment Labeling is reviewed and updated not to exceed a five-year basis (i.e., switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers) for accuracy (i.e., nominal system voltage, arc flash boundary, available incident energy and work distance, minimum arc rating of clothing, level of PPE).

4.15 Look-Alike Equipment

ENSURE when working on de-energized equipment that is placed in an ESWC in a work area that includes equipment of a similar size, shape, and construction that alerting techniques (e.g., safety sign and tags, barricades, attendants) are used to prevent personnel from entering look-alike equipment.

ENSURE when working on de-energized equipment that is placed in an ESWC in a work area where look-alike equipment is present that all applicable labeling is accurate, up-to-date drawings, and diagrams are a match to the work/task location, and the verification of the relationship between electrical sources and equipment are established **PRIOR TO** working on look-alike equipment.

4.16 Audit Requirements

NOTE 1: *Ensure all assessments and audits are submitted to the integrated audit schedule, which is maintained by Consolidated Nuclear Security (CNS) Quality Assurance.*

NOTE 2: *Audits shall be performed and documented using Y60-95-803,* UPF General Assessments*, as applicable.*

4.16.1 Electrical Safety Program Audit

The triennial audit is performed to ensure compliance with all applicable codes, practices, principles, and procedures that are indicated in the Electrical Safety Program. The information received from this audit will be used to document and improve the Electrical Safety Program.

4.16.2 Field Work Audit

The annual FWAs are performed on a yearly basis to ensure compliance with all applicable codes, practices, principles, and procedures that are indicated in the Electrical Safety Program. Any discrepancies in practice, procedures, or training will be revised to ensure all requirements for electrical safety-related work practices are documented and implemented.

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4.16.3 Lockout/Tagout Audit

The LOTO Program and procedure audits are conducted on a yearly basis to ensure compliance with all applicable codes, practices, principles, and procedures that are indicated in the Electrical Safety Program. At least one actual LOTO in progress of being performed will be audited annually. The LOTO Program and procedure audit will attempt to identify any discrepancies in the LOTO procedure or training to improve electrical safety-related work practices.

4.17 Emergency Response

The QEPs that either work on energized electrical circuits, conductors, and equipment or work as a Buddy/Safety Observer (B/SO), which could provide immediate response to a medical emergency are trained, certified, and qualified for the proper use of an Automated External Defibrillator (AED), how to safely perform Cardiopulmonary Resuscitation (CPR), deliver First Aid (FA), and safely perform Contact Release.

ENSURE any QEPs performing any job/task or verifications on energized electrical circuits complete UPF AHA Adult CPR, AED, and FA training. Classroom based training will occur on an annual basis.

NOTE: *All electrical incidents, whether or not an injury results, shall be reported to the Y-12 Operations Center (865) 574-7172 in order to initiate the investigation process.*

4.17.1 Automated External Defibrillator

PRIOR TO entry, assess the area/situation using Human Performance (HU) Tools (i.e., situational awareness, self-check) to determine if the location is safe to enter.

PRIOR TO entry contact the Operations Center requesting for Emergency Medical Services (EMS) and a QEP to de-energize prior to entering the area.

PRIOR TO contact Universal Precautions should be used to prevent contact with bloodborne pathogens including blood or Other Potentially Infectious Material (OPIM).

ENSURE you **DO NOT** use an AED on a conductive surface, in moving vehicles, in direct contact with water or fluids, or on someone under eight years old or under 90 pounds.

ENSURE an AED is **NOT** used around flammable materials, **DO NOT** wipe the victim's chest with alcohol, and **DO NOT** use on someone with nitroglycerine or other patches without removing.

ENSURE QEPs who either work on energized electrical circuits, conductors, and equipment or work as a B/SO, which could provide immediate response to a medical emergency use AEDs in accordance with training and certification received from certifying body.

ENSURE AED retraining/training occurs annually.

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4.17.2 Cardiopulmonary Resuscitation

PRIOR TO entry, assess the area/situation using HU Tools (i.e., situational awareness, self-check) to determine if the location is safe to enter.

PRIOR TO entry contact the Operations Center requesting for EMS and a QEP to de-energize **PRIOR TO** entering the area.

PRIOR TO contact Universal Precautions should be used to prevent contact with bloodborne pathogens including blood or OPIM.

ENSURE QEPs who either work on energized electrical circuits, conductors, and equipment or work as a B/SO, which could provide immediate response to a medical emergency use CPR in accordance with training and certification received from certifying body.

ENSURE CPR retraining/training occurs annually.

4.17.3 First Aid

PRIOR TO entry, assess the area/situation using HU Tools (i.e., situational awareness, self-check) to determine if the location is safe to enter.

PRIOR TO entry contact the Y-12 Operations Center requesting for EMS and a QEP to de-energize PRIOR TO entering the area.

PRIOR TO contact Universal Precautions should be used to prevent contact with bloodborne pathogens including blood or OPIM.

