


# LAR Electrical Safety Program


	DOCUMENT NUMBER (FROM DMS) <b>LAR-MNT-ELE-DOC-0004</b>	REVISION DATE: <b>10/15/2019</b>
	ISSUING DEPARTMENT <b>Reliability Engineering</b>	NEXT REVIEW DATE: <b>10/15/2022</b>

<b>High Consequence</b> <input type="checkbox"/>	<b>Standard</b> <input checked="" type="checkbox"/>
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## 1.0 Discussion

Lockout/Tagout is the preferred method of controlling personnel exposure to the hazards of electrical energy.

Andeavor Electrical Safety Program (ESP) provides safety-related work practices that shall be used to safeguard employees from injury while they are working on or near exposed electric conductors or circuit parts that are or can become energized. The specific safety-related work practice shall be consistent with the nature and extent of the associated electrical hazard. Mitigation techniques shall be considered to prevent inadvertent or accidental contact to energized parts. If the mitigation techniques are determined to be inadequate to prevent injury from electric shock or exposure to arc flash, then the energized parts shall be put into an electrically safe work condition by applying lockout/tagout.


## 2.0 Purpose

The purpose of this program is to establish electrical safety related practices for Andeavor employee personnel relative to electrical hazards arising from the use of electricity within the work place. This program will identify the proper procedures to work on or near electrical live parts, the protective apparel to be worn while doing the work and the personnel qualifications to perform the work. NFPA 70E article 130 was used as a guidance document in developing this document to address the electrical hazards requirements when performing work.

## 3.0 Permit to Work Process

The Permit to Work (PTW) process is a separate document that provides the requirements to risk assess and document how to safely perform a task. The PTW includes a “Work Classification Table” that list the task, task description, task ID, task risk level, supplemental documents, and required approvals. The PTW process shall include compliance with the LARs electrical safety program (ESP). The ESP and PTW will work hand in hand that when used together to execute an electrical task will provide safe work practices, electrical qualifications, and the PPE requirements based on the task risk level, incident energy exposure from an electrical arc flash and electrical shock hazard. Both the PTW process and the ESP are part of LARs electrical safety program.

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## 4.0 Reference Documents

The following are relevant industry references for this program:

- 4.1 National Electric Code NFPA 70
- 4.2 IEEE NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces -2018 Edition
- 4.3 IEEE 1584 Procedure to Perform Flash Analysis
- 4.4 Cal OSHA Title 8, Section 2700, Subchapter 5 “Electrical Safety Orders”
- 4.5 Federal OSHA 29CFR 1910.331 thru 335 and 1910.269

## 5.0 LAR Safety Standard and Policies


- 5.1 HSS 008 Control of Hazardous Energy
- 5.2 HSS-201 “Permit to Work” (PTW) policy
- 5.3 LAR-ELEC-001 “Electrical Isolation of Field Equipment”
- 5.4 HSS FS 810 and 820 Lock Out/Tag Out Policy
- 5.5 HSS FS 1002 Assured Grounding Program
- 5.6 LAR Refinery HSSE Policies and Standing Orders

## 6.0 Tesoro Refining Standards

The Tesoro Refining Standards are corporate standards that require compliance in addition to LARs electrical safety program. The Tesoro Refining Standards to reference are:

- 6.1 TES 605 Arc Flash
- 6.2 TES 606 Arc Flash Assessment

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## 7.0 Definitions

**Andeavor Employee**- individuals who are hired directly by Andeavor to provide work.

**Approved Test Meter** – A Test instrument and its accessories that is voltage rated for the circuits and equipment to which it will be connected. The test instrument and its accessories shall be designed for the environment to which it will be exposed and to the manner in which it will be used. The test meter shall have a minimum of category 3 rating certified by a third party.

**Arc Flash Hazard** - A dangerous condition associated with the possible release of energy caused by an electric arc.

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

**Arc Rating** - The value attributed to a material that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm<sup>2</sup> and is derived from the determined value of the arc thermal performance value (ATPV) or energy of break open threshold ( $E_{BT}$ ) (should a material system exhibit a break open response below the ATPV value). Arc rating is reported as either ATPV or  $E_{BT}$  whichever is the lower value.


**Balaclava (Sock Hood)** - An arc-rated hood that protects the neck and head except for the facial area of the eyes and nose.

**Barricade** - A device to prevent or limit access to an area where a hazard exists. Barricades include those of permanent design (gates, k-rails, roadblocks, metal protective barriers around manholes), and temporary (i.e., plastic tape, orange plastic cones, wooden “saw horse” type barricades). intended to provide a warning and to limit access.

**Boundary, Arc Flash** - 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 to unprotected skin to an electric arc flash above the incident energy level of 1.2 cal/cm<sup>2</sup>.*

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**Boundary, Limited Approach** – An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

**Note:** *A qualified person can enter into the limited approach space. An unqualified person can cross into the limited approach boundary only if escorted by a qualified person.*

**Boundary, Prohibited Approach** – The prohibited approach boundary was deleted in the NFPA 70E 2015 Edition and is not used in the ESP. The requirement for using shock protective equipment typically begins at the restricted approach boundary. No additional PPE is required when crossing the prohibited approach boundary, therefore this boundary was deleted.

**Boundary, Restricted Approach** – An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement, for personnel working in a close proximity to the energized electrical conductor or circuit part.

**Conductive** - Suitable for carrying electric current.

**Conductor, Bare** - A conductor having no covering or electrical insulation whatsoever.

**Conductor, Insulated** - A conductor encased within material of composition and thickness that is recognized by the NEC as electrical insulation.

**De-Energized** – Isolated from electricity. Free from any electrical connection to a voltage source and from electrical charge; not having a potential difference from that of the earth.

**Electrical Hazard** – A dangerous condition such that contact, or equipment failure can result in electric shock, flash burn, thermal burn or blast.

**Electrical Safety** – Recognizing hazards associated with the use of electrical energy and taking precautions so that hazards do not cause injury or death.

**Electrical Safe Work Condition** – A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged in accordance with established refinery standards, tested to ensure the absence of voltage, grounded if determined necessary.


**Electrical Systems** – Equipment or devices that require electrical power to operate. Electrical equipment or devices are electrically connected together for the purpose of controlling process equipment.

**Electrical Worker** - An Instrument or Electrical Technician who is qualified to do the specific task when working on 50Volts or higher electrical circuits.

**ETAP Model** - Software used to model LARs electrical system. ETAP is used to calculate incident energy and arc flash boundaries based on a prescribed distance.

**Energized** - Electrically connected to a voltage source or to a source of potential difference.

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**Exposed Energized Parts** – 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.

**Electrical Switching** – The opening and closing operation of a device for the purpose of removing or supplying power to an electrical system or load.

**Guarded Parts** – A physical obstruction (covers, shielded, enclosed) that is intended to prevent contact with equipment or energized electrical conductors and circuit parts or to prevent unauthorized access to a work area.

**LRA** - Low risk assessment; is not covered in the ESP but is covered in the PTW policy. See HSS 201 Permit to Work for reference.

**MRA** - Medium risk assessment; the level of risk as determined by the TRA. See TRA in definitions

**Near Exposed Energized Parts** - A distance at which a person is close enough with his body or object in hand to inadvertently come in contact with an exposed energized part. A person working inside the limited approach boundary is considered near exposed energized parts.

**Incident Energy** - The amount of thermal energy impressed on a surface, a certain distance from the source, generated during and electrical arc event. Incident energy is typically expressed in calories per square centimeter (cal/cm<sup>2</sup>).


**Qualified Person** – One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved. A person that is trained to do a specific task and is qualified to perform a risk analysis of that task.

**PTW** - Refers to HSS 201 Permit to Work Standing Instruction. Permit to work is the method LAR uses to track permitted work, a permit to do all work including electrical work.

