



Electrical Safe Work CoW Technical Standard

Version	Date	Approver
1.0	March, 31 2024	JO EHS Division

Introduction

Electrical safe work procedures are designed to help prevent personnel injuries, property damage or adverse environmental impact due to electrical shock, arc flash, arc blast and fire ignition.

In addition to the requirements of this standard, local electrical code and safety code regulations shall apply and may require additional or more conservative practices than those defined in this standard. In the absence of local codes or regulatory standards for electrical safety in the workplace to meet the intent of the requirements of this standard, Chevron Engineering Standard "ELC-SC-6206" accompanied by this standard shall apply.

Scope

This standard defines requirements for performing work safely on or near electrical equipment operating at 50 volts dc or ac (rms) and above. This standard does not apply to work on low voltage/low current capacity electrical systems defined as less than 50 volts dc or ac (rms) and are not required to be placed in an electrically safe condition.

Requirements

The following sections provide minimum requirements for electrical safe work as well as supporting guidance to clarify the intent of those requirements.

- Requirements of this Standard **shall** be met.
- Guidance in this Standard **may** be used as an aid to develop local documents that meet or exceed Control of Work (CoW) requirements. If examples are provided within guidance sections, they are not meant to represent the only acceptable means for meeting a requirement. WJO may develop or utilize other suitable methods not discussed in this document as long as the requirements are met. Implementation of guidance is not auditable.

1. Requirement:	All electrical systems, power lines, electrical equipment or electrical parts shall be considered energized until they are verified to be in an electrically safe work condition.
2. Requirement:	<ol style="list-style-type: none"> a. All electrical systems, power lines, electrical equipment, or electrical parts (greater than or equal to 50 AC/DC volts) shall be placed into an electrically safe work condition before any personnel perform work if either of the following circumstances exist: <ol style="list-style-type: none"> i. A worker is within the limited approach boundary for shock protection ii. A worker interacts with electrical equipment (e.g., operating a switch, turning a circuit on/off for the purpose of isolation) where conductors or circuit parts are not exposed but there is an increased risk of injury from an exposure to an arc flash hazard b. Establishing electrical safe work conditions are not required if any of the following conditions are met: <ol style="list-style-type: none"> i. Operation of equipment with the equipment itself functioning under “normal” operating conditions ii. Interaction with an energized disconnect switch or isolation means to achieve an electrical safe work condition iii. Performing a task that is not feasible in a de-energized state due to equipment design iv. De-energizing will introduce additional hazards or compromise the operation of critical safety systems v. Energized conductors or circuit parts are below 50V of limited short-circuit capacity and low thermal burn exposure c. Approval by a High-Level Approver shall be required prior to working under any of the conditions in requirement 2.a.
Guidance:	<ol style="list-style-type: none"> 1. Normal operating conditions satisfy all the following conditions: <ul style="list-style-type: none"> • Installed in accordance with industry codes and standards and manufacturer’s recommendations • Maintained in accordance with manufacture’s recommendations and applicable industry maintenance standards (e.g., NFPA 70B) • Equipment design is rated for the available fault current at the point of connection to the power system • Used in accordance with the manufacturer’s instructions and product safety listing (if applicable) • Compartment doors closed and properly secured • Covers or panels in place and properly secured

	<ul style="list-style-type: none"> • No signs of impending equipment failure (e.g., evidence of overheating, visible damage or deterioration to enclosures or components, signs of water ingress) <ol style="list-style-type: none"> 2. Operation of a disconnect switch for LOTO or return to service, by Opening/Closing a circuit breaker / contactor / switch as designed. 3. Examples of infeasibility include diagnostic troubleshooting, thermography, DC battery sources, or a continuous process that has the potential to cause ignition of flammable or combustible vapors or liquids in hazardous(classified) areas (e.g., pressurization system used to maintain an unclassified area for non-hazardous rated equipment). Note: there is a significant difference between “infeasible” and “inconvenient,” and the two terms should not be used interchangeably. If it is determined necessary to work on electrical equipment while energized, there will be an exposure to a shock and/or arc flash hazard. Therefore, you need to implement other safeguards or safety related work practices including, but not limited to, insulated tools, shields, barriers, engineered solutions, and personal protective equipment. 4. Examples where de-energizing could introduce additional hazards include critical life support systems, hazardous area ventilation, access and egress lighting. In most cases emergency control systems, life support equipment, and plant lighting are required by other codes and standards to have redundancy or back-up capability therefore it is nearly impossible to meet the requirements of this exception. 5. LV control systems, i.e., capacity limited battery banks, etc., where the system has overcurrent protection and insufficient energy to result in a thermal related burn.
<p>3. Requirement:</p>	<p>A hazard analysis shall be conducted in accordance with the Hazard Analysis CoW technical standard when planning work on or near electrical equipment. The hazard analysis shall include shock and arc flash hazards and take into consideration the following:</p> <ol style="list-style-type: none"> a. Operating condition, maintenance condition and protective devices b. Work practices to be used c. Boundaries to be established d. Personnel competency e. Voltage exposure, and f. PPE
<p>Guidance:</p>	<p>The Electrical Hazard Analysis (EHA) for electrical work includes an evaluation of the shock and arc flash hazards that may be present during energized work.</p> <p>Shock Analysis identifies:</p> <ul style="list-style-type: none"> • Electric shock hazards where work takes place, including all possible electrical sources at or near where the work is

