THE NATION'S URANIUM PROCESSING FACILITY

UPF PAGE/PROCEDURE CHANGE NOTICE (PRCN)

PRCN Number:	PRCN-UPF-MANUAL-CM-001-R06-03	Effective Date:	08/15/2023

NOTE: PRCN Effective Date cannot precede effective date of associated document.

☒ Intent Change ☐ Non-Intent Change

Associated Document Number:	UPF-MANUAL-CM-001	Rev:	6
Associated Document Title:	*Uranium Processing Facility Construction Electrical Safety Manual*		
Justification for Change:	General corrections and additions needed to Procedure. Update to Section 4.7.2 is in response to CR-25774-000-GCA-GAM-04491: *Review and revise UPF-MANUAL-CM-001 to determine if clarification is needed regarding portable generators*		

Identify the scope of the change, including mark-up (i.e., strike-through for deletions, colored text for additions) of any new, removed, or changed content.

Clerical Correction to Section 4.3.4, *Energized Work*

From:

PRIOR TO first use, and every six months thereafter, rubber-insulating gloves must have Dielectric Testing performed in accordance with ASTM ~~F479~~, *Standard Specification for In-Service Care of ~~Insulating Blankets~~.*

To:

PRIOR TO first use, and every six months thereafter, rubber insulating gloves must have Dielectric Testing performed in accordance with ASTM F496, *Standard Specification for In-Service Care of Insulating Gloves and Sleeves.*

Addition to 4.4.13, *Underground Utilities and Anomalies:*

From:

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 Hydro Excavation.

To:

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.

Addition to 4.7.2, Bullet #6:

From:

ENSURE properly rated grounding is provided on ~~**ALL**~~ portable electrical generators to include temporary light plants/systems that function as a generator, along with a lighting plant function

To:

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

Add to Section 6.2, *Interfacing References*:
ASTM F478, *Standard Specification for In-Service Care of Insulating Line Hose and Covers*
ASTM F496, *Standard Specification for In-Service Care of Insulating Gloves and Sleeves*

RC-UPF DMC
08/15/23 15:18

THE NATION'S URANIUM PROCESSING FACILITY

UPF PAGE/PROCEDURE CHANGE NOTICE (PRCN)

Preparer			
UPF Construction Issues Management	Kellie R. Coleman		08/10/23
		Printed Name/Signature	Date
Approval			
UPF Electrical Safety Manager	Jonathan T. King		08/10/23
		Printed Name/Signature	Date
UPF Sr. Startup I&C Test Engineer	James A. Carson		08/10/23
		Printed Name/Signature	Date
UPF ES&H Manager, BNI	Kieran S. Kelly		08/10/23
		Printed Name/Signature	Date
UPF Startup Manager	Jeremy D. Wilkins		08/15/23
	Phillip Tarbox for	*Printed Name/Signature*	Date
UPF Site Manager	Gary J. Cough		08/15/23
		Printed Name/Signature	Date

THE NATION'S URANIUM PROCESSING FACILITY

UPF PAGE/PROCEDURE CHANGE NOTICE (PRCN)

PRCN Number:	PRCN-UPF-MANUAL-CM-001-R06-02	Effective Date:	06/28/2023

NOTE: PRCN Effective Date cannot precede effective date of associated document.

☒ Intent Change ☐ Non-Intent Change

Associated Document Number:	UPF-MANUAL-CM-001	Rev:	6
Associated Document Title:	*Uranium Processing Facility Construction Electrical Safety Manual*		
Justification for Change:	This PRCN is in response to Condition Report 25774-000-GCA-GAM-04372, *Additional Construction Personnel Need QEP Designation to Perform DLRO, HiPot, and Megger Testing* and to bring the Electrical Safety Manual in alignment with Bechtel SWPP 4MP-T81-03314, Electrical Safety-Related Work Requirements.		

Identify the scope of the change, including mark-up (i.e., strike-through for deletions, colored text for additions) of any new, removed, or changed content.

Section 3.4 UPF Qualified Electrical Person

From:
The UPF QEP can be qualified for certain equipment and tasks and still be considered unqualified for others. The UPF QEP should read, understand, and comply with all aspects of the ESP and NFPA 70E.

To:
The UPF QEP can be qualified for certain equipment and tasks (i.e., performing Risk Assessments, performing DLRO/HiPot/Megger Testing) and still be considered unqualified for others. The UPF QEP should read, understand, and comply with all aspects of the ESP and NFPA 70E.

Section 4.3.2 Energized Electrical Work Permit
Add at the bottom of the section:

WARNING: Under no circumstances shall work inside the RAB or AFB be performed if the incident energy is >40 Cal/cm2.

Section 4.3.4 Energized Work
Add at the bottom of the section:

WARNING: Under no circumstances shall work inside the RAB or AFB be performed if the incident energy is >40 Cal/cm2.

RC-UPF DMC
06/28/23 12:58

This document has been reviewed by a Y-12 DC / UCNI-RO and has been determined to be UNCLASSIFIED and contains no UCNI. This review does not constitute clearance for Public Release.

Name: Steve Buffalo Date: 06/28/23

THE NATION'S URANIUM PROCESSING FACILITY

UPF PAGE/PROCEDURE CHANGE NOTICE (PRCN)

Section 4.4.13 Underground Utilities and Anomalies, last paragraph

From:
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.

To:
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 Hydro Excavation.
NOTE 1: *Using appropriate "Safe Work Practices" includes performing a Risk Assessment using CFN-1317.*

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**.*

Add to 6.1 Source References
UPF-CP-108, *UPF Event Management and Investigation*
TGUI-TR-801768-A003, *UPF Training Requirements Matrix (TRM)*

Add to Acronyms
DLRO – Digital Low Resistance Ohmmeter
HiPot – High Potential (High Voltage Test)
Megger – Megohmmeter

Add to Definitions
Digital Low Resistance Ohmmeter (DLRO) – A test to measure low resistance by passing current through the circuit and then measuring voltage drop.
High Potential Testing (HiPot) – Testing that exposes electrical insulation to transient over-voltages to determine if there are insulation issues which could prevent isolation from electrical equipment or circuit parts.
Megohmmeter (Megger) – A testing device that applies DC voltage and measures electrical resistance in ohms.

Preparer			
UPF Construction Issues Management	Mark W. Murdock	Mark W Murdock	06/22/23
	Printed Name/Signature		Date
Approval			
UPF Electrical Safety Manual	Jonathan T. King		06/26/23
	Printed Name/Signature		Date
UPF Sr. Startup I&C Test Engineer	James A. Carson		06/27/23
	Printed Name/Signature		Date
UPF ES&H Manager, BNI	Kieran S. Kelly		06/26/23
	Printed Name/Signature		Date
UPF Startup Manager	Jeremy D. Wilkins		06/26/23
	Printed Name/Signature		Date
UPF Site Manager	Gary J. Cough	Gary Cough	06/28/23
	Printed Name/Signature		Date

THE NATION'S URANIUM PROCESSING FACILITY

UPF PAGE/PROCEDURE CHANGE NOTICE (PRCN)

PRCN Number:	PRCN-UPF-MANUAL-CM-001-R06-01	Effective Date:	04/26/23
NOTE: PRCN Effective Date cannot precede effective date of associated document.			
☒ Intent Change		☐ Non-Intent Change	
Associated Document Number:	UPF-MANUAL-CM-001	Rev:	6
Associated Document Title:	Uranium Processing Facility Construction Electrical Safety Manual		
Justification for Change:	This PRCN is to delete reference to Y17-95-64-908, *Temporary Power Electrical Safety*, from this manual, in response to Condition Report ACT-5-25774-000-GCA-GAM-04327, *Discontinued Use of Temp Power Electrical Safety Walkdown Checklist in Procedure Y17-95-64-908* and change needed to Records section to resolve CR 25774-000-GCA-GAM-03941, *CNS Concerns with BNI Compliance with Records Identification and Retention Requirements (CNS letter 25774-22-CNS-017) [*CA],* Action 10.		

Identify the scope of the change, including mark-up (i.e., strike-through for deletions, colored text for additions) of any new, removed, or changed content.

Add to Revision Log:
Y17-95-64-908, *Temporary Power Electrical Safety* is superseded by UPF-MANUAL-CM-001, *Uranium Processing Facility Construction Electrical Safety Manual.*

Changes to Section 4.9, *Temporary Power*:
From:
4.9 Temporary Power

For any job/task that is performed working on TP, the ~~TP/TPQEP personnel~~ ~~will refer to~~ ~~Y17-95-64-908, *Temporary Power Electrical Safety*~~.

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*
- CFN-1261
- CFN-1317
- CFN-1324, *GFCI Inspection and Test Record*
- CFN-1325, *Temporary Power Maintenance Record*
- CFN-1326
- CFN-1327, *Temporary Power Request Form*
- CFN-1339, *Construction Power Generator Installation Record*
- CFN-1344
- CFN-1345
- OT-SH-801768-A037
- OT-SH-801768-A038

To:
4.9 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*
- CFN-1261, *UPF Electrical Inspector Approval*
- CFN-1317
- CFN-1324, *GFCI Inspection and Test Record*
- CFN-1325, *Temporary Power Maintenance Record*
- CFN-1326

RC-UPF DMC
04/26/23 11:54

This document has been reviewed by a Y-12 DC / UCNI-RO and has been determined to be UNCLASSIFIED and contains no UCNI. This review does not constitute clearance for Public Release.

Name: Chuck Heatherly Date: 04/26/23

THE NATION'S URANIUM PROCESSING FACILITY

UPF PAGE/PROCEDURE CHANGE NOTICE (PRCN)

- CFN-1327, *Temporary Power Request Form*
- CFN-1339, *Construction Power Generator Installation Record*
- CFN-1344
- CFN-1345
- OT-SH-801768-A037
- OT-SH-801768-A038

Revise Section 5.0, Records

From:

~~Records generated by this Document will be maintained in accordance with Y15-95-800, UPF Document Management. Record types for documents managed by the UPF DMC in InfoWorks are identified in ML-PS-801768-A004, Uranium Processing Facility Project Records Retention and Turnover List, as prescribed by Y15-95-806, UPF Records Retention and Turnover. In accordance with E-PROC-3114, Records Management, Quality Records are deemed Lifetime or Nonpermanent. The record Quality Type will be identified as Quality-Lifetime (QA-L) or Quality-Nonpermanent (QA-NP) for Quality Records. All non-quality records will be designated Non-Quality (Non-QA).~~

~~Records generated during the performance of this ESM include:~~

Record or Form Number	Record Title	~~Record Holder~~	System/ Location	Document Type	~~Quality Type~~
CFN-1232	*Energized Electrical Work Permit (EEWP)*	~~UPF DMC~~	InfoWorks	EEWP	~~QA-L~~
CFN-1261	*UPF Electrical Inspector Approval*	~~UPF DMC~~	InfoWorks	EIDF	~~QA-L~~
CFN-1317	*UPF Electrical Hazard Risk Assessment & Testing Form (permanent power only)*	~~UPF DMC~~	InfoWorks	ERAT	~~QA-L~~
CFN-1324	*GFCI Inspection and Test Record*	~~UPF Construction~~	~~Shared Drive~~	~~N/A~~	~~Non-QA~~
CFN-1325	*Temporary Power Maintenance Record*	~~UPF Construction~~	~~Shared Drive~~	~~N/A~~	~~Non-QA~~
CFN-1326	*Temporary Power – Grounding Assurance Test Record*	~~UPF Construction~~	~~Shared Drive~~	~~N/A~~	~~Non-QA~~
CFN-1327	*Temporary Power Request Form*	~~UPF Construction~~	~~Shared Drive~~	~~N/A~~	~~Non-QA~~
CFN-1339	*Construction Power Generator Installation Record*	~~UPF Construction~~	~~Shared Drive~~	~~N/A~~	~~Non-QA~~
CFN-1344	*UPF Electrical Field Work Audit*	~~UPF DMC~~	InfoWorks	TQR	~~QA-L~~
CFN-1345	*Initial Qualified Electrical Person Checklist*	~~UPF DMC~~	InfoWorks	TQR	~~QA-L~~

To:

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

The following records generated are:

THE NATION'S URANIUM PROCESSING FACILITY

UPF PAGE/PROCEDURE CHANGE NOTICE (PRCN)

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-1317	*UPF Electrical Hazard Risk Assessment & Testing Form (permanent power only)*	InfoWorks	ERAT
Document Specific	*Construction Work Package (may include CFN-1324, CFN-1325, CFN-1326, CFN-1339)*	InfoWorks	CWP
CFN-1327	*Temporary Power Request Form*	InfoWorks	TPRF
CFN-1344	*UPF Electrical Field Work Audit*	InfoWorks	TQR
CFN-1345	*Initial Qualified Electrical Person Checklist*	InfoWorks	TQR

Revise Section 6.2, *Interfacing References,* to remove:

~~E-PROC-3114, *Records Management*~~
~~ML-PS-801768-A004, *Uranium Processing Facility Project Records Retention and Turnover List*~~
~~Y15-95-806, *UPF Records Retention and Turnover*~~
~~Y17-95-64-908, *Temporary Power Electrical Safety*~~

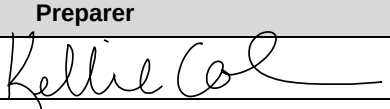
Added Section 6.3, *Forms*:

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, *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-1339, *Construction Power Generator Installation Record*
CFN-1344, *UPF Electrical Field Work Audit*
CFN-1345, *Initial Qualified Electrical Person Checklist*

Corrected typo in Definition for 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.

