Electrical Safe Work Practices

Overview

Purpose

This document is designed to guard against and prevent injury to personnel and provide for the protection of property by educating employees in proper safe electrical work practices, including the use of appropriate personal protective equipment.

Scope

This document is to be considered as the minimum acceptable standard for all Marathon Petroleum Company LP (MPC) employees and contractors performing work at MPC Refining. Only qualified persons may work on or near energized electrical equipment. Such persons shall be trained and capable of working safely on or near energized circuits and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools. More stringent requirements may be necessary for certain situations.

Records Retention

Printed copies of this document should not be retained more than 12 months. Any revision to this document will be retained indefinitely.

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1.0 References

1.1 Refining References

The table below lists the Refining references used with this document.

Number	Description
RSP-1121-010	Blinding & Energy Isolation
RSP-1163-000	Assessment of Electrical Infrastructure
RSP-1310	PSM/RMP Incident Investigation

1.2 Industry References

The table below lists the industry references used with this document.

Number	Description
American Society for Testing and Materials (ASTM)	
ASTM F855	Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment
ASTM F1117	Standard Specification for Dielectric Footwear
ASTM F1959	Standard Test Method for Determining the Arc Rating of Materials for Clothing
National Electrical Manufacturers Association (NEMA)	
NEMA Z535.4	Product Safety Signs and Labels
National Fire Protection Association (NFPA)	
NFPA 70	National Electric Code
NFPA 70E	Standard for Electrical Safety in the Workplace

1.3 Regulatory References

The table below lists the regulatory references used with this document.

Number	Description
OSHA 1910.136	Occupational Foot Protection
OSHA 1910.137	Electrical Protective Devices
OSHA 1910.269	Electric Power Generation, Transmission, and Distribution
OSHA 1910.331-335	OSHA Electrical Requirements
OSHA 1910.147	Control of Hazardous Energy Source

1.4 Terms

For definition of terms used in this document, see Appendix A: Terms and Definitions.

2.0 Roles and Responsibilities

2.1 Roles and Responsibilities

The table below describes the roles and responsibilities related to this document.

Roles	Responsibilities
Managers and Supervisors	**(a)** Ensure organizational compliance with this Electrical Safe Work Practice. **(b)** Ensure responsibilities regarding the Energized Electrical Work Permit (Appendix G) are fulfilled. **(c)** Ensure that audit deficiencies are corrected.
Electrical Foreman and Supervisors; Instrumentation and Analyzer Technician Forman and Supervisors	**(a)** Ensure departmental compliance with this Electrical Safe Work Practice. **(b)** Ensure all MPC electricians, Instrument and Analyzer Technicians are trained in this Electrical Safe Work Practice. **(c)** Ensure this Electrical Safe Work Practice is properly implemented and the appropriate Personal Protective Equipment (PPE) utilized through periodic inspections. **(d)** Ensure only qualified persons work on energized equipment. **(e)** Ensure recordkeeping for PPE is updated. **(f)** Ensure all electrical equipment is labeled properly.
Qualified Persons and Contractors	**(a)** Ensure this Electrical Safe Work Practice is utilized for all electrical work. **(b)** Ensure that requirements specified in this Electrical Safe Work Practice are followed. If the requirements cannot be followed as specified, the work will be suspended until a safe alternative can be determined. **(c)** Obtain, inspect, and use the required PPE and safety equipment, and return it to its proper location at the completion of the task. **(d)** When performing work on plant electrical equipment, ensure it is properly labeled and in good operating condition. Report any deficiencies to the MPC electrical foreman or electrical supervisor.
Electrical Reliability Engineers	**(a)** Ensure the Arc Flash Risk Assessment is up to date. **(b)** Ensure accuracy on all electrical arc flash equipment labeling. **(c)** Model any protective or overcurrent relay setting changes.
Electrical Project Engineers	**(a)** Ensure that an Arc Flash Risk Assessment is performed on all new electrical equipment and is labeled accordingly. **(b)** Evaluate designs of all new electrical equipment.
Training Department	**(a)** Ensure that all affected employees receive training on this Electrical Safe Work Practice. **(b)** Ensure that training records are updated. **(c)** Notify employees and supervision when out of compliance.
Safety Department	**(a)** When required, participate on a team to complete the Energized Electrical Work Permit (Appendix G). **(b)** Understand the general safety requirements in Section 5.0 of this Electrical Safe Work Practice. **(c)** Participate in safety audits of this standard.
Unqualified Persons	Ensure compliance with Section 3.0, Section 5.0, and Section 6.0 of this Electrical Safe Work Practice.
Corporate Electrical Specialist	Own the program and is responsible for updating the RSP and ensuring it uses the latest version of the **NFPA 70E** standard.

3.0 Training Requirements

3.1 Training for Employees Exposed to Electrical Hazards

Employees that are exposed to an electrical hazard that is not reduced to a safe level shall be trained in the following:

(a) Understanding of the specific hazards associated with electrical energy,
(b) Electrical safe work practices and procedures to provide protection from electrical hazards associated with their job tasks and assignments, and
(c) Identification and understanding of the relationship between electrical hazards and possible injury.

3.2 Training for Qualified Persons

Qualified Persons shall be trained in the following:

(a) Knowledge and understanding of the construction and operation of equipment or in specific work methods,
(b) Identification of electric hazards and methods to avoid them,
(c) Proper use of special precautionary techniques, electrical safe work practices and procedures,
(d) Personal Protective Equipment selection and use of arc flash suits, insulating gloves, shielding materials, and other required PPE,
(e) Insulating and Shielding Material selection and use,
(f) Insulating Tools & Test Equipment selection, use, and limitations;
(g) Lockout / Tagout Training (LOTO) in accordance with **RSP-1121-010**,
(h) Approved emergency procedures, first aid methods, and resuscitation methods, including cardiopulmonary resuscitation (CPR) and automatic external defibrillator (AED) use, and

Note: CPR/AED refresher training shall occur every 2 years.

(i) Methods for releasing victims from contact with exposed energized electrical conductors or circuit parts (e.g., the use of a shepherd's hook).

3.3 Training for Qualified Persons Authorized to Work Within Limited Approach Boundary

Qualified Persons permitted to work within the limited approach boundary shall be trained in the following:

(a) Skills and techniques necessary to distinguish exposed energized components from other parts,
(b) Ability to determine nominal voltage of energized components,
(c) Approach distances specified in Appendix C.1, and
(d) Decision making process necessary to be able to perform job safety planning, identify electrical hazards, assess risk, and to select appropriate risk control methods.

3.4 Training for Unqualified Persons

Unqualified persons shall be trained to recognize electrical hazards to which they may be exposed and in the proper methods of avoiding the hazards. Unqualified persons shall comply with Section 3.0, Section 5.0, and Section 6.0 of this standard. Unqualified persons shall receive refresher training through computer-based training.

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3.0 Training Requirements, Continued

3.5 RSP-1162-000 Refresher Training

Refresher training for qualified persons shall not exceed 3 years.

3.6 Training Methods

Training may consist of classroom training, computer-based training, on-the-job training, or a combination of these. Electrical training plans shall comply with the requirements of **NFPA 70E** (***Article 110.2***).

Note: An employee is considered trained once they have demonstrated proficiency in the work practices involved.

4.0 Auditing

4.1 Electrical Safety Program

This RSP shall be reviewed every three years to assure that it is in compliance with the latest version of **NFPA 70E**.

4.2 Electrical Auditing

Apply the following electrical auditing requirements:

4.2.1 An audit, including verification of field activities shall be performed at least annually to verify that all requirements of this standard are being followed.

4.2.2 The audit team shall consist of a representative of the Electrical Maintenance Group and a representative of the Safety Department. Results of the audit shall be documented, and deficiencies shall be corrected. A formal report shall be presented to the Refinery Leadership Team.

5.0 General Electrical Safe Work Practices

5.1 General Electrical Safety

Apply the following for general electrical safety:

5.1.1 The installation or repair of any electrical equipment shall be performed by a qualified person only.

5.1.2 The safe work practices outlined in this document shall be utilized to safeguard personnel from injury while working on or near equipment or circuits that may be energized.

5.1.3 Extreme care shall be taken for any work that requires opening energized electrical equipment. A hot work permit shall be required prior to opening an explosion-proof or purged enclosure in an electrically classified area.

