THE NATION'S URANIUM PROCESSING FACILITY

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08/12/2021
~~09/09/21~~
Effective Date

Initials:
Date: 08/12/21

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

Page Numbers Affected: 1

Reason for Change:
Changing effective date to the correct date.

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.

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REVISION LOG

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

Revision 4 ☒ Intent ☐ Non-Intent

- This revision incorporates the changes identified in PRCN-UPF-MANUAL-CM-001-R03-01 and PRCN-UPF-MANUAL-CM-001-R03-02 to reference ML-SH-801768-A001, *UPF Quarterly Inspection Color Codes*, in **Section 3.12, *Assured Grounding Program for Powered Hand Tool Cords and Extension Cords***.
- This revision incorporates the Pen and Ink Change issued on 06/23/2020 to remove reference to Y73-528, *Electrical Safety Manual*.
- Forms:
  - CFN-1232INST, *Energized Electrical Work Permit Instruction*–new.
  - CFN-1261, *UPF Electrical Inspector Approval*–revised.
  - CFN-1317, *UPF Energized Electrical Testing Form*–new.
  - CFN-1318, *UPF Electrical Hazard Risk Assessment*–new.
- An evaluation determination has been performed confirming that this Command Media implements BNI quality requirements as tracked in the Programmatic Requirements Management System (PRMS).
- Other changes include:
  - Global update to references.
  - Global updates to add clarification to the procedure.
  - Editorial changes.
  - Added new roles and responsibilities to **Section 2.0, *Responsibilities***.
- Document is considered a complete rewrite:
  - Because of the extent of changes, revision bars are not shown.

Previous revisions on record

CONTENTS

1.0 INTRODUCTION

This Manual describes the responsibilities and requirements of the Uranium Processing Facility (UPF) for work performed on or near electrical energy sources, both temporary and permanent. The provisions of this Manual apply to all work where there is a potential for personnel to be exposed to a voltage of 50 volts (V) or more.

1.1 Purpose

The purpose of this Manual is to ensure that all potential safety and health hazards are identified, controlled, and communicated to personnel before they begin working on or near electrical energy sources.

This Manual ensures that all Project work on or near electrical energy sources is performed in accordance with applicable electrical safety requirements, including the following standards for the National Fire Protection Association (NFPA), National Electric Safety Code (Institute of Electrical and Electronics Engineers [IEEE] C2-2012), and Occupational Safety and Health Administration (OSHA) 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)
- 29 CFR 1926, *Safety and Health Regulations for Construction*, *Subpart K, "Electrical" (Code of Record 2013)*
- 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 1910 are from PL-RM-801768-A001,* UPF Code of Record*.*

1.2 Scope

This Manual applies to all UPF Project personnel, including subcontractors, during the construction and startup of the UPF Project.

2.0 RESPONSIBILITIES

2.1 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 participate in Ground Fault Circuit Interrupter (GFCI) requirements (refer to Section 3.5.1)
- Providing worker support, facilities, and other resources necessary to effectively carry out manual, required safe work practices

2.2 UPF Environmental, Safety and Health Manager

The UPF ES&H Manager assists in interpreting:

- Regulations associated with this Manual
- Intent and application of this Manual

The ES&H Manager will consult with the Electrical Contractor Authority Having Jurisdiction (ECAHJ) for guidance on implementing this Manual.

2.3 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 electrical equipment:

- Understand and implement the requirements of this Manual
- Are properly trained and qualified for each voltage-level or hazard-level of the task/work assigned

2.4 UPF Supervisors/Startup Test Engineer

UPF Supervisors/Startup Test Engineers (STEs) are responsible for:

- Verifying all personnel who work around electrical equipment have been trained, qualified, and properly instructed regarding the hazards of specific equipment
- Understanding and implementing the requirements in this Manual
- Reviewing each job involving electrical equipment and identifying hazardous voltages to ensure that proper Electrical Safety measures are being followed
- Preparing or providing the required Job Hazard Analyses (JHAs) for assigned jobs, and reviewing them with assigned personnel
- Submitting JHAs to the ES&H Representative for review and completion
- Planning work activities in advance to identify the appropriate tools and equipment to use
- Ensuring personnel directly performing or indirectly performing work near electrical work have been trained to this Manual
- Ensuring personnel do not perform work alone on energized circuits or equipment at 50 V or more

- Ensuring the safety materials necessary to perform the tasks required by this manual are identified and provided in proper working order
- Verifying the Personal Protective Equipment (PPE) selected for a work task meets the requirements of NFPA 70E and this manual
- Completing a Safety Task Analysis and Risk Reduction Talk (STARRT) card for energized work
- Determining the Restricted Approach Boundary (RAB), Limited Approach Boundary (LAB), and the Arc Flash Boundary (AFB) (see **Figure 1** and **Table 5**)
- Preparing CFN-1232, *Energized Electrical Work Permit (EEWP)* (hereinafter referred to as the Energized Electrical Work Permit [EEWP])
- Preparing CFN-1317, *UPF Electrical Hazard Risk Assessment & Testing Form,* as needed
- Ensuring protective shields are installed (where appropriate) to prevent personnel from inadvertently coming into contact with energized equipment
- Maintaining the EEWP log

2.5 UPF Unqualified Electrical Personnel

All UPF Unqualified Electrical Personnel (UEP) may work near or enter the LAB if:

- Trained in, and familiar with, any electrical safety-related practices necessary for their safety
- Escorted by a Qualified Electrical Person
- Advised of the electrical hazards

CAUTION:
A UEP is never allowed to cross the RAB.

2.6 UPF Qualified Electrical Personnel

NOTE: *All UPF Qualified Electrical Personnel are qualified to either/both a Low Voltage Qualified Electrical Person (LQEP) for < 600 or a Medium Voltage Qualified Electrical Person (MQEP) for ≥ 600 V to 35,000 V. The UPF Project max voltage is 13,800V.*

All UPF Qualified Electrical Personnel are responsible for:

- Understanding and complying with this Manual
- Being trained and qualified for the level of work involved

CAUTION:
Qualified Electrical Personnel should not work alone on energized circuits or equipment at 50 V or more.