Preparer			
UPF Construction Issues Management	Kellie R. Coleman *Printed Name/Signature*		04/20/23 Date
Approval			
UPF Electrical Safety Manager	Jonathan T. King *Printed Name/Signature*		04/20/23 Date

THE NATION'S URANIUM PROCESSING FACILITY

UPF PAGE/PROCEDURE CHANGE NOTICE (PRCN)

UPF Sr. Startup I&C Test Engineer	James A. Carson		04/20/23
	Printed Name/Signature		Date
UPF ES&H Manager, BNI	Kieran S. Kelly		04/26/23
	Printed Name/Signature		Date
UPF Startup Manager	Phillip Tarbox For Jeremy D. Wilkins		04/25/23
	Printed Name/Signature		Date
UPF Site Manager	Gary J. Cough		04/21/23
	Printed Name/Signature		Date

THE NATION'S URANIUM PROCESSING FACILITY

Preparer:

Mark W. Murdock
UPF Issues Management — 10/05/22 Date

Approval:

Jonathan T. King
UPF Electrical Safety Manager — 10/05/22 Date

James A. Carson
Sr. Startup I&C Test Engineer — 10/25/22 Date

Kieran S. Kelly
UPF ES&H Manager, BNI — 10/05/22 Date

Jeremy D. Wilkins
UPF Startup Manager — 10/25/22 Date

Gary J. Cough
UPF Site Manager — 10/10/22 Date

Initials: MWM
Date: 11/30/22

01/30/23
~~12/09/22~~
Effective Date

Pen & Ink for Minor Correction (Non-Intent) in accordance with Y15-95-800

Page Numbers Affected: Page 1

Reason for Change:

Extend effective date to accomplish required training

O&AS Document Services will ensure the Pen & Ink change is documented as a Pending Update and will be included in the next revision, if appropriate.

Signatures below confirm the changes made are deemed Non-Intent (Minor Changes) only.

Mark W. Murdock — 11/30/22
Requestor – Printed Name/Signature — Date

Bradley Lewis — 12/02/22
Approver – Printed Name/Signature (RM/FDC for Document) — Date

RC-UPF DMC
10/26/22 11:05

This document has been reviewed by a Y-12 DCRO and has been determined to **RETAIN ITS CURRENT CLASSIFICATION.**
Name: Steve Buffalo Date: 10/26/22
Title: Y-12 Classification Specialist

This document has been reviewed by a Y-12 DC / UCNI-RO and has been determined to be UNCLASSIFIED and contains no UCNI. This review does not constitute clearance for Public Release.
Name: Chuck Heatherly Date: 10/25/22

REVISION LOG

Revision 6 ☒ Intent ☐ Non-Intent

- These changes are in response to Condition Report 25774-000-GCA-GAM-03326, Action 3, *Define NFPA 70E Auditing R2A2 (Roles and Responsibilities, Authority and Accountabilities)*:
  - Wording of the R2A2 for Auditing has been clarified and expanded to better define
  - Issuance of UPF-MANUAL-CM-001
- These changes are in response to Condition Report 25774-000-GCA-GAM-03326, Action 4, *Flow-down NFPA 70E Auditing Requirements*:
  - Audit requirements have been clearly defined in accordance with NFPA 70E
  - Issuance of UPF-MANUAL-CM-001
- These changes are in response to Condition Report 25774-000-GCA-GAM-03326, Action 6, *Complete SMCCB Change Form to Document Impacts for Implementing Latest NFPA 70E Requirements*:
  - No longer looking to change the Code of Record, incorporated as best practice where applicable
- These changes are in response to Condition Report 25774-000-GCA-GAM-03733, Action 1, *Determine if UPF Construction Electrical Safety Program includes a Risk Assessment Procedure*:
  - UPF Form CFN-1317, *UPF Electrical Hazard Risk Assessment & Testing Form*, is used to establish safe work practices and electrically safe working conditions
- These changes are in response to Condition Report 25774-000-GCA-GAM-03733, Action 2, *Determine if Section 3.11.1 exclusion from the Electrical Safety Manual needs to be removed*:
  - Section was moved to Section 4.3.3 and renamed “Exemptions to a Work Permit”
- These changes are in response to Condition Report 25774-000-GCA-GAM-03734, Action 1, *Review observation 1 and determine if UPF-MANUAL-CM-001 needs to be updated*:
  - UPF-MANUAL-CM-001, *Uranium Processing Facility Construction Electrical Safety Manual*, has not been completely updated with information from the 2015 edition of NFPA 70E, as mandated by the technical amendment to 10 CFR 851
    - The manual does not require leather protectors when using rubber-insulated gloves (correct per NFPA 70E). There are exemptions for wearing rubber gloves without leather protectors in NFPA 70E; those exceptions and instructions were added to ESM
    - The manual uses the incident energy analysis method to determine the PPE Category. This method is allowed per NFPA 70E. The Arc Flash Category Method was also added to the ESM in the revision. NFPA 70E allows the use of either/or (but not both) on the same job/task, as the use of both can create a hazard on the same job/task. To avoid job hazards, this was not included
    - The manual has references to prohibitive approach boundary. Verbiage changed to “Restricted Space” inside the Restricted Approach Boundary (RAB), where applicable in ESM
    - The manual excludes the form used to document the electrical risk assessments for performing zero energy checks. Form was actually mentioned; however, several additional references to our CFN-1317 risk assessment were added to ESM
    - The definition of “Normal Operating Condition” does not include manufacturer’s instructions. Definition verbiage changed, added to Normal Operation Condition criteria for Normal Operating Condition in body of ESM
    - The manual does not reconcile with the training curriculum; this statement should be removed. The training curriculum is updated to align with ESM as it is revised and released concurrently
- These changes are in response to Condition Report 25774-000-GCA-GAM-03734, Action 2, *Review observation 2 and determine if updates are needed to UPF-MANUAL-CM-001*:

- The electrical safety program implemented by the project does not mandate the safe to work check required to be performed by NFPA 70E 120.2(F)(2)(f). It shall be performed before starting work activities or after a prolonged, unattended break—including operability of the test instrument. This is a testing procedure, content is included as well as references to other testing procedures (Appendix D, *Establishing an Electrically Safe Work Condition*, and other locations)

- These changes are in response to Condition Report 25774-000-GCA-GAM-03427, *Y-12 APMO-O-1: Discrepancies Related to GFCI Testing Found in Construction Electrical Safety Manual (ASM-C&ESH-11.10.2020.898337)*
  - Section 4.9.3: 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
  - Section 4.5.3: ENSURE extension cords are NOT fastened with staples or otherwise suspended in a manner that damage can occur to the outer jacket or insulation
- Y17-95-64-908, *Temporary Power Electrical Safety,* is superseded by UPF-MANUAL-CM-001, *Uranium Processing Facility Construction Electrical Safety Manual*
- Form changes include:
  - CFN-1345, *Initial Qualified Electrical Person Checklist (LQEP, MQEP)*
  - CFN-1344, *UPF Electrical – Field Work Audit*
  - CFN-1339, *Temporary Electrical Work Practices and Plan Construction Power Generator Installation Record*
  - CFN-1327, *Temporary Power Request Form*
  - CFN-1326, *Temporary Power – Grounding Assurance Test Record*
  - CFN-1325, *Temporary Power Maintenance Record*
  - CFN-1324, *Temporary Electrical Work Practices and Plan GFCI Inspection and Test Record*
  - CFN-1317
  - CFN-1232, *Energized Electrical Work Permit (EEWP)*
  - CFN-1261, *UPF Electrical Inspector Approval,* was revised to remove the requirement that candidates for Electrical Inspector must be an employee of Bechtel National, Inc. (BNI)
- An evaluation determination has been performed confirming that this Command Media does implement Programmatic Requirements Management System (PRMS) requirements
- This revision is a total rewrite; due to the extent of changes, revision bars are not shown

PRCN 01

Revision 5 ☒ Intent ☐ Non-Intent

- The following changes are in response to Condition Report 25774-000-GCA-GAM-03155, *While Being Moved, One End of a 480v Cable Separated from a Meltric Plug Causing an Arc and Tripping a Breaker (OPRS Reportable NA-UPO-CNS-UPFPROJ-2021-0006)*
  - Added a bullet to Section 3.7, *Temporary Construction Power Distribution*
  - Revised first and third bullet in Section 3.16, *Electrical Power and Lighting Circuits*
- This revision incorporates the changes identified in and supersedes PRCN-UPF-MANUAL-CM-001-R04-01
- Consolidated forms CNF-1318 and CFN-1317 into CFN-1317, *UPF Electrical Hazard Risk Assessment & Testing Form*; Section 5.0, *Records*, updated accordingly
- An evaluation determination has been performed confirming that this Manual does implement Programmatic Requirements Management System (PRMS) requirements
- Other changes include:
  - Updated Section 4.0, *Records*, with new references
  - Updated references
  - Updated acronyms

• Editorial changes
Previous revisions on record

CONTENTS

1.0 INTRODUCTION

The Uranium Processing Facility (UPF) Construction Electrical Safety Manual (ESM) describes the responsibilities and requirements of UPF's Electrical Safety Program (ESP) and any work performed on or energized electrical energy sources (this includes both temporary and permanent provisions). The UPF Construction ESM and the ESP provide electrical safety-related work practices which apply to any work where there is potential for personnel to be exposed to voltages equal to or greater than 50 V.

1.1 Purpose

The purpose of the ESM 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.

The UPF Construction ESM ensures that all UPF-related Project work on electrical energy sources is performed in accordance with the appropriate and applicable electrical safety requirements, including the following: National Fire Protection Association (NFPA), National Electric Safety Code (NESC), Institute of Electrical and Electronics Engineers (IEEE) C2-2012, Occupational Safety and Health Administration (OSHA), and the Code of Federal Regulations (CFR):

- IEEE C2, *National Electric Safety Code® (Code of Record 2012)*
- NFPA 70E®, *Standard for Electrical Safety in the Workplace (Code of Record 2015)*
- NFPA 70, *National Electrical Code (Code of Record 2014)*
- 29 CFR 1926, *Safety and Health Regulations for Construction, Subpart K, "Electrical" (Code of Record 2013)*
- 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*

NOTE: *All 29 CFR 1910s are from PL-RM-801768-A001,* UPF Design Code of Record.

1.2 Scope

The UPF Construction ESM 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 and providing the UPF Construction Project with the NFPA 70E requirements (e.g., updating related forms, procedures, and processes). The UPF Electrical Safety Manager will also provide auditing requirements 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. The UPF Electrical Safety Manager serves as the UPF Electrical Safety Committee (ESC) Charter Chairperson working with the Y-12 National Security Complex (Y-12) Electrical Contractor Authority Having Jurisdiction (ECAHJ) and Y-12 Electrical Subject Matter Expert (SME) to ensure NFPA 70E requirements are incorporated to establish an electrically safe work condition (ESWC) and safe work practices for the UPF Project.

2.2 UPF Lead Electrical Superintendent/Test Lead

The UPF Lead Electrical Superintendent/Test Lead (TL) is responsible for verifying all personnel within their organizations who work with energized electrical equipment understand and implement the requirements of the ESM and are properly trained and qualified for each voltage-level or hazard-level of the task/work assigned. The UPF Lead Electrical Superintendent/TL will ensure ESP, FWA, and LOTO Audits are scheduled and conducted in accordance with NFPA 70E requirements.

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 Construction Form Number (CFN)-1345, *Initial Qualified Electrical 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, *Electrical Field Work Audit*.