**Protection Devices** – A device that is used to interrupt a circuit under a fault or overload condition. Examples of protection devices that interrupt or isolate/de-energize circuits under a fault or overload condition are panel board circuit breakers, switchgear circuit breakers, enclosed hand operated circuit breakers, protection relays and fuses.

**PPE** - Personnel Protective Equipment such as arc rated clothing, safety glasses, face shield, barriers, and insulating blankets and other similar equipment to protect a person from an electrical hazard.

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**TRA** - Team risk assessment; an assessment to determine the level of risk in performing the job task considering several hazards that are present within the refinery, including electrical hazards. The purpose of the TRA is to determine and assign a level of risk and what mitigation needs to be in place when performing the task. The level of risk may be LRA, MRA, or High risk. See MRA in definitions and see HSS 201 “Permit to Work” (PTW) policy for complete definition of terms.

**Risk** - A 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.

**Risk Assessment** - 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. See HSS 201 “Permit to Work” (PTW) policy for additional information.

**Unqualified Person** - A person who is not a qualified person.

**Voltage of a Circuit** – Unless specifically stated otherwise, it is the voltage potential between any two conductors or between a given conductor and ground.

**Voltage, Nominal** - A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class. Examples are 120/240, 480Y/277, and 600Volts. The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

**Working Distance (IEEE 1584 definition)** - The dimension between the possible arc point and the head and body of the worker positioned in place to perform the assigned task.


**Working on energized electrical conductors or circuit parts, (“Hot Work”)** - A person intentionally coming in contact with energized electrical conductors or circuit parts with the persons hands or other body parts, including while using tools, probes, or test equipment, regardless of the personal protective equipment (PPE) the person is wearing. There are two categories of “working on energized conductors”:

**Diagnostic Testing** - Taking readings or measurements of electrical equipment with approved test equipment that does not require making any physical change to the equipment.

**Repair** - Physical alteration of electrical equipment such as making or tightening connections, removing or replacing components, etc.



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## 8.0 Electrical Arc Flash Boundary, Incident Energy and Distances

- 8.1 The Arc Flash Boundary distance indicated on the Arc Flash label (see section 8.0) was taken from (Table B: Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection). The distances shown in Table B are conservative when compared to the distances calculated by LARs ETAP model. For incident energy ETAP model utilizes the working distances indicated in IEEE 1584 when making these calculations.

*Table B arc flash boundary distances were selected based on voltage and the worst-case distance as calculated through the ETAP model. For example, if Substation 1G 12.47Kv system has an arc flash boundary distance of 30ft and Substation 1E 12.47Kv system has an arc flash boundary distance of 50ft then a 50ft distance is the boundary for both Substations.*


- 8.2 The ETAP Model is used to calculate the incident energy utilizing IEEE 1584 “Procedure to Perform Arc Flash Analysis” as the basis.
- 8.3 The working distance indicated on the Arc Flash label is from IEEE 1584 Table 2 - “Class of equipment and typical working distances”. The working distance is the worker’s distance in the event of an arc flash from that type of equipment. For cable, it is the distance the worker is standing from a cable fault arc flash.
- 8.4 The ESP Category PPE indicated on the label meets or exceeds what is required based on the incident energy.

*The arc flash PPE issued to the TSO electrical worker in the Refinery is in general limited to 4, 8 and 40 Cal/cm<sup>2</sup>. The ESP Category PPE indicated on the label shows what is required based on what arc flash PPE that is available and LARs PPE requirement from **Table D**.*

- 8.5 The incident energy on the label is not meant to indicate the energy for all tasks but is only to warn personnel of the hazards in working on the equipment.
- 8.5.1 The incident energy at the distance indicated is with reference to maintained equipment and the equipment is in normal operating service.

**Note:** A risk assessment must be done to discuss what could go wrong including the condition of the equipment. If the equipment is past due on its Preventive Maintenance schedule, or there are known issues with the equipment, or the protection relays up-stream of the equipment is past due on its Preventive Maintenance schedule or other issues that could increase the incident energy then mitigation needs to be considered that also includes consulting with Engineering.

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- 8.6 The arc flash incident energy, working distance, arc flash boundary, and ESP PPE Category shall be studied at a frequency not exceeding 6 years or when changes are done to the electrical distribution system by the Andeavor Electrical Engineer. If the study results show the information on the field label is incorrect then the Andeavor Electrical Engineer will assign electric department representative to replace out dated or unreadable labels with a new labels.

### IEEE 1584 Table 2: Classes of equipment and typical working distances

Classes of equipment	Typical working distance	Typical working distance
	(mm)	(in)
15Kv switchgear	910	36
5Kv switchgear	910	36
Low-voltage switchgear	610	24
Low-voltage MCCs and panelboards	455	18
Cable	455	18
480Vac Switch Racks	455	18


*Typical working distance is the sum of the distance between the worker standing in front of the equipment and from the front of the equipment to the potential arc source inside the equipment.*

*480Vac Switch Racks is not listed in IEEE 1584 Table 2 but is added here.*

- 8.7 The Incident Energy Analysis method as described in NFPA 70E is the method used for determining the arc flash energy.

**Note:** The incident energy analysis method is a method that uses actual voltage, short circuit current and fault clearing time data to determine the incident energy. The calculated incident energy is then used to determine the PPE required. The PPE can meet or exceed what is required to protect the worker.

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8.8 The incident energy is based on the working distance to the employee's face and chest areas from a prospective arc source for the specific task to be performed.

8.9 If the electrical task requires the distance to be less than what is on the arc flash label, recognizing that incident energy increases as the distance from the arc flash decreases, then the LAR Electrical Engineer shall perform an incident energy analysis to determine if additional PPE is required.


## 9.0 Electrical Arc Flash Labeling (See Section 7.0 regarding information on label)

Arc flash and shock hazard warning labeling will be located on switchgear, switchboards, panel boards, industrial control panels, switch racks, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized. Arc flash labeling will also be located on equipment that is identified as a work hazard in NFPA 70E Table 130.5(C), such as insertion or removal of circuit breakers from cubicles.

The warning labels will be located where it is visible and affixed on the equipment. The information will contain:

- 9.1 Arc Flash and Shock Hazard Warning, and Nominal Voltage
- 9.2 How working distance was determined
- 9.3 Arc Flash Boundary (Site ESP Table B as minimum distance)
- 9.4 ESP PPE Category number (Site PPE required in Table A)
- 9.5 Source Protective I.D. (Upstream energy source fault clearing equipment)

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## **WARNING**



### Arc Flash and Shock Hazard, Appropriate PPE Required

Refer to LAR Electrical Safety Program (ESP) for Category PPE

Working Distance: Determined from racking in and out circuit breakers

<b>Incident Energy and Working Distance:</b> 30Cal/cm <sup>2</sup> at 36inches	<b>Arc Flash Boundary from</b> <b>ESP Table B: 20Ft.</b>
<b>Nominal Voltage: 2.4Kv</b>	<b>ESP PPE Category: 4</b> Source Protective I.D. 1JSG2401 BKR 52-M1

## 10.0 Responsibilities

The Electric or Instrument Shop Supervisor is responsible for assigning tasks that are within the qualifications and level of training of personnel working on or near exposed energized parts.

## 11.0 Requirements


The Qualified Instrument or Electrical Technician has received the required level of training and demonstrated competency to supervision to work on or near exposed energized parts for the assigned task.

- 11.1 Test instruments and equipment for the purpose of testing voltages above 50Vac and 50Vdc shall be operated by qualified personnel when working on or near these voltages.

## 12.0 Electrical Safety Work Clearances

The appropriate work clearance distance must be obtained prior to performing any electrical work.