5.1.4 After a circuit is de-energized by the automatic operation of a circuit's overcurrent protective device the circuit shall not be re-energized until it has been determined that the equipment and circuit can be safely re-energized by a qualified person. When it is determined that the automatic operation of a device was caused by an overload rather than a fault condition, examination of the circuit or connected equipment shall not be required before the circuit is re-energized. Repetitive manual reclosing of a tripped circuit breaker or re-energization of circuits through replacement of blown fuses is prohibited and shall require investigation.

5.1.5 Safety signs, safety symbols, or accident prevention tags shall be used where necessary to caution personnel about electrical hazards which may endanger them.

5.1.6 Anytime an excavation encounters an electrical duct bank encased in red concrete, a known electrical duct bank encased in old white concrete or bare conduits buried directly in the soil, a representative of the Electrical Maintenance Group shall be contacted before additional exposure occurs.

5.1.7 Overcurrent protection of circuits and conductors shall not be modified beyond that permitted by applicable portions of the National Electrical Code (**NFPA 70**) and other standards dealing with overcurrent protection.

5.1.8 Newly installed or modified electrical equipment shall be inspected to comply with applicable installation codes and MPC specifications before placing in service.

5.1.9 Working spaces about electrical equipment shall be kept clear and not used for storage.

5.1.10 General Purpose electrical equipment shall not be used in an electrically classified area without following the site's Hot Work Permit procedures.

5.2 Battery Systems

5.2.1 Prior to any work on a battery system, a risk assessment shall be performed to determine the chemical, electrical shock and arc flash hazards and assess the risks associated with the type of task to be performed.

5.2.2 Handling of electrolyte shall require the use of chemical PPE including goggles or face shield, gloves, and an apron.

5.2.3 Measuring or testing of components 50 volts or greater requires voltage rated gloves.

5.2.4 Working on terminations greater than 50 volts to ground or negative terminal requires an energized work permit.

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5.0 General Electrical Safe Work Practices, Continued

5.3 Overhead Power Lines

Apply the following for overhead power lines:

5.3.1 Any overhead wiring shall be considered energized until the MPC Electrical Maintenance Group verifies that the wiring does not pose a hazard or is in an electrically safe work condition.

5.3.2 Overhead cranes, manlifts, scaffold, and mechanical equipment, shall not be constructed or operated closer than 20 feet from any energized electrical overhead line without approval of the MPC's Electrical Maintenance Group.

Note: The MPC Electrical Maintenance Group can approve closer operation.

5.3.3 Unqualified persons shall not place themselves closer than 10 feet from any energized electrical overhead line. See the table in Appendix C.1 for exposed movable conductor limited approach distances for voltages above 69kV.

Note: MPC Electrical Maintenance Group can approve closer working distances by placing the overhead line in an electrically safe work condition or by installing voltage rated shielding.

5.3.4 The MPC Electrical Maintenance Group shall determine if a "Qualified Overhead Line Spotter" is needed when mechanical equipment is operating closer than 20 feet from any energized electrical overhead lines. This spotter's sole responsibility is to observe safe working clearances around all overhead lines and to direct the operator accordingly. This person shall wear a bright colored vest so that he/she is clearly visible to the crane operator at all times.

6.0 Temporary Power Requirements

6.1 Portable Electrical Equipment Specifications

Apply the following for portable electrical equipment specifications:

6.1.1 Portable cords and cables shall be NEC listed for "extra hard usage" or "hard usage" service and third-party listed for wet locations when used outdoors.

6.1.2 480Vac cords and cables shall be rated for 600Vac.

6.1.3 Attachment plugs and connectors shall be third-party listed and of watertight design when used outdoors.

6.1.4 120Vac WYEs and portable GFCIs shall be factory assembled, watertight, and third-party listed.

6.1.5 Portable lighting and floodlights shall be third-party listed and watertight design when used outdoors. Portable halogen and quartz work lighting fixtures are not permitted due to high operating temperatures.

6.1.6 Attachment plugs, receptacles, cover plates, and cord connectors shall be maintained such that the following criteria are met:

- **(a)** There are no breaks, damage, or cracks exposing energized conductors and circuit parts.
- **(b)** There are no missing cover plates.
- **(c)** Terminations have no stray strands or loose terminals.
- **(d)** There are no missing, loose, altered or damaged blades, pins, or contacts.
- **(e)** Polarity is correct.

6.1.7 Cords and cord caps for portable electrical equipment shall be repaired and replaced by qualified personnel and checked for proper polarity, grounding and continuity prior to returning to service.

6.1.8 Flexible cords and cables shall be protected from accidental damage. Sharp corners and projections shall be avoided. Where passing through doorways or other pinch points, protection shall be provided to avoid damage. They shall also be supported in place at intervals that ensure that they will be protected from physical damage.

6.2 Use of GFCI with Portable Equipment

Apply the following for the use of ground fault circuit interrupter (GFCI) with portable equipment:

6.2.1 GFCI protection shall be used for 125-volt, 15-, 20-, and 30-ampere cord sets (extension cords) or cord- and plug-connected tools when performing maintenance or construction activities. Portable GFCIs shall be located at the power source to protect the circuit.

6.2.2 Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, Class A GFCI protection or an Assured Equipment Grounding Conductor Program (AEGCP) shall be implemented (see Appendix H.4). This requirement includes 480 volt temporary cords and equipment.

6.2.3 Specialized electrical test equipment that will not operate with GFCI protection (due to current leakage) shall not require the use of GFCI. Special precaution shall be taken to ensure personnel protection such as voltage-rated PPE.

6.2.4 All 125-volt and 125/250-volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are part of a portable generator, welding machine, light plant, or other portable equipment shall have listed GFCI protection for personnel.

6.2.5 GFCIs shall be tested per the manufacturer's instructions.

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6.0 Temporary Power Requirements, Continued

6.3 Use of Generator and Alternate Power Sources

Apply the following for the use of generator and alternate power sources:

6.3.1 When temporary or portable generators or other alternate power sources are connected to the permanent electrical distribution system for any reason or to temporary supply process equipment loads, an MOC and Temporary Power Approval Checklist (Appendix F) shall be completed. Prior to energizing equipment an MPC Electrical Maintenance Group Employee shall perform a visual inspection, approve, sign, and complete the Temporary Power Approval Checklist (Appendix F).

6.3.2 After removal of generator or alternate power source and prior to re-energizing permanent power, an MPC Electrical Maintenance Group Employee shall perform a visual inspection, approve, sign, and complete the Temporary Power Approval Checklist (Appendix F).

6.3.3 The Temporary Power Approval Checklist (Appendix F) is ***NOT*** required when using temporary or portable generators or supplying temporary power that does not tie into the permanent electrical system. These installations shall be in compliance with other temporary power requirements and approved by the MPC Electrical Maintenance Group.

6.3.4 Unless labeled otherwise, portable generators need not be grounded if:

- **(a)** the generator supplies only equipment mounted on the generator or cord and plug-connected equipment through receptacles mounted on the generator, and
- **(b)** non-current carrying metal parts and the equipment grounding terminals of the power receptacles are bonded to the generator frame.

6.3.5 If the portable generator is providing electric power to a structure or a portion of the refinery electrical distribution system, it must be connected to the structure's grounding system or the refinery grounding grid.

6.4 Temporary Electrical Installations

Apply the following for temporary electrical installations:

6.4.1 Temporary electrical power and lighting installations shall be permitted during the period of construction, maintenance, repair, or demolition of equipment, or similar activities.

6.4.2 Temporary wiring shall be removed immediately upon completion of construction or purpose for which the wiring was installed.

6.4.3 Permanent installations shall not be installed using flexible cords and other equipment intended for portable or temporary use.

6.4.4 Temporary wiring methods are approved based on criteria such as length of time in service, location, severity of service, exposure to weather, or other special conditions.

7.0 Work Involving Electrical Hazards

7.1 Risk Assessment

Apply the following for Risk Assessment when working on energized electrical equipment operating at 50 volts or above:

7.1.1 The risk assessment process shall address employee exposure to electrical hazards and shall identify the task complexity and frequency, and the level of consequences. The risk assessment shall use the following hierarchy:
- **(a)** Remove the electrical hazards,
- **(b)** Minimize the electrical hazards,
- **(c)** Wear electrical PPE.