2.5 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 (e.g., 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 should also ensure they are using the latest revision when following UPF procedures and processes to provide proper protection from electrical hazards (EHs). The UPF Construction Site Electricians are trained to work with a variety of electrical equipment, including the safe operation and application of Ground Fault Circuit Interrupters (GFCIs) while using human performance tools (e.g., situational awareness, questioning attitude, peer check, self-check, stop authority) to keep themselves and others safe from EHs.

2.6 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)*, for the ESP. 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.

2.7 UPF Electrical Inspector

The UPF Electrical Inspector (who is appointed by the ECAHJ) reviews design documents, performs construction rough-in inspections/final inspections, observes and participates in Construction Acceptance Testing, documents electrical installation inspections in the Electrical Inspection Request System (EIRS), and submits the inspections to the ECAHJ.

To be nominated as a UPF Electrical Inspector, one must have a minimum of five years' combined education/experience with electrical/electronic system design and/or electrical system education and experience. The Electrical Inspector will complete the required Continuing Education Credits every three years to remain an active inspector.

The Electrical Inspector must verify, inspect, and document that all requirements of applicable Electrical Codes and of the engineering design have been met before systems or equipment are energized. Inspections focus on permanent and temporary installations and are documented in the EIRS at https://engwebapps/ElectricalInspection/. It is the responsibility of the requester to properly fill out the New Request section of the electronic form. This is to include the projected inspection date, inspection type, unique identifiers (UNIDs), locations, and all applicable Design Documents as attachments.

The UPF Electrical Inspector will be nominated for approval by the Project Field Engineer and approved by the ECAHJ. The ECAHJ maintains the list of approved Electrical Inspectors for the UPF Project.

2.8 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 that all UPF construction site personnel actively comply with GFCI requirements, and providing worker support, facilities, and other resources necessary to effectively conduct required safe work practices.

2.9 UPF Startup Supervisors/Test Engineer

The UPF Startup Supervisor/Test Engineers (STEs) are responsible for verifying employees who work around electrical equipment are trained, qualified, and properly instructed, in regards to the hazards of specific equipment. The UPF Startup STEs also prepare, provide, and review Job Hazard Analyses (JHAs) with employees and submit to ES&H for review and completion.

The UPF Startup STEs review each job/task involving energized electrical equipment to ensure job briefing/planning, procedures, processes, risk assessments, and work orders are followed to ensure an ESWC and safe work practices.

The UPF Startup STEs ensure alerting techniques, other protective equipment, proper personal protective equipment (PPE), shielding/safeguarding materials, special precautionary techniques, and tools/insulated tools are used properly for the job/task in accordance with NFPA 70E standards to protect employees from electrical hazards.

The UPF Startup STEs ensure electrical work is not performed by only a single QEP when exceeding 50 V, determine boundaries (e.g., Arc Flash Boundary [AFB], Limited Approach Boundary [LAB], Restricted Approach Boundary [RAB]), complete and prepare permits and forms (e.g., Energized Electrical Work Permit [EEWP], Electrical Risk Assessment and Testing [ERAT] Form, Safety Task Analysis and Risk Reduction Talk [STARRT] Cards) as needed, and maintain EEWP log for all work on energized equipment.

2.10 BNI Environmental, Safety, and Health Representative

The 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 PPE (when requested) and provide field electrical oversight assistance.

2.11 BNI Environmental, Safety, and Health Manager

The BNI ES&H Manager has the authority to provide oversight for the regulations and standards associated with UPF procedures, processes, and safe work practices. The

BNI ES&H Manager will consult with the ECAHJ for guidance on implementing the intent and application of the UPF procedures, processes, and safe work practices.

2.12 Y-12 Electrical Contractor Authority Having Jurisdiction

The Y-12 ECAHJ, or their delegate, will have access to any area where work concerning electrical installations are being performed. The Y-12 ECAHJ is responsible for ensuring requirements of electrical codes and standards, 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. The Y-12 ECAHJ is also responsible for construction equipment/installations found unsafe to place into an ESWC until it has been corrected and properly reinspected.

3.0 ROLES

3.1 UPF Electrical Safety Committee

The UPF ESC Charter will work together to provide a worksite with ESWC for employees, contractors, subcontractors, and vendors. This ESC Charter (established by OT-SH-801768-A037, *UPF Electrical Safety Committee [ESC]*), identifies, investigates, and reviews electrical safety issues to eliminate EHs. The ESC uses the process defined in OT-SH-801768-A038, *UPF Electrical Hazard and Incident Investigations*, for electrical incidents. In the event of an electrical incident, the ESC makes up the Electrical Incident Investigation Team (EIIT), which is role-based and includes the following:

- Y-12 ECAHJ
- Y-12 Safety SME
- Y-12 Chief Electrical Engineer
- UPF Electrical Chief/Bull Steward
- UPF Electrical Safety Manager
- BNI ES&H Representative
- UPF Field Engineering Administrative Assistant
- UPF Lead Electrical Field Engineer (FE)
- UPF Temp Power Electrician
- UPF Startup Electrician
- UPF Temp Power Superintendent/FE
- Additional Stakeholders as requested

3.2 UPF Electrical Incident Management Team

The UPF EIIT is established by the ESC Chairperson to conduct investigations using OT-SH-801768-A038 for any electrical events and incidents from Electrical Arc Flash or Shock. The ESC Chairperson will distribute the ESC investigation findings and report to the necessary stakeholders. The ES&H Department Representative will

retain final reports and ensure Lessons Learned are discussed and reviewed, to include tracking and trending of Energy Facility Contractors Group (EFCOG) report information to evaluate performance in accordance with the Electrical Safety Program.

3.3 UPF Unqualified Electrical Person

The UPF Unqualified Electrical Person (UEP) may work in the LAB if they are trained in Electrical Safety Training, understand specific hazards associated the electrical energy, have received training in safety-related work practices and procedural requirements required to provide protection from EHs associated with their job/task, and have been trained to identify/understand the relationship between EHs and potential injury.

The UPF UEP, under the direct supervision of a UPF Qualified Electrical Person (QEP) qualified for the job/task, will be considered a UPF QEP when undergoing on-the-job training to obtain further skills and knowledge, which have already demonstrated proficiency to perform specific duties based on competency. The UPF UEP is allowed to work in the LAB when they have been trained in and are familiar with electrical safe work practices, advised of EHs, and are escorted by a UPF QEP. The UPF UEP is not allowed to cross the RAB. The UPF UEP should read, understand, and comply with all aspects of the ESP and NFPA 70E.

3.4 UPF Qualified Electrical Person

The UPF QEP are trained and qualified to be an LQEP for working on equipment, conductors, or circuit parts less than 600 V; an MQEP for working on equipment, conductors, and circuit parts from 600 V to 35,000 V; or a combination of the two. The UPF QEP that is working on energized circuits at or above 50 V should never do so alone.

The UPF QEP can be qualified for certain equipment and tasks (i.e., performing Risk Assessments, performing DLRO/HiPot/Megger Testing) and still be considered unqualified for others. The UPF QEP should read, understand, and comply with all aspects of the ESP and NFPA 70E.

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It is recommended—and considered best practice—that QEPs performing any work or verifications on energized electrical circuits under 600 V (considered LQEPs) complete NFPA 70E training. NFPA 70E retraining occurs based on NFPA 70E Code updates.

It is recommended—and considered best practice—that QEPs performing any work or verifications on energized electrical circuits 600 V or greater/up to project maximum voltage (considered MQEPs) complete NESC training. NESC retraining reoccurs based on NESC Code updates.

3.5 UPF Low-Voltage Qualified Electrical Person

The UPF LQEP is qualified for working on energized equipment, conductors, or circuit parts less than 600 V. The UPF QEP should read, understand, and comply with all aspects of the ESP. The UPF LQEP designation is given once competency is reached by the successful completion of an initial assessment using the CFN-1345, *UPF Initial Qualified Electrical Person Checklist*, for qualification. The UPF LQEP will

be required to complete an additional annual CFN-1344, *UPF Electrical Field Work Audit*, assessment to maintain the LQEP qualification.

3.6 UPF Medium-Voltage Qualified Electrical Person

The UPF MQEP is qualified for working on energized equipment, conductors, and circuit parts from 600 V to 35,000 V. The UPF QEP should read, understand, and comply with all aspects of the ESP. The UPF MQEP designation is given once competency is reached by the successful completion of an initial assessment using the CFN-1345 for qualification. The UPF MQEP will be required to complete an additional annual CFN-1344 assessment to maintain the MQEP qualification.

3.7 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 an LQEP and MQEP and once competency is reached by the successful completion of an initial assessment using the CFN-1345 for qualification. 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 volts.

3.8 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

4.1 General Electrical Safety Requirements

The requirements in this section apply to all personnel potentially 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 Y15-95-912, *UPF Completion and Turnover*.

The Normal Operation of electric equipment is permitted where all of the following conditions are satisfied:

- Equipment is properly installed
- Equipment is properly maintained
- Equipment is used in accordance with instructions included in the listing and labeling and in accordance with manufacturer's instructions
- Equipment doors are closed and secured
- Equipment covers are in place and secured

NOTE: *The phrase "properly installed" means the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase "properly maintained" means the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase "evidence of impending failure" means there is evidence such as arcing, overheating, loose, or bound equipment parts, visible damage, or deterioration.*

ENSURE areas where access is limited by LAB requirements are released after protection shields are installed and no exposed energized components remain to pose an EH.

Any work performed within the LAB or AFB will comply with the following procedural requirements:

1. **ENSURE** the assigned personnel/Person in Charge (PIC) and Supervisor complete a pre-job STARRT card and JHA to communicate known hazards to each employee/personnel in the designated work area. A STARRT card and JHA are required on **ALL** work activities. **ENSURE** all workers involved in the scope have signed the STARRT card and related JHA(s), signifying they have read, understand, and will comply with measures prescribed to prevent injuries from identified hazards
2. **ENSURE** red and black "DANGER" barrier marker (e.g., tape, rope, chain) is installed as a visible barrier to prevent unauthorized entry into the LAB or AFB from all potential access points or accessible directions. **ENSURE** signs and tags identifying the specific hazard, name of responsible person, and date posted will be attached or placed at the barrier
3. **ENSURE** the assigned personnel/PIC prevent access of other personnel in the vicinity into the LAB and AFB when work is being performed. The assigned personnel/PIC may allow qualified personnel and escorted personnel to cross the LAB and AFB when it is safe to do so, and assigned personnel/PIC will ensure no electrical work is being performed and the RAB is not crossed when entry is permitted. **ENSURE** at least two voltage-level-qualified QEPs (e.g., LQEP, MQEP) are present at the job/task location when testing, troubleshooting, voltage measuring, thermography, ultrasound, or visual inspections are being performed. **ALL** personnel inside the LAB or AFB will wear the same level of PPE to provide the appropriate protection from the EH
4. **ENSURE** QEPs qualified for the voltages of the job/task are the **ONLY** ones permitted to perform the actual hands-on job/task for electrical circuit parts, conductors, or equipment. Other personnel (e.g., UEP, QEP) who are unqualified for the voltages of the job/task and assigned to the scope of work **CANNOT** perform the QEP job/task in the LAB and/or AFB **UNLESS**:
    - They are under the direct supervision of the QEP (who is qualified for the job/task)
    - They have demonstrated the ability to perform the specific duties safely
    - They are undergoing on-the-job training to become a QEP for the voltages of the job/task

5. **ENSURE** an ABC-rated fire extinguisher is present and readily available at the work site. This ESM identifies the work site as the barricaded area immediately adjacent to the location where the physical job/task is being performed
6. **VERIFY** the work location is dry, adequately illuminated, and free of obstructions and debris that could potentially become a hazard or interfere with work activities
7. **ENSURE** tools are kept in storage while not in use. **ENSURE** tools or other equipment/items are not placed on top of cabinets, leaned against, or stored where they could potentially fall into or come into contact with energized circuit parts, conductors, or equipment
8. **ENSURE** only non-conductive, insulated, and voltage-rated tools (rated for the voltage being worked on [including non-conducting ladders]) are to be used in the vicinity of live electrical conductors

4.2 Additional Training and Retraining

4.2.1 Additional Training

ENSURE personnel receives additional training if they are introduced to new equipment, technology, or changes in procedures which differ from normal use.

ENSURE the personnel receives additional training if job-related duties change from normal duties.

ENSURE training consists of classroom, on-the-job, or a combination of the two.

ENSURE Electrical Safety Training Documentation is to be retained for the duration of employment **AFTER** proficiency is demonstrated.