- Participating in the development and/or preparation of the JHA for the assigned job, as directed by the Supervisor
- Reporting any unsafe practices, both to the individual involved and to their Supervisor
- Demonstrating competence in the skills, knowledge, and techniques necessary to distinguish exposed energized parts from other parts of the equipment

- Demonstrating they have received training to recognize and avoid the hazards involved as specified in NFPA 70E
- Demonstrating competence in the proper use of special precautionary techniques, PPE, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

2.7 UPF Startup Electrical Personnel

All UPF Startup Electrical personnel are responsible for:

- Understanding and implementing the requirements of this Manual
- Training through a classroom/lab environment in order to be qualified to work on Low Voltage and Medium Voltage levels

NOTE 1: *An LQEP is qualified to work with voltage levels < 600 V.*

NOTE 2: *An MQEP is qualified to work at Voltage levels ≥ 600 V to 35,000 V.*

- Operating electrical equipment at the direction of the assigned STE
- Completing all Zero-Energy checks for voltage levels equal to or greater than 1000 V

2.8 UPF Construction Site Electricians

All UPF Construction Site electricians are responsible for:

- Training through a classroom/lab environment in order to be qualified to work on Low Voltage levels

NOTE: *An LQEP is qualified to work with voltage levels < 600 V.*

- Understanding and complying with the requirements of this Manual
- Knowing how to apply GFCI requirements to work safely, but also pausing or stopping work when they observe unsafe conditions or new hazards emerging in their work area

2.9 UPF Environmental, Safety and Health Representative

NOTE: *The ES&H Manager has the authority to assist in interpreting the regulations associated with this Manual, including its intent application.*

The UPF ES&H Representative is responsible for:

- Reviewing and (if applicable) approving JHAs and EEWPs
- Assisting in the development of JHAs and EEWPs (when requested)
- Reviewing assigned electrical PPE (when requested)
- Providing field electrical safety oversight

2.10 UPF Training Manager

The UPF Training Manager is responsible for:

- Tracking and maintaining all electrical safety training records
- Maintaining the training database

2.11 UPF Electrical Contractor Authority Having Jurisdiction

The UPF ECAHJ is responsible for:

- Enforcing the requirements of a code or standard
- Confirming the assignment of Electrical Inspectors
- Ensuring the Electrical Inspectors are trained and qualified in accordance with the requirements in NFPA 70®, *National Electric Code*®
- Reviewing and approving electrical inspection documentation
- Participating in the review of accidents or incidents, as requested

NOTE: *ECAHJ or their delegate shall have access to any area where work concerning electrical installations is being performed*

- During the Construction phase, if equipment or its installation is found unsafe, to have it put into a safe condition until it has been corrected and properly re-inspected
- Approving equipment, materials, installation, and delegating personnel responsible for interpreting the electrical requirements of NFPA 70

2.12 UPF Electrical Inspector

The UPF Electrical Inspector(s), as appointed by the ECAHJ:

- Reviews design documents
- Performs construction rough-in inspections
- Performs final inspections
- Observes and/or participates in Construction Acceptance testing
- Documents Electrical Installation Inspections on the Electrical Inspection Request System and submits them to the ECAHJ

3.0 PROCESS

3.1 General Requirements

The requirements in this section shall apply to all personnel who perform tasks that could expose them to electrical shock hazards that are not reduced to a safe level by the applicable electrical installation requirements.

NOTE: *Only the Startup Organization will operate or perform 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*.*

Normal operation of electric equipment shall be permitted where all of the following conditions are satisfied:

- Equipment is properly installed
- Equipment is properly maintained
- Equipment doors are closed and secured
- All equipment covers are in place and secured
- There is no evidence of impending failure

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

Areas to which access is limited by LAB requirements shall be released after protection shields are installed and no exposed energized components remain to pose a hazard.

The organization performing work within the LAB or AFB shall also adhere to these requirements:

A. The assigned personnel and Supervisor must complete a pre-job STARRT card and JHA to communicate known hazards to each employee in the designated work area. The STARRT card and JHA are required on all work activities. All assigned personnel shall sign the STARRT card and JHA to acknowledge that they have reviewed it before starting work

B. Red and black "DANGER" barrier tape shall be installed as a visible barrier to preclude unauthorized entry into the LAB or AFB from all accessible directions. Additionally, a sign or tag identifying the hazard shall be present at the barrier

C. The assigned personnel shall ensure that all others in the vicinity are kept outside the LAB and AFB when work is being performed. The assigned personnel may allow qualified personnel and escorted personnel to cross the LAB and AFB when it is safe to do so. Two electrical personnel qualified to the appropriate voltage level for work being performed are required when testing is being performed, and all personnel inside the LAB or AFB shall wear the same level of PPE

D. Only Qualified Electrical Personnel can perform the actual hands-on work. Other personnel assigned to the scope of work cannot perform the work in the LAB and/or AFB

E. An ABC-rated fire extinguisher must be readily available at the work site. This manual defines the work site as the barricaded area immediately adjacent to the location where the physical work is being performed

F. The work area must be dry, adequately illuminated, and free of obstructions and debris that may become a hazard or interfere with the work activity

G. Tools must be kept in storage while not in use. Tools shall not be placed on top of cabinets or any other item where they could possibly fall onto energized components

H. Before a conductor may be pulled through an area with exposed energized components, the ends of the conductor shall be sufficiently protected with an insulating material of the same rating as the conductor itself. If a pulling device is used, it must be made of a nonconductive material

I. Only voltage-rated tools, rated for the voltage being worked on (including non-conducting ladders), shall be used in the vicinity of live electrical conductors

3.2 Working On or Near Energized Circuits

Live parts to which an employee may be exposed shall be de-energized before the employee works on or near them, unless it can be demonstrated that de-energizing introduces additional or increased hazards, or is infeasible because of equipment design or operational limitations.