ENSURE QEPs who either work on energized electrical circuits, conductors, and equipment (or work as a B/SO), which could provide immediate response to a medical emergency use FA in accordance with training and certification received from certifying body.

ENSURE FA retraining/training occurs annually.

4.17.4 Contact Release Requirements

ENSURE ALL QEP who perform any job/task or verifications on energized electrical circuits complete the applicable training in Contact Release for the safe release of victims exposed to electrical circuit parts, conductors, or equipment **PRIOR TO** being exposed to shock hazards.

PRIOR TO entry assess the area/situation using HU Tools (i.e., situational awareness, self-check) to determine if it is safe to enter.

PRIOR TO entry contact the Operations Center requesting for EMS and a QEP to de-energize PRIOR TO entering the area.

ENSURE contact release is performed using a rescue hook or non-conductive materials to remove victim from the hazardous area if properly trained to do so safely.

ENSURE the applicable/appropriate PPE for the job/task is worn in accordance with NFPA 70E.

ENSURE contact release retraining/training occurs annually.

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NOTE: *All personnel who respond to medical emergencies shall be trained in UPF AHA Adult CPR, AED, and FA.*

4.18 Maintenance of Electrical Equipment and Systems

The condition of maintenance should be taken into consideration when performing PM or EPM and in the performance of Arc Flash and Shock Assessments, to determine risks associated with electrical equipment and systems, using CFN-1317.

4.18.1 Electrical Equipment and System Maintenance

PRIOR TO the maintenance and operation of any electrical equipment or system **ENSURE** any training and qualifications required to perform work task have been completed and are documented.

PRIOR TO starting job/task **ENSURE** all associated and applicable risk assessments and permits are completed to ensure UPF processes and procedures are being followed for safe work practices and to establish ESWC.

ENSURE ALL covers or safeguards that are removed from equipment for maintenance are replaced, once the job/task activity is completed, and **PRIOR TO** returning to service.

ENSURE the proper PPE and tools are used for maintenance and operation.

ENSURE any required specialized tools, unusual PPE, or other equipment used for maintenance or operation are used in accordance with UPF processes, procedures, and in accordance with manufacturer's instructions and with NFPA 70E.

ENSURE up-to-date schematics, diagrams, drawings are used, using human performance tools (e.g., questioning attitude, stop work authority) if the equipment or system **DOES NOT** align with provided information. **ENSURE ALL** maintenance of electrical equipment and systems is conducted, performed, and completed in accordance with manufacturer's instructions following all applicable NFPA 70E requirements.

4.18.2 Substations, Switchgear Assemblies, Switchboards, Panelboards, Motor Control Centers, and Disconnect Switch Maintenance

ENSURE enclosures be kept free of materials that could potentially expose personnel to EHs.

ENSURE area enclosures, including fences, physical protection, enclosures, or other protective means used to prevent unauthorized access or unintentional contact with energized conductors or circuit parts are properly maintained in accordance with manufacturer's instructions while using NFPA 70E.

ENSURE conductors, including current carrying conductors (e.g., buses, switches, disconnects, joints, and terminations), and bracing are properly maintained in accordance with manufacturer's instructions while using NFPA 70E.

ENSURE the insulation integrity is maintained to support the associated voltages impressed in accordance with manufacturer's instructions while using NFPA 70E.

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ENSURE protective devices are maintained to adequately withstand or interrupt the available fault current in accordance with manufacturer's instructions while using NFPA 70E.

4.18.3 Premises Wiring Maintenance

ENSURE covers for wiring system components are in place with all associated hardware, and that there are no unprotected openings.

ENSURE open wiring protection location or barrier is maintained to prevent unintentional contact.

ENSURE raceways and cable trays are maintained to provide physical protection and support conductors.

4.18.4 Controller Equipment Maintenance

ENSURE controller equipment is maintained, including equipment that governs starting/stopping, direction of motion, acceleration, speed, protection from rotating equipment, and other power utilization apparatus which are in the workplace.

ENSURE controller equipment maintenance provides protection and control circuitry guarding to prevent unintentional contact and prevent electrical or mechanical hazards.

4.18.5 Fuses and Circuit Breaker Maintenance

ENSURE there are no breaks or cracks in fuse cases, ferrules, and insulators.

ENSURE fuse clips are maintained to provide adequate contact with fuses.

ENSURE current limiting and non-current limiting fuse holders are **NOT** altered or modified to fit fuses from each other for which they are **NOT** designed.

ENSURE molded-case circuit breakers are maintained to **ENSURE** they are free from cracks in cases and cracked or broken operating handles.

ENSURE circuit breaker testing after electrical faults are inspected and tested in accordance with manufacturer's instructions.

4.18.6 Rotating Equipment Maintenance

ENSURE terminal chambers, enclosures, and terminal boxes are maintained to safeguard from unintentional contact with any exposed energized conductors, circuit parts, and other EHs.