ENSURE all applicable training and qualifications are completed, current, and up-to-date **PRIOR TO** performing **ANY** work/task on energized electrical conductors, circuit parts, or equipment.

ENSURE CFN-1345, *UPF Initial Qualified Electrical Person Checklist*, for initial qualification, are completed by the RS, General Foreman, or Foreman currently trained and qualified for the work that is to be performed.

4.2.2 Retraining

ENSURE personnel are retrained if they are found not to be complying with safety-related work practices.

ENSURE personnel are retrained if they are expected to perform a task that is performed less than once a year.

ENSURE personnel are retrained if they need to review safety-related work practices not normally used during regular job duties.

ENSURE retraining consists of classroom, on-the-job, or a combination of the two.

ENSURE Electrical Safety Training Documentation is to be retained for the duration of employment **AFTER** proficiency is demonstrated.

ENSURE all applicable retraining and requalifications are completed, current, and up-to-date **PRIOR TO** performing **ANY** work/task on energized electrical conductors, circuit parts, or equipment.

ENSURE CFN-1344, *UPF Electrical Field Work Audit*, for re-qualification, are completed by the RS, General Foreman, or Foreman currently trained and qualified for the work that is to be performed.

4.3 Work Involving Electrical Hazards

4.3.1 Risk Assessment

The UPF Project uses the CFN-1317, *UPF Electrical Hazard Risk Assessment & Testing Form*, for risk assessment associated with EHs.

ENSURE risk assessment procedure is included in the ESP:

- Addresses exposure to EHs
- Identifies processes to be used **PRIOR TO** the work/task being started
- Identifies hazards
- Assesses risks
- Implements risk control in accordance with NFPA 70E

ENSURE all UPF Risk Assessments are performed by the RS, General Foreman, or Foreman currently trained and qualified for the work that is to be performed.

ENSURE arc flash hazard and shock hazard risk assessment aspects are included in the risk assessment procedure.

ENSURE the risk assessment procedure addresses the potential for human error and the negative consequences on people, processes, the work environment, and equipment, in which the EHs are related to the job/task.

VERIFY the amount of personnel required to perform work/task safely. Any additional training or equipment that those personnel should have (e.g., electrical emergency response, contact release, other protective equipment) are indicated on the risk assessment procedure.

ENSURE the preventative and protective risk control methods included in the hierarchy of risk control methods be implemented in accordance with the following hierarchy:

1. Elimination
2. Substitution
3. Engineering Controls
4. Awareness
5. Administrative Controls
6. PPE

4.3.2 Energized Electrical Work Permit

In accordance with **Section 4.3.3, *Exemptions to a Work Permit***, the completion of an EEWP is necessary unless the requirements for an Exemption to a Work Permit are applicable for working on enclosed or exposed energized circuit parts, conductors, or equipment.

An Exemption to a Work Permit will **ONLY** be permitted after the work group (e.g., TP, Startup) has determined hazardous energy isolation **CANNOT** be reasonably accomplished or required data/information can only be obtained while remaining energized.

If the exposed energized components **CANNOT** be electrically isolated by providing an ESWC, then the Supervisor or their designee will **ENSURE** QEPs are provided with and use the appropriate safe work practices and PPE. This will include, but not be limited to, the following:

- **ENSURE** a STARRT card or JHA for each job/task (based on specific configurations) is completed, as applicable
- **ENSURE** a risk assessment is performed using CFN-1317, which will be maintained to meet the requirements of NFPA 70E
- **ENSURE** the LAB, AFB, and PPE requirements are established and documented on EEWP
- **ENSURE** EHs are mitigated by using other protective equipment (e.g., insulated tools, equipment, protective shields and/or barriers), where appropriate and applicable, to prevent accidental or unintentional contact of personnel, materials, and tools from exposed energized electrical equipment
- **ENSURE** applicable alerting techniques (e.g., safety tags and signs, barricades, attendants) are used to warn personnel of the EHs identified, based on the risk assessment procedure. When barricades are used, **ENSURE** safety tags and signs are placed on all sides of the barricade, including the swing gates
- **VERIFY** applicable and properly rated PPE is used, based on the risk assessment procedure and EHs identified. **ENSURE** either the Arc Flash PPE Category Method or the Incident Energy Analysis Method are used to select the appropriate PPE, but **NOT** a combination of the two on the same job/task
- **PRIOR TO** any energized work equal to or greater than 50 V, **ENSURE** an automated external defibrillator (AED) has been issued from UPF Tool Crib, the QEP is currently trained and certified on the AED, and the AED is at job/work locations and readily available for use for each EEWP
- **PRIOR TO** any energized work equal to or greater than 50 V, **ENSURE** there is Contact Release Equipment (e.g., rescue hook), the user is currently trained on this equipment, and the Contact Release Equipment is at job/work locations and readily available for use for each EEWP

NOTE 1: *An applicable STARRT card and JHA are required on all work activities when voltages are equal to or greater than 50V.*

NOTE 2: *Prepare the EEWP, unless an exception to a work permit applies, in accordance with* ***Section 4.3.3,*** **Exemptions to a Work Permit***.*

Document the following information on the EEWP for energized work equal to or greater than 50 V (and any additional applicable information):

- Description and location of the circuits and equipment to be worked on
- Justification for why the work must be performed in an energized condition
- Description of the safe work practices to be employed
- Determination of the LAB for exposed energized parts for unqualified personnel

- Determination of LAB and RAB for QEP
- Results of the flash hazard analysis
- The approach AFB
- Identification (ID) of any applicable PPE to safely perform the assigned task
- Barriers employed to restrict the access of unqualified persons from the work area
- Evidence of completion of a job briefing/planning, including a discussion of any job-specific hazards
- Energized work approval signature(s)

WARNING

Under no circumstances shall work inside the RAB or AFB be performed if the incident energy is >40 Cal/cm2

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4.3.3 Exemptions to a Work Permit

The following electrical work is permitted **WITHOUT** an EEWP when a QEP is provided with and uses appropriate safe work practices and PPE:

1. Testing, troubleshooting, and voltage measurements
2. Thermography, ultrasound, and visual inspections (RAB is not crossed)
3. Access to, and egress from, an area with energized electrical equipment are permitted if no electrical work is performed (RAB is not crossed)
4. General housekeeping and miscellaneous non-electrical tasks are permitted to be performed if the (RAB is not crossed)

NOTE 1: *Using appropriate "Safe Work Practices" includes performing a Risk Assessment using CFN-1317.*

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.*

4.3.4 Energized Work

ENSURE any energized circuit parts, conductors, or equipment equal to or above 50 V (to which a QEP may be exposed) are de-energized and placed into an ESWC **PRIOR TO** the QEP working on them, **UNLESS** it can be demonstrated that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations.

Examples of additional or increased hazards that de-energizing may bring about include:

1. Interruption of life support equipment
2. Deactivation of emergency alarm systems
3. Shutdown of hazardous location ventilation equipment

4. Removal of illumination for an area

These are all examples of “Energized Work” that must be performed on energized circuit parts, equipment, or conductors while energized:

- Testing, troubleshooting, and voltage measurements
- Thermography, ultrasound, and visual inspections if the RAB is not crossed
- Work performed on a circuit or piece of equipment that **CANNOT** be isolated from an operating process or safety system that requires continuous, uninterrupted operation (i.e., the process or system cannot be shut down completely)

ENSURE job safety planning and job safety briefings are performed **PRIOR TO** working on **ANY** energized electrical circuit parts, conductors, or equipment. Plan for **ALL** sources of potential hazardous energy (e.g., electrical, pressure, mechanical, thermal) to be identified and isolated in accordance with Y17-95-64-801.

If **ALL** sources of hazardous energy **CANNOT** be identified and isolated (e.g., out-of-date drawings, job/task not matching the job briefing/planning/JHA/Risk Assessment, other conflicting information preventing the QEP from successfully establishing an ESWC), **ENSURE** a Questioning Attitude and Stop Work Authority is applied/used until safe work practices or an ESWC can be established to continue with job/task.

If it is **NOT** possible to identify and isolate **ALL** sources of hazardous energy to establish an ESWC, the job/task is considered energized electrical work, in accordance with the ESM. **ENSURE ALL** safe work practices, PPE, principles, processes, and procedures applicable to energized electrical work are used to protect personnel.

ENSURE a physical walkdown of the electrical circuit parts, conductors, and equipment has occurred, and the isolation from **ALL** potential hazardous energy sources are verified and the LOTO will establish an ESWC.

ENSURE after **ALL** potential hazardous energy sources have been isolated, the Zero Energy Check/Absence of Hazardous Energy has been performed and is documented, in accordance with Y17-95-64-801, that the work is then **NOT** considered “Energized Work” (as it is then considered isolated and de-energized).

When permitted and circumstances require work to be performed on energized electrical systems, the following electrical safety-related work practices will be implemented:

- **ENSURE** all electrical jobs/tasks are performed by QEPs who are qualified to the appropriate voltage level for the work that is to be performed
- **ENSURE** the LAB and the RAB is determined by using **Table 1** or **Table 2** in **Section 4.4.5, *Safe Working Space/Clearance (600 V, Nominal, or Less)***
- **ENSURE** insulated Tools and equipment is used inside the RAB and that it is properly rated, designed, and constructed for the conditions and voltages in which they are used
- **ENSURE** all required permits (e.g., EEWPs) are completed and approved **PRIOR TO** beginning job/task, the **ONLY** exemptions to EEWP requirements are described in **Section 4.3.3, *Exemptions to a Work Permit***, of this ESM
- **ENSURE** all tools and inspection equipment are insulated and rated for the voltage of the energized equipment to be used for the job/task. When working in

enclosures, **DO NOT** reach blindly into the enclosure **WITHOUT** visually verifying the correct working area for the job/task

- **ENSURE** when work is being performed on de-energized equipment in the same work area of other energized equipment that would be considered similar in size, shape, construction, or labeling that alerting techniques (e.g., Safety Sign/Tags, Barricades, or Attendants) are properly used to prevent personnel from entering "Look-Alike Equipment". **ENSURE** the properly designed and rated PPE for the applicable voltages and conditions are used on energized electrical circuit parts, conductors, and equipment
- **ENSURE** a second QEP (e.g., Buddy/Safety Observer [B/SO]) is 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 use of an intercom or two-way radio is **NOT** an acceptable substitute for this requirement. This requirement **DOES NOT APPLY** to the use of electrical portable hand tools (e.g., drills, saws) or completely enclosed electronic equipment of conventional type (e.g., computers, copiers, fax machines)
- **ENSURE** all QEPs and B/SOs performing the job/task on energized electrical circuit parts, conductors, and equipment are currently trained and qualified on AED, cardiopulmonary resuscitation (CPR) and First Aid (FA), Contact Release, and that the AED and appropriately rated Contact Release equipment are readily available for an energized job/task that is equal to or above 50 V

NOTE 1: *The B/SO must know the specific breaker(s) to open if it becomes necessary to shut off the power in case of emergency.*

NOTE 2: *Any work inside the RAB that has energized circuits with exposed, non-insulated parts is considered "Energized Work" if the plane of the RAB is broken during the course of that work activity by tools or body parts.*

NOTE 3: *Use the greater of the two distances between the AFB and LAB for determining PPE requirements.*

- **ENSURE NO** conductive items or articles of clothing are worn (e.g., watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread metal, headgear, or belt buckles) while performing energized electrical jobs/tasks **UNLESS** such articles are rendered non-conductive by covering, wrapping, or other insulating means
- **ENSURE PRIOR TO** issuing an Electrical Hazard Risk Assessment and Testing Form (ERAT) or an EEWP to work on energized electrical circuit parts, conductors, or equipment operating at 600 V, nominal, or more, that the RS has researched all options to safely de-energize the electrical circuit parts, conductors, or equipment to establish and ESWC

As part of the Electrical Work Package, the job safety planning/briefing by RS it will be required that QEPs follow **ALL** of the electrical safety requirements and applicable table(s) indicated in NFPA 70E, Article 130, *Work Involving Electrical Hazards*, when work is performed on energized electrical circuit parts, conductors, or equipment for those applications involving up to 600 V, nominal.

Additional considerations include the following:

VERIFY insulating material (e.g., rubber matting) is clean, dry, free from damage, and properly rated for the applicable voltage for the job/task and location.

ENSURE rubber-insulating blankets are inspected for damage **PRIOR TO** each use. **PRIOR TO** the first issue and every 12 months thereafter, they must have Dielectric Testing performed in accordance with American Society for Testing and Materials (ASTM) F479, *Standard Specification for In-Service Care of Insulating Blankets*, and NFPA 70E.