Before a battery system may be worked on, a risk assessment (e.g., JHA) shall be performed to identify the chemical, electric shock, and arc flash hazards and to assess the risks associated with the types of tasks to be performed. Live parts of equipment operating at less than 50 V need not be de-energized if there will be no increased exposure to electrical burns or explosion from electrical arcs.

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

- Interruption of life support equipment
- Deactivation of emergency alarm systems
- Shutdown of hazardous location ventilation equipment
- Removal of illumination for an area

Examples of work that may be performed on or near energized circuit parts because equipment design or operational limitations make it infeasible to shut down the equipment include:

- Testing, troubleshooting, and voltage measurements with the use of CFN-1317
- Thermography and visual inspections if the RAB is not crossed with the use of CFN-1317
- 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)

When planning to perform work on electrical circuits, components, or equipment, all sources of potential energy (e.g., electrical, pressure, mechanical, thermal) shall be identified. If it is not possible to identify all such sources because necessary drawings or other information is not available, the work shall be considered energized electrical work in accordance with this manual. Only after a physical walkdown occurs and isolation from all potential energy sources is verified shall Lockout/Tagout (LOTO) be used. After all potential energy sources have been isolated then a Zero Energy Check is performed and documented in accordance with Y17-95-64-801, *UPF Energy Isolation Management (EIM) - Lockout/Tagout (LOTO)*, then work is no longer Energized work.

When circumstances require work on energized electrical systems, the following protective measures shall be implemented:

- All electrical work shall be performed by electrical personnel qualified to the appropriate voltage level for the work that is to be performed
- Determine the LAB and the RAB using **Table 5** or **Table 6** in **Section 3.9, *Shock Hazard Protection***
- All required permits (specifically EEWPs) shall be completed prior to commencement of work; exemptions to EEWP requirements are described in **Section 3.11.1, *Work Permit Exemptions***, of this manual

- All tools and inspection equipment shall be insulated and rated for the voltage of the energized equipment
- When working in enclosures, do not reach blindly into the enclosure without visually verifying the correct working area for the task
- Only PPE that is designed and rated for the voltage of the energized equipment shall be used

Two Qualified Electrical Persons shall 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. Use of an intercom or 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). The second person (i.e., the Buddy/Safety Observer [B/SO]) must be present and within the immediate area while the work is being performed.

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

All work inside the RAB that has energized circuits with exposed, non-insulated parts shall be considered energized work if the plane of the RAB is broken during the course of that work activity with tools or body parts.

NOTE 2: *Use the greater distance (AFB or LAB) to trigger the need for PPE.*

Conductive articles of clothing shall not be worn (e.g., watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread metal, headgear, or belt buckles) unless such articles are rendered nonconductive by covering, wrapping, or other insulating means.

Before issuing an Energized Electrical Testing Forms (EETF), Energized Hazard Risk Assessment (EHRA), or an EEWP to work on or near electrical devices operating at 600 V, nominal, or more, the Supervisor must research all options to de-energize the devices.

As part of the Electrical Work Package planning, Supervision shall ensure personnel, at minimum, follow the electrical safety requirements in Table 130.7(C)(15)(A)(a) and Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B) of NFPA 70E when working on energized circuits for those applications involving up to 600 V, nominal.

Additional considerations include the following:

- Insulating material (e.g., rubber matting) must be undamaged, clean, dry, and rated for the voltage
- Inspecting rubber insulating blankets prior to each use for damage; prior to first use and, every 12 months thereafter, must have Dielectric Testing performed in accordance with ASTM F479, *Standard Specification for In-Service Care of Insulating Blankets*
- Personnel must use insulated tools when working on energized circuits; tools must be inspected for defects before use (this includes expiration and due dates); if tools are damaged, remove from service
- Personnel must wear rubber gloves (electrical) when working on energized circuits; at minimum, rubber gloves must be rated for the voltage being worked on,

tested, and certified for maintenance operations in accordance with the OSHA requirements specified in 29 CFR 1910.137. Inspect rubber gloves prior to each use for damage. Prior to first use, and every six months thereafter, must have Dielectric Testing performed in accordance with ASTM F479. If gloves have not been issued for Service, then they must have been Dielectric Tested within the last 12 Months

- Personnel must wear undergarments that are fire retardant or 100 percent cotton when working on energized electrical circuits

NOTE 3: *Electrical hazard footwear meeting ASTM F2413,* Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear*, can provide a secondary source of electric shock protection under dry conditions.*

NOTE 4: *Insulated footwear is used as protection against step and touch potential. Additional considerations include the following:*

  - Dielectric footwear shall be required
  - Insulated soles shall not be used as primary electrical protection

- Personnel must always wear shoes with nonconductive soles when working on energized circuits
- All exposed electrical sources not being worked on must be covered to prevent personnel from touching them

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

NOTE 5: *If an area contains an energized single phase Free Air routed cable >50 V, then the evaluation mitigation strategy must be evaluated.*

- Protective shields, barriers, and/or insulating materials shall be used to prevent inadvertent contact with exposed energized parts over 50 V
- If an area contains any unguarded, uninsulated, energized lines or parts of electric equipment, then operating at 50 V or more requires a Qualified Electrical Person
- Doors and hinged panels that are of sufficient weight or can be “moved” by the wind so as to push an employee into an exposed electrical circuit shall be secured to prevent their movement
- A Confined Space Entry Permit evaluation must be performed prior to issuing a permit and entering the confined space
- A safe working space/clearance must be maintained as specified in **Table 1** in **Section 3.2.1, *Safe Working Space/Clearance—600 V, Nominal, or Less*** or **Table 2** in **Section 3.2.2, *Safe Working Space/Clearance—600 V, Nominal, or More***

3.2.1 Safe Working Space/Clearance—600 V, Nominal, or Less

Sufficient access and working space/clearance shall be provided and maintained around all electrical equipment to permit ready and safe operation and maintenance of such equipment.