ENSURE guards, barriers, and access plates are maintained to prevent personnel from coming into contact with moving or energized parts.

4.18.7 Portable Electrical Tools and Equipment Maintenance

ENSURE attachment plugs, receptacles, cover plates, and cord connectors for portable electric tools and equipment are maintained in accordance with manufacturer's instruction and the following criteria:

1. There are no breaks, damage, or cracks exposing energized conductors and circuit parts

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2. There are no missing cover plates
3. Terminations have no stray strands or loose terminals
4. There is not any missing, loose, altered, or damaged blades, pins, or contacts
5. Polarity is correct

5.0 RECORDS

Records generated by this Document shall be maintained in accordance with Y15-95-800, *UPF Document Management*.

The following records are generated:

Record or Form Number	Record Title	System/ Location	Document Type
CFN-1232	*Energized Electrical Work Permit (EEWP)*	InfoWorks	EEWP
CFN-1261	*UPF Electrical Inspector Approval*	InfoWorks	EIDF
CFN-1324	*Temporary Electrical Work Practices and Plan GFCI Inspection and Test Record*	InfoWorks	TEGI
CFN-1344	*UPF Annual Field Work Audit*	InfoWorks	TQR
CFN-1345	*UPF Initial Qualified Person Checklist*	InfoWorks	TQR
CFN-1359	*Electrical Event Investigation Report*	InfoWorks	ELER

6.0 REFERENCES

6.1 Source References

520-U07-00229, *Startup functional independent review program, Initial Energization/Synchronization Procedures and Independent Reviews*

Bechtel Power Corporation (BPC) Procedure 2KP_K10B_00296, *Records Retention and Turnover*

Bechtel Power Corporation (BPC) Procedure 4MP-T81C-N3314, *Working On or Near Energized Circuits*

IEEE 1584-2018, *IEEE Guide for Performing Arc-Flash Hazard Calculations*

SVP-RM-801768-A111, *Facility Grounding System (GND) System Verification Matrix for the UPF*

TGUI-TR-801768-A003, *UPF Training Requirements Matrix (TRM)*

UL 943, *UL Standard for Ground-Fault Circuit-Interrupters*

UPF-CP-108, *UPF Event Management and Investigation*

UPF-CP-227, *UPF Safety Watches*

6.2 Interfacing References

NOTE: *All 29 CFR 1910s are referenced in PL-RM-801768-A001.*

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10 CFR 851, *Worker Safety and Health Program*

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1910.137, *Electrical Protective Equipment*

29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*

29 CFR 1910.269, *Electric Power Generation, Transmission, and Distribution*

29 CFR 1910.302, *Electric Utilization Systems*

29 CFR 1910.303, *General*

29 CFR 1910.304, *Wiring Design and Protection*

29 CFR 1910.305, *Wiring Methods, Components, and Equipment for General Use*

29 CFR 1910.308, *Special Systems*

29 CFR 1910.331, *Scope*

29 CFR 1910.332, *Training*

29 CFR 1910.333, *Selection and Use of Work Practices*

29 CFR 1910.335, *Safeguards for Personnel Protection*

29 CFR 1926, *Safety and Health Regulations for Construction*, Subpart K, "*Electrical*" (Code of Record 2013)

IEEE C2-2012, *National Electric Safety Code®*

ML-SH-801768-A001, *UPF Quarterly Inspection Color Codes*

NFPA 70, Article 445, *Generators*

NFPA 70, Article 450, *Transformers and Transformer Vaults*

NFPA 70, Article 460, *Capacitors*

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

NFPA 70E, *Standard for Electrical Safety in the Workplace®*, Article 130, *Work Involving Electrical Hazards*

OT-SH-801768-A038, *UPF Electrical Hazard and Incident Investigations*

PL-RM-801768-A001, *UPF Design Code of Record*

UPF-CP-200, *UPF General Safe Work Practices*

UPF-CP-214, *Barricades and Signs*

UPF-MANUAL-CM-001, *Uranium Processing Facility Construction Electrical Safety Manual*

Y15-95-100, *UPF Control of Temporary Modifications*

Y15-95-800, *UPF Document Management*

Y15-95-813, *Suspect/Counterfeit Item Prevention and Detection*

Y15-95-926, *UPF Work Authorization*

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Y17-95-64-801, *UPF Energy Isolation Management (EIM) – Lockout/Tagout (LOTO)*

Y17-95-64-822, *UPF Site Excavation and Backfill*

Y17-95-64-823, *UPF Field Level Hazard Assessment//Job Hazard Analysis Program (FLHA/JHA Process)*