ENSURE QEPs use insulated tools when working on energized circuits and the insulated tools are properly inspected for defects, expired dates, and damages to the tool or insulation **PRIOR TO** each use. If insulated tools are damaged, properly tag them for removal from service.

ENSURE QEPs wear rubber-insulating gloves with leather protectors if there is potential danger of hand injury from electric shock. Personnel must wear rubber-insulating gloves with leather protectors and rubber-insulating sleeves if there is potential danger of hand and arm injury from electric shock.

ENSURE rubber-insulating gloves worn by QEPs are rated for the voltages of the circuit parts, conductors, or equipment; they are properly tested in accordance with NFPA 70E; and the rubber-insulating gloves are certified for maintenance operations in with the requirements specified in OSHA, 29 CFR 1910.137.

ENSURE rubber-insulating and leather gloves worn by QEPs are properly inspected for damage **PRIOR TO** each use and disposed of properly if damages are found.

PRIOR TO first use, and every six months thereafter, rubber insulating gloves must have Dielectric Testing performed in accordance with ASTM F496, *Standard Specification for In-Service Care of Insulating Gloves and Sleeves*. Dielectric Testing must have been performed within the last 12 months on rubber-insulating gloves not issued for service.

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PRIOR TO the reissue/reuse of **ANY** rubber-insulating gloves involved in an electrical incident where there was suspected damage, the rubber-insulating gloves are to be inspected **PRIOR TO** reissue/reuse or disposed of properly.

ENSURE QEPs are wearing undergarments (permitted in accordance with NFPA 70E) when working on energized electrical circuit parts, conductors, or equipment. **ENSURE** acetate, nylon, polyester, polypropylene, and spandex **ARE NOT** worn as underlayers, as they are not permitted.

Rubber-insulating gloves will be permitted **WITHOUT** leather protectors under the following conditions:

1. There will be **NO** activities performed that risks cutting or damaging the rubber-insulating gloves
2. The rubber-insulating gloves are either properly disposed of or electrically retested prior to reuse
3. The voltage rating of the rubber-insulating gloves is reduced by 50 percent for Class 00 and by one whole class for Classes 0–4

NOTE 4: *EH-rated footwear that meets ASTM F2413,* Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear*, can provide an additional/secondary source of electric shock protection under dry conditions.*

Insulated footwear is used as secondary protection from step and touch potential. Additional considerations include the following:

- **ENSURE** properly rated DI, insulating footwear (based on the EH) are required for secondary protection when working on energized circuit parts, conductors, or equipment
- **ENSURE** footwear other than leather or Dielectric has been tested to demonstrate no ignition, melting, or dripping at the minimum arc rating for the respective arc flash PPE category. If testing on footwear has demonstrated no ignition, melting, or dripping at the minimum arc rating for the respective arc flash PPE category, it will be permitted
- **ENSURE** EH-rated safety boots and shoes with isolated soles are **NOT** used as the only EH protection for step and touch potential. Secondary protective/Dielectric footwear is required when working on energized circuit parts, conductors, or equipment
- **ENSURE** all exposed electrical sources not being worked on are covered to prevent accidental/unintentional contact from step and touch potential
- **ENSURE** all secondary protective footwear will be inspected at the start of every job/task and immediately **AFTER** any event that could potentially cause damage to the footwear. **ENSURE ALL** damaged secondary protective footwear will be disposed of properly and replaced **PRIOR TO** starting the job/task

NOTE 5: *The Dielectric footwear can be either a combination work/Dielectric boots or shoes type, or an overshoe type.*

NOTE 6: *If EH-rated footwear (e.g., EH-rated boots and shoes) with isolated soles and made of non-conductive materials is worn, they can provide additional shock protection under dry conditions.*

When electrical work is performed in confined/enclosed work spaces (e.g., manholes, vaults), the following rules must be followed:

- **ENSURE** protective shields, barriers, and/or insulating materials are used to prevent inadvertent contact with exposed energized parts equal to or above 50 V
- **ENSURE** if an area contains any unguarded, uninsulated, energized lines or circuit parts of electric equipment operating at 50 V or more, a QEP qualified for the level of voltage in the confined/enclosed work space is required
- **ENSURE** doors and hinged panels are of sufficient weight and/or **CANNOT** be moved or cause inadvertent contact, potentially pushing an employee into an exposed electrical circuit. When these conditions or concerns exist, the doors and hinged panels will be secured to prevent their movement
- **ENSURE** a Confined Space Entry Permit Evaluation is performed **PRIOR TO** issuing a permit and/or entering the confined space

NOTE 7: *If an area contains an energized, single-phase Free Air-routed cable greater than 50 V, the evaluation mitigation strategy must be evaluated.*

NOTE 8: *A safe working space/clearance must be maintained as specified in **Table 3** in **Section 4.4.5,** **Safe Working Space/Clearance (600 V, Nominal, or Less)**, or **Table 4** in **Section 4.4.6,** **Safe Working Space/Clearance (600 V, Nominal, or More)**.*

WARNING

Under no circumstances shall work inside the RAB or AFB be performed if the incident energy is >40 Cal/cm2

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4.4 Approach Boundaries

4.4.1 Limited Approach Boundary

ENSURE UEPs are **NOT** allowed in the LAB **WITHOUT** being advised of possible hazards. UEPs must be continuously escorted by QEPs when circuit parts, conductors, or equipment are energized.

ENSURE applicable limits of approach are followed for an LAB in accordance with NFPA 70E standards when circuit parts, conductors, or equipment are energized.

NOTE: *If any Unqualified Persons are working inside the LAB, apply a combination of Alerting Methods/Techniques.*

4.4.2 Restricted Approach Boundary

ENSURE UEPs are **NOT** allowed to cross into the RAB when circuit parts, conductors, or equipment are energized.

ENSURE applicable limits of approach are followed for an RAB (in accordance with NFPA 70E standards) when circuit parts, conductors, or equipment are energized.

NOTE: *If any QEPs need to approach or take a conductive object into the RAB, they must be insulated or guarded from energized electrical conductors or circuit parts operating at 50 V or above.*

4.4.3 ARC Flash Hazard Protection

- Additional “safety-related work practices” are used to protect personnel who might be exposed to the EHs involved for energized circuit parts, conductors, or equipment that are not placed into ESWC. These “safety-related work practices” will protect personnel from arc flash and the direct contact with energized circuit parts, conductors, or equipment which have potential to come into direct contact with any part of the body or indirectly through some other conductive object or means
- The work practices used will be suitable for the conditions under which the work is being performed and for the voltage level of the live parts
- The flash hazard analysis is used to determine the AFB and the PPE required within the AFB. The flash hazard analysis to determine AFB and PPE requirements must be performed by Design Engineering for applications greater than 600 V. The primary means of documenting the flash hazard analysis is the ERAT, with the Secondary means being the EEWP, if required. Flash hazard analyses shall be done before the assigned employee approaches any exposed electrical conductor or circuit part that has not been placed into an ESWC
- If a flash hazard analysis calculation has been performed by Design Engineering (as per NFPA 70E, Section 130.5 [3][C][1]), the value of the incident energy exposure in calories per square centimeter (cal/cm^2) may be used to determine the appropriate PPE

NOTE: *In certain instances, the AFB might be a greater distance than the LAB, and the greater distance shall be used to trigger the need for PPE.*

- NFPA 70E specifies the requirement of PPE for personnel within the AFB. All parts of the body that may be exposed to the arc flash need to be covered by the appropriately rated type and quality of PPE. The entire PPE set may be comprised of arc flash or fire resistant (FR) rated helmet or headgear, face shields, safety glasses, rubber and leather gloves, leather shoes, etc., depending upon the magnitude of the arc energy
- The AFB is calculated by Design Engineering. The protective clothing will limit the incident energy reaching the chest/face of the employee to less than 1.2 cal/cm^2. FR clothing provides thermal insulation and is also self-extinguishing. Protective clothing is rated in cal/cm^2

4.4.4 Shock Hazard Protection

Figure 1, **Table 1**, and **Table 2** describe the approach distances for exposed, energized electrical conductors. **Table 1** and **Table 2** also identify LABs and RABs.

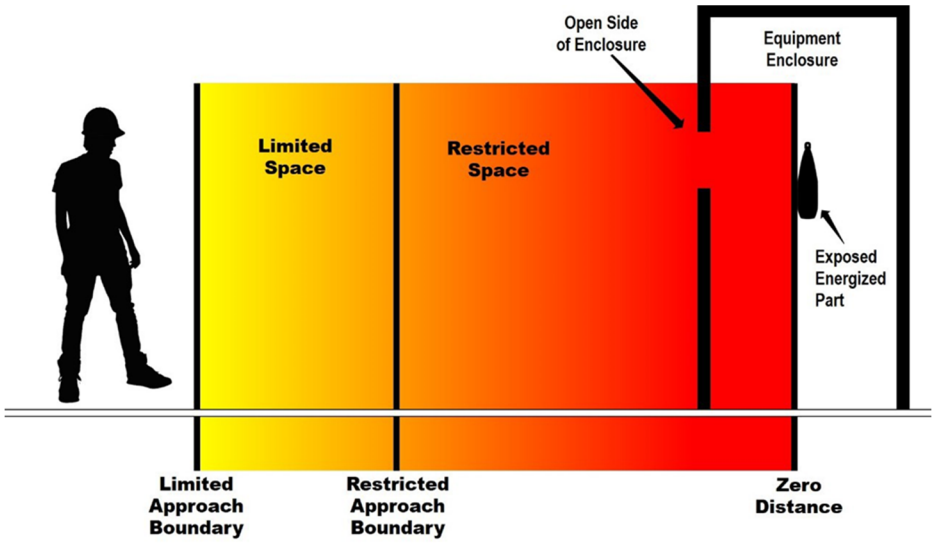

Figure 1. Approach Boundaries

Table 1. Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Alternating Current Voltage Systems

Nominal System Voltage Range, Phase to Phase[i]	LAB		RAB
	Exposed Movable Conductor	Exposed Fixed Circuit Part	Includes Inadvertent Movement Adder
Less than 50 V	Not specified	Not specified	Not specified
50–150 V	10 ft. 0 in.	3 ft. 6 in.	Avoid Contact
151–750 V	10 ft. 0 in.	3 ft. 6 in.	1 ft. 0 in.
751 V–15 kV	10 ft. 0 in.	5 ft. 0 in.	2 ft. 2 in.
15.1–36 kV	10 ft. 0 in.	6 ft. 0 in.	2 ft. 7 in.
36.1–46 kV	10 ft. 0 in.	8 ft. 0 in.	2 ft. 9 in.
46.1–72.5 kV	10 ft. 0 in.	8 ft. 0 in.	3 ft. 3 in.

Nominal System Voltage Range, Phase to Phase[i]	LAB		RAB
	Exposed Movable Conductor	Exposed Fixed Circuit Part	Includes Inadvertent Movement Adder
72.6–121 kV	10 ft. 8 in.	8 ft. 0 in.	3 ft. 4 in.
138–145 kV	11 ft. 0 in.	10 ft. 0 in.	3 ft. 10 in.
161–169 kV	11 ft. 8 in.	11 ft. 8 in.	4 ft. 3 in.
230–242 kV	13 ft. 0 in.	13 ft. 0 in.	5 ft. 8 in.
345–362 kV	15 ft. 4 in.	15 ft. 4 in.	9 ft. 2 in.
500–550 kV	19 ft. 0 in.	19 ft. 0 in.	11 ft. 10 in.
765–800 kV	23 ft. 9 in.	23 ft. 9 in.	15 ft. 11 in.

Footnotes:

1. Source: NFPA 70E, Table 130.4(D)(a)
2. [i] For single-phase systems above 250 VACs, select the range that is equal to the systems maximum phase to ground voltage multiplied by 1.732.