7.1.2 Before starting each job that involves exposures to electrical hazards, the employee in charge shall complete a job safety plan to address:
- **(a)** potential hazards,
- **(b)** approach boundaries,
- **(c)** lockout/tagout procedures,
- **(d)** risk assessment (including the severity and likelihood of injury),
- **(e)** condition of equipment maintenance,
- **(f)** proper PPE, and
- **(g)** the proper equipment to conduct the task.

7.1.3 Safety related work practices shall be used when workers are exposed to electrical hazards. Working inside the Arc Flash Boundary will require an arc flash risk assessment and working inside the shock approach boundaries will require a shock risk assessment to be performed. The risk assessments shall identify the electrical hazards, estimate the likelihood of occurrence and severity of injury or damage to health and determine if additional measures are required, including PPE. The job safety plan shall be documented.

7.1.4 Additional job safety planning shall be held if changes in the scope of work occur that may affect employee safety.

7.1.5 An Arc Flash Risk Assessment shall determine the arc flash boundary, the incident energy at the working distance, and the personal protective equipment that qualified persons within the arc flash boundary shall use. For arc flash PPE requirements see Appendix D.

7.1.6 The Arc Flash Risk Assessment shall be updated when a major modification, renovation, or protective/overcurrent setting change takes place. The Arc Flash Risk Assessment shall be revalidated periodically, not to exceed 5 years.

7.1.7 A shock risk assessment shall determine the shock approach boundary and the required shock protection PPE. For work within the shock approach boundary, see Appendix B.

7.1.8 Interacting with energized electrical equipment with incident energy levels 40 calories or greater shall be avoided. Risk control methods should be considered such as, operating upstream devices, remote operation, remote racking, maintenance mode settings, etc.

7.2 Work Involving Electrical Hazards

Apply the following for work involving electrical hazards:

7.2.1 When operating (turning on or off) 480V circuit breakers in Motor Control Centers or 480V panelboards, arc flash PPE is required as specified by the arc flash label.

7.2.2 For low and medium voltage circuit breakers and motor starters that are designed to be racked in and out while energized, arc flash PPE is required as specified by the arc flash label.

7.2.3 Remote racking equipment and remote switching equipment shall be utilized when available.

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7.0 Work Involving Electrical Hazards, Continued

7.2 Work Involving Electrical Hazards (continued)

7.2.4 Local operation or racking of Arc Resistant electrical equipment with the doors closed, shall require a minimum level of arc flash PPE for 8 calories/cm^2. For open door interaction, refer to the arc flash label.

7.2.5 When working inside of energized power panels, operating at 120/208V three-phase or 120/240V single-phase with covers removed and fed from transformers 45kVA and less, without an arc flash label, the minimum Arc Flash PPE requirements are:

- **(a)** Arc-rated clothing with an arc rating of at least 8 cal/cm^2,
- **(b)** Long-sleeve shirt and pants OR coverall OR arc flash suit,
- **(c)** Arc-rated face shield and arc-rated balaclava OR arc flash suit hood,
- **(d)** Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) as needed,
- **(e)** Heavy-duty leather gloves, arc-rated gloves, OR rubber insulating gloves with leather protectors,
- **(f)** Hard hat (Class E),
- **(g)** Safety glasses OR safety goggles,
- **(h)** Hearing protection (ear canal inserts), and
- **(i)** Leather footwear.

7.2.6 All electrical transmission, distribution and utilization equipment that requires maintenance and operation, shall have an incident energy analysis performed to identify the arc flash hazard per the requirements of **RSP-1163-000**. All 480-volt utilization equipment and all power panels 120/208V three-phase or 120/240V single-phase fed from transformers greater than 45kVA shall be included in the arc flash study and labeled using the arc flash incident energy method. Arc Flash PPE is required to operate circuit breakers inside the Arc Flash Boundary.

Note: Single phase branch circuits, external from the panel, operating at 240 or less volts are considered to have less than 1.2 calories, the minimum arc flash PPE is hand protection. If electrical equipment is encountered that does not have an arc flash label, refer to the upstream device feeding the equipment for the Incident Energy Level, or contact your supervisor for instructions.

7.2.7 Energized electrical conductors and circuit parts operating at voltages greater than or equal to 50V shall be put into an electrically safe work condition before an employee performs work if any of the following conditions exist:

- **(a)** The employee is within the limited approach boundary.
- **(b)** The employee interacts with equipment where conductors or circuit parts are not exposed, but an increased likelihood of injury from an exposure to an arc flash hazard exists.

7.2.8 Diagnostic testing is allowed by qualified persons on energized equipment by performing a risk assessment and wearing proper PPE.

7.2.9 Electrical safety incidents shall be investigated in accordance with **RSP-1310**.

7.2.10 Establishing and verifying an electrically safe work condition shall include all of the following steps, which shall be performed in order if feasible:

- **(a)** Identify all of the electrical energy sources of the equipment by using updated drawings and field verifying all equipment.
- **(b)** Open disconnect devices at each source.
- **(c)** Where possible, visually verify that all blades of the disconnected or draw out type circuit breakers are fully withdrawn.
- **(d)** Release stored electrical energy.
- **(e)** Release or block stored mechanical energy.
- **(f)** Apply lock-out / tag-out (LOTO). Refer to **RSP-1121-010** for installing the LOTO device and ensure it is secure in place.

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7.0 Work Involving Electrical Hazards, Continued

7.2 Work Involving Electrical Hazards (continued)

7.2.11 Verify absence of voltage with a rated test instrument. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.

7.2.12 Where work performed on equipment that is de-energized and placed in an electrically safe work condition exists in a work area with other energized equipment that is similar in size, shape, and construction, an alerting method shall be employed to prevent an employee from entering the lookalike equipment.

7.2.13 Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit access to work areas with exposed energized conductor or circuit parts. If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect other personnel.

7.2.14 Where conductors are de-energized in order to cut, remove, or reroute them and conductor terminations are not within sight, such as where they are in a junction box or pull box, additional steps to verify absence of voltage or identify the conductors shall be taken prior to cutting, removal, or rerouting of conductors.

7.3 Energized Electrical Work

7.3.1 Energized Electrical Work:

(a) Greater Hazard: Energized electrical work shall be permitted if de-energizing creates additional hazards or increased risk.

(b) Infeasibility: Energized electrical work shall be permitted if de-energizing is infeasible due to electrical equipment design or operational limitations.

(c) Less Than 50 Volts: Energized electrical conductors and circuit parts that operate at less than 50 volts shall not be required to be de-energized where the capacity of the source and any overcurrent protection between the energy source and the worker are considered and it is determined that there will be no increased exposure to electrical burns or to explosion due to electric arcs.

7.3.2 Energized Electrical Work Permit:

(a) An Energized Electrical Work Permit (Appendix G) is required:
- When work is performed within the restricted approach boundary, or
- When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.

(b) An Energized Electrical Work Permit (Appendix G) shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE under any of the following conditions:
- Testing, troubleshooting, and voltage measuring,
- Installing guarding or shielding insulating materials for hazard mitigation,
- Thermography and visual inspections if the restricted approach boundary is not crossed,
- Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed, or
- General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed.

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7.0 Work Involving Electrical Hazards, Continued

7.3 Energized Electrical Work (continued)

(c) An Energized Electrical Work Permit (Appendix G) is not required for electrical equipment designed and intended to be installed or removed while energized (such as fused cutouts, racking type circuit breakers or racking type starters). Arc flash PPE shall be required as specified on the arc flash label.

7.3.3 There are two signoff levels of an Energized Electrical Work Permit (Appendix G): Level 1 is for equipment rated 50V to 240V and level 2 is for equipment rated > 240V. Appendix B shall be used to determine the requirement for, and the signoff level, of an Energized Electrical Work Permit (Appendix G).

7.3.4 Energized Electrical Work Permit Instructions:

(a) Once the energized electrical work is deemed necessary, the originator shall complete ***Section I*** of the Energized Electrical Work Permit (Appendix G).

(b) The owning department and the qualified person shall complete ***Section II*** of the Energized Electrical Work Permit (Appendix G).

Notes:

(1) Level 1 approval requires the signature of MPC's electrical supervision and the owning department supervisor.

(2) Level 2 approval requires the signature of MPC's electrical supervision, the owning department supervisor, the Maintenance Manager, and the owning department manager.

(c) Prior to starting the energized work, the qualified persons performing the work shall complete ***Section III*** of the Energized Electrical Work Permit (Appendix G).