Y17-95-64-871, *UPF Construction Hoisting and Rigging Work Operations*

Y17-95-64-880, *UPF Electrical Safety in the Workplace*

Y60-95-803, *UPF General Assessments*

Y73-528, *Electrical Safety Manual*

6.3 Forms

CFN-1232, *Energized Electrical Work Permit (EEWP)*

CFN-1261, *UPF Electrical Inspector Approval*

CFN-1317, *UPF Electrical Hazard Risk Assessment & Testing Form*

CFN-1324, *Temporary Electrical Work Practices and Plan GFCI Inspection and Test Record*

CFN-1325, *Temporary Power Maintenance Record*

CFN-1326, *Temporary Power – Grounding Assurance Test Record*

CFN-1327, *Temporary Power Request Form*

CFN-1344, *UPF Annual Field Work Audit*

CFN-1345, *UPF Initial Qualified Person Checklist*

CFN-1359, *UPF Electrical Event Investigation Report*

7.0 SUPPLEMENTAL INFORMATION

Appendix A, *Acronyms and Definitions*

Appendix B, *Personal Protective Equipment (PPE)*

Appendix C, *Examples of Equipment Arc Flash Labels*

Appendix D, *Establishing an Electrically Safe Work Condition*

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APPENDIX A
Acronyms and Definitions

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Acronyms

AED - Automated External Defibrillator 35
AEGCP - Assured Equipment Grounding Conductor Program 14
AFB - Arc Flash Boundary 10
B/SO - Buddy/Safety Observer 35
BNI - Bechtel National, Inc. 8
CFR - Code of Federal Regulations 6
CNS - Consolidated Nuclear Security 35
CPR - Cardiopulmonary Resuscitation 35
DC - Direct Current 29
ECAHJ - Electrical Contractor Authority Having Jurisdiction 9
EEWP - Energized Electrical Work Permit 7
EH - Electrical Hazard 9
EMS - Emergency Medical Services 36
EPM - Electrical Preventative Maintenance 25
ERAT - Electrical Hazard Risk Assessment & Testing 7
ES&H - Environmental, Safety, and Health 8
ESWC - Electrically Safe Work Conditions 7
FA - First Aid 35
FWA - Field Work Audit 7
GFCI - Ground Fault Circuit Interrupter 8
HU - Human Performance 36
HVAC - Heating, Air Conditioning and Ventilation 26
ID - Identification 27
IEEE - Institute of Electrical and Electronics Engineers 6
JHA - Job Hazard Analysis 7
LAB - Limited Approach Boundary 12
LOTO - Lockout/Tagout 7
LQEP - Low-Voltage Qualified Electrical Person 9
MQEP - Medium-Voltage Qualified Electrical Person 9
MSAD - Minimum Safe Approach Distance 12
NEC - National Electric Code 16
NEMA - National Electrical Manufacturers Association 26
NFPA - National Fire Protection Association 6
OPIM - Other Potentially Infectious Material 36
OSHA - Occupational Safety and Health Administration 6
PDC - Power Distribution Cart 26
PDU - Power Distribution Unit 26
PIC - Person in Charge 29
PM - Preventative Maintenance 21
PPE - Personal Protective Equipment 8
PSUM - Project Startup Manager 8

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Definitions

Arc Flash Boundary (AFB)	An approach limit that specifies a distance from exposed live parts, within which a person could receive a second-degree burn if an electrical arc flash were to occur. The AFB is the distance from the arc source (energized exposed equipment) at which the potential incident heat energy from an arcing fault falling on the surface of the skin is 1.2 cal/cm^2. An exposure to 1.2 cal/cm^2 would ordinarily result in a curable second-degree burn. Within this boundary, personnel are required to wear protective clothing like FR shirts, pants, and other equipment to cover various parts of the body. This distance may vary from equipment to equipment since it is a function of the available fault current of the system at that point, the voltage, and the tripping characteristics of the upstream protective device.
Buddy/Safety Observer (B/SO)	A second qualified electric person who is required to be present and within the immediate area at all times while work is being performed on potentially energized electrical equipment at 50 V or more. The B/SO must know which breaker to open if it becomes necessary to shut off the power. The B/SO currently trained and qualified in emergency response and contact release, to be wearing the appropriate and applicable PPE for the EH where they are located, and have the necessary equipment readily available (e.g., AED, Contact Release, Other Protective Equipment/Rubber-Insulating Mat).
Cable	A combination of conductors insulated with a common jacket that provides protection during cable handling and pulling activities.
Cord	Two or more flexible insulated conductors enclosed in a flexible covering that provides mechanical protection.
Electrical Incident	An undesirable condition or unintentional event where an electrical current either led to the injury of a person, damage to property, or had the potential to do either or both.
Electrically Safe Work Condition (ESWC)	A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked out or tagged out in accordance with established standards, tested to ensure the absence of voltage (i.e., zero energy), and if necessary, temporarily grounded for personal protection.