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## 13.0 Qualifications of Employees

- 13.1 Any person who works on or near 50Vdc or 50Vac to ground and above shall be electrically qualified to perform the task.
- 13.2 Qualified personnel shall meet the requirements in section 14.0 and 15.0
- 13.3 Qualified personnel working on or near exposed energized electrical conductors or circuit parts shall be trained in methods of release of victims from contact with exposed energized conductors or circuit parts.
- 13.4 They shall be qualified on first aid and CPR.
- 13.5 Unqualified persons shall not be permitted to enter cubicles, cabinets, enclosures or spaces where exposed live parts 50Vdc or 50Vac and higher to ground are present.
- 13.6 Unqualified persons shall remain at a safe distance and not cross the “Limited Approach Boundary” as discussed in section 18.0 where exposed live parts are present.

## 14.0 Qualification of Personnel for Electrical Work on 50Vac and 50Vdc and Above

- 14.1 Shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.
- 14.2 Shall be familiar with precautionary techniques in the use of personal protective equipment including arc flash suit, insulating or installing barriers, and insulated tools and test equipment.
- 14.3 Shall possess skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment.
- 14.4 Shall possess skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts.
- 14.5 Shall understand and be familiar with approach distances specified in Table B.
- 14.6 Shall be able to understand the decision-making process necessary to determine the degree and extent of the hazard, associated risks and what personal protective equipment and job planning is necessary to do the task safely.

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## 15.0 Level of Training for Electrical Workers to Work on 50Vac and 50Vdc and Above

- 15.1 Successfully complete OSHA 29CFR 1910.331-335 and 1910.269 or NFPA 70E Electrical Safety Training equivalent every 3 years.
- 15.2 Review, comply with, and understand this document including understanding limited, restrictive and arc flash boundaries.
- 15.3 Shall be trained on the specific equipment to be worked on or operated. Reasonably be expected to recognize and avoid the hazards involved in the job.
- 15.4 Demonstrate skills sufficient to satisfy supervision (i.e. Superintendent and Supervisor responsible for the electrical worker) to perform the specific task.

## 16.0 Hazardous Nature and Extent of Task for an Electrical Worker to Work on or Near Energized Parts


- 16.1 The hazard is a risk to an electric shock or arc flash to the electrical worker or other personnel in the work area from the electrical worker (or worker with conductive object in hand) coming in direct contact with exposed bus or bare energized parts.
  - Diagnostic Testing and Repair when performed on energized conductors are considered “working on energized conductors”. For definitions of “Working On”, Diagnostic Testing, and “Repair” see section 9.0 Definitions.
- 16.2 After mitigation techniques have been considered, and the risk of a person from inadvertent or accidental contact to energized parts is injury from electric shock or exposure to arc flash has been determined unacceptable, then the energized parts shall be put into an electrically safe work condition by applying lockout/tagout.
- 16.3 Lock out tag out may not always apply because of equipment design, operational limitations, diagnostic testing, proving circuit integrity and other tasks that need to perform while the circuit is energized.
- 16.4 The shock protection boundaries identified as limited approach boundary and restricted approach boundary shall be applicable where approaching personnel are exposed to energized electrical conductors or circuit parts. See Table B for Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection.

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- 16.5 All equipment must be considered and treated as energized until verified de-energized using an approved test meter.
- 16.6 Performing diagnostics or barrier installation to isolate energized parts, has a reduced risk of creating an arc flash when compared to working on live parts with tools. PPE requirement shown in Table D “Hazard Risk Analysis PPE Table” for the task being performed is less restrictive to allow mobility when performing this task. Diagnostics or installation of barriers under the “Description of Task” column in Table D requires the person to:
  - 16.6.1 Wear the proper PPE when entering the restricted approach boundary.
  - 16.6.2 Limit the diagnostics to voltage testing with an approved test meter.
  - 16.6.3 Use insulating equipment when installing a barrier.
  - 16.6.4 Not have any metal or conductive objects in the “Restricted Approach Boundary”
- 16.7 Diagnostic testing including verifying the part is de-energized, energized, or circuit integrity is considered working on energized parts and the proper PPE, as shown in Table D “Hazard Risk Analysis PPE Table” shall be worn.
- 16.8 Diagnostic testing shall be done in a safe manner such that the person is not at risk in making contact with an energized part (e.g. blindly reaching over exposed energized bus to test voltages).
  - 16.8.1 If the person is at risk in testing energized parts, then the person shall do a pre task risk assessment with his/her Supervisor to determine if the risk can be mitigated or to stop the task.
- 16.9 Diagnostic testing on or near energized conductors above 600 volts will require:
  - 16.9.1 Authorization from the electric shop Superintendent
  - 16.9.2 Authorization from the electric shop Supervisor
  - 16.9.3 A pre task risk assessment in compliance with the PTW process with Supervision that is familiar and knowledgeable with the hazards (see section 17.0)
  - 16.9.4 Electrical Engineering review

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16.9.5

- 16.10 If coming in contact with energized parts is possible, safety-related work practices shall be used to safeguard employees from injury while they are exposed to electrical hazards from electrical conductors or circuit parts that are or can become energized.
- 16.10.1 Appropriate safety-related work practices shall be determined before any person is exposed to the electrical hazards involved by using both shock risk assessment and arc flash risk assessment.
- 16.10.2 The specific safety-related work practices shall be consistent with the electrical hazards and the associated risk.
- 16.10.3 Only qualified persons shall be permitted to work on electrical conductors or circuits parts that have not been put into an electrically safe work condition.
- 16.10.4 PPE shall be used to insulate the body from shock and arc flash exposure.  
body.
- 16.10.5 A barrier or guard to protect against direct contact shall be installed.
- 16.11 Table D “Hazard Risk Analysis PPE Table” shall be used in determining the proper PPE for the task. The PPE required in Table D is for incident energy of 40Cal/cm<sup>2</sup> or lower. If incident energy is greater than 40Cal/cm<sup>2</sup> then the task shall stop and a Team Risk assessment is required to determine how to lower the incident energy below 40Cal.
- 16.12 Pre task risk assessment shall be completed to work on energized equipment to determine the hazards involved and to mitigate the risk of injury to personnel.
- 16.12.1 The risk assessment shall cover such subjects as work procedures, hazard precautions, energy source control, and personnel protective equipment requirements.
- 16.13 Operational impacts that may justify working on energized exposed parts 150 to 600Volts could occur if de-energizing the part introduces additional hazards or increased




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risk. An additional hazard or increased risk could be:


- 16.13.1 Removal of illumination for a large area where portable lighting is unreasonable
- 16.13.2 Loss of power would create process unit upsets that, in itself, would create a hazard and alternate methods to prevent those hazards are not available.
- 16.14 When working on or near exposed energized parts less than 50 volts is considered low risk and requires the following:
  - 16.14.1 A risk assessment shall be done to confirm that it is low risk even though it is on 50 volts or less.
  - 16.14.2 There is no increased exposure to electrical burns or to explosions due to electric arcs.
  - 16.14.3 For battery banks, the hazards have been risk assessed for arcs, spills and containment.
- 16.15 When working on or near exposed energized parts 50 to 240 volts, the task is considered **medium** risk and requires the following:
  - 16.15.1 A risk assessment shall be done with his/her Supervisor to determine if the task can be done safely.
  - 16.15.2 Working on energized parts requires at least two qualified personnel on the job, with one person working as the safety observer.
  - 16.15.3 If the task is determined as unsafe then coordination with supervision shall be done to de-energize the part.
- 16.16 When working on or near exposed energized parts 240 to 600 volts the task is considered high risk and requires the following:
  - 16.16.1 Every effort shall be made to de-energize the part.
  - 16.16.2 Justification on why the work must be performed with the part energized.
  - 16.16.3 Working on energized parts requires at least two qualified personnel on the job, with one person working as the safety observer.