Notes:

(1) Level 1 approval requires the signature of MPC's electrical supervision and the qualified persons.

(2) Level 2 approval requires the signature of MPC's electrical supervision, the qualified persons, and safety representative.

7.3.5 Conductive apparel shall be prohibited when work is performed within the restricted approach boundary of exposed energized parts. Personnel shall remove exposed conductive apparel (such as keys, chains, rings, wrist watches, bands, etc.) to prevent contact with exposed energized parts.

7.3.6 The number of persons within the arc flash boundary shall be kept to a minimum. The arc flash boundary shall be barricaded with red WARNING tape.

7.3.7 For minimum approach distance to exposed energized electrical parts, see Appendix C.

7.3.8 For additional personnel requirements, see Appendix B.

7.3.9 For voltage rated gloves and tool requirements, see Appendix B.

7.3.10 Completed Energize Work permits shall be retained for 1 year.

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7.0 Work Involving Electrical Hazards, Continued

7.4 Switching Procedures

Apply the following for switching procedures:

7.4.1 A written electrical switching procedure shall be developed and followed for all complex or multi-step switching of the electrical power system or other critical refinery electrical systems (such as UPS, battery systems, and emergency generators). In the development of the switching procedures, the risks to the power system shall be evaluated, understood, and communicated to the areas it may affect.

Note: Complex or multi-step switching is defined as the operation of two or more circuit breakers, current interrupters, fuse disconnects, or isolating switches.

7.4.2 The Electrical Switching Procedure Form (Appendix E) shall be written by a MPC person that has the knowledge and understanding of the electrical system. It shall then be reviewed and approved by a second knowledgeable MPC electrical supervisor or designee prior to beginning switching operation. Site specific forms may be used as long as they contain all the requirements of the Electrical Switching Procedure Form (Appendix E).

7.4.3 The Switching Procedure shall include the following:

- **(a)** Job safety plan,
- **(b)** Identify hazards and energy sources,
- **(c)** Identify PPE requirements,
- **(d)** Verify loading, voltages and currents before and after switching,
- **(e)** Switching sequence should take into consideration arc flash levels, and
- **(f)** Identify LOTO and safety ground locations.

7.4.4 Each time electrical switching procedure forms are required, they shall be reviewed or re-written to ensure they are up-to-date and accurate. The latest drawings shall be used to develop the switching procedures.

7.4.5 Switching that occurs at different times will require separate written procedures.

7.4.6 A pre-job meeting shall occur immediately prior to the switching so that all persons involved understand the switching procedure. This meeting can take place at the jobsite.

7.4.7 All of the following shall be met in the order presented before circuits and equipment are re-energized:

- **(a)** A qualified person shall conduct tests and visual inspections, as necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed so that the circuits and equipment can be safely energized.
- **(b)** Employees who could be exposed to hazards associated with re-energizing electrical equipment shall be warned to stay clear.
- **(c)** Removal of LOTO will be in accordance with the site's LOTO procedure.

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7.0 Work Involving Electrical Hazards, Continued

7.5 Personal Protective Equipment

Apply the following for personal protective equipment:

Note: All electrical PPE shall meet the applicable standards for Personal Protective Equipment

7.5.1 Head, Face, Neck, Chin, Ear, & Eye Protection:

- **(a)** Employees shall wear nonconductive Class E head protection, where there is a danger of head injury from electric shock or burns due to contact with energized electrical conductors or circuit part or from flying objects resulting from electrical explosions. Employees shall wear nonconductive protective equipment for the face, neck, and chin wherever there is a danger of injury from exposure to electric arcs or flashes or from flying objects resulting from electrical explosions.
- **(b)** Employees shall wear protective equipment for the eyes whenever there is a danger of injury wherever there is a danger of injury from exposure to electric arc or flashes or from flying objects resulting from electrical explosions.
- **(c)** Hearing protection (ear canal inserts) shall be worn while working within the Arc Flash Boundary.

7.5.2 Hand Protection:

- **(a)** For hand protection, refer to Appendix B.
- **(b)** Glove protectors (e.g., leather) shall be worn over rubber gloves to protect the insulation from damage.
- **(c)** Testing of Glove Protectors: Gloves shall be inspected before use and shall not be used if they have holes, tears or other defects that affect their ability to give mechanical protection to insulating rubber gloves.
- **(d)** Testing of Insulating Rubber Gloves: Gloves shall be visually inspected for damage and defects before every use and immediately following any incident that is suspected of having caused damage to the glove. In addition, rubber gloves shall be given an air test along with each visual inspection. This can be achieved by rolling the cuff tightly toward the palm in such a manner to entrap air inside the glove or by use of a mechanical inflator.
- **(e)** If any defect or contamination is identified that could adversely affect the insulating qualities or mechanical integrity of the glove, it shall be removed from service. Third party rubber glove testing frequency shall not exceed 6 months. The date stamped on the cuff is the test date. Use of the gloves shall not exceed 6 months from the test date.
- **(f)** Heavy-duty leather gloves (0.03” minimum thickness) or arc rated gloves shall be worn while working within the arc flash boundary of exposed energized electrical equipment.

Continued on next page

7.0 Work Involving Electrical Hazards, Continued

7.5 Personal Protective Equipment (continued)

7.5.3 Arc Rated Clothing:

(a) Employees shall wear arc-rated clothing wherever there is a possible exposure to an electric arc flash above the threshold incident energy level for a second degree burn, 1.2 cal/cm^2.

(b) An arc-rated hood or an arc-rated balaclava with an arc-rated face shield shall be used when the back of the head is within the arc flash boundary. An arc-rated hood shall be used when the anticipated incident energy exposure exceeds 12 cal/cm^2.

(c) Appropriate arc-rated flash suits shall be required to be worn when performing electrical tasks within the arc flash boundary, see Appendix D.

(d) Personnel working within the Arc Flash Boundary shall not wear clothing containing meltable fiber materials such as acetate, nylon, polyester, polypropylene, and spandex over or underneath FR clothing.

(e) Clothing shall cover potentially exposed areas as completely as possible. Shirt and coverall sleeves shall be fastened at the wrists, shirts shall be tucked into pants, and shirts, coveralls, and jackets shall be closed at the neck.

7.5.4 Protective Footwear:

(a) Heavy-duty leather footwear shall be worn, where required for arc flash protection.

(b) When the shock risk assessment indicates a risk of step and touch potential, dielectric overshoes shall be worn. Insulated soles shall not be used as primary electrical protection.

7.5.5 Recordkeeping: A data log identifying the electrical protective equipment which successfully passed the periodic test and is suitable for use shall be maintained.

7.6 Electrical Tools and Equipment

7.6.1 Electrical Tools & Equipment: All Electrical Protective Equipment shall meet the applicable standards.

(a) Live Line Tools (Hot Sticks): Class 2 insulating rubber gloves with leather protectors shall be worn when using hot sticks on energized equipment. Hot sticks shall be wiped cleaned and visually inspected for defects before each use. If any defect or contamination is identified that could adversely affect the insulating qualities or mechanical integrity of the hot stick, the tool shall be removed from service. Test frequency shall not exceed 24 months. Use of live line tools (hot sticks) shall not exceed 24 months from the last test date.

(b) Protective Safety Grounding Equipment: Personal protective ground cable sets shall be inspected for cuts in the protective sheath and damage to the conductors. Clamps and connector strain relief devices shall be checked for tightness. These inspections shall be performed as service conditions require, but in no case shall the interval exceed 1 year.

7.6.2 Rubber Insulating Blankets: Insulating blankets shall be wiped cleaned and visually inspected for defects before each use. If any defect or contamination is identified that could adversely affect the insulating qualities or mechanical integrity of the insulating blankets, the blanket shall be removed from service. Testing frequency shall not exceed 12 months. The latest test date shall be stamped on the blanket. Use of rubber insulating blankets shall not exceed 12 months from the last test date.

Continued on next page

7.0 Work Involving Electrical Hazards, Continued

7.6 Electrical Tools and Equipment (continued)

7.6.3 Hand Tools:

(a) Employees shall use insulated tools or handling equipment, or both, when working inside the restricted approach boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make accidental contact.

(b) Insulated hand tools shall be rated for the nominal voltage.