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APPENDIX A
Acronyms and Definitions

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Energized Electrical Work	Any work on exposed non-insulated parts involving more than 50 V where a shock hazard exists. De-energized circuits in close proximity to live unprotected circuits will be treated as energized circuits. When the plane of the front of an electrical panel or other enclosure is broken and it has exposed energized circuits in it, all of the wiring will be treated as if it were energized.
Energized Electrical Work Permit	A permit for where energized work is permitted and performed when the employer has demonstrated that being performed in a de-energized state would introduce additional hazards, increased risk, or would be infeasible due to equipment design or limitations.
Exposed	(As applied to live parts) Capable of being inadvertently touched or approached nearer than a safe distance by any individual. This term is also applied to parts not suitably guarded, isolated, or insulated.
Flexible Cable	A cable or special cable manufactured with flexing or constant flexing properties.
Flexible Cord Set	The use of Flexible Cords and Cables, often interconnected, which are used as temporary branch circuit conductors used for temporary wiring as permitted and approved (amperage, voltage, wattage) for the conditions of use and location.
Job Hazard Analysis (JHA)	A process that identifies key job activities/tasks associated with a definable activity, examines key job activities/tasks to determine the foreseeable hazards associated with the task (e.g., chemical, biological, physical, workplace), and establishes criteria to eliminate or control the hazards.
Limited Approach Boundary (LAB)	An approach limit that specifies a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists; it is not to be crossed by unqualified persons unless escorted by a qualified person.
Lockout/Tagout (LOTO)	The placement of a lock and tag on an energy-isolating device to prevent the unexpected energizing, start-up, or release of stored energy from equipment or machines that could cause injury to personnel. Methods of LOTO include locking and tagging the entire electrical supply or individual switches, locking or blocking internal moving parts in resting position, or conducting both if the potential exists that performing one or the other does not control all energy sources.

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Qualified Electrical Person (QEP)	One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received electrical safety training to identify the hazards and reduce the associated risk. All UPF Qualified Electrical Personnel are qualified to either/both a Low Voltage Qualified Electrical Person (LQEP) for < 600 V or a Medium Voltage Qualified Electrical Person (MQEP) for ≥ 600 V to 35,000 V. The UPF Project max voltage is 13,800 V. Qualified personnel are specifically trained in the requirements contained in both NFPA 70E and 29 CFR 1910.332. Such persons shall also be familiar with the proper use of special precautionary techniques, PPE, insulating/shielding materials, and insulating tools and test equipment. Qualified persons permitted to work within LABs of exposed energized conductors and circuit parts shall, at minimum, be additionally trained in all of the following: • The skills and techniques necessary to distinguish exposed energized electrical parts from other parts of electrical equipment • The skills and techniques necessary to determine the nominal voltage of exposed energized parts • The space/clearance distances, specified in Table 1 and Table 2 in Appendix B, of Y17-95-64-880, and the corresponding voltages to which the qualified person will be exposed • The decision-making process necessary to determine the degree and extent of the hazard, and the PPE and job planning necessary to perform the task safely • An employee who is undergoing on-the-job training and, in the course of such training, has demonstrated an ability to perform duties safely commensurate with the level of training received under the direct supervision of a qualified person shall be considered to be a qualified person for the performance of those duties • An Electrician, Foreman, General Foreman, Field Engineer, Superintendent, STE, or STR could be designated as a QEP based on confirmed qualifications
Restricted Approach Boundary (RAB)	An approach limit that specifies a distance from an exposed energized electrical conductor or circuit part within which there is an increased risk of shock due to electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part; it is to be crossed by only qualified persons.

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Work On (Energized Electrical Conductors or Circuit Parts)	Coming in contact with energized electrical conductors or circuit parts with the hands, feet, or other body parts, with tools or probes, or with test equipment, regardless of the PPE worn. There are two categories of Work On: • **Diagnostic (testing)** is taking readings or measurements of electrical equipment with approved test equipment that does not require making any physical change to the equipment; this would require an ERAT (i.e., CFN-1317) • **Repair** is any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.); this would require an EEWP if performing directly on the energized component
Zero-Energy Check	A task performed only by a qualified electrical person to test de-energized and isolated conductors and circuit parts. The qualified electrical person will verify proper operation of the test equipment before and after use. **NOTE:** *For voltage levels ≥ 1000 V, Startup Electrical Personnel qualified as MQEP shall perform all Zero-Energy Checks, using noncontact test instruments to test each phase conductor.* The task is to prove that conductors and circuit parts are free from any connection to a voltage source and that no residual or stored electrical charge is present within the defined boundaries of the equipment or system being worked on. The qualified electrical person performing the test also ensures that grounding measures have been installed if required. Thorough and successful zero energy testing enables the LOTO to be completed for the isolation points defined for the equipment or system via its LOTO form. Once the LOTO form is completed and signed by the qualified personnel, the level of electrical safety PPE required for this testing can be reduced as long as the installed LOTO remains in place and the associated conditions and equipment do not change in any way.