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- 16.16.4 A Team risk assessment is required with the minimum participants being the Operations Maintenance Coordinator (OMC), Electrician, Electrical Supervisor, and Electrical Engineer Safety representative.
- 16.16.5 The risk assessment shall include safe work practices to be employed, electrical shock, arc flash hazard, PPE and appropriate levels of management approvals.

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## 16.17 Installation of Barriers:

Working on or near exposed energized parts above 600 volts other than diagnostic testing or the installation of barriers is prohibited.

Installation of barriers shall be done in a safe manner such that the person is not at risk in making inadvertent or accidental contact with an energized part. If the person is at risk then the person shall do a pre task risk assessment with his/her Supervisor to mitigate the risk or de-energize the part.

Installing barriers directly on or making direct contact with exposed live parts above 600Vac is **Prohibited**.

To install barriers to prevent inadvertent contact to exposed energized parts above 600Vac shall require the following:


- 16.17.1 When installing the barriers, an electrical hazard risk assessment shall be done to determine how to install the barriers safely.
- 16.17.2 The safe distance to maintain while installing the barriers is dependent on the risk assessment and in any case shall not be less than the restricted approach boundary. The approach boundary distance is shown in Table B.

## 17.0 Permit to Work (PTW) Process

The PTW process is a requirement for all crafts when performing work inside LAR. The PTW document is controlled by the Health and Safety department. The LAR Electrical Safety Program provides guidance and requirements to the PTW process for energized electrical work. See section 3.0

- 17.1 All work on energized parts requires a PTW permit and must follow the PTW Process. The intent of the permit to work process is to assure that the appropriate risk assessment is completed and that all safety precautions are taken.

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- 17.2 If a task is not listed on the Work Classification Table or if a task is listed as a High Risk on the Work Classification Table, a Team Risk Assessment (TRA) shall be performed prior to conducting the task. The assessment shall comply with section 16.0 as minimum requirements, including the minimum level of authority to approve the work. The TRA may increase the level of authority to obtain the proper process to inform supervision and requirements to mitigate the task.


The PTW process uses a TRA to determine the level of risk. A medium risk level work uses a Medium Risk Assessment (MRA) as standing orders for whenever that task is done.

- 17.3 The MRA and TRA Job Hazard analysis (JHA) for work on energized equipment will address and include in the PTW the following:

**Note:** *Several sections in the ESP are to comply with Tesoro's TES 605 and 606 standards. Some of the following minimum requirements were taken from TES 606.*


- 17.3.1 A description of the circuit, the equipment to be worked on and its location
- 17.3.2 Review of electrical drawings and walk down identifying all sources of energy and its means of disconnecting
- 17.3.3 Associated safe work permit number
- 17.3.4 Can the work be deferred until the next scheduled shutdown?
- 17.3.5 Justification why the work must be performed in an energized condition
- 17.3.6 Description of the safe work practices to be performed
- 17.3.7 A rescue response plan
- 17.3.8 Results of the shock hazard analysis
- 17.3.9 Incident Energy with the distance to the energized part specific to the task being evaluated
- 17.3.10 The flash protection boundary distance
- 17.3.11 Identify the need for barriers to prevent inadvertent contact with energized parts

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- 17.3.12 Identify the necessary PPE in compliance with the ESP to safely perform the assigned task
  - 17.3.13 Identify required diagnostic test meters for task and that they are category rated and approved for the voltage.
  - 17.3.14 Verify test equipment that will be used has up to date certifications and last tested stickers on the equipment by a third party.
  - 17.3.15 Identify the insulation of protective equipment and protective tools that will be used as protection from shock hazards.
    - And verify by testing and inspection, as suitable for use and in compliance with Industry standards (see Table C).
  - 17.3.16 Identify written task procedures that need to be included
  - 17.3.17 Determine the number of qualified electrical personnel required to complete the task
  - 17.3.18 Means employed to restrict unqualified personnel from the work area
  - 17.3.19 Evidence of completion of a job briefing
  - 17.3.20 The execution plan of the task is in compliance with the ESP
  - 17.3.21 Appropriate level of management approval
- 17.4 The MRA and TRA Job Hazard analysis (JHA) shall address site conditions and include the following:
- 17.4.1 Is there a partial or solid ground on the electrical system where the work will occur
  - 17.4.2 Are the electrical protection devices such as switchgear circuit breakers, protection relays, and low voltage electronic trip devices current with their maintenance intervals (arc flash exposure is dependent on protective devices operating as designed).
  - 17.4.3 Is work area clear from hazards and is accessible to personnel and equipment?
  - 17.4.4 Site walked down identifying all sources of energy and its means of disconnecting

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17.4.5 Is area lighting adequate?

17.4.6 Are there additional hazards such as hot surfaces, tripping points, chemicals, or other tasks not involved with the electrical task being assessed that would hinder or prevent the electrical work from being done safely?

## 18.0 Distance of Approach While Working on Exposed Energized Parts for Shock and Flash Protection (High Energy Hotwork) Protection

18.1 The “Distance of Approach” boundaries are used to determine the safe distance a person can be from an exposed energized part. The three boundaries and their associated spaces are: arc flash boundary, limited approach boundary, and restricted approach boundary. Where a person is with respect to the distance of approach from an exposed energized part will determine what pre-task safety assessment needs to be completed and what PPE that person is required to wear.

18.1.1 The boundary distances are shown in Table B “Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection” and illustrated in Figure 1.0.

18.1.2 .


18.2 Limited Approach Boundary

18.2.1 No unqualified person shall be permitted to approach nearer than the limited approach boundary of energized conductors and circuit part unless continuously escorted by a qualified person.

18.2.2 Where one or more unqualified persons are working at or close to the limited approach boundary a designated person in charge of the work space, where the electrical hazard exists shall advise the unqualified person(s) of the electrical hazards and warn him or her to stay outside of the limited approach boundary. If the nature of the work is such that the person may enter the limited boundary inadvertently then barriers shall be installed to prevent entry.


18.3 Restricted Approach Boundary

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- 18.3.1 When repair work (see definition of repair under “Working on”) is being done in the restricted space, unqualified personnel shall be outside the “Arc Flash Boundary” or “Limited Approach Boundary”, whichever has the greater distance. Qualified personnel that are in the “Arc Flash Boundary” shall wear the same PPE as the work requires.
- 18.3.2 Entry into the restricted space requires that the qualified person be insulated or guarded from the live parts. Insulating gloves or insulating sleeves are considered insulation only with regard to the energized parts upon which work is being performed.
- 18.3.3 The qualified person shall minimize the risk due to inadvertent movement by keeping as much of the body out of the restricted space as possible. Use only protected body parts in the restricted space as necessary to accomplish the work.
- 18.3.4 No qualified person shall enter the restricted space with a conductive object in hand without suitable PPE unless the energized parts are guarded from contact through a barrier.
- 18.3.5 Personnel shall use insulated tools and/or insulating material when working inside the restricted approach boundary if it is possible for tools or handling equipment to make accidental contact with exposed energized parts.
- 18.4 Arc Flash Risk Assessment
  - 18.4.1 An arc flash risk assessment shall be done to determine if an arc flash hazard exists.
  - 18.4.2 The risk assessment shall be included in the PTW process to determine the appropriate safety related work practices and additional PPE.
  - 18.4.3 Refer to Table B for the Arc Flash boundary.
- 18.5 Arc Flash Boundary
  - 18.5.1 Arc flash boundary is not to be crossed without required PPE when others are working inside the “Restricted Approach Boundary”.

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- 18.5.2 The “Arc Flash Boundary” shall be identified with (Red) Danger barrier tape and posted sign,.
- 18.5.3 The arc flash boundaries shall be reviewed per section 7.0.
- 18.5.4 Arc Flash boundary distances are shown in Table B. The arc flash boundary shown in Table B may be adjusted based on an arc flash analysis completed by Andeavor Electrical Engineering.