7.6.4 Line Hoses and Covers: Insulating hoses and covers shall be wiped cleaned and visually inspected for defects before each use. If any defect or contamination is identified that could adversely affect the insulating qualities or mechanical integrity of the hoses or covers, the tool shall be removed from service. Testing shall be performed if insulating value is suspect.

7.7 Test Instruments

Apply the following for test instruments:

7.7.1 Only qualified persons shall be permitted to perform diagnostic testing work on electrical circuits or equipment.

7.7.2 When test instruments are used for confirming absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified on a known voltage source before and after an absence of voltage test is performed.

7.7.3 Rubber insulating gloves with leather protectors shall be worn when test instruments are used on energized equipment. Equipment shall be considered energized until it is proven to be de-energized.

7.7.4 Test instruments and all accessories (such as test leads, cables, power cords, probes, and conductors) shall be clean and visually inspected for defects before each use.

7.7.5 If any defect or contamination is identified that could adversely affect the insulating qualities or mechanical integrity of the tool, it shall be removed from service. The tool shall not be used until it is rendered as safe by a person qualified to perform the necessary repairs and tests.

7.7.6 Test instruments and their accessories shall be rated for the circuits and equipment where they are utilized.

7.7.7 Test instruments shall have a CAT III or higher safety rating.

7.7.8 Solenoid or “Wiggy” style voltage testers shall not be used.

7.7.9 Low voltage, lighted, non-contact style voltage detectors shall not be used to determine an electrically safe work condition.

7.8 Personal Protective Grounding

Apply the following personal protective grounding:

7.8.1 The purpose of personal protective grounding is to provide adequate protection against electrical shock causing death or injury to personnel while working on de-energized lines or equipment.

7.8.2 Personal protective ground cables shall be installed in areas where induced voltages, stored energy, or the potential for back-feed exists. Installation and location of protective ground cables shall be recorded in the switching instructions.

7.8.3 Personal protective grounding equipment shall be factory assembled and shall meet the requirements of **ASTM F855**.

7.8.4 For testing of personal protective grounds, see Section 7.6.1(b).

8.0 Electrical Equipment Labeling

8.1 Equipment Labeling

Apply the following for equipment labeling:

8.1.1 Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers (MCC) that are likely to require operation, inspection, adjustment, servicing, or maintenance while energized shall be field marked with a label containing:

- **(a)** Nominal system voltage,
- **(b)** Arc flash boundary,
- **(c)** Available incident energy and the corresponding working distance,
- **(d)** Shock protection Boundaries, and
- **(e)** Equipment number/name.

Exception: 120/208V and 120/240V panelboards supplied by transformers 45kVA and less are not required to have arc flash labels.

8.1.2 Equipment labeling shall be in compliance with **NEMA Z535.4**.

8.1.3 Electrical distribution equipment shall be marked to indicate the loads that it supplies.

Appendix A: Terms and Definitions

A.1 Approved

Approved is defined as being acceptable to the authority having jurisdiction.

A.2 Arc Flash Hazard

Arc Flash Hazard is a dangerous condition associated with the possible release of energy caused by an electric arc.

Note: An arc flash hazard may exist when energized electrical conductors or circuit parts are exposed or when they are within equipment in a guarded or enclosed condition, provided a person is interacting with the equipment in such a manner that could cause an electric arc. Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard.

A.3 Arc Flash Risk Assessment

Arc Flash Risk Assessment is a study investigating a worker's potential exposure to arc flash energy, conducted for the purpose of injury prevention and the determination of safe work practices, arc flash boundary, and the appropriate levels of personal protective equipment (PPE).

A.4 Arc Rating

Arc Rating is the value attributed to materials that describe their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm^2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of break open threshold (EBT) (should a material system exhibit a break open response below the ATPV). Arc rating is reported as either ATPV or EBT, whichever is the lower value.

Notes:

(1) Arc-rated clothing or equipment indicates that it has been tested for exposure to an electric arc. Flame-Resistant (FR) clothing without an arc rating has not been tested for exposure to an electric arc. All arc-rated clothing is also flame-resistant.

(2) Break open is a material response evidenced by the formation of one or more holes in the innermost layer of arc-rated material that would allow flame to pass through the material.

(3) ATPV is defined in **ASTM F1959** as the incident energy on a material or a multilayer system of materials that results in a 50% probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second degree skin burn injury based on the Stoll curve, cal/cm^2.

(4) EBT is defined in **ASTM F1959** as the incident energy on a material or a material system that results in a 50% probability of break open. Break open is defined as a hole with an area of 1.6 cm^2 (0.5 in^2) or an opening of 2.5 cm (1.0 in.) in any dimension.

A.5 Arc Flash Suit

Arc Flash Suit is a complete arc-rated clothing and equipment system that covers the entire body, except for the hands and feet.

Note: An arc flash suit may include pants or overalls, a jacket or a coverall, and a balaclava fitted with a face shield.

Continued on next page

Appendix A: Terms and Definitions, Continued

A.6 Assured Equipment Grounding Program	***Assured Equipment Grounding Program*** is an ongoing program of verifying the integrity of the equipment grounding conductor of cord sets and cord-and-plug connected equipment. Requirements for an assured equipment grounding program can be found in ***Article 590.6(B)(2)*** of the 2011 edition of the National Electrical Code (**NFPA 70**).
A.7 Balaclava	***Balaclava*** (Sock hood) is an arc-rated hood that protects the neck and head except for the facial area of the eyes and nose.
A.8 Barricade	***Barricade*** is a physical obstruction (such as tapes, cones, or A-frame-type wood or metal structures) intended to provide a warning and to limit access.
A.9 Boundary, Arc Flash	***Boundary, Arc Flash*** is, when an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur. **Note:** A second degree burn is possible by an exposure of unprotected skin to an electric arc flash above the incident energy level of 5 J/cm^2 (1.2 cal/cm^2).
A.10 Boundary, Limited Approach	***Boundary, Limited Approach*** is a specific type of shock approach boundary which is an approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists. If an unqualified person is required to work within the limited approach boundary, the employee must be directly and continuously supervised by a qualified person.
A.11 Boundary, Restricted Approach	***Boundary, Restricted Approach*** is a specific type of shock approach boundary which is an approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electrical shock, due to electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part. Qualified persons may only enter within this boundary.
A.12 Circuit Breaker	***Circuit Breaker*** is a device designed to open and close a circuit by non-automatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating. **Note:** The automatic opening means can be integral, direct acting with the circuit breaker, or remote from the circuit breaker.
A.13 Complex Switching	***Complex Switching*** or multi-step switching is defined as the operation of two or more circuit breakers, current interrupters, fuse disconnects, or isolating switches.

Continued on next page

Appendix A: Terms and Definitions, Continued

A.14 Conductive	***Conductive*** is defined as being suitable for carrying electric current.
A.15 Controlled Access	***1910.304(b)(3)(ii)(C)(5)*** ***Controlled Access*** is limited access to cord sets and equipment, the equipment and cord sets are not accessible for employee use. This means that the area is locked with keys and locks or Lenel access control with access limited to Electrical Supervision or Qualified personnel as identified by the Refinery.
A.16 Determine / Determined	***Determine/Determined*** is defined as being established or decided beyond dispute or reasonable doubt through investigation, testing, reasoning or calculation.
A.17 Device	***Device*** is a unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function.
A.18 Electrical Hazard	***Electrical Hazard*** is a dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.
A.19 Electrical Maintenance Group	***Electrical Maintenance Group*** is the personnel in the refinery that are responsible for performing work on the electrical system.
A.20 Electrically Safe Work Condition	***Electrically Safe Work Condition*** is a state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established site standards, tested to ensure the absence of voltage, and grounded if determined necessary.
A.21 Enclosure	***Enclosure*** is the case or housing of apparatus — or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized electrical conductors or circuit parts or to protect the equipment from physical damage.
A.22 Energized	***Energized*** is defined as being electrically connected to, or is, a source of voltage.
A.23 Equipment	***Equipment*** is a general term, including fittings, devices, appliances, luminaires, apparatus, machinery, and the like, used as a part of, or in connection with, an electrical installation.
A.24 Exposed	***Exposed*** (as applied to energized electrical conductors or circuit parts) is defined as capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to electrical conductors or circuit parts that are not suitably guarded, isolated, or insulated.