NOTE 1: *All dimensions are distance from energized electrical conductor or circuit part to employee.*

NOTE 2: *Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.*

Table 2. Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage System

Nominal Potential Difference	LAB		RAB
	Exposed Movable Conductor*	Exposed Fixed Circuit Part	Includes Inadvertent Movement Adder
Less than 50 V	Not specified	Not specified	Not specified
50 V–300 V	3.0 m (10 ft. 0 in.)	1.0 m (3 ft. 6 in.)	Avoid Contact
301 V–1 kV	3.0 m (10 ft. 0 in.)	1.0 m (3 ft. 6 in.)	1 ft. 0 in.
1.1–5 kV	3.0 m (10 ft. 0 in.)	1.5 m (5 ft. 0 in.)	1 ft. 5 in.
5 kV–15 kV	3.0 m (10 ft. 0 in.)	1.5 m (5 ft. 0 in.)	2 ft. 2 in.
15.1–45 kV	3.0 m (10 ft. 0 in.)	2.5 m (8 ft. 0 in.)	2 ft. 9 in.
45.1–75 kV	3.0 m (10 ft. 0 in.)	2.5 m (8 ft. 0 in.)	3 ft. 2 in.
75.5 kV–150 kV	3.3 m (10 ft. 8 in.)	3.0 m (10 ft. 0 in.)	4 ft. 0 in.
150.1 kV–250 kV	3.6 m (11 ft. 8 in.)	3.6 m (11 ft. 8 in.)	5 ft. 3 in.
250.1 kV–500 kV	6.0 m (20 ft. 0 in.)	6.0 m (20 ft. 0 in.)	11 ft. 6 in.
500.0 kV–800 kV	8.0 m (26 ft. 0 in.)	8.0 m (26 ft. 0 in.)	16 ft. 5 in.

Footnotes:

1. Source: NFPA 70E, Table 130.4(D)(b)

NOTE 3: *All distances referenced in tables are the appropriate distance from energized electrical circuit parts, conductors, or equipment to personnel.*

NOTE 4: *Exposed movable conductor describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.*

The information in this section pertains to both **Table 1** and **Table 2**:

When there is a need for an unqualified person to cross the LAB to perform a minor task or look at equipment, a QEP will advise them of the possible EHs and ensure the unqualified person is safeguarded.

The RAB is the closest distance for a QEP. Under **NO** circumstances will an unqualified person be permitted to cross the RAB. To cross this boundary, a person must meet all of the following criteria:

- Be currently trained and qualified as a QEP for the voltage and the job/task and be an authorized person by the PIC
- Have an approved EEWP specific for each job/task, with the exception of a job/task that meets the "Exemption to Work Permit" criteria, in which the QEP is provided with and uses safe work practices and PPE. This includes the performance of a risk assessment using the CFN-1317
- Use the applicable/appropriate arc flash-rated PPE, based on either the Arc Flash Category Method or Incident Energy Analysis Method (but **NOT** both on the same piece of equipment), approved for the conditions and location of the job/task
- An Arc Flash Category Method analysis cannot be used to select an Arc Flash PPE Category based on an Incident Energy Analysis result.
- The Incident Energy Analysis Method is the Project-preferred method.

  An Incident Energy Analysis will be used for the following:
  - **Alternating Current Equipment**
    - Power Systems with greater than the estimated maximum fault clearing times
    - Power Systems width longer than the maximum fault clearing times
    - Less than the minimum working distance
  - **Direct Current Equipment**
    - Power Systems with greater than the estimated maximum fault clearing times
    - Power Systems width longer than the maximum arc duration
    - Less than the minimum working distance
- Positioning the body of the QEPs performing jobs/tasks in a manner that will minimize risk of inadvertent contact (e.g., left hand rule, use of other protective equipment). Work that is outside the RAB (but within the person's reach) may be classified as restricted work if the following apply:
  - The determination of the PICs or the QEPs involved, deeming it to be a potentially unsafe position based on Human Performance (HU) Tools (e.g., peer check, questioning attitude, self-check, stop work authority)
  - Any conductive objects or ungrounded body parts could potentially make unintentional contact; if so, use Stop Work Authority and contact Supervisor to

perform an additional risk assessment based on the positioning concern during the job/task to establish a safe work practice

Crossing the RAB and entering the restricted space will be considered the same as making contact with exposed energized circuit parts, conductors, and equipment and to cross the restricted space, the QEP must have or perform the following:

- Currently trained and qualified for Energized Work and the voltage for the job/task are provided with and use the safe-work practices and PPE
- Have documented risk assessment, job planning, and job briefing that provides the appropriate justification(s) for the need to work inside the RAB and **NOT** establishing an ESWC
- Have a risk assessment performed by using ERAT/CFN-1317 to determine the arc flash and shock hazards, either using the Arc Flash Category Method or Incident Energy Analysis Method (**NOT** both), to determine the applicable/appropriate arc flash-rated PPE
- Have the risk assessment, job planning, and job briefing, including the justification for not establishing an ESWC approved by the Site Manager or designee

ALL electrical equipment (e.g., switchboards, panel boards, industrial control panels, meter socket enclosures, motor control centers [MCCs]) in other than dwelling units and likely to require examination, adjustment, servicing, or maintenance while being energized will be field marked with a label containing all the following information, in accordance with DAC-EE-801768-A113, *UPF AC System Arc Flash Risk Assessment*:

- Nominal System Voltage
- Working Distance
- Available Fault Current
- Clearing Time
- Limited Approach Boundary
- Restricted Approach Boundary
- Equipment UNID number
- Reference Drawing
- Source Protective Device
- AFB

NOTE 5: *Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B) of NFPA 70E for the equipment, but not both.*

4.4.5 Safe Working Space/Clearance (600 V, Nominal, or Less)

ENSURE sufficient access/working space/clearance is provided and maintained around all electrical equipment to permit proper egress, ready/safe operation, and maintenance of such equipment.

ENSURE the depth of the working space/clearance in the direction of access to live parts is not less than what is indicated in **Table 3**. These distances are measured from the live parts if such are exposed, or from the enclosure front or opening if such are enclosed.

Conditions and exceptions for safe working spaces/clearances are as follows:

Condition 1. Exposed energized electrical circuit parts, conductors, and equipment on one side and no live or grounded parts on the other side of the working space, or exposed energized electrical circuit parts, conductors, and equipment on both sides, effectively guarded by suitable fire-retardant treated (FRT) wood or other insulating materials; insulated wire, or insulated bus bars operating at not over 300 V will not be considered live parts.

Condition 2. Exposed energized electrical circuit parts, conductors, and equipment on one side and grounded parts on the other side; concrete, brick, or tile walls will be considered grounded surfaces.

Condition 3. Exposed energized electrical circuit parts, conductors, and equipment on both sides of the work space (not guarded, as provided in Condition 1) with the operator between.

Table 3. Working Distances

Nominal Voltage to Ground	Minimum Clear Distance		
	Condition 1	Condition 2	Condition 3
51–150 V	3 feet (ft.)	3 ft.	3 ft.
151–600 V	3 ft.	3½ ft.	4 ft.

NOTE: *Use the greater of the two distances between the AFB and LAB for determining PPE requirements.*

4.4.6 Safe Working Space/Clearance (600 V, Nominal, or More)

Conditions for safe working spaces/clearances are as follows:

Condition 1. Exposed energized electrical circuit parts, conductors, and equipment on one side and no live or grounded parts on the other side of the working space/clearance, or exposed live parts on both sides, effectively guarded by suitable FRT wood or other insulating materials; insulated wire or insulated bus bars operating at not over 300 V will not be considered live parts.

Condition 2. Exposed energized electrical circuit parts, conductors, and equipment on one side and grounded parts on the other side; concrete, brick, or tile walls will be considered grounded surfaces.

Condition 3. Exposed energized electrical circuit parts, conductors, and equipment on both sides of the work space (not guarded, as provided in Condition 1) with the operator between.

ENSURE the depth of the working space/clearance in the direction of access to live parts is not less than what is indicated in **Table 4**.

Table 4. Minimum Depth of Space/Clearance in Front of Electrical Equipment

Nominal Voltage to Ground	Minimum Clear Distance		
	Condition 1	Condition 2	Condition 3
601–2500 V	3 ft.	4 ft.	5 ft.
2501–9000 V	4 ft.	5 ft.	6 ft.
9001–25,000 V	5 ft.	6 ft.	9 ft.
25,001–75,000 V	6 ft.	8 ft.	10 ft.
>75,000 V	8 ft.	10 ft.	12 ft.

4.4.7 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 4.4.8, *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

4.4.8 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.

4.4.9 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 5** 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 5** 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

Table 5. Power Line Clearance Minimums during Transport

Normal Voltage	**LAB** *(Minimum)*	**Y17-95-6Y-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.*

4.4.10 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.

4.4.11 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 6**.

Table 6. 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.*

4.4.12 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 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

4.4.13 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.*

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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4.5 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 4.5.1, *GFCI Requirements***.

4.5.1 GFCI Requirements

GFCIs must be used for electrical equipment when the AEGCP is **NOT** used in accordance with **Sections 4.6.2, *AEGCP – Powered Hand Tool Cords and Extension Cords***; **Section 4.6.3, *AEGCP – Inspection of Powered Hand Tools***; and **Section 4.6.4, *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 Step 1 through Step 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.*

4.5.2 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.

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.*

4.5.3 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

- **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 Underwriters Laboratory (UL) or Factory Mutual (FM) 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.*

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

4.6.1 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:

- **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.*

4.6.2 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:

- 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 7 describes the colors to use during each quarter of the inspection schedule.

Table 7. 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 7**.

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.

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

4.6.3 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 and that they are inspected quarterly by a QEP.

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

4.6.4 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 amp [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 4.5.1**
- **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.*

4.7 Capacitors, Generators, and Transformers

4.7.1 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
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*.

4.7.2 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 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)

PRCN 03

4.7.3 Transformers

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

4.8 Startup

The forms, processes, and procedures for all Startup activities for the UPF Project are completed in compliance with the ESM and NFPA 70E for establishing electrical safety requirements.

4.9 Temporary Power

PRCN 01

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:

PRCN 01

- CFN-1232, *Energized Electrical Work Permit*
- CFN-1261, *UPF Electrical Inspector Approval*
- CFN-1317
- CFN-1324, *GFCI Inspection and Test Record*
- CFN-1325, *Temporary Power Maintenance Record*
- CFN-1326
- CFN-1327, *Temporary Power Request Form*

- CFN-1339, *Construction Power Generator Installation Record*
- CFN-1344
- CFN-1345
- OT-SH-801768-A037
- OT-SH-801768-A038

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.*

4.9.1 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
- **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
- **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

NOTE: ***ALL** 480-V extension cords shall be inspected quarterly and marked with appropriately color-coded tape.*

The following color coding will be used for TP Construction Power Distribution cabling purposes:

- 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)

4.9.2 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 (cart w/wheels or fork lift inserts) provides 480 V distribution to HVAC, Welders, and any other equipment requiring 480 V. This PDU then provides the 480 V feeders to the PDC, which then provides lighting, tool power, and 50A Spider Boxes (in some instances) are distributed out.

The TP – Power Distribution Carts (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.

The TP – Power Distribution Units (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 that 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 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.

4.9.3 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.

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.

4.9.4 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 [MEB], Yard, Main Processing Building [MPB], or PSF)

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
- 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).*

4.10 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. Refer to **Section 4.3.4, *Energized Work***, for information on working on energized battery systems.

4.10.1 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 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, 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.

VERIFY battery ventilation system openings are unobstructed.

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

4.10.2 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.*

4.11 Other Protective Equipment

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

4.11.1 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 LAB are non-conductive.

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.

4.11.2 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.

4.12 Inspection and Maintenance of Personal Safety and Protective Equipment

4.12.1 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
- 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.

4.12.2 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.

4.13 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.

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.

4.14 Test Instruments and Equipment

4.14.1 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 person 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 expose 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.*

4.14.2 Proper Use of Proximity Testers

ENSURE on electrical systems over 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 under 1000 volt alternating current (VAC), 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 under 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.”

4.15 Alerting Techniques

4.15.1 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.

4.15.2 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.

4.15.3 Attendants

ENSURE if safety signs and barricades **DO NOT** provide sufficient warning/protection from EHs, that 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.

4.16 Equipment Labeling

ALL electrical equipment including switch-boards, panelboards, industrial control panels, meter socket enclosures, MCCs, other than those in dwelling units are examined, adjusted, serviced, or have maintenance performed while energized will have labels containing the following information:

- Nominal system voltage
- Arc flash boundary
- At least one of the following:
  - Available incident energy and the corresponding working distance, or the arc flash PPE category table for equipment, but not both
  - Minimum arc rating of clothing
  - Site-specific level of PPE

ENSURE documentation of the method of calculating data is included on the label (e.g., Incident Energy Analysis Method, Arc Flash PPE Category Method).

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 MCCs) for accuracy (i.e., nominal system voltage, arc flash boundary, available incident energy and work distance, minimum arc rating of clothing, level of PPE).

4.17 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.

4.18 Audit Requirements

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

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

4.18.1 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.

4.18.2 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.

4.18.3 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.