## 19.0 Personal Protective Equipment for Electrical Tasks

- 19.1 Conductive articles of jewelry such as watchbands, bracelets, rings, and unrestrained metal frame glasses shall not be worn where they present an electrical contact hazard with live parts.
- 19.2 If fall protection is required while performing the task, it shall be of the burn resistant type.
- 19.3 Table A “Personal Protective Equipment” identifies the clothing risk category by assigning a category number of 0 through 4.
  - 19.3.1 Category 0 in Table A applies to tasks that are not listed in NFPA 70E as an arc flash hazard but is a standard PPE for any task performed in the LAR refinery.
  - 19.3.2 Category 1 through 4 is PPE requirements based on the arc flash analysis for the tasks listed in Table D.
- 19.4 Table D describes the PPE required to meet the energy rating associated with the category number. The PPE in Table D shall be worn by all personnel whenever there is a potential for shock or arc flash.
- 19.5 Table D “Risk Analysis for PPE” for work on energized equipment identifies voltage, assigns a clothing hazard risk category number and gives a task type description. Table D is not all-inclusive. If a task is not described in Table D, a shock hazard analysis and arc flash hazard analysis are required to determine the proper PPE.
- 19.6 Arc flash and electrical insulated type PPE shall be properly maintained and stored. All PPE shall be visually inspected before and after each use.



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- 19.7 The need for additional PPE as shown in Table A “Personnel Protective Equipment” depends upon the electrical flash incident energy measured in cal/cm<sup>2</sup>.
- 19.8 For incident energy above 1.2 cal/cm<sup>2</sup> head, neck, forehead and leather glove protection is required.
- 19.9 The LAR PPE standard for electrical workers is a minimum of category 2 rated clothing.
- 19.10 Clothing worn under the required PPE shall be non-melting.


## 20.0 Electrical Switching Procedure Requirements

- 20.1 A switching procedure is required to isolate electrical equipment for maintenance purpose or electrical tie-ins where the equipment being isolated has multiple isolation devices.
  - 20.1.1 The switching procedure will indicate requestor, purpose, affected process units, and single line representation of the equipment being switched.
  - 20.1.2 The procedure will also indicate the PPE required for each task, a walk down of the equipment being switched, and pre-task assessment analysis
  - 20.1.3 The procedure shall include steps for returning the electrical equipment back to service.
  - 20.1.4 Form 1.0 “Guideline for Writing Switching Procedure” shall be used.

## 21.0 Written Work Procedures

- 21.1 A Pre-Task Assessment/Job Briefing may require a detailed written work procedure when there is a risk of an unplanned power outage or the work in itself


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is of a particular hazardous nature. Examples where written work procedures are required:

- 21.1.1 Positive cable identification inside an electrical manhole or vault for the purpose of de-energizing and cutting of cable.
- 21.1.2 First time energizing power distribution equipment such as power transformers, switchgear, or motor control centers.
- 21.1.3 Systematic energizing or de-energizing of equipment where coordinated effort between personnel is required.

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## 22.0 Safe Work Practices

- 22.1 Safe work practices are written procedures to be used by personnel to perform the specific task. The written procedure should include the following:
  - 22.1.1 State the purpose and objectives.
  - 22.1.2 State any cautions or warnings.
  - 22.1.3 Perform “What if” query to identify possible hazards in pre-task assessments.
  - 22.1.4 As the need is recognized by engineering, supervision or technician; safe work practices will be developed by the electric shop department personnel, Permit to Work authorities, and reviewed by electrical Engineering.

## 23.0 Insulating Materials, Safety Tools and Test Equipment Maintenance

- 23.1 Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before each use.
- 23.2 Insulating materials, safety tools and test equipment shall be:
  - 23.2.1 Properly maintained and stored
  - 23.2.2 Protected from damaged
  - 23.2.3 Voltage rated for the task
- 23.3 Insulating materials, safety tools and test equipment shall meet ASTM and ANSI standards.
  - 23.3.1 The ASTM standards are listed in Table C


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**Table A: Personal Protective Equipment**

PPE Category	Personal Protective Equipment	ARC cal/cm <sup>2</sup>	Notes
0	FRC, Leather work shoes, safety glasses, hard hat, earplugs.	4	FRC- Flame retardant clothing with an arc rating minimum of 4 cal/cm <sup>2</sup> . Leather gloves as required
1	FRC, Leather work shoes, safety glasses, hard hat, earplugs, heavy duty leather gloves	4	
	Arc rated flash suit hood or arc rated face shield		
2	Same as Cat 0, heavy duty leather gloves	8	
	Min 8cal/cm <sup>2</sup> arc rated clothing, arc rated long sleeve shirt and pants or arc rated coveralls		
	Arc rated flash suit hood or arc rated face shield and arc rated balaclava		
3	Same as Cat 0, Arc rated gloves	25	
	Min 25cal/cm <sup>2</sup> arc rated clothing, arc rated long sleeve shirt and pants or arc rated coveralls		
	Min 25 cal/cm <sup>2</sup> arc rated flash suit hood		
4	Same as Cat 0, Arc rated gloves	40	
	40 cal/cm <sup>2</sup> arc rated flash hood, flash suit jacket and pants		


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**Table B: Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection**

<b>Nominal System Voltage Range - Phase to Phase</b>	<b>Limited Approach Boundary - Exposed Fixed Circuit Part</b>	<b>Restricted Approach Boundary: Includes Inadvertent Movement Adder</b>	<b>Arc Flash Protection Boundary; 1.2 cal/cm<sup>2</sup> Exposure</b>
50V to 150V	3ft. 6in.	Avoid Contact	None
151V to 250V	3ft. 6in.	1ft. 0in.	3ft.
251V to 600V	3ft. 6in.	1ft. 0in.	10ft.
601V to 2.6Kv	5ft. 0in.	2ft. 2in.	40ft.
3Kv to 5Kv	5ft. 0in.	2ft. 2in.	40ft.
11Kv to 15Kv	5ft. 0in.	2ft. 2in.	50ft. (Out of Building)
15.1Kv to 36Kv	6ft. 0in.	2ft. 7in.	50ft. (Out of Building)


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**Table C: ASTM and ANSI Standards on Other Protective Equipment**