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APPENDIX B
Personal Protective Equipment (PPE)

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NFPA 70E, *Standard for Electrical Safety in the Workplace*®, Article 130, *Work Involving Electrical Hazards*	
PPE Category 1	
Arc-rated clothing minimum arc rating of 4 cal/cm2	**Protective Equipment**
• Arc-rated long-sleeve shirt and pants or art-rated coverall • Arc-rated face shield or arc-flash suit hood • Arc-rated jacket, parka, rainwear, or hard hat liner (AN)	• Hard hat • Safety glasses or safety goggles (SR) • Hearing projection (ear canal inserts) • Heavy-duty leather gloves • Leather footwear (AN)
PPE Category 2	
Arc-rated clothing minimum arc rating of 8 cal/cm2	**Protective Equipment**
• Arc-rated long-sleeve shirt and pants or arc-rated coverall • Arc-rated flash suit hood or arc-rated face shield and arc-rated balaclava • Arc-rated jacket, parka, rainwear, or hard hat liner (AN)	• Hard hat • Safety glasses or safety goggles (SR) • Heavy-duty leather gloves • Leather footwear
PPE Category 3	
Arc-rated clothing selected so the system arc rating meets the required minimum arc rating of 25 cal/cm2	**Protective Equipment**
• Arc-rated long-sleeve shirt (AR) • Arc-rated pants (AR) • Arc-rated coverall (AR) • Arc-rated arc flash suit jacket (AR) • Arc-rated arc flash suit pants (AR) • Arc-rated arc flash suit hood • Arc-rated gloves • Arc-rated jacket, parka, rainwear, or hard hat liner (AN)	• Hard hat • Safety glasses or safety goggles (SR) • Hearing protection (ear canal inserts) • Leather footwear
PPE Category 4	
Arc-rated clothing selected so the system arc rating meets the required minimum arc rating of 40 cal/cm2	**Protective Equipment**
• Arc-rated long-sleeve shirt (AR) • Arc-rated pants (AR) • Arc-rated coverall (AR) • Arc-rated arc flash suit jacket (AR) • Arc-rated arc flash suit hood • Arc-rated gloves • Arc-rated jacket, parka, rainwear, or hard hat liner (AN)	• Hard hat • Safety glasses or safety goggles (SR) • Hearing protection (ear canal inserts) • Leather footwear

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The following table identifies usage of rubber-insulating gloves and equipment.

Maximum Use Voltage for Rubber-insulating Gloves			
Class Designation of Glove or Sleeve	**Maximum AC-Use Voltage RMS, Volts**	**Maximum DC-Use Voltage Avg. Volts**	**Distances Between Gauntlet and Cuff Minimum**
00	500	750	13mm (0.5 in.)
0	1,000	1,500	13mm (0.5 in.)
1	7,500	11,250	25mm (1 in.)
2	17,000	25,500	51mm (2 in.)
3	26,500	39,750	76mm (3 in.)
4	36,000	54,000	102mm (4 in.)
Maximum Test Intervals for Rubber-insulating Equipment			
Rubber-insulating Equipment	When to Test		Governing Standard for Test Voltage
Blanket	Before first issue; every 12 months thereafter		ASTM F479
Covers	If insulating value is suspect		ASTM F478
Gloves	Before first issue; every six months thereafter		ASTM F496
Line Hose	If insulating value is suspect		ASTM F478
Sleeves	Before first issue; every 12 months thereafter		ASTM F496

NOTE: *Information provided and based on applicable ASTM and NFPA 70E standards.*

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APPENDIX C
Examples of Equipment Arc Flash Labels

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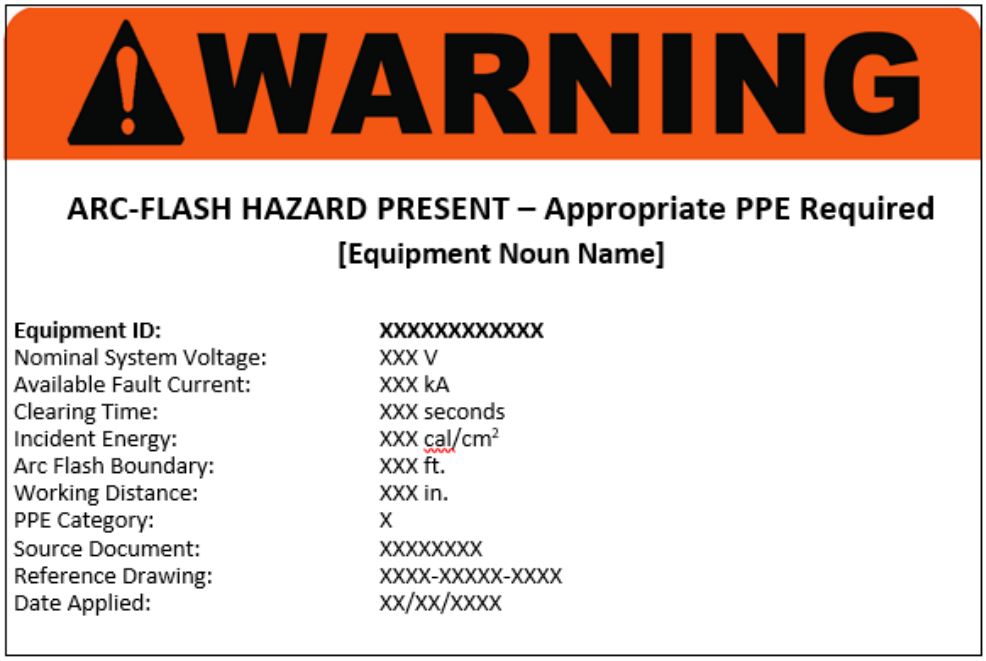