The depth of the working space/clearance in the direction of access to live parts shall not be less than that indicated in **Table 1**. Distances shall be 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 live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating materials; insulated wire or insulated bus bars operating at not over 300 V shall not be considered live parts
- *Condition 2.* Exposed live parts on one side and grounded parts on the other side; concrete, brick, or tile walls will be considered grounded surfaces
- *Condition 3.* Exposed live parts on both sides of the work space (not guarded as provided in Condition 1) with the operator between

Table 1. 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 distance (AFB or LAB) to trigger the need for PPE.*

3.2.2 Safe Working Space/Clearance—600 V, Nominal, or More

Conditions for safe working spaces/clearances are as follows:

- *Condition 1.* Exposed live parts 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 wood or other insulating materials; insulated wire or insulated bus bars operating at not over 300 V shall not be considered live parts
- *Condition 2.* Exposed live parts on one side and grounded parts on the other side; concrete, brick, or tile walls will be considered grounded surfaces
- *Condition 3.* Exposed live parts on both sides of the work space (not guarded as provided in Condition 1) with the operator between

Table 2. 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

3.3 Overhead Transmission Power Lines

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 3.3.1, *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)
- Work must be planned, as far as practical, to avoid close proximity to the overhead lines and accidental contact

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

3.3.1 Reviewing Transport Routes with Overhead Utilities

Prior to moving heavy equipment across the UPF construction site and support areas, the Discipline Superintendent/Supervisor, with support from Field Engineering, are to 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.

3.3.2 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 Disciplined Superintendent/Supervisor must ensure that:

- All parts of the equipment are lowered/stowed sufficiently to meet height restrictions
- Clearances specified in **Table 3** are maintained
- Effects of speed and terrain on equipment movement (including movement of the boom/mast) are considered to ensure that the minimum clearance distances specified in **Table 3** are not breached
- When traveling at night or in conditions of poor visibility, in addition to the measures specified previously, make plans to ensure that the power lines are illuminated or another means of identifying the location of the lines is used

Table 3. Power Line Clearance Minimums during Transport

Normal Voltage	**LAB** *(Minimum)*	**Y17-95-6Y-871** *(Transport Criteria)*
< 600 V	4 ft	7 ft
13.8 kilovolts (kV)	6 ft	9 ft
161 kV	10 ft	13 ft

NOTE 1: *Normal Voltage are the standard installations found on the Y-12 National Security Complex facility and expected to be encountered by UPF work operations.*

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

3.3.3 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.

3.3.4 Heavy Equipment Operations near Overhead Utilities

Except when 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 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 4**.

Table 4. 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.*

3.3.5 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 a work operation, if the equipment operator is unable to see the warning line while performing the work, establish the following:

- A dedicated spotter to provide warning of boundary encroachment
- A boom range control warning device set to give the operator sufficient warning when approaching the boundary

Identify and post clearance heights for all overhead utilities located over established haul routes on the UPF construction site and support areas.

3.4 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:

- 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.*

3.5 Electrical Equipment

All 120 V or 240 V, single-phase receptacles and portable power tool equipment must comply with the GFCI requirements as specified in **Section 3.5.1, *GFCI Requirements***.

3.5.1 GFCI Requirements

NOTE 1: *GFCI is the Project-preferred method.*

A GFCI is a piece of equipment that senses a leak to ground electrical charge and then interrupts the circuit, cutting the power. GFCIs must be used for Electrical Equipment when the Assured Grounding Program is NOT utilized in accordance with **Sections 3.12, *Assured Grounding Program for Powered Hand Tool Cords and Extension Cords***, **Section 3.13, *Assured Grounding Program for Inspection of Powered Hand Tools***, and **Section 3.14, *Assured Grounding Program for Non-Permanent Plant Ground Fault Circuit Interrupter***. The GFCIs are to be plugged in at the source of electricity and then the cord is to be attached in line after.

A GFCI must be tested for correct operation before 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.

Step 4 Press the test button.

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

NOTE 2: *If a GFCI is defective, refer to Y15-95-813,* Suspect/Counterfeit Item Identification and Investigation*.*

If the GFCI fails any part of the test, then there is something wrong with the installation, or the GFCI is damaged and must be destroyed and replaced

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

In the field, if a 110 V hard wired or portable generator is used, then a GFCI must also be used

3.6 Portable Power Generators

The following are applicable to Portable Generators

- Generators and welding transformers will be maintained in a serviceable condition
- Fuel tanks will be located in areas with containment provisions rated to 110% of the total tank contents
- The area around generators will be maintained free of oil and diesel spills
- Rotating components will be guarded
- Grounding will be provided on all mobile electrical generators to include light plants that function as a generator, along with a light plant function
- Outlets will be in good condition (e.g., no cracked outlets, outlet cover without damage that exposes conductors)

3.7 Temporary Construction Power Distribution

The following are applicable to Temporary Construction Power Distribution:

- Distribution boards shall have GFCIs or residual-current devices fitted
- Temporary Construction Power that is to be connected to Permanent Plant Equipment for Startup Testing shall be installed and maintained in accordance with Y15-95-100, *Control of Temporary Modifications*
- Terminal points will be in an enclosure via rubber/plastic grommets
- Cables shall be of a size and rating suitable for purpose
- Grounding will be fitted to all distribution boards and metal support frames
- Splicing of cables will only be allowed if in accordance with a field sketch; cables will be extended or repaired with the correct fittings
- All cables used shall be sufficient and durable for use in the construction work environment; contact electrical Field Engineering for cable type and sizing
- Particular attention will be given to cable management to ensure that cables are routed in a manner that does not create an obstruction or trip hazard; the method of such routing shall be in a manner that does not damage or affect the integrity of the cable (refer to UPF-CP-200, *UPF General Safe Work Practices*)
- All 480 V extension cords shall be inspected quarterly and marked with appropriately color-coded tape

3.8 Flash Hazard Protection

Additional safety-related work practices shall be used to protect personnel who might be exposed to the electrical hazards involved if the live parts are not placed into electrically safe work conditions. Such work practices shall protect each employee from the arc flash and from contact with live parts directly with any part of the body or indirectly through some other conductive object. The work practices that are used shall be suitable for the conditions under which the work is to be 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 EEWP. 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 electrically safe work condition.