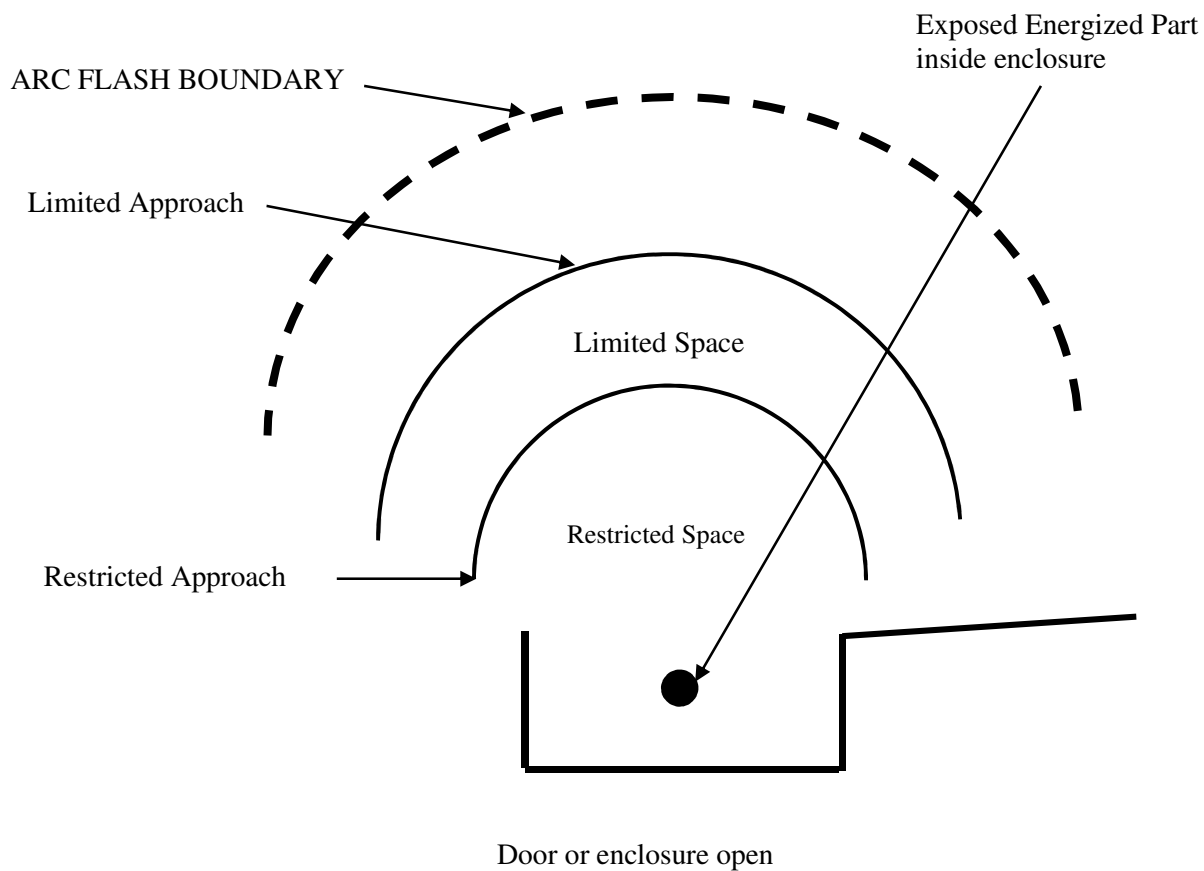
<b>SUBJECT</b>	<b>STANDARD DOCUMENT</b>	<b>DOCUMENT NUMBER</b>
Arc Protective Blankets	Test method for determining the protective performance of an arc protective blanket	ASTM F2676
Blankets	Specifications for rubber insulating blankets	ASTM D1048
Blankets - In Service Care	Service care of insulating blankets	ASTM F479
Covers	Rubber covers	ASTM 1049
Fiberglass Rods - Live Line Tools	Specification for fiberglass reinforced plastic (FRP) rod and tube used in live line tools	ASTM F711
Insulated Hand Tools	Specifications for insulated and insulating hand tools	ASTM F1505
Ladders	Ladders - Wood - safety requirements	ANSI/ASC A14.1
	Ladders - Fixed - safety requirements	ANSI/ASC A14.3
	Safety requirements for job made ladders	ANSI/ASC A14.4
	Ladders - Portable - reinforced safety requirements	ANSI/ASC A14.5
Line Hose	Specification for rubber insulating line hoses	ASTM D1050
Line Hose and Covers - In-service Care	Specification for In-Service care of insulating line hose and covers	ASTM F478
Plastic Guard	Test methods and specifications for electrically insulating plastic guard equipment for protection of workers	ASTM F712
Sheeting	Specification for PVC insulating sheeting	ASTM F1742
	Specification for rubber insulating sheeting	ASTM F2320
Safety Signs and Tags	Series of standards for safety signs and tags	ANSI Z535
Shield Performance on Live Line Tools	Test method for determining the protective performance of a shield attached to live line tools or on racking rods for electric arc hazards	ASTM F2522
Test Instruments	Safety requirements for measurement, control and laboratory use - Part 1	ANSI/ISA -61010-1
Temporary Protective Grounds - In Service Testing	Specification for In-Service test methods for temporary grounding jumper assemblies used on de-energized electric power lines and equipment	ASTM F2249
Temporary Protective Grounds - Test Specifications	Specifications for temporary protective grounds to be used on de-energized electric power lines and equipment	ASTM F855

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**Figure 1.0**

Boundaries illustrated from Table 1.0 showing distance from energized parts. For cubicle distance starts from front of switchgear or motor control center to the persons face or chest.



**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	PPE Category	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
50Vdc to 288Vdc	Control circuits, relays, equipment power to UPS, instrument, meters, lighting, etc.	Diagnostic, voltage testing or installation of barrier with insulated material Note 2,4	1	Y	N	1. 2. Use insulated test leads or material
		Repair work on energized parts note 4	1	Y	Y	
50Vac to 120Vac	Control circuits, relays, equipment power to UPS, instrument, meters, lighting, etc.	Diagnostic, voltage testing or installation of barrier with insulated material, Note 2	1	Y	N	3. Arc Flash and Shock risk analysis to determine PPE and mitigation requirements.
		Repair work on energized parts	1	Y	Y	
120/208/ 240Vac	Panel boards 225amps rated and below fed through a power transformer rated at 75Kva and below	Diagnostic, voltage testing or installation of barrier with insulated material	1	Y	Y	4. Working on Batteries follow HSE PPE safety requirements 5. 6. If contact is possible to voltage above 50V then PPE rated for that voltage
		Infrared thermography and other non contact inspection outside the restricted boundary	0	N	N	
		CB or Fuse switch operation with covers off	1	N	N	
		Repair work on energized conductors and circuit parts	1	Y	Y	
		Removal of bolted covers to expose energized parts	1	N	N	
		Open hinged covers to expose energized parts	1	N	N	
		Work on energized conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	1	Y	Y	
	Panel boards above 225amp rated and upstream fault clearing device is a molded case breaker with instantaneous interruption or fused. Same as Panel Boards 225amp and below with exceptions noted.	Diagnostic, voltage testing or installation of barrier with insulated material	1	Y	Y	
		Work on energized conductors and circuit parts	2 Note 3	Y	Y	
		Removal of bolted covers to expose energized parts	2	N	N	
	Open hinged covers to expose energized parts	1	N	N		



**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
Greater than 240 up to 600Vac	Panel boards 225amps rated and below fed and upstream clearing device is an insulated case breaker with instantaneous interruption or fuses.	Use VOM for Diagnostic testing on branch breaker or its circuit.	1	Y	Y	1. 2. Use insulated test leads or material 3. Arc Falsh and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer 4. This task is only done by exception on a live bus. Every effort to de-energize bus should be done.
		Use VOM for Diagnostic testing on Main Breaker or its bus.	2	Y	Y	
		Installation of barrier with insulated material	2	Y	Y	
		Infrared thermography and other non contact inspection outside the restricted boundary	0	N	N	
		CB or Fuse switch operation with covers on	1	N	N	
		CB or Fuse switch operation with covers off	2	Y	N	
		Repair work on energized conductors and circuit parts	2	Y	Y	
		Remove/Install CBs or Fused switches	2	Y	Y	
		Removal of bolted covers to expose energized parts	2	N	N	
		Open hinged covers to expose energized parts	2	N	N	
		Repair work on energized conductors and circuit parts of utilization equipment fed directly by a molded case branch circuit breaker of the panelboard	2	Y	Y	
	Panel Boards fed from a low voltage 480Vac switchgear breaker same as above except as noted.	Repair work on energized conductors and circuit parts	Note 3&4	Y	Y	
		Remove/Install CBs or Fused switches	Note 3&4	Y	Y	