Continued on next page

Appendix A: Terms and Definitions, Continued

A.25 Ground Fault Circuit Interrupter (GFCI)	***Ground Fault Circuit Interrupter (GFCI)*** is 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 exceeds the values established for a Class A device (trips when the current to ground is 6mA or higher and does not trip when the current to ground is less than 4mA).
A.26 Grounded / Grounding	***Grounded/Grounding*** is defined as being connected (connecting) to ground or to a conductive body that extends the ground connection.
A.27 Hazard	***Hazard*** is a source of possible injury or damage to health.
A.28 Incident Energy	***Incident Energy*** is the amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. Incident energy is typically expressed in calories per square centimeter (cal/cm^2).
A.29 Management of Change (MOC)	***Management of Change (MOC)*** is an OSHA-required process for managing and documenting changes.
A.30 Motor Control Center (MCC)	***Motor Control Center (MCC)*** is an assembly of one or more enclosed sections having a common power bus and principally containing motor control units.
A.31 Originator	***Originator*** is the Electrical Maintenance Group.
A.32 Overcurrent	***Overcurrent*** is any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.
A.33 Overload	***Overload*** is operation of equipment in excess of normal, full load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault (such as a short circuit or ground fault) is not an overload.
A.34 Panelboard	***Panelboard*** is a single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front.

Continued on next page

Appendix A: Terms and Definitions, Continued

A.35 PPE	Personal Protective Equipment
A.36 Qualified Overhead Line Spotter	***Qualified Overhead Line Spotter*** is one who has skills and knowledge related to the overhead power lines and has received safety training to recognize and avoid the hazards involved.
A.37 Qualified Person	***Qualified Person*** is one who has demonstrated skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to identify and avoid the hazards involved.
A.38 Qualified Personnel	***Qualified Personnel*** are electricians or other trained personnel that can inspect and test the covered equipment per this document.
A.39 Racking	***Racking*** is the physical make or break of a breaker into an energized electrical buss.
A.40 Readily Available	***Readily Available*** are covered cord sets and equipment that is easy accessible to employees for use.
A.41 Relay Maintenance Setting	***Relay Maintenance Setting*** is a lower trip setting that reduces the arc thermal performance value for the downstream equipment and shall only be used during maintenance activities. This term is only used and shown on the energized electrical work permit.
A.42 Repetitive	***Repetitive*** is defined as being more than once.
A.43 Risk	***Risk*** is the combination of the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard.
A.44 Risk Assessment	***Risk Assessment*** is an overall process that identifies hazards, estimates the potential severity of injury or damage to health, estimates the likelihood of occurrence of injury or damage to health, and determines if protective measures are required. **Note:** As used in this standard, arc flash risk assessment and shock risk assessment are types of risk assessments.
A.45 Shall	***Shall*** is defined as a provision which is mandatory. Any deviations or exceptions to "shalls" will be on a case-by-case basis and will need to be approved via the Refining Standard Practice Waiver Form **REF-1051-WRSP**.

Continued on next page

Appendix A: Terms and Definitions, Continued

A.46 Shock Approach Boundary	***Shock Approach Boundary*** is an approach limit related to direct contact with energized electrical conductors and circuit parts only and does not consider exposure to arc flash. Limited and restricted approach boundaries are all types of shock approach boundaries.
A.47 Shock Hazard	***Shock Hazard*** is a dangerous condition associated with the possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.
A.48 Should	***Should*** is defined as a provision which represents preferred good practices and/or possibilities. Deviations or exceptions to "shoulds" are at the discretion of the site management personnel and should be thoroughly vetted, reviewed and approved.
A.49 Standby Person	***Standby Person*** is one who can notify emergency personnel in case of an electrical events, and keeps unqualified persons away from the arc flash zone. The standby person can also be a qualified person.
A.50 Step Potential	***Step Potential*** is a ground potential gradient difference that can cause current flow from foot to foot through the body.
A.51 Temporary Power Coordinator	***Temporary Power Coordinator*** is one who is responsible for coordination and implementation of temporary power.
A.52 Touch Potential	***Touch Potential*** is a ground potential gradient difference that can cause current flow from hand to hand, hand to foot, or another path, other than foot to foot, through the body.
A.53 Unqualified Person	***Unqualified Person*** is a person that has not been qualified for the task.

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Appendix A: Terms and Definitions, Continued

A.54 Voltage, Nominal

Voltage, Nominal is a nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts).

Note: The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

A.55 Working On

Working On (energized electrical conductors or circuit parts) is intentionally coming in contact with energized electrical conductors or circuit parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment (PPE) a person is wearing. There are two categories of "working on":

(a) 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.

(b) Repair: Is any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.).

Appendix B: Energized Electrical Work Matrices

B.1 Work within the Restricted Approach Boundary

The following is the Energized Electrical Work Matrix for work within the restricted approach boundary.

Note: Voltage rated gloves require leather protectors.

Table B.1: Work within the Restricted Approach Boundary

Hazard	V Rated Gloves	V Rated Tools	Arc Flash PPE	Additional Personnel Requirement	Energized Electrical Work Permit
Diagnostics 50-600 Volts	Class 0	1000V	Appendix D	None	NO
Diagnostics 600-7500 Volts	Class 1	use rated equipment	Appendix D	Qualified Person	NO
Diagnostics 7500-17000 Volts	Class 2	use rated equipment	Appendix D	Qualified Person	NO
When Performing Work 50-240 Volts	Class 0	1000V	Appendix D	Qualified Person	Sign off Level 1
When Performing Work >240 Volts	Class 0 for ≤ 600V	1000V for ≤ 600V	Appendix D	Qualified Person	Sign off Level 2
	Class 1 or 2 > 600V	use rated equipment for > 600V			

B.2 Work within the Limited Approach Boundary

The following is the Energized Electrical Work Matrix for work within the limited approach boundary.

Note: Voltage rated gloves require leather protectors.

Table B.2: Work within the Limited Approach Boundary

Hazard	V Rated Gloves	V Rated Tools	Arc Flash PPE	Additional Personnel Requirement	Energized Electrical Work Permit
Diagnostics 50-600 Volts	Class 0	None	Appendix D	None	NO
Diagnostics 600-7500 Volts	Class 1	None	Appendix D	Qualified Person	NO
Diagnostics 7500-17000 Volts	Class 2	None	Appendix D	Qualified Person	NO
When Performing Work 50-240 Volts	None	None	Appendix D	Qualified Person	NO
When Performing Work >240 Volts	None	None	Appendix D	Qualified Person	NO

Continued on next page

Appendix B: Energized Electrical Work Matrices, Continued

B.3 Work within the Arc Flash Boundary

The following is the Energize Electrical Work Matrix for work within the Arc flash boundary.

Note: Voltage rated gloves require leather protectors.

Table B.3: Work within the Arc Flash Boundary

Hazard	V Rated Gloves	V Rated Tools	Arc Flash PPE	Additional Personnel Requirement	Energized Electrical Work Permit
Diagnostics 50-600 Volts	Class 0	None	Appendix D	None	NO
Diagnostics 600-7500 Volts	Class 1	None	Appendix D	Qualified Person	NO
Diagnostics 7500-17000 Volts	Class 2	None	Appendix D	Qualified Person	NO
When Performing Work 50-240 Volts	None	None	Appendix D	Qualified Person	NO
When Performing Work >240 Volts	None	None	Appendix D	Qualified Person	NO
Circuit Breaker Rack in / Rack Out	None	None	Appendix D	Standby Person	NO
Medium Voltage Motor Starter Rack In / Rack Out	None	None	Appendix D	Standby Person	NO
Operating MCC Breaker Arc Flash Incident Energy < 12 cal/cm^2	None	None	Appendix D	None	NO
Operating MCC Breaker Arc Flash Incident Energy ≥ 12 cal/cm^2	None	None	Appendix D	Standby Person	NO

Appendix C: Approach Distances

C.1 Approach Distance Table

The following table shows the minimum approach distances to exposed energized electrical parts for Shock Protection for Alternating-Current Systems.

Note: All dimensions are distance from energized electrical conductor or circuit parts to employee.