4.19 Emergency Response

The QEPs that either work on energized electrical circuits, conductors, and equipment or work as a BS/O, which could provide immediate response to a medical emergency are trained, certified, and qualified for the proper use of an AED, and how to safely perform CPR, and FA, and how to 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 Operations Center (865) 574-7172 in order to initiate the investigation process.*

4.19.1 Automated External Defibrillator

PRIOR TO entry to 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 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 BS/O, 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.

4.19.2 Cardiopulmonary Resuscitation (CPR)

PRIOR TO entry to 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 other potentially infectious material (OPIM).

ENSURE QEPs who either work on energized electrical circuits, conductors, and equipment or work as a BS/O, 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.

4.19.3 First Aid

PRIOR TO entry to 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 other potentially infectious material (OPIM).

ENSURE QEPs who either work on energized electrical circuits, conductors, and equipment or work as a BS/O, 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.

4.19.4 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.

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

4.20 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.

4.20.1 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.

4.20.2 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.

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

4.20.3 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.

4.20.4 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.

4.20.5 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.

4.20.6 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.

4.20.7 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
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 will be maintained in accordance with Y15-95-800, *UPF Document Management*. PRCN 01

The following records generated are:

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-1317	*UPF Electrical Hazard Risk Assessment & Testing Form (permanent power only)*	InfoWorks	ERAT
Document Specific	*Construction Work Package (may include CFN-1324, CFN-1325, CFN-1326, CFN-1339)*	InfoWorks	CWP
CFN-1327	*Temporary Power Request Form*	InfoWorks	TPRF
CFN-1344	*UPF Electrical Field Work Audit*	InfoWorks	TQR
CFN-1345	*Initial Qualified Electrical Person Checklist*	InfoWorks	TQR

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6.0 REFERENCES

6.1 Source References

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*

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

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

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UPF-CP-227, *UPF Safety Watches*

6.2 Interfacing References

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

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)*

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

ASTM F2413, *Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear*

ASTM F478, Standard Specification for In-Service Care of Insulating Line Hose and Covers

ASTM F479, *Standard Specification for In-Service Care of Insulating Blankets*

ASTM F496, Standard Specification for In-Service Care of Insulating Gloves and Sleeves

DAC-EE-801768-A113, *UPF AC System Arc Flash Risk Assessment*

DI-SU-801768-A001, *UPF Turnover Scoping*

IEEE C2-2012, *National Electric Safety Code® (Code of Record 2012)*

ML-PS-801768-A006, *Uranium Processing Facility Project Turnover Package Deliverables List*

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

MNL-SU-801768-A001, *UPF Startup Test Program Manual*

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MOA-PM-942404-A001, Memorandum of Agreement, Ownership, Responsibilities, and Operational Boundaries for Medium Voltage Power System (MVP) at the Process Support Facility (PSF)

MOA-PM-942404-A002, *Energization of PSF Medium Voltage Power*

NFPA 70, Article 445, *Generators*

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

NFPA 70, Article 460, *Capacitors*

NFPA 70E, Article 130, *Work Involving Electrical Hazards*

NFPA 70E, *Standard for Electrical Safety in the Workp*lace OT-SH-801768-A037, *UPF Electrical Safety Committee (ESC)*

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

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

PL-SU-801768-A001, *Uranium Processing Facility Project Test Plan*

SICD-EE-801768-A005, *Structures, Systems, and Components (SSC) Interface Control Document for MVP*

SVP-RM-801768-A058, *Medium Voltage Electrical Power (MVP) System Verification Matrix*

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

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

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

UPF-CP-211, *Fire Prevention and Protection*

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*

Y15-95-912, *UPF Completion and Turnover*

Y15-95-915, *Notice of Energization*

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 Safety Task Analysis and Risk Reduction Talk/Job Hazard Analysis Program (STARRT/JHA)*

Y17-95-64-848, *UPF Control of Punchlist Items*

Y17-95-64-850, *UPF Control of Measuring and Test Equipment*

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

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Y60-95-803, *UPF General Assessments*

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, *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-1339, *Construction Power Generator Installation Record*

CFN-1344, *UPF Electrical Field Work Audit*

CFN-1345, *Initial Qualified Electrical Person Checklist*

7.0 SUPPLEMENTAL INFORMATION

Appendix A, *Acronyms and Definitions*

Appendix B, *Personal Protective Equipment (PPE)*

Appendix C, *Example of an Equipment Arc Flash Label*

Appendix D, *Establishing an Electrically Safe Work Condition*

APPENDIX A
Acronyms and Definitions

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Acronyms

A	Amp (or Ampere)
AE	Authorized Employee
AED	Automated External Defibrillator
AEGCP	Assured Equipment Grounding Conductor Program
AFB	Arc Flash Boundary
AFE	Affected Employee
AO	Authorized Operator
ASTM	American Society for Testing and Materials
B/SO	Buddy/Safety Observer
BK	Black
BL	Blue
BNI	Bechtel National, Inc.
BR	Brown
CA	Corrective Action
cal/cm^2	Calories per Square Centimeter
CFN	Construction Form Number
CFR	Code of Federal Regulations
CNS	Consolidated Nuclear Security
CPR	Cardiopulmonary Resuscitation
CR	Condition Report
DLRO	Digital Low Resistance Ohmmeter
DMM	Digital Multi-Meter
ECAHJ	Electrical Contractor Authority Having Jurisdiction
EEWP	Energized Electrical Work Permit
EFCOG	Energy Facility Contractors Group
EH	Electrical Hazard
EHRA	Energized Hazard Risk Assessment
EIIT	Electrical Incident Investigation Team
EIM	Energy Isolation Management
EIP	Energy Isolation Permit
EIRS	Electrical Inspection Request System
EPM	Electrical Preventative Maintenance
ERAT	Electrical Risk Assessment and Testing Form
ES&H	Environmental, Safety, and Health
ESC	Electrical Safety Committee

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ESH&Q	Environmental, Safety, Health, and Quality
ESM	Electrical Safety Manual
ESP	Electrical Safety Program
ESWC	Electrically Safe Work Condition
FA	First Aid
FE	Field Engineer
FM	Factory Mutual
FR	Fire Resistant
FRT	Fire- Retardant Treated
ft.	Foot/Feet
FWA	Field Work Audit
GFCI	Ground Fault Circuit Interrupter
HiPot	High Potential (High-Voltage Test)
HU	Human Performance
ID	Identification
IEEE	Institute of Electrical and Electronic Engineers
in.	Inch
JHA	Job Hazard Analysis
kV	Kilovolt
LAB	Limited Approach Boundary
LOTO	Lockout/Tagout
LQEP	Low- Voltage Qualified Electrical Person
MCC	Motor Control Center
MEB	Mechanical Electrical Building
Megger	Megohmmeter
MPB	Main Processing Building
MQEP	Medium -Voltage Qualified Electrical Person
MSAD	Minimum Safe Approach Distance
NEMA	National Electrical Manufacturers Association
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
Non-QA	Non-Quality
OR	Orange
OSHA	Occupational Safety and Health Administration
PDC	Power Distribution Cart
PDE	Power Distribution Equipment
PIC	Person in Charge

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Acronyms and Definitions

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PM	Preventative Maintenance
PPE	Personal Protective Equipment
PRMS	Programmatic Requirements Management System
PSF	Process Support Facility
PSUM	Project Startup Manager
PSUM	Project Startup Manager
QA-L	Quality-Lifetime
QA-NP	Quality-Nonpermanent
QEP	Qualified Electrical Person
RAB	Restricted Approach Boundary
RD	Red
RS	Responsible Superintendent
SME	Subject Matter Expert
STARRT	Safety Task Analysis and Risk Reduction Talk
STE	Startup Supervisor/ Test Engineer
SUQEP	Startup Qualified Electrical Person
TL	Test Lead
TP	Temporary Power
TPQEP	Temporary Power Qualified Electrical Person
UEP	Unqualified Electrical Person
UL	Underwriters Laboratories
UNID	Unique Identifier
UPF	Uranium Processing Facility
V	Volt
VAC	Volt Alternating Current
VDC	Volt (or Voltage) Direct Current
VRLA	Valve-Regulated Lead Acid
WH	White
Y-12	Y-12 National Security Complex
YL	Yellow

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Acronyms and Definitions
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Definitions

Ampere (A)	Also abbreviated as “amp,” the unit for measuring the rate at which electric current flows (i.e., the strength of the electric current).
Assured Grounding Program	The process of testing electrical tools and extension cords to assure their proper grounding, polarity, and resistance.
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.
Audit	A systematic, independent, and documented assessment of the compliance to, and effectiveness of, this Procedure and/or the implementation of this Procedure.
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).
Digital Low Resistance Ohmmeter (DLRO)	A test to measure low resistance by passing current through the circuit and then measuring voltage drop.
Dwelling Unit	A single unit providing complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, cooking, and sanitation.
Electrical Equipment	Any equipment that could require personnel to work near exposed electrical conductors, buses, terminations, or other surfaces that may be energized. The equipment’s electrical sources and circuits are locked out and tagged out in the de-energized position. Other methods may be used in conjunction with electrical de-energization and LOTO, but not in substitution. A piece of equipment or machinery capable of being locked out uses an LO method, not a TO method.
Electrical Hazard (EH)	A dangerous condition in which contact by personnel, or equipment failure, can result in electric shock, arc flash burn, thermal burn, or blast from an energy source greater than 50 V.
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.

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APPENDIX A
Acronyms and Definitions

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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.
Energized	Connected to an energy source or containing residual or stored energy.
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.
Evidence of Impending Failure	There is evidence such as arcing, overheating, loose, or bound equipment parts, visible damage, or deterioration.
Exclusive Control	Under the exclusive control of the employee means that the authorized employee is continuously in physical possession of the de-energized machine or equipment being serviced or maintained (or within arm's reach of the cord/plug AND the cord/plug is within 5 ft. line of sight of the authorized employee) to prevent other individuals from reenergizing the machine or equipment. Exclusive control shall only be used in instances where the cord/plug is the only energy source to the machine or equipment. It may be used for calibration and pressure indicator change-out. Any other applications or work scenarios shall be evaluated and approved by the ES&H Department on a case-by-case basis.
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.
Exposed Fixed Circuit Part	A fixed circuit part refers to a task in which the conductor is not expected to move (e.g., within a unit substation).
Exposed Movable Conductor	Intended to mean that either the conductor might move (as in an overhead line) or the person might move (as in an articulating support platform).
Flash Suit	This is a complete FR clothing and equipment system that covers the entire body except for the hands and feet. The system includes pants, a jacket, and a beekeeper-type hood fitted with a face shield.
Ground Fault Circuit Interrupter (GFCI)	A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current-to-ground (fault) exceeds the values established for a Class A device. According to UL 943, *Standard for Ground-Fault Circuit-Interrupters*, a Class A GFCI trips when the current-to-ground has a value in the range of four to six mille-amperes.

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Guarded	Electrical equipment or components are covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms that remove the likelihood of approach or contact by persons or objects to a point of danger.
Hazardous Energy Source	A form of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or *other energy that has the potential to harm personnel or damage plant and equipment. NOTE 1: *Stored batteries, radiation, mass and height (suspended loads), falling, sliding, or slipping objects and tension springs, belts, cables, chains, or ropes, etc.* See **Appendix N** for a hazardous level table. NOTE 2: *Personnel, when developing permits, must consider any (not just common or conventional) potential source of energy that could be harmful and the best method of isolating the potential energy source.*
Heavy Equipment	Equipment powered by internal combustion engines (diesel, gasoline, and liquid propane gas), which is self-propelled or mobile construction equipment, such as mobile cranes, dozers, scrapers, excavators, graders, dump-bed trucks (single, dual, and tri-axle), or vehicles designed to move or lift heavy loads or supply heavy driving force.
High Potential Testing (HiPot)	Testing that exposes electrical insulation to transient over-voltages to determine if there are insulation issues which could prevent isolation from electrical equipment or circuit parts.
Human Performance Tools (HU)	The consistent and effective use of Human Performance Tools when performing work reduces the probability that an error may cause and accident or serious event (e.g., peer-check, questioning attitude, self-check, stop work authority)
Insulated	Separated from other conducting surfaces by a Dielectric (including air space), offering a high resistance to the passage of current.
Isolation/Isolating	The physical act undertaken (e.g., closing a valve and locking it in position, opening a breaker and locking it in position, removing an electrical component to create an energy break, inserting a blind or spade in a segment of piping) to prevent the release of energy that may cause injury to personnel, damage to plant or equipment, or harm to the environment.
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.