If a flash hazard analysis calculation has been performed by Design Engineering, the value of the incident energy exposure in calories per square centimeter (cal/cm^2) may be used to determine the appropriate PPE category as detailed in **Appendix B, *Protective Clothing Characteristics***. Whether the flash protection category is determined with Tables 130.7(C)(15)(A)(a), Table 130.7(C)(15)(A)(b) and Table 130.7(C)(15)(B) of NFPA 70E or with a flash hazard analysis/calculation and **Appendix B**, the proper level of PPE for arc flash protection is determined by consulting the **Appendix B** and selecting the PPE category number that has been determined.

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 appropriate type and quality of PPE. The entire PPE set may be comprised of fire resistant (FR) helmet or headgear, face shield, safety glasses, rubber and leather gloves, leather shoes, etc., depending upon the magnitude of the arc energy.

The AFB shall be calculated by Design Engineering in accordance with the general formula in **Appendix C, *Arc Flash Boundary Distance Calculations***. The protective clothing shall 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.

3.9 Shock Hazard Protection

Figure 1, **Table 5**, and **Table 6** describe the approach distances for exposed, energized electrical conductors. **Table 5** and **Table 6** also identify LABs and RABs.

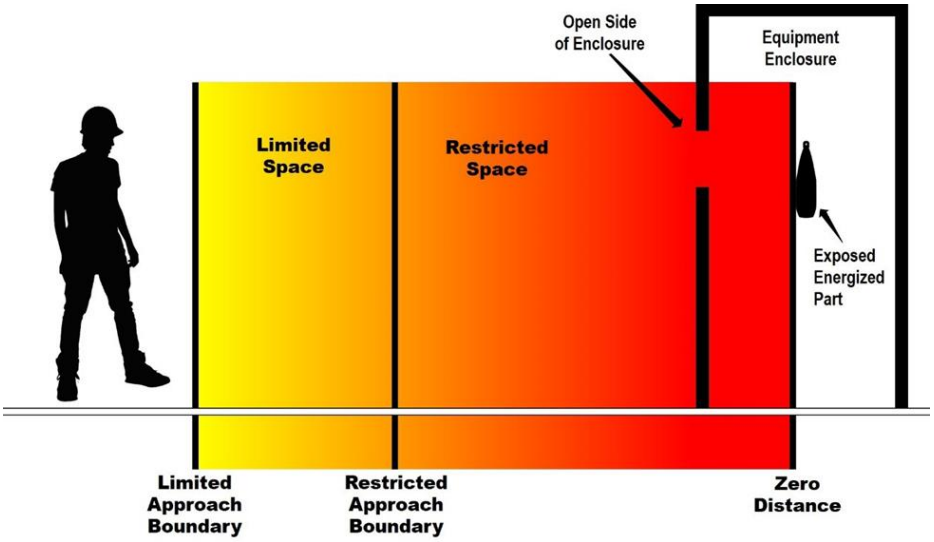

Figure 1. Approach boundaries.

Table 5. 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; Includes Inadvertent Movement Adder
	Exposed Movable Conductor	Exposed Fixed Circuit Part	
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.
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.

Source: NFPA 70E, Table 130.4(D)(a)

[i]For Single Phase systems above 250 volts alternating current (VAC), 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 6. Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage System

Nominal Potential Difference	LAB		Restricted Approach Boundary; Includes Inadvertent Movement Adder
	Exposed Movable Conductor*	Exposed Fixed Circuit Part	
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.

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

NOTE 3: *All dimensions are distance from energized electrical conductor or circuit parts to employee.*

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 below for this section pertains to both **Table 5** and **Table 6**:

- The LAB is the limit of approach distance for an unqualified person to a live part. In concept, unqualified people are less capable of recognizing a shock and flash hazard; therefore, these persons should remain at a safer distance from open, energized conductors. When there is a need for an unqualified person to cross the LAB to perform a minor task or look at equipment, a qualified person shall advise them of the possible hazards and ensure the unqualified person is safeguarded. Under no circumstances shall an unqualified person be permitted to cross the restricted approach boundary
- The RAB is the closest distance for a qualified person. Under no circumstances shall an unqualified person be permitted to cross the RAB. To cross this boundary, a person must meet all of the following criteria:
  - Be a qualified and authorized person
  - Have an approved EEWP, except for testing and troubleshooting where an approved CFN-1317 would be required.
  - Use arc flash rated PPE, approved for the conditions

    - Position the body in a way that minimizes risk of inadvertent contact in some instances. Work outside the restricted approach boundary (but within the person's reach) may be classified as restricted work if, in the judgment of the personnel involved, conductive objects or ungrounded body parts could make unintentional contact
- The Restricted Space is the area within the RAB where personnel could be exposed to energized conductor or circuit part

Crossing this boundary and entering the restricted space shall be considered the same as making contact with exposed energized conductors or circuit parts to cross the restricted space, the qualified person must:

- Have specified training to work on energized conductors or circuit parts
- Have a documented plan that justifies the need to work inside the restricted approach boundary
- Perform a flash hazard risk analysis
- Have both the documented justification plan and the flash hazard risk analysis approved by the Site Manager or designee

Electrical equipment, such as switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling units, and that are likely to require examination, adjustment, servicing, or maintenance while energized, shall 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 unique identifier (UNID) number
- Reference Drawing
- Source Protective Device
- AFB
- 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

3.10 Batteries and Battery Rooms

UPF Project utilizes Valve-Regulated Lead Acid (VRLA) batteries. Safety-related work practices shall be used to protect personnel who might be exposed to the electrical hazards involved with 24 Volts Direct Current (VDC) and 48 VDC Battery Systems. Refer to **Section 3.2, *Working On or Near Energized Circuits***, for information on working on or near energized battery systems.