taking place (e.g., back feeds into equipment, induced voltages, overhead power lines, etc.)

- An estimate of the likelihood and severity of an electric shock injury if it occurred. The estimate is based on:
 - The physical design of the equipment involved
 - The condition of maintenance of the equipment at the time of the work is conducted
- Identify additional protective measures and other equipment necessary to perform the tasks safely including, but not limited to, insulated tools, physical barriers or covers, gas testing, voltage level exposure, shock boundary distances associated with the hazard
- The results of the shock analysis are documented for the given task and conditions and are re-evaluated if the tasks, hazards, or other conditions have changed prior to or as the work is being performed.

Arc Flash Analysis identifies:

- Arc flash hazards where the work takes place, this includes arc flash hazards possible from adjacent energized equipment.
- An estimate of the likelihood and severity of an arc flash injury if it occurred. The estimate is based on:
 - The physical design of the equipment involved
 - Overcurrent protection means
 - Energy reduction/arc mitigation methods that can reduce the likelihood of exposure to and/or reduce the incident energy associated with the arc flash event
 - The condition of maintenance of the equipment at the time of the work is conducted
- Identify additional protective measures and safe work practices necessary to perform the tasks safely, including the arc flash boundary and the appropriate level of personal PPE used within the arc flash boundary.
- Physical barriers or covers, gas testing, voltage level exposure, protective boundary distances associated with the hazard. The results of the arc flash analysis are documented for the given task and conditions and are re-evaluated if the tasks, hazards, or other conditions have changed prior to or as the work is being performed.

4. Requirement: Work that can involve exposures to electrical hazards shall include a documented work plan or procedure as defined by a Qualified Electrical Person.

Guidance: As part of the electrical safety program requirements, every job where personnel can be exposed to electrical hazard needs to be planned and documented. Procedures are to be developed and used to identify all potential hazards, (e.g., electrical, environmental, heights), for each task and a job safety plan be completed by a Qualified person and documented.

Information to be included in the Job Safety Plan should include:

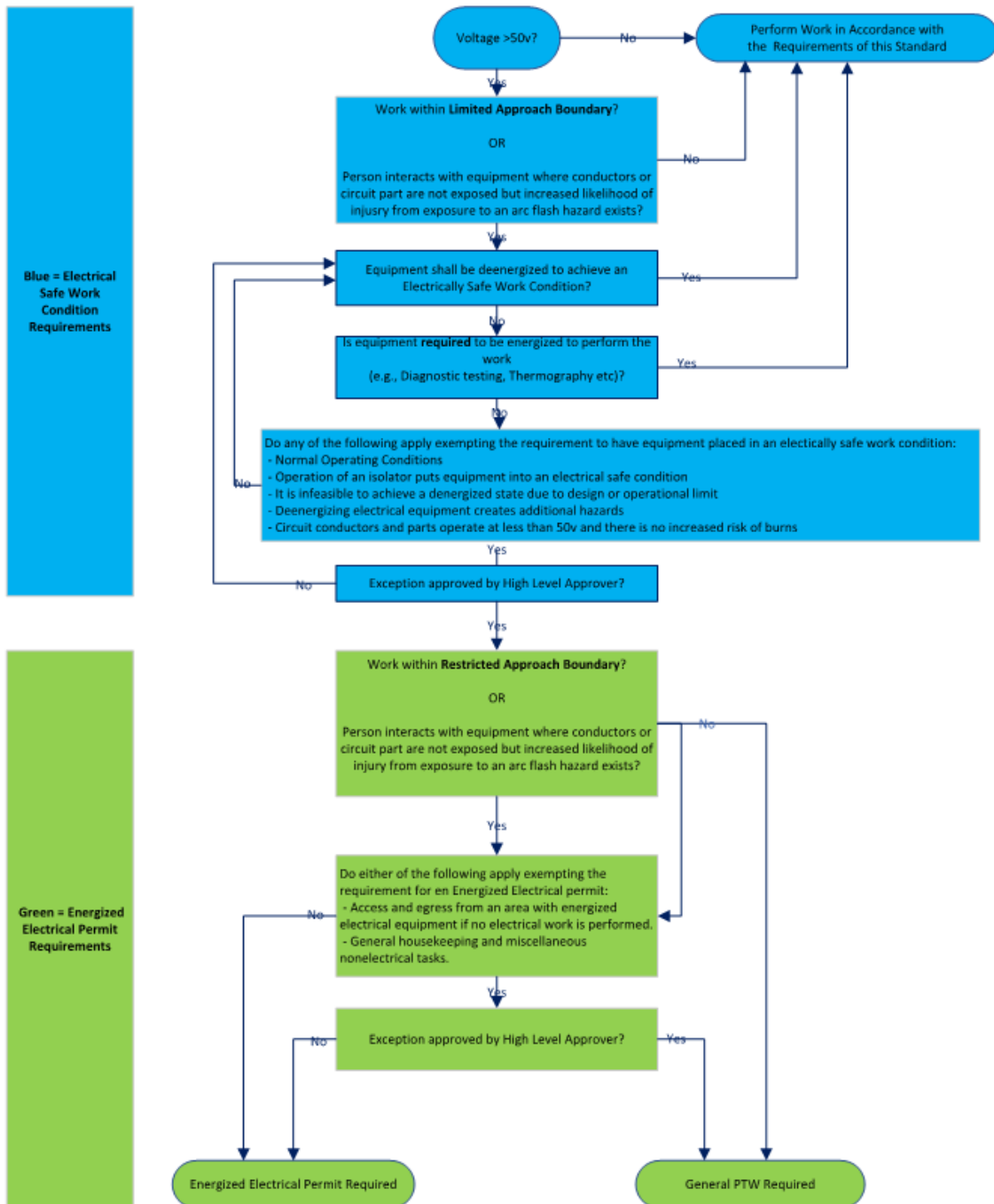
		<ul style="list-style-type: none"> • Job description and list of individual tasks to be done • Identification of hazards associated with each task • Electric shock and arc flash analysis • Specific work procedures and energy source controls (i.e., Isolation of Hazardous Energy) • Emergency response plan • A job safety briefing shall be conducted prior to the start of work covering the job safety plan and any additional precautions identified on the permit to work. <p>This may be incorporated as part of the CoW documentation approved and accessible at the worksite.</p>
5.	Requirement:	Personnel performing electrical work shall be provided with PPE in compliance with industry standards (e.g., ASTM/ANSI, IEC) and be selected for the intended part of the body to be protected, for the work being performed.
6.	Requirement:	Electrical systems and equipment shall be de-energized, isolated and then re-energized in compliance with the Required Isolation of Hazardous Energy CoW Technical Standard and Chevron Engineering Standard ELC-SC-6206.
7.	Requirement:	<ol style="list-style-type: none"> a. Work shall be authorized in accordance with the Work Authorization CoW Technical Standard. b. Permitting requirements (i.e., general Permit to Work (PTW) or Energized Electrical permit shall be required per Appendix A - Electrical Permitting Process Workflow.
8.	Requirement:	<ol style="list-style-type: none"> a. An Energized Electrical Work Permit (certificate) approved by a High-Level Approver shall be required if: <ol style="list-style-type: none"> i. Performing work (e.g., replacing main fuses, tightening bolted connections) inside the restricted approach boundary or ii. Interaction with equipment when energized electrical conductors or circuit parts that are not exposed but pose an increased hazard. b. An Energized Electrical Work Permit (certificate) shall not be required if any of the following tasks are to be conducted: <ol style="list-style-type: none"> i. Testing and troubleshooting ii. Thermography or visual inspection outside the restricted approach boundary iii. Access and egress from an area with energized electrical equipment if no electrical work is performed iv. General housekeeping and miscellaneous nonelectrical tasks.
9.	Requirement:	Safe work zones (as defined by the greater of either the limited approach boundary or arc flash boundary) shall be