Nominal Voltage Voltage Rating Phase-to-Phase	Arc Flash Boundary	Limited Approach Boundary (1)		Restricted Approach Boundary (2)
		Exposed Movable Conductor	Exposed Fixed Circuit Part	Standard Inadvertent Movement
	Energized Part to Employee (distance in feet - inches)			
50V - 150V	See Equipment Arc Flash Label	10’ – 0”	3’ – 6”	Avoid Contact
151V - 750V		10’ – 0”	3’ – 6”	1’ – 0”
751V - 15kV		10’ – 0”	5’ – 0”	2’ – 2”
15.1kV - 36kV		10’ – 0”	6’ – 0”	2’ – 7”
36.1kV - 46kV		10’ – 0”	8’ – 0”	2’ – 9”
46.1kV - 72.5kV		10’ – 0”	8’ – 0”	3’ – 6”
72.6kV – 121kV		10’ – 8”	8’ – 0”	3’ – 6”
138kV - 145kV		11’ – 0”	10’ – 0”	3’ – 10”
161kV - 169kV		11’ – 8”	11’ – 8”	4’ – 3”
230kV - 242kV		13’ – 0”	13’ – 0”	5’ – 8”
345kV - 362kV		15’ – 4”	15’ – 4”	9’ – 2”
500kV - 550kV		19’ – 0”	19’ – 0”	11’ – 8”
765kV - 800kV		23’ – 9”	23’ – 9”	15’ – 11”

Notes:

(1) Unless permitted, no unqualified person shall enter the limited approach boundary. Where permitted, a qualified person shall advise of the possible hazards and continuously escort the unqualified person while inside the limited approach boundary.

(2) Only qualified persons shall be permitted to enter the restricted approach boundary.

Appendix D: Arc Flash PPE

D.1 Arc Flash PPE Table for Incident Energy Analysis Method

The following table provides Arc Flash PPE requirements when using the Incident Energy Analysis Method for arc flash labeling.

Estimated Incident Energy	PPE Required
1.2 cal/cm^2 – 12 cal/cm^2	**(a)** Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy **(b)** Long-sleeve shirt and pants OR coverall OR arc flash suit **(c)** Arc-rated face shield and arc-rated balaclava OR arc flash suit hood **(d)** Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) as needed **(e)** Heavy-duty leather gloves, arc-rated gloves, OR rubber insulating gloves with leather protectors **(f)** Hard hat (Class E) **(g)** Safety glasses OR safety goggles **(h)** Hearing protection (ear canal inserts) **(i)** Leather footwear
>12 cal/cm^2	**(a)** Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy **(b)** Long-sleeve shirt and pants OR coverall OR arc flash suit **(c)** Arc-rated arc flash suit hood **(d)** Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) as needed **(e)** Arc-rated gloves, OR rubber insulating gloves with leather protectors **(f)** Hard hat (Class E) **(g)** Safety glasses OR safety goggles **(h)** Hearing protection (ear canal inserts) **(i)** Leather footwear

Appendix E: Electrical Switching Procedure Form

E.1 Form

The following is the Electrical Switching Instructions Form (**RSP-1162-000-FORM1**).

Reference: For the most up-to-date, working copy of this form, go to http://cbgrs20/red/copyout.aspx?lib_no=32&doc_no=3200.

Electrical Switching Procedure Form

(RSP-1162-000-FORM1)

Location: _____

Equipment Name: _____

One-Line Diagram: _____

Reason: _____

Restricted App. Boundary: _____ **Arc Flash Boundary:** _____

Voltage Rating: _____ **Arc Flash Calories:** _____

PPE Required: _____ **Lock Box Lock Number:** _____

Written By: _____ **Reviewed By:** _____

Switching Technicians: _____

Standby Person: _____

Point of Contact: _____

Identify: Location, Equipment, Task Performed and Installation of Locks, Tags, and Grounds.

	Switching Instructions	Time	Technician
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
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Appendix F: Temporary Power Approval Checklist

F.1 Checklist The following is the Temporary Power Approval Checklist (**RSP-1162-000-FORM2**).

Reference: For the most up-to-date, working copy of this form, go to http://cbgrs20/red/copyout.aspx?lib_no=32&doc_no=3201.

Temporary Power Approval Checklist

(RSP-1162-000-FORM2)

Requester Name: _____ **MOC#:** _____

This checklist approval checklist is required when temporary power is hardwire to a permanent electrical system. Plug and cord installations are exempt from this approval checklist.

Planning

Equipment Requiring Temporary Power (list all equipment numbers):	
Justification for Temporary Power:	
Planned Tie-In Point and Location (include equipment numbers and plot plans if applicable):	
List Isolations and Methods (Loto sheet/switching instructions may be referenced):	

One-Line Numbers: _____

Confirm drawings are marked, attached, and submitted to document controls _____

(initial after completion)

Planned Installation Date/Time: _____

Anticipated Return Date/Time: _____

Approval Signatures

Temporary Power Coordinator: _____ **Date:** _____

MPC Electrical Maintenance Group Employee: _____ **Date:** _____

Continued on next page

Appendix F: Temporary Power Approval Checklist, Continued

F.1 Checklist (continued)

The section below is to be completed when generators or alternate power sources are connected to the electrical system.

Temporary Power Ready to Energize		Removal and Restoration of Permanent Power	
Isolation and LOTO verified with one-line:	☐	De-isolation verified with one-line:	☐
Walkdown and visual verification of temporary power installation completed by an MPC Electrical Maintenance Department Representative:	☐	Walkdown and visual verification of temporary power removal completed by MPC Representative:	☐
Equipment tagged/labeled:	☐	Equipment tagged/labeled corrected:	☐
Verify visible air break:	☐	Return drawings to original condition:	☐
The following parties shall be notified prior to startup		*The following parties shall be notified prior to removal*	
Owning Department: Signature: _____ Date: _____		**Owning Department:** Signature: _____ Date: _____	
MPC Electrical Maintenance Department Employee Approval: Signature: _____ Date: _____		**MPC Electrical Maintenance Department Employee Approval:** Signature: _____ Date: _____	

Appendix G: Energized Electrical Work Permit

G.1 Permit

The following is the Energized Electrical Work Permit (**RSP-1162-000-FORM3**).

Reference: For the most up-to-date, working copy of this form, go to http://cbgrs20/red/copyout.aspx?lib_no=32&doc_no=3202.

Energized Electrical Work Permit

(RSP-1162-000-FORM3)

Section I: To be completed by the Originator	
Location: _____ **Area:** _____ **Work Order #:** _____	
Equipment Function # / Description: _____	
Energized Equipment	☐ Switchgear ☐ Starter Rack ☐ Overhead Lines ☐ Panelboards ☐ Transformer ☐ MCC ☐ Other (specify): _____
Work Scope & Justification	Detailed description of work to be done: Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:
Electrical Hazard	☐ Working within the Restricted Approach Boundary ☐ Interacting with equipment with no exposed energized parts
Work Performed	☐ Hand or Tool Contact ☐ Cable Connection ☐ New Installation/Construction ☐ MCC Bucket Removal/Insertion ☐ Install/Removal Shielding Material ☐ Panel/Molded Case Breaker Removal/Install ☐ Maintenance/Repairs ☐ Other (specify): _____
Electrical Information	Feeds to: Feeds from: One-Line Drawing Number: Voltage Level: Incident Energy:

Continued on next page

Appendix G: Energized Electrical Work Permit, Continued

G.1 Permit (continued)

Section II: To be completed by the Owning Department and the Electrically Qualified Person			
YES	NO		
☐	○	1. Can all circuit(s) be de-energized without creating additional hazards?	
☐	☐	2. Is a hot work permit required? (Obtain prior to work if required)	
☐	○	3. Are the one line diagrams of the circuit to be worked on available?	
		4. The Shock Protection Boundaries has been determined as:	
		5. The Arc Flash Protection Boundary has been determined as:	
If any circles were checked, explain all special precautions taken.			
Special Precautions			
Sign-Off Level		☐ **Level 1**	☐ **Level 2**
Approvals		MPC Electrical Supervision / Date:	MPC Electrical Supervision / Date:
		Owning Department Supervision / Date:	Owning Department Supervision / Date:
			Maintenance Manager / Date:
			Owning Department Manager / Date:

Continued on next page

Appendix G: Energized Electrical Work Permit, Continued

G.1 Permit (continued)