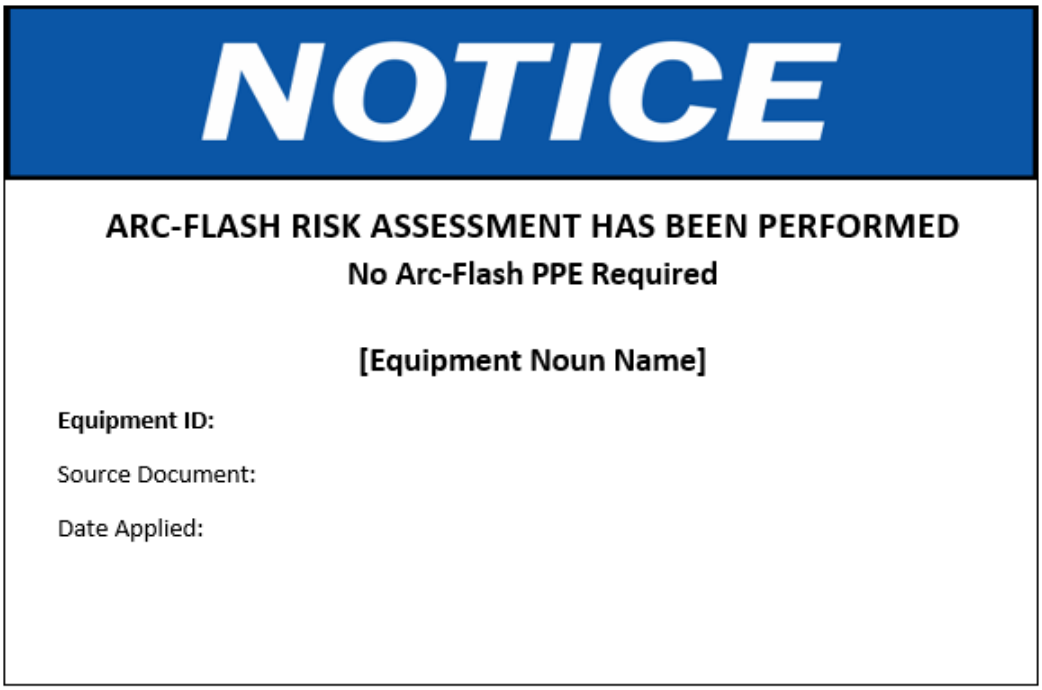

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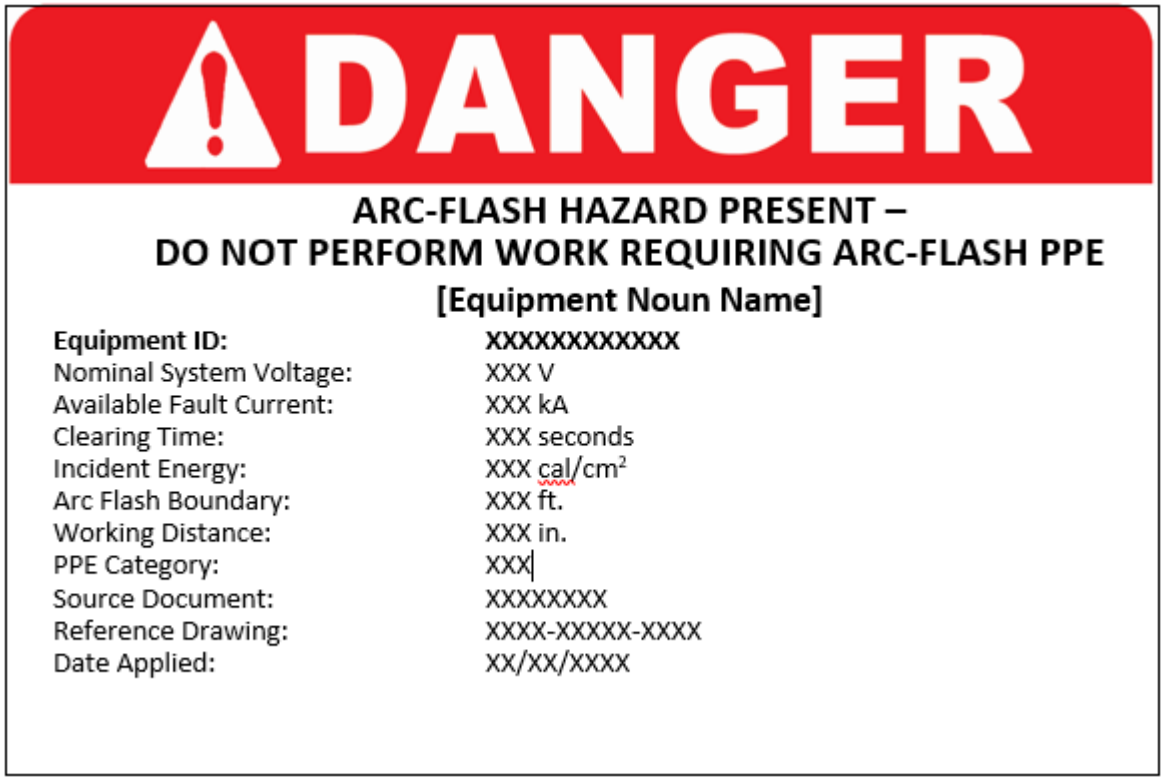