**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
480Vac switchrack fed from a MCC or switchgear breaker from a power source no larger than a 1500Kva transformer.	Outdoor Switchrack	Diagnostic testing using test meters, If testing main bus	2	Y	Y	1.
		Installation of barrier with insulated material	2	Y	Y	2. Use insulated test leads or material
		Infrared thermography and other non contact inspection outside the restricted boundary	0	N	N	3. Arc Flash and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer
		CB or fused switch or starter operation with explosion proof enclosure doors closed	0	N	N	
		Reading a panel meter while operating a meter switch	0	N	N	
		CB or fused switch operations with explosion proof enclosure doors open	4	N	N	
		Repair work on 480vac energized circuits conductors and circuit parts.	Note 5	Y	Y	4. This task is only done by exception on a live bus. Every effort to de-energize bus shall be done.
		Repair work on 120Vac energized parts with exposed 480V	4	Y	Y	5. This task is not allowed
		Repair work on 120Vac energized parts with 480 Vac barriered off to prevent inadvertent contact	1	Y	Y	
		Removal of non hinged bolted covers on starter or bus box (to expose bare, energized electrical conductors and circuit parts, Note 4	4	N	N	
		Opening bolted hinged covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N	
		Removal or install dome enclosure top with line side energized	2	Y	N	
		Removal or install dome enclosure bottom to expose energized parts with load energized. Note 4	4	Y	N	

**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
480Vac switchgear breaker fed from a power source no larger than a 1500Kva transformer	Switch gear or power circuit breakers	Diagnostic testing using test meters, If testing on main bus	Note 3	Y	Y	1. 2. Use insulated test leads or material 3. Arc Falsh and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer 4. This task is only done by exception on a live bus. Every effort to de-energize bus should be done. 5. This task is not allowed
		Installation of barrier with insulated material.	Note 3	Y	N	
		Infrared thermography and other non contact inspection outside the restricted boundary	0	N	N	
		CB or fused switch operation with enclosure doors closed	4	N	N	
		Diagnostic testing on 480Vac circuits with TEST breaker	4	Y	Y	
		Phasing and testing through cubicle shutters.	4	Y	Y	
		Reading a panel meter while operating a meter switch	0	N	N	
		CB or fused switch operations with enclosure doors open	4	N	N	
		Repair work on 480vac energized control circuits (No. 10 and smaller) conductors and circuit parts.	Note 3	Y	Y	
		Repair work on 120Vac energized parts with energized exposed 480V parts.	4	Y	Y	
		Repair work on 120Vac energized parts with 480 Vac barriered off to prevent inadvertent contact	1	Y	Y	
		Insertion or removal (racking) of CBs from cubicles doors open or closed	4	N	N	
		Removal of bolted covers to expose bare, energized electrical conductors and circuit parts	4	N	N	
		Opening hinged covers (to expose energized electrical conductors, feeder cables, or circuit parts)	2	N	N	
		Repair work on Energized parts in main or feeder cable entry sections	Notes 5			
Application of grounds after voltage test	2	Y	N			

**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
480Vac switchrack fed from a MCC or switchgear breaker from a power source no larger than a 1500Kva transformer.	Outdoor Switchrack	Diagnostic testing using test meters, If testing main bus	2	Y	Y	<b>1.</b> 2. Use insulated test leads or material 3. Arc Falsh and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer 4. This task is only done by exception on a live bus. Every effort to de-energize bus shall be done. 5. This task is not allowed
		Installation of barrier with insulated material	2	Y	Y	
		Infrared thermography and other non contact inspection outside the restricted boundary	0	N	N	
		CB or fused switch or starter operation with explosion proof enclosure doors closed	0	N	N	
		Reading a panel meter while operating a meter switch	0	N	N	
		CB or fused switch operations with explosion proof enclosure doors open	4	N	N	
		Repair work on 480vac energized circuits conductors and circuit parts.	Note 5	Y	Y	
		Repair work on 120Vac energized parts with exposed 480V	4	Y	Y	
		Repair work on 120Vac energized parts with 480 Vac barriered off to prevent inadvertent contact	1	Y	Y	
		Removal of non hinged bolted covers on starter or bus box (to expose bare, energized electrical conductors and circuit parts, Note 4	4	N	N	
		Opening bolted hinged covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N	
		Removal or install dome enclosure top with line side energized	2	Y	N	
		Removal or install dome enclosure bottom to expose energized parts with load energized. Note 4	4	Y	N	

**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm2 or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
120 to 240Vac other tasks on class of equipment	Miscellaneous tasks for equipment other than a specific type	Use VOM for Diagnostic testing	1	Y	Y	1.  2. Use insulated test leads or material  3. Arc Falsh and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer
		Repair work on a circuit protected by a 120/240Vac 50amp or less branch circuit breaker or fuse	1	Y	Y	
		Small cover removal with 120Vac circuits	0	N	N	
277 - 480Vac Other tasks on class of equipment	Miscellaneous tasks for equipment other than a specific type	Use VOM for Diagnostic testing	1	Y	Y	4. This task is only done by exception on a live bus. Every effort to de-energize bus should be done.  5. This trask is not allowed  6. If contact is possible to voltage above 50V then PPE rated for that voltage
		Installation of barrier with insulated material	2	Y	Y	
		Infrared themography and other non contact inspection outside the restricted boundary	0	N	N	
		Reading a panel meter while operating a meter switch	0	N	N	
		Miscellaneous equipment small cover removal or installation	1	N	N	
		Lighting Transformer - removal of bolted covers to expose bare energized conductors	1	N	N	
		Lighting Transformer - Opening hinged covers to expose bare energized conductors.	1	N	N	
		Lighting Transformer - Repair on energized conductors and circuit parts. Note 4	4	Y	Y	
		Cable trough or tray cover removal or installation with cables energized	1	N	N	
		busways - removal or insertion of plug in devices to energized busway.	Note 4,5	Y	N	
		Application of grounds after voltage test	2	Y	N	
		Cable Inspection	Examination of insulated energized cable inside vault or manhole (physical contact with cable for the purpose of examination)	Note 3	Y	
	Examination of insulated energized cable in open area (physical contact with cable for the purpose of examination).		Note 3	Y	N	

**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
2.4/4.16Kv Med Voltage MCC	Motor control centers with NEMA E2 Fused Contactor motor starter	Use VOM for Diagnostic testing of 480Vac and below inside a separate low voltage compartment	1	Y Note 6	Y Note 6	1.  2. Use insulated test leads or material  3. Arc Falsh and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer  4. This task is only done by exception on a live bus. Every effort to de-energize bus should be done.  5. This task is not allowed  6. If contact is possible to voltages above 50V then PPE rated for that voltage.  7. Some existing contactors have the line disconnect mounted on the contactor carriage. Racking this type contactor in or out requires removal or insertion to a live bus.
		Use VOM for Diagnostic testing of control circuits inside the same enclosure with medium voltage (e.g.Elliott Controllers)	Note 5			
		Infrared themography and other non contact inspection outside the restricted boundary through engineered viewing window	0	N	N	
		Energizing and de-energizing Contactor by using door mounted controls with enclosure doors closed	2	N	N	
		Reading a panel meter while operating a meter switch	0	N	N	
		Line disconnect fused switch operations with doors open	Note 5			
		Line disconnect fused switch operations with enclosure doors closed	2	N	N	
		Repair work on energized conductors and circuit parts	Note 5			
		Repair work on 120Vac energized parts with exposed 480V, inside a separate low voltage compartment	4	Y	Y	
		Repair work on 120Vac energized parts with 480V barriered off to prevent inadvertent contact	1	Y	Y	
		Insertion or removal (racking) of individual starters with line disconnect open. Note 7.	4	N	N	
		Removal of bolted covers to expose bare energized electrical conductors and circuit parts	Note 5			
		Opening hinged covers to expose bare energized electrical conductors and circuit parts	4	N	N	