Section III: To be completed by the Electrically Qualified Person performing the work			
Safety Equipment Required	☐ Leather Gloves ☐ Class 2 Insulating Gloves ☐ Hearing Protection ☐ Voltage Detection Device ☐ Insulating Shielding Blankets ☐ Insulated Tools ☐ Class 0 Insulating Gloves ☐ _____ Cal Arc Flash Suit ☐ Face Shield ☐ Hot Stick	☐ Sleeves ☐ Relay Maintenance Setting ☐ Class 1 Insulating Gloves ☐ Rubber Overshoes ☐ Balaclava (Sock Hood) ☐ AED ☐ Barricades ☐ Rescue Hook ☐ Other (specify): _____	
YES ☐	NO ○	1. Are all parts mechanically sound?	
○	☐	2. Are there signs of overheating, deteriorated insulation, moisture, dirt, dust, tracking?	
☐	○	3. Have all the affected areas been notified?	
☐	☐	4. Will ladders and/or scaffolds be needed?	
☐	○	5. Is lighting sufficient?	
○	☐	6. Are weather conditions a safety factor?	
☐	○	7. Are there two means for exiting work?	
☐	○	8. Have the voltage & current ratings of replacement parts been verified?	
☐	○	9. Are barricades or designated watch in place?	
☐	○	10 Has job briefing been completed?	
If any circles were checked, explain all special precautions taken.			
Special Precautions			
Sign-Off Level	☐ **Level 1**	☐ **Level 2**	
Final Review & Approval	MPC Electrical Supervision:	MPC Electrical Supervision:	
	Electrically Qualified Person:	Electrically Qualified Person:	
	Electrically Qualified Person:	Electrically Qualified Person:	
		Safety Representative:	

Appendix H: Assured Equipment Grounding Conductor Program

H.1 Purpose

The purpose of this appendix is to provide guidance for the development of an Assured Equipment Grounding Conductor Program (AEGCP) at MPC Refineries.

H.2 Scope

The scope of this appendix applies to the following covered cords and equipment (***1910.304 (b)(3)(ii)(C)***):

(a) 480 volt cord sets and portable cord and plug connected equipment, owned, rented or leased by MPC, and

(b) Any other Cord Sets and Portable Cord and Plugged Equipment ***greater*** than 125-volt, single phase, 15-, 20-, or 30-ampere that are not protected by a Ground Fault Circuit Interrupter (GFCI), owned, rented or leased by MPC.

Note: See Section 6.2.1 of this standard for additional information.

H.3 Roles and Responsibilities

1910.304 (b)(3)(ii)(C)(2)

The Refinery shall establish personnel to implement the Assured Equipment Grounding Conductor Program (AEGCP) as follows:

(a) Competent Person(s) who are responsible for the implementation of the AEGCP, and

(b) Qualified Personnel responsible for inspection & testing of covered cord sets & equipment.

H.4 AEGCP Management System

1910.304 (b)(3)(ii)(C)(1)

H.4.1 Identification Requirements for Cord Sets and Equipment: All cord sets and equipment included in the written AEGCP shall be marked with a unique number on a durable tag attached to the cord set or equipment.

Note: The tag should be imprinted with the refinery identifier and equipment item number (e.g., GVL 0825).

H.4.2 Issuing Cord Sets and Equipment for Use (1910.304 (b)(3)(ii)(C)(6)): When electrical cord sets or equipment is issued for use, the following information shall be documented:

(a) Name of MPC employee or Contractor employee checking out the equipment/cord sets,

(b) If not MPC, then Contractor Company name,

(c) Supervisor's name,

(d) Location where the equipment is expected to be put into service (e.g., process unit, shop, fab area, etc.), and

(e) Legible signature of MPC employee or Contractor employee.

Note: By signing for the cord set or equipment, the MPC employee or Contractor employee is acknowledging that they understand their responsibility to ensure the equipment is returned when the job is completed or re-inspected and tested prior to the due date listed on the tag.

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Appendix H: Assured Equipment Grounding Conductor Program,
Continued

H.4 AEGCP Management System (continued)

H.4.3 Covered Equipment Inspection and Testing Requirements (1910.304(b)(3)(ii)(C)(3) & 1910.304(b)(3)(ii)(C)(4)): The following Inspection and Testing requirement shall be established for all covered cord sets and equipment.

H.4.3.1 Inspection and testing per this document shall be performed by Qualified personnel as follows:

- **(a)** Before first use on site,
- **(b)** When there is evidence of damage,
- **(c)** Before equipment is returned to service following any repairs, and
- **(d)** At intervals described below.

H.4.3.2 Inspecting and Testing shall be conducted on the following intervals:

- **(a)** When covered equipment is first put in service at the Refinery and at intervals not exceeding 3 months if the equipment continues to be in use in the field.
- **(b)** Covered equipment that is readily available for use must also be inspected and tested at intervals not exceeding 3 months.
- **(c)** Covered equipment stored in a controlled access location "not available for use" is not required to be inspected every three months. Covered equipment in this controlled access location must be inspected prior to issuing.

H.4.3.3 Inspection & Testing Requirements:

- **(a)** Prior to testing, all covered equipment shall be inspected for obvious damage to the visible parts of the cord sets or equipment including outside insulation, cord ends, metal housing, etc.
- **(b)** All covered equipment grounding conductors shall be tested for continuity and shall be electrically continuous. This test shall be performed with an Ohmmeter, and resistance checked between cord ends or cord end and equipment. The maximum resistance shall be determined by the size and length of wire or cable. For standard 60 amp or 100 amp cords sets 100 feet or less, the resistance shall be 2 ohms or less.
- **(c)** Each receptacle and attachment plug shall be tested for correct attachment of the equipment grounding conductor. The equipment grounding conductor shall be connected to its proper terminal.
- **(d)** Insulation Resistance shall be checked between all terminals with a 500 volt Meg-ohmmeter and the minimum resistance shall be 100 meg-ohms between any two terminals.
- **(e)** All covered equipment in use in the field shall be inspected daily for obvious damage. No documentation is required for this daily field inspection.

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Appendix H: Assured Equipment Grounding Conductor Program, Continued

H.4 AEGCP Management System (continued)

H.4.4 Documentation of Covered Equipment Inspection & Testing (1910.304(b)(3)(ii)(C)(6)):

H.4.4.1 If the cord set or equipment passes all inspections/ tests and is deemed "approved for use," a second durable tag imprinted with the "due date" shall be attached near the refinery identifier and equipment item number tag.

Note: The "due date" will be the date three months after the test date listed in the record/log.

H.4.4.2 Documentation for equipment issued for use shall be kept until the next inspection (3 months).

H.4.4.3 Each refinery shall establish a tracking system to maintain required documentation. The system shall include notification when covered cord sets & equipment are coming due for inspection.

H.4.5 Covered Equipment Inspection, Testing and Returned Equipment Handling Area Requirements (1910.304(b)(3)(ii)(C)(5)):

H.4.5.1 Each Refinery shall establish an inspection & testing area where the covered cords and equipment can be inspected and tested and the inspection and testing can be documented.

H.4.5.2 The Refinery shall establish a controlled access location for returned covered equipment. This will ensure that un-inspected equipment is not available for use.

H.4.5.3 If the refinery has covered equipment that will remain in storage for extended periods and will "not available for immediate use", and will not be inspected and tested as required by this document, then the Refinery must also establish a controlled access location for this "stored covered equipment" to ensure that covered equipment that has not been inspected and tested per this document can be put into service.

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Appendix H: Assured Equipment Grounding Conductor Program,
Continued

H.5 Example Log The table below is an example of a Covered Equipment Inspection & Testing Log.

Name of Inspector:	*Print:*		*Signature:*
Covered Cord Sets and Equipment ID#	**Date of Inspection**	**Approved for Use**	**Comments**
		Yes / **No**	

Revision History

Document Revision History Complete the following table for each document revision.

Rev. No.	Description of Change	Author	Approved By	Rev. Date
0	First issue of document.	Electrical Advisory Group	Refining General Managers	9/29/14
1	Updated to the 2015 version of **NFPA 70E**.	D.K. Watts	T.M. Hearn	10/20/14
2	Minor clarifications.	D.K. Watts	T.M. Hearn	10/31/14
3	Added CBD conformance date.	J.L. Nelson	J.S. Stefko	4/29/15
4	Added information from **IG-35** as ***Appendix H***.	D.K. Watts	M.A. Henschen	1/25/18
5	Reviewed, updated and approved for 3 years. Revised to align with the 2018 version of **NFPA 70E**.	D.K. Watts	M.A. Henschen	2/7/19
6	Clarified wording in several sections	T.W. Perilloux and D.K. Watts	M.A. Henschen	9/18/19