3.10.1 General Safety Hazards

Before a battery system may be worked on, a risk assessment (e.g., JHA) shall be performed to identify the chemical, electric shock, and arc flash hazards and to assess the risks associated with the types of tasks to be performed. Live parts of equipment operating at less than 50 V need not be de-energized if there will be no increased exposure to electrical burns or explosion from electrical arcs.

UPF DCP 48Vdc system(s) operates at a float voltage >50Vdc; therefore, the DCP system(s) is required to be de-energized to be worked on.

Employees shall not enter spaces containing batteries unless illumination is provided that enables the employees to perform the work safely.

Personnel shall not wear electrically conductive objects such as jewelry while working on a battery system.

Electrical hazard warnings indicating the shock hazard due to the battery voltage and the arc flash hazard due to the prospective short-circuit current, and the thermal hazard.

3.10.2 Electrolyte Hazards

Employees performing any activity including the handling of electrolyte shall wear safety glasses or goggles, as appropriate.

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

3.11 Energized Electrical Work Permit

Unless the requirements for an exemption for an EEWP applies in accordance with **Section 3.11.1,** working on or near live parts and/or exposed energized electrical equipment requires the completion of an EEWP. An EEWP exemption shall only be permitted after the work group has determined that the energy isolation cannot be reasonably accomplished, or that the needed data can best be obtained while the circuit is energized.

If the exposed energized components cannot be electrically isolated, the Supervisor or their designee shall:

- Complete, as applicable, a STARRT card or JHA for each scope based on specific configurations; the STARRT card and JHA are required on all work activities when voltages exceed 600 VAC and 250 volt direct current
- Determine the LAB, AFB, and PPE requirements
- Mitigate hazards, when feasible, by installing protective shields and/or barriers, where appropriate, to prevent accidental contact by personnel, materials, and tools with exposed energized equipment
- Verify appropriate PPE and tools are used by the personnel
- Prepare the EEWP, unless an exemption for EEWP applies in accordance with **Section 3.11.1**

The following items, at minimum, shall be documented on the EEWP for energized electrical work:

- 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 restricted and prohibitive approach boundaries for qualified personnel
- Results of the flash hazard analysis
- Approach AFB
- Identification of necessary 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, including a discussion of any job-specific hazards
- Energized work approval signature(s)

3.11.1 Work Permit Exemptions

An EEWP shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE, in accordance with NFPA 70E, under any of the following conditions:

- Testing, troubleshooting, and voltage measurements with the use of CFN-1317

NOTE: *CFN-1317 are not required for zero energy checks.*

- Thermography and visual inspections of the RAB is not crossed with the use of CFN-1317
- Access to, and egress from, an area with energized electrical equipment if no electrical work is performed and the RAB is not crossed
- General housekeeping and miscellaneous non-electrical tasks shall be performed if the RAB is not crossed

A UEP may work near or enter the LAB if:

- Trained in, and familiar with, any electrical safety-related practices necessary for their safety
- They are escorted by a Qualified Electrical Person
- Advised of the electrical hazards

3.12 Assured Grounding Program for Powered Hand Tool Cords and Extension Cords

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, or contacts
- Frayed or damaged cords

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

If the cord does not pass inspection, the equipment is tagged with a “DO NOT USE” tag and returned to the tool crib for repair or disposal.

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
1	January, February, March	Yellow
2	April, May, June	Green
3	July, August, September	Red
4	October, November, December	Blue

Cords shall not be used to raise or lower equipment.

Cords shall not be fastened with staples or otherwise hung so that damage can occur to the outer jacket or insulation.

Extension cords shall be protected from accidental damage. Sharp corners and projections shall be avoided. Extension cords shall not pass through walls, doors, partitions, or other pinch points, or otherwise be subject to physical damage, unless protections are provided to avoid damage.

Extension cords shall not substitute for the fixed wiring of a structure, but may be used under the following conditions:

- Extension cord connected to an Underwriters Laboratories (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
- The maximum electrical load attached to the extension cord must not exceed the cord’s listed capacity
- Where used as permitted, each extension cord shall be equipped with an attachment plug and shall be energized from a receptacle outlet

Equipment attached with plug-in cords used in outdoor and/or wet locations shall be protected by GFCIs.

All receptacles shall be of the grounding type. All branch circuits shall include a separate equipment grounding conductor, and all receptacles shall be electrically connected to the equipment grounding conductors(s). Receptacles shall not be connected to the same ungrounded conductor of multi-wire circuits that supply temporary lighting.

Suitable disconnecting switches or plug connectors shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit.

All lamps for general illumination shall be protected from accidental contact or breakage by a suitable luminaire or lamp holder with a guard.

Cable assemblies and flexible cords and cables shall be supported in place at intervals that ensure they will be protected from physical damage. Support shall be in the form of staples, cable ties, straps, or similar type fittings installed so as not to cause damage.

Electrical hand tools and equipment shall 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
- Tools will be in good condition and will be subject to preventative maintenance schedules recommended by the manufacturer

3.13 Assured Grounding Program for Inspection of Powered Hand Tools

All required tests shall be performed before first use, before equipment is returned to service following any repairs, before equipment is used after any incident that can be reasonably suspected to have caused damage (e.g., when a cord set is run over), and at intervals not to exceed three months.