**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
2.4/4.16Kv SWGR	Medium Voltage Metal Clad SWGR	Use VOM for Diagnostic testing of 480Vac and below inside a separate low voltage compartment	1	Y Note 6	Y Note 6	1. 2. Use insulated test leads or material 3. Arc Falsh and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer 4. This task is only done by exception on a live bus. Every effort to de-energize bus should be done. 5. This task is not allowed 6. If contact is possible to voltages above 50V then PPE rated for that voltage. 7.
		Use VOM for testing of control circuits inside the same enclosure of medium voltage	Note 5			
		Infrared themography and other non contact inspection outside the restricted boundary through engineered viewing window	0	N	N	
		Diagnostic testing with TEST breaker. Note 3	4	Y	Y	
		Phase testing through cubicle shutters; Note 3	4	Y	Y	
		Circuit Breaker operation with doors closed	4	N	N	
		Insertion or removal (racking) of circuit breaker doors open or closed	4	N	N	
		Operating a switch and viewing a panel meter	0	N	N	
		Repair work on energized circuits conductors and circuit parts	Note 5			
		Removal of bolted covers to expose energized parts	Note 5			
		Repair work on 120Vac energized parts with exposed 480V, inside a separate low voltage compartment	4	Y	Y	
		Repair work on control circuits 120Vac or DC energized parts with 480 Vac barriered off to prevent inadvertent contact	1	Y	Y	
		Removal of bolted covers to expose energized feeder cables	4	N	N	
		Open hinged covers to expose energized electrical feeder cables	2	N	N	
		Opening/ inserting or closing PT or CPT transformer compartments or truck carriages.	Note 3	N	N	
		Application of temporary grounds after voltage test	4	Y	N	

### Table D: Hazard Risk Analysis PPE Table

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
12.4/13.8Kv SWGR	Medium Voltage Metal Clad SWGR	Use VOM for Diagnostic testing of 480Vac and below inside a separate low voltage compartment	1	Y Note 6	Y Note 6	1. 2. Use insulated test leads or material 3. Arc Falsh and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer 4. This task is only done by exception on a live bus. Every effort to de-energize bus should be done. 5. This task is not allowed unless it is an emergency. Risk of Loss of production is not considered an emergency 6. If contact is possible to voltages above 120V then PPE rated for that voltage. 7.
		Use VOM for testing of 480Vac and below inside the same enclosure of medium voltage	Note 5			
		Infrared themography and other non contact inspection outside the restricted boundary through engineered viewing window	0	N	N	
		Diagnostic testing with TEST breaker. Note 3	4	Y	Y	
		Phase testing thru cubicle shutters. Note 3	4	Y	Y	
		Circuit Breaker operation with doors closed	4	N	N	
		Insertion or removal (racking) of circuit breaker doors open or closed	4	N	N	
		Operating a switch and viewing a panel meter	0	N	N	
		Repair work on energized circuits conductors and circuit parts	Note 5			
		Removal of bolted covers to expose energized parts	Note 5			
		Repair work on 120Vac energized parts with exposed 480V, inside a separate low voltage compartment	4	Y	Y	
		Repair work on control circuits 120Vac or DC energized parts with 480 Vac barriered off to prevent inadvertent contact	1	Y	Y	
		Removal of bolted covers to expose energized feeder cables. Note 3	4	N	N	
		Open hinged covers to expose energized electrical feeder cables	2	N	N	
		Opening/ inserting or closing PT or CPT transformer compartments or truck carriages.	Note 3	N	N	
Application of temporary grounds after voltage test	4	Y	N			




**Table D: Hazard Risk Analysis PPE Table**

**NOTE: Incident energy at 40Cal/cm<sup>2</sup> or less**

VOLTAGE	EQUIPMENT	DESCRIPTION OF TASK	HAZARD/RISK PPE CATEGORY	Voltage Rated Gloves	Insulated and Insulating Hand Tools	NOTES
2.4Kv through 13.8KV other Tasks	Metal Enclosed Fused and Non Fused Load Break Switches	Work on Energized circuit conductors	Note 5			1. 2. Use insulated test leads or material 3. Arc Falsh and Shock Hazard risk analysis to determine PPE and mitigation to arc flash and electrical shock. Note: Source protective clearing device may be outside of equipment, e.g. on line side of power transformer 4. This task is only done by exception on a live bus. Every effort to de-energize bus should be done. 5. This task is not allowed. 6. If contact is possible to voltages above 50V then PPE rated for that voltage. 7.
		Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts	Note 5			
		Open hinged covers to expose energized electrical feeder cables and terminations	2	N	N	
		Opening or Closing switch to connect or disconnect load, doors closed	4	N	N	
	Metal enclosed disconnect fused and non fused switches	Work on Energized circuit conductors	Note 5			
		Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts	Note 5			
		Open hinged covers to expose energized electrical insulated feeder cables and terminations	2	N	N	
		Opening or Closing switch to isolate (Not used to energize or de-energize load)	4	N	N	
	Outdoor Disconnects	Outdoor disconnect switch operation (hookstick operated)	4	Y	Y	
		Outdoor disconnect switch operation (gang operated from grade)	Note 3	Y	N	
	Cable Examinations	Examination of insulated energized cable inside vault or manhole (physical contact with cable for the purpose of examination)	Note 3	Y	N	
		Examination of insulated energized cable in open area (physical contact with cable for the purpose of examination).	Note 3	Y	N	

# LAR Electrical Safety Program

	DOCUMENT NUMBER (FROM DK) <b>LAR Electrical Safety Program</b>	REVISION DATE: <b>6/11/2018</b>
	ISSUING DEPARTMENT <b>Reliability Engineering</b>	NEXT REVIEW DATE: <b>6/11/2021</b>

## Form 1.0: Guideline for Writing Switching Procedure

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**Switching procedures must contain the following:**


### **Procedure Cover Page**

1. Date of switching
2. Number of pages in switching procedure
3. Switching requested by: The person or group requesting the switching
4. Purpose of switching: State the reason whether to perform work, align the power distribution system, electrical tie in, isolate distribution equipment, other
5. Switching procedure written by and date: The author of the procedure
6. Switching procedure reviewed by and date: Engineering or Electrical Supervision review. The review shall consider risk assessment, mitigation, arc flash, PPE
7. Switching procedure checked by and date: The switching crew checks the procedure by walking down the equipment prior to start of work. Comments, clarifications, and concerns from the walk down are discussed with Supervision
8. Process Units or other electrical loads that are or could be affected by the switching are listed. The stake holders of the electrical loads shall be consulted and a single person contact identified
9. Single line or switching diagram drawing numbers illustrating the equipment to be switched are listed
10. Name of person in charge of the switching: One person executing the switching procedure that will have a radio or other continuous way of being in contact with the switching crew.
11. Name of all personnel involved in the switching

### **Switching procedure step by step outline**

1. Number for each step with sub-numbers for each minor steps
2. Description of each task, identifying substation, switchgear and device
3. Verify the nameplates of field equipment matches the description in the procedure
4. Warnings for safety precautions or PPE required for next step
5. Check box marked “Completed” for each task
6. Deviation from procedures requires Engineering or Electrical Supervisor’s signature


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## **Person in Charge of Switching: Check boxes indicating a switching task was completed as described in the procedure**

1. Review work scope with switching crew
2. Validate PPE required is being worn, both for personnel and insulated materials needed
3. Communication has been made to affected stakeholders of intent to execute switching procedure
4. Walk down switching procedure with switching crew
5. Visual inspection and any required electrical testing of switching equipment with the switching crew (safe work area and equipment integrity)
6. Review refinery "Permit to Work" requirements
7. Review Lockout Tagout procedures and lockout equipment required
8. What if plan (plan ahead for what may happen and how to recover.) Consider:
  - a. Device fails to open
  - b. Device fails to close
  - c. Wrong device opens
  - d. Device experiences a fault
9. Review responsibilities of each crew member involved in the switching
10. Review the incident energy level and risk for each task

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## 24.0 Revision History

Revision Date	Author	Custodian	Revision Details	Field Verification Needed	
				Y/N	Date
6/11/2018	Mark Saldana	Gerard Ngo	Updated to NFPA 70E 2018 Edition	N	
10/15/2019	Gerard Ngo	Gerard Ngo	Minor procedure requirements	N	10/15/19