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APPENDIX D
Establishing an Electrically Safe Working Condition

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The ESWC is established by identifying and implementing the following elements of control: de-energizing equipment (shutdown), stored energy, disconnecting means to verify circuit is held open, LOTO responsibility and PIC, verification that equipment cannot be restarted, testing equipment and requirements to be used, grounding requirements established, shift change to transfer responsibility, coordination with PIC for other job/task or personnel, accountability of all authorized/affected employees and personnel, LOTO application in accordance with applicable procedures, details for removal of LOTO devices, steps for the release for return to service, and the temporary release for process for testing/positioning (must be identical for release for return to service) as indicated in Y17-95-64-801 and applicable UPF forms, processes, and procedures.

The following steps should be used to obtain an ESWC:

Step 1 Ensure all applicable training, retraining, and qualifications are current and rated for the type of voltage and equipment of the job/task to be performed.

Step 2 Ensure any relevant supporting information is accurate such as: pre-Job planning/briefs, JHA, updated documentation (forms, procedures, and processes, procedures, permits, FLHA Cards, and work orders/packages) are all identified and performed in accordance with this Manual and NFPA 70E.

Step 3 Identify possible electrical supply sources to equipment. Compare and contrast any associated or applicable drawings, diagrams, manufacturing/equipment labeling, and system schematics to the current configurations of the electrical source and equipment. Use Stop Work Authority if the configurations are not consistent with the documentation provided, placing the equipment into an ESWC, contacting your direct supervision in order to **ENSURE** all associated and applicable documentation can be either confirmed or updated (i.e., Engineering, Quality).

Step 4 Review the scope of work and the written discharge procedure (when applicable). Determine all safe approach boundaries and the necessary PPE and tools for the job/task. Implement the scope of work in accordance with training requirements, procedures, and manufacturer’s instructions.

Step 5 Perform the interruption of the supply current, then open the disconnecting device(s) each source feeding the equipment. Performed with a properly rated device capable of disconnecting/interrupting load currents.

Step 6 When applicable, visually inspect and **VERIFY** all blades/contacts of the disconnecting devices are fully open or that draw out-type circuit breakers are withdrawn to the fully disconnected position. If this inspection for a fully disconnected position requires any removal of engineering controls (i.e., door covers, panels), then appropriate PPE must be selected and used in accordance with either the information provided on the risk assessment for arc/shock hazards (CFN-1317) using either the Incident Energy Analysis Method or the Arc Flash Category Method (not both on the same piece of equipment).

Step 7 Apply Lockout/Tagout Devices in accordance with latest revision of Y17-95-64-801.

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Step 8 Use an appropriately rated testing device for the job/task in accordance with the latest revision of this Manual. **VERIFY** each circuit part and phase conductor in which the worker may be exposed are fully de-energized and that an ESWC is established.

Step 9 Ensure circuit parts with potential for induced voltages or stored electrical energy (i.e., capacitors) are properly grounded (e.g., temporary grounding, ground sticks) to dissipate electrical energy and eliminate potential for build-up of stored electrical energy, which may also include a discharge procedure, shorting circuit, and discharge times to meet acceptable thresholds to establish an ESWC. If potential for de-energized conductors to come in contact with energized conductors or circuit parts, then temporary safety grounding equipment will be applied rated for the available fault.

Step 10 Perform the applicable zero energy voltage testing (e.g., verification that it cannot be restarted, “test before touch,” “no look-alike” concerns addressed, grounding requirements established) on the potentially de-energized circuit parts, conductors, or equipment to ensure an ESWC has been established.

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