If any of the following conditions exist, the equipment must be tagged with a “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, or contacts
- Frayed or damaged cords
- Incorrect polarity

Double insulated tools (tools without a manufacturer ground) shall:

- Have a visual inspection before use
- Be inspected quarterly by qualified electrician

3.14 Assured Grounding Program for Non-Permanent Plant Ground Fault Circuit Interrupter

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

- According to applicable codes/standards, GFCIs will be provided for all 120 V, single-phase, 15-amp (A), and 20 A receptacle outlets (or 240 V, single-phase, 30 and 40 A, as applicable) that are not part of the permanent wiring of a building or structure (e.g., temporary wiring during construction)
- GFCIs will be provided for lavatory, washroom, and change room outlets
- GFCIs will be 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:

- 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. GFCIs do not protect in the event of line-to-line contact
- It is essential that 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
- 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, at minimum, the following:

- A GFCI must be tested for correct operation before use in accordance with **Section 3.5.1**
- All GFCIs will be inspected and checked on a quarterly basis in accordance with ML-SH-801768-A001
- Documentation will be maintained by the Construction Electrical Field Engineering

3.15 Inspection of Protective Equipment

Insulating equipment shall be inspected by the assigned employee for damage before each day's use and immediately following any incident that can reasonably be suspected to have caused damage. 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 before use.

Insulating equipment with any of the following defects may not be used:

- 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

Repaired insulating equipment shall be tested again before it may be used by personnel to show that it can withstand the voltage for which it is intended to be used.

Insulating protective equipment will be tested by an approved electrical testing service in accordance with 29 CFR 1910.137. Equipment will be stamped/tagged with the date it was tested, the class of the equipment, and the test voltage.

Test equipment and accessories are labeled and rated for the voltages and other limits that apply. The items are tested and certified on a periodic basis in accordance with NFPA 70E.

3.16 Electrical Power and Lighting Circuits

Switches and breakers used for the routine opening and closing of circuits under loads shall be load rated.

After a circuit has been de-energized by the operation of an over-current device, the circuit may not be manually energized until it has been determined by Qualified Electrical Personnel or Supervisor that it is safe to do so, with the following exception:

- 120 V, 15 A, and 20 A breakers may be reset ONCE by operators. If the breaker trips again, it must be evaluated by Qualified Electrical Personnel
- Circuit breaker panels, transformers, and switchgear shall be labeled to show the voltage involved
- All panelboards, disconnects, and major electrical equipment shall have their upstream power source(s) clearly identified on the equipment
- Circuit breaker panels shall be labeled to show what each breaker energizes
- Test instrument equipment and accessories shall be rated for the circuits and equipment to which they will be connected
- Electrical panel boxes (usually kept closed) may be left open when a LOTO device that has been attached to a circuit breaker holds a door open so that it cannot be closed

3.17 Use of Proximity Testers

On electrical systems over 1000 V, noncontact test instruments shall be permitted to be used to test each phase conductor by Startup qualified electricians (i.e., MQEP) for Zero-Energy checks in electrical switchgear. Prior to use in these instances, the qualified electrician must meet the requirements in this Manual.

For voltages under 1000 VAC, the noncontact tester WILL NOT be used and does not meet the requirements for zero energy check or verification under Y17-95-64-801. The proximity tester may be used by a qualified electrician as a personal verification tool only for voltages under 1000 V. When used for trouble shooting circuits, a multi-meter shall be used to verify the proximity tester results. Prior to being issued a proximity tester, personnel will be trained on the proper use and limitations of the proximity tester that will be issued by the tool room. Personal proximity testers are not authorized for use on the UPF construction site. The proximity tester will be issued only to qualified electricians after having the appropriate training; that training is documented (by the authorized trainer sending an email to the Tool Room and ES&H) adding the person to the competent persons' list.

3.18 UPF-Authorized Electrical Inspectors

NOTE: *Refer to **Section 2.9,*** **Environmental, Safety and Health Representative**, and **Section 2.10, Training Manager***, to view the responsibilities of the ECAHJ and OI.*

3.18.1 UPF Electrical Inspector

To be nominated to be a UPF Electrical Inspector, one must be a Bechtel National, Inc. (BNI) employee who has a minimum of five years combined schooling/experience with electrical/electronic system design and/or electrical system construction/installation/inspection. The employee must complete the current

NFPA 70 training every three years. The employee must also complete the International Code Council certification for Commercial Electrical Inspector or International Association of Electrical Inspectors.

3.18.2 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 installation and are documented in the Electronic Inspection Request System at: https://engwebapps/ElectricalInspection/. The Electrical Inspection Request System is utilized to request an Electrical Inspection. 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, UNIDs, Locations, and all applicable Design Documents as attachments.

The Electrical Inspector will be nominated for approval by the Project Field Engineer and approved by the ECAHJ using CFN-1261, *UPF Electrical Inspector Approval.* The ECAHJ maintains the list of approved Electrical Inspectors for the UPF Project.

4.0 RECORDS

Records generated by this Procedure shall 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*. Quality Type is listed as Quality-Lifetime (QA-L), Quality-Nonpermanent (QA-NP), or Non-Quality (Non-QA) in accordance with E-PROC-3114, *Records Management* (Consolidated Nuclear Security).

Records generated during the performance of this Procedure 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*	UPF DMC	InfoWorks	ERAT	QA-L

5.0 REFERENCES

5.1 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*

UPF-CP-214, *Barricades and Signs*

UPF-CP-227, *UPF Safety Watches*

5.2 Interfacing References

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

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)

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

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

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

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

E-PROC-3114, *Records Management*

ML-PS-801768-A004, *Uranium Processing Facility Project Records Retention and Turnover List*

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

NFPA 70®, *National Electrical Code®* (2014)

NFPA 70E®, *Standard for Electrical Safety in the Workplace®* (Code of Record 2015)

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

UL 943, *UL Standard for Safety Ground-Fault Circuit-Interrupter*

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

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

Y15-95-800, *UPF Document Management*

Y15-95-806, *UPF Records Retention and Turnover*

Y15-95-813, *Suspect/Counterfeit Item Identification and Investigation*

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

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

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

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

6.0 SUPPLEMENTAL INFORMATION

Appendix A, *Acronyms and Definitions*

Appendix B, *Protective Clothing Characteristics*

Appendix C, Arc *Flash Boundary Distance Calculations*

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

APPENDIX A
Acronyms and Definitions

(Page 1 of 5)