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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.
Look-Alike Equipment	The energized equipment in a work area which is similar, in size, shape, construction, and labeling to the characteristics of equipment being de-energized and placed in an electrically safe working condition in the same work area. When “Look-Alike” Equipment exists safety signs/tags, barricades, or attendants shall be used to prevent employee entry into energized equipment.
Megohmmeter (Megger)	Testing that exposes electrical insulation to transient over-voltages to determine if there are insulation issues which could prevent isolation from electrical equipment or circuit parts.
Normal Operating Condition	Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied: 1. The equipment is properly installed 2. The equipment is properly maintained 3. The equipment is used in accordance with instructions included in the listing and labeling and in accordance with manufacturer’s instructions 4. The equipment doors are closed and secured 5. All equipment covers are in place and secured 6. No evidence of impending failure
Permit	A document used to manage specific tasks and/or work areas that require a further degree of control or task preparation (e.g., confined space entry).

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Qualified Electrical Person (QEP)	A qualified person trained and knowledgeable of the construction and operation of equipment or a specific work method, and trained to recognize and avoid the EHs that might be present with respect to that equipment or work method. This is broken up into two qualifications: 6.1.1.1.1.1.1 LQEP for voltages < 600 V 6.1.1.1.1.1.2 MQEP for voltage ≥ 600 V up to 35,000 V Qualified personnel are specifically trained in the requirements contained in 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 **Section 4.4.4**, and the corresponding voltages to which the qualified person will be exposed • The approach distances for LAB and RAB, specified in **Table 1** and **Table 2** in **Section 4.4.4**, 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
Questioning Attitude	A Human Performance Tool that is when individuals avoid complacency and continuously challenge existing conditions and activities in order to identify discrepancies that might result in error or an inappropriate action.
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.
Restricted Space	The area within the RAB where personnel could be exposed to energized conductor or circuit part.
Single-Phase	Of or designating an electrical circuit having an alternating current with one phase.
Stop Work Authority	A Human Performance Tool that is pausing of job/task due to conditions or behaviors that threaten or endanger personnel, equipment, or the environment.

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Suspect/Counterfeit Item (S/CI)	An item is suspect when visual inspection or testing indicates that it may **NOT** conform to established government or industry-accepted specifications or national consensus standards or whose documentation, appearance, performance, material, or other characteristics may have been misrepresented by the supplier or manufacturer. A counterfeit item is one that has been copied or substituted without legal right or authority or whose material, performance, or characteristics have been misrepresented by the supplier or manufacturer.
Unqualified Electrical Person (UEP)	A person who is not a Qualified person. Unqualified persons shall be trained in, and be familiar with, any electrical safety-related practices necessary for their safety. An unqualified person **MUST** be continuously escorted by a QEP if there is a need to be inside the limited approach boundary. Under no circumstance shall the escorted unqualified persons be permitted to cross the RAB.
Valve-Regulated Lead Acid (VRLA)	A lead-acid cell that is sealed, with the exception of a valve that opens to the atmosphere when the internal pressure in the cell exceeds atmospheric pressure by a preselected amount, and that provides a means for recombination of internally generated oxygen and the suppression of hydrogen gas evolution to limit water consumption.
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 Working 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
Work Site	The barricaded area immediately adjacent to the location where the physical work is being performed.

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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.

APPENDIX B
Personal Protective Equipment (PPE)

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

APPENDIX B
Personal Protective Equipment (PPE)

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Table 8 identifies usage of rubber-insulating gloves and equipment.

Table 8. Personal Protective 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.*

APPENDIX C
Example of an Equipment Arc Flash Label

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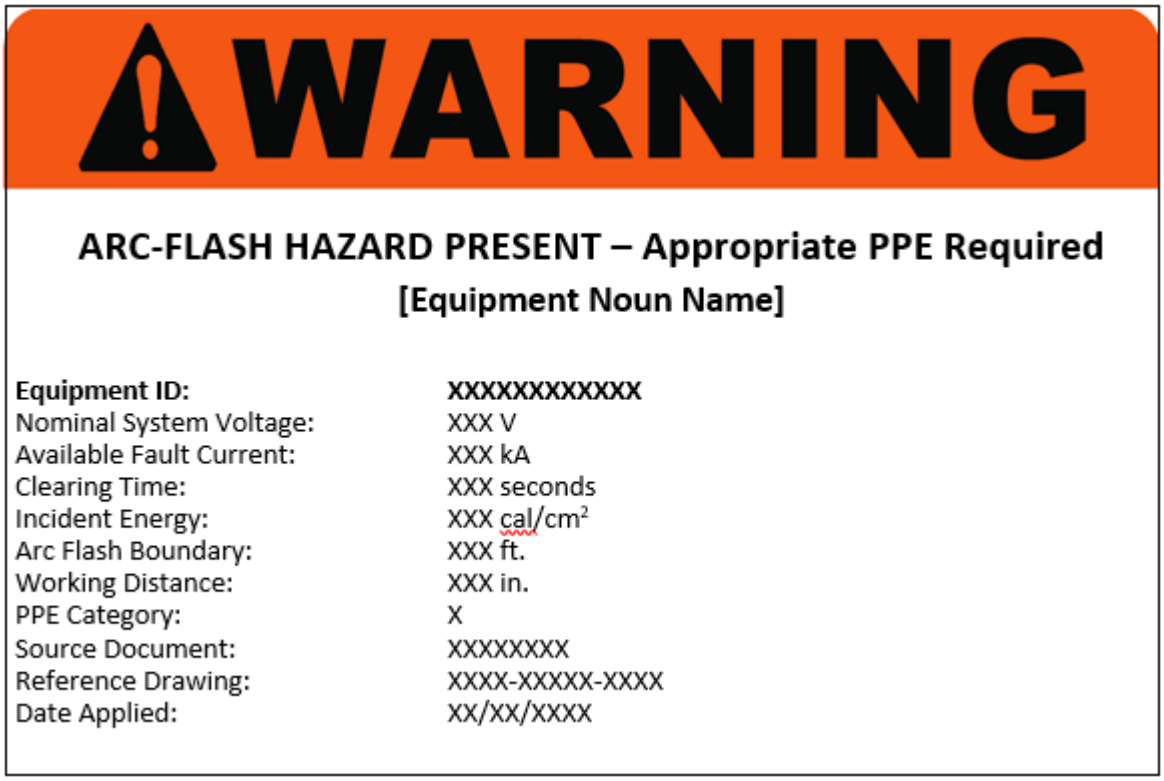

APPENDIX C
Example of an Equipment Arc Flash Label
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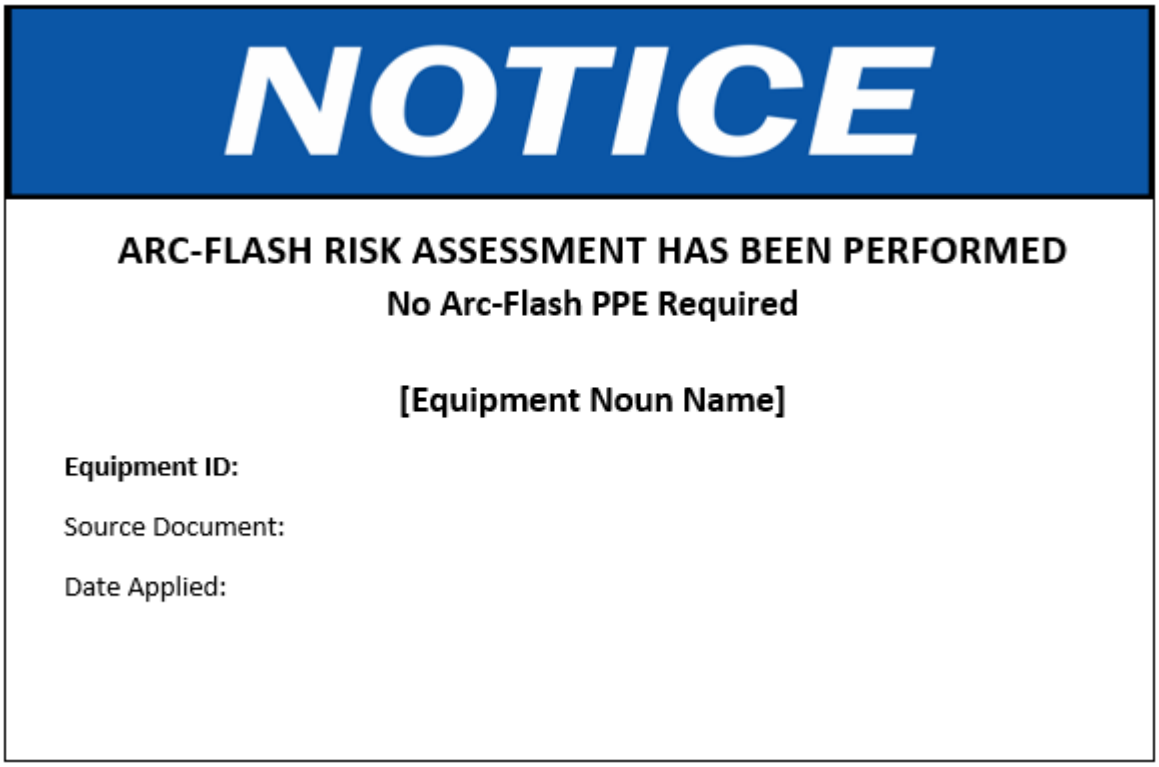

APPENDIX C
Example of an Equipment Arc Flash Label
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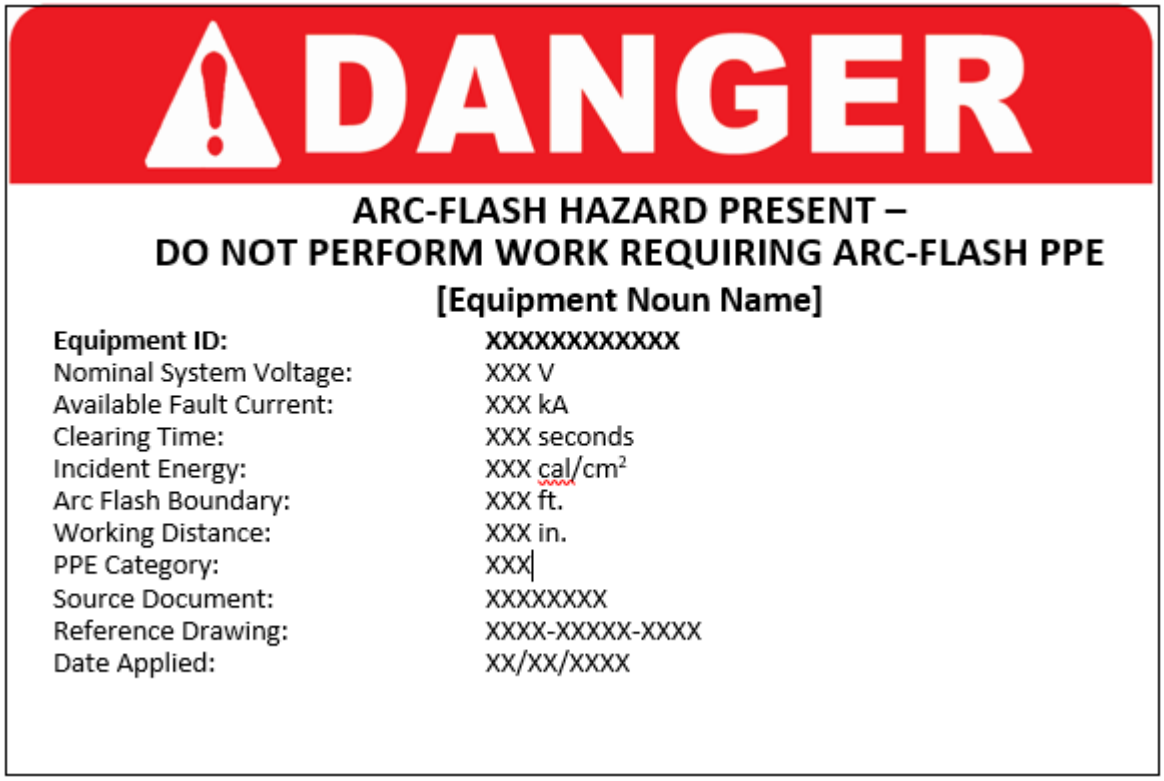

APPENDIX D
Establishing an Electrically Safe Working Condition

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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, STARRT Cards, and work orders/packages) are all identified and performed in accordance with the ESM 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 a 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 the procedure Y17-95-64-801.

APPENDIX D
Establishing an Electrically Safe Working Condition

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Step 8 Use an appropriately rated testing device for the job/task in accordance with the latest revision of the UPF ESM. **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.