Acronyms

A	Amp (or Ampere)
AFB	Arc Flash Boundary
AN	As Needed
AR	As Required
B/SO	Buddy/Safety Observer
BNI	Bechtel National, Inc.
cal/cm^2	Calories per Square Centimeter
CFR	Code of Federal Regulations
ECAHJ	Electrical Contractor Authority Having Jurisdiction
EETF	Energized Electrical Testing Forms
EEWP	Energized Electrical Work Permit
EHRA	Energized Hazard Risk Assessment
ES&H	Environmental, Safety and Health
FR	Fire Resistant
ft.	Feet
GFCI	Ground Fault Circuit Interrupter
in.	Inch
JHA	Job Hazard Analysis
kV	Kilovolt
LAB	Limited Approach Boundary
LOTO	Lockout/Tagout
LQEP	Low Voltage Qualified Electrical Person
MSAD	Minimum Safe Approach Distance
MQEP	Medium Voltage Qualified Electrical Person
NFPA	National Fire Protection Association
Non-QA	Non-Quality
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
PRMS	Programmatic Requirements Management System
PSUM	Project Startup Manager
QA-L	Quality-Lifetime
QA-NP	Quality-Nonpermanent
RAB	Restricted Approach Boundary
SR	Selection Required
STARRT	Safety Task Analysis and Risk Reduction Talk
STE	Startup Test Engineer

APPENDIX A
Acronyms and Definitions

(Page 2 of 5)

TL	Test Lead
UEP	Unqualified Electrical Personnel
UL	Underwriters Laboratories
UNID	Unique Identifier
UPF	Uranium Processing Facility
V	Volt
VDC	Volts Direct Current
VAC	Volt Alternating Current
VRLA	Valve-Regulated Lead Acid

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.
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.
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	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.

APPENDIX A
Acronyms and Definitions

(Page 3 of 5)

Electrically Safe Work Condition	A state in which a worker is able to work safely on or near an electrical conductor or circuit part because the 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 grounded if determined necessary.
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 shall 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 shall be treated as if it were energized.
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, *Safety Ground-Fault Circuit-Interrupter*, a Class A GFCI trips when the current-to-ground has a value in the range of four to six milliamperes.
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.
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.

APPENDIX A
Acronyms and Definitions

(Page 4 of 5)

Limited Approach Boundary (LAB)	An approach limit that specifies a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists; it is not to be crossed by unqualified persons unless escorted by a qualified person.
Lockout/Tagout (LOTO)	The placement of a lock and tag on an energy-isolating device to prevent the unexpected energizing, start-up, or release of stored energy from equipment or machines that could cause injury to personnel. Methods of LOTO include locking and tagging the entire electrical supply or individual switches, locking or blocking internal moving parts in resting position, or conducting both if the potential exists that performing one or the other does not control all energy sources.
Normal Operation	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 doors are closed and secured 4. All equipment covers are in place and secured 5. There is no evidence of impending failure
Qualified Electrical Person	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 electrical hazards that might be present with respect to that equipment or work method. This is broken up into two qualifications: 1. LQEP for voltages < 600 V 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 3.2** and the corresponding voltages to which the qualified person will be exposed • The approach distances for LAB and RAB are specified in **Table 5** and **Table 6** in **Section 3.9** 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

APPENDIX A
Acronyms and Definitions

(Page 5 of 5)

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.
Single-Phase	Of or designating an electrical circuit having an alternating current with one phase.
Suspect/Counterfeit Item	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 Person	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(s) MUST be continuously escorted by a Qualified person if there is a need to be inside the limited approach boundary. Under no circumstance shall the escorted unqualified person(s) 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 pre-selected amount, and that provides a means for recombination of internally generated oxygen and the suppression of hydrogen gas evolution to limit water consumption.
Work Near (Live Parts)	Any work activity inside a LAB.
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 EETF and an EHRA • **Repair** is any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.); this would require an EEWP
Work Site	The barricaded area immediately adjacent to the location where the physical work is being performed.
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
Protective Clothing Characteristics

(Page 1 of 2)

NOTE: *The following is used below: As Needed (optional) (AN), As Required (AR), Selection Required (SR).*

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)

APPENDIX B
Protective Clothing Characteristics

(Page 2 of 2)

- 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

NOTE 1: *Arc rating is defined in Article 100 of NFPA 70E.*

NOTE 2: *Face shields are to have wrap-around guarding to protect not only the face, but also the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn.*

NOTE 3: *If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.*

NOTE 4: *Any deviations require approval by the Site Manager and the ES&H Manager, or their designees.*

APPENDIX C
Arc Flash Boundary Distance Calculations

600 V and below:

Dc=[2.65 × MVAbf × t]1/2

or

Dc=[53 × MVA × t]1/2,

where

Dc=Distance of person from an arc source in feet MVAbf=Bolted fault MVA at point involved

MVA=MVA rating of transformer

(For transformers with MVA rating below 0.75 MVA, multiply the transformer MVA rating by 1.25.)

t=Time of arc exposure in seconds Above 600 V:

At voltage levels above 600 V, the AFB is the distance at which the incident energy level equals cal/cm^2. For situations in which the fault clearing time is 0.1 second (or faster), the AFB is the distance at which the incident energy level equals 1.5 cal/cm^2.

APPENDIX D
Example of an Equipment Arc Flash Label

UPF Calculation Sheet

Document #: DAC-EE-801768-A113
Revision
Date:

WARNING

Arc Flash and Shock Hazard Present
Appropriate PPE Required

ARC FLASH PROTECTION		**SHOCK PROTECTION**	
Working Distance	**in**	Shock Hazard When **covers removed**	
Incident Energy	**cal/cm²**		**VAC**
Arc Flash Boundary	**ft**	LimitedApproach	**ft**
Available Fault Current	**kA**	Restricted Approach	**ft**
Clearing Time	**cycles**		

Equipment: **UNID**
Ref Dwg:

Equipment Name:

Source Protective Device:

Std. IEEE 1584-2002 and NFPA 70E-2015 Date:

Project Name: Uranium Processing Facility
Calculation: DAC-EE-801768-A113