		controlled and marked with warning labels, barricades or attendant(s) used to prevent access to electrical work areas containing energized conductors or circuit parts.
10.	Requirement:	Intrusive electrical work conducted within a hazardous classified area shall be performed in accordance with the SHEERS Required Hot Work CoW technical Standard.
11.	Requirement:	Unqualified individuals who are not escorted by a Qualified Electrical Person shall remain outside the limited approach boundary and arc flash boundary of exposed, energized electrical components per the results of the hazard assessment.
12.	Requirement:	<p>A minimum of two workers shall be present for work inside the limited approach boundary where a shock hazard exists. One worker shall be a Qualified Electrical Person and the second worker shall act as an Electrical Stand-by Person. Exceptions to this requirement are permitted if one of the following conditions are satisfied:</p> <ol style="list-style-type: none"> a. All voltage sources greater than or equal to 50V AC/DC to the equipment have been proven to be de-energized, including possible back-feeds prior to starting work, or b. The equipment has a built-in grounding device that is clearly visible to confirm that grounding is accomplished. <ol style="list-style-type: none"> i. Prior to working on a previously energized conductor or circuit part, the Qualified Electrical Person shall test for absence of voltage.
13.	Requirement:	Personnel working within the limited approach boundary of exposed energized electrical conductors or circuit parts shall remove all jewelry and other conductive apparel.
14.	Requirement:	Only Qualified Electrical Personnel shall work inside the restricted approach boundary.
15.	Requirement:	<p>If working near energized overhead power lines where energy isolation is not feasible:</p> <ol style="list-style-type: none"> a. Elevated equipment, including the load, shall maintain an approach distance of 20 feet (6 meters) to a power line if voltages are unknown, or b. Appendix B shall be used along with Qualified Electrical Person support for encroachment situations where voltages are known. Encroachment controls shall be identified in the hazard analysis if there is any potential to enter the minimum clearance distance, and include at least one of the following: <ul style="list-style-type: none"> • barriers, • spotter, • proximity alarm, or • voltage detector.

	Guidance:	Further safe approach distances may be required for higher voltage situations, and a Qualified Electrical Person should be consulted in the planning stages of the task to be performed.
16.	Requirement:	WJO shall develop Power System Switching Procedures in accordance with Chevron Engineering Standard ELC-SC-6206.
17.	Requirement:	Voltage testing procedures shall at a minimum include the selection of: <ol style="list-style-type: none"> a. Appropriately rated PPE, and b. Adequately rated test equipment for anticipated voltage
18.	Requirement:	If energized insulated cable runs, used for temporary power distribution, need to be moved or handled manually, the use of insulating live-line tools or electrical insulating gloves that are properly rated for the voltage shall be required.
19.	Requirement:	Ground-fault circuit interrupters (GFCIs) or residual current devices (RCDs) shall be provided for personnel protection and used in accordance with manufacturer's recommendations, regulatory standards, or local codes on cord-connected power tools and other cord-connected devices used outdoors.
20.	Requirement:	<ol style="list-style-type: none"> a. Portable or vehicle mounted generators shall comply with the following: <ol style="list-style-type: none"> i. local electrical installation code requirements ii. specific grounding and bonding requirements, and generator frame grounded (earthed) by an approved connection means to a grounding electrode or the grounding system for main output voltages greater than 240V. b. Portable generators, (e.g., light plant, welder, etc.) do not require a physical connection to ground (earth), the frame can serve as that ground (earth)reference if: <ol style="list-style-type: none"> i. cord connected equipment are connected through GFCI receptacles integrated into the generator, and ii. non-current carrying metallic parts of the generator (e.g., fuel tanks, engines, weather enclosures,) are bonded to that frame
21.	Requirement:	Access equipment used for electrical work, (e.g., ladders, bucket truck booms, live-line tools) shall be insulated using components made of non-conductive materials in compliance with regulatory standards and industry standards.
22.	Requirement:	Temporary Protective Grounding shall be required to prevent back-feeds on equipment, including but not limited to: <ol style="list-style-type: none"> a. Switchgear buses

		<ul style="list-style-type: none"> b. Feeders from sub-stations c. Bare conductor circuits d. Motor circuits greater than 690 volts, nominal, or e. Overhead Powerlines greater than > 600 volts
23.	Requirement:	WJO shall establish a frequency of inspection, maintenance and recertification of electrical test and safety equipment (e.g., voltage meters, insulating gloves, PPE) in compliance with regulatory standards, industry standards and manufacturer's recommended maintenance practices.
24.	Requirement:	<ul style="list-style-type: none"> a. Personnel conducting electrical work shall meet the training and competency CoW standard requirements that apply to their roles in accordance with the Training and Competency Standard. b. Training requirements and competency assessments for personnel conducting electrical work shall be documented including, but not limited to, the following personnel: <ul style="list-style-type: none"> i. Authorized Electrical Person ii. Electrical Standby Person iii. Qualified Electrical Person c. Refresher training shall be required at a minimum of every three years or under any of the following conditions. <ul style="list-style-type: none"> i. Hazards change ii. New technologies and types of equipment are introduced iii. Procedures change iv. Safety-related work practices differ from those normally used, or v. Annual inspections indicate that personnel are not complying with the safety-related work practices
25.	Requirement:	Unqualified persons whose work could result in contact with greater than 50 Volts AC/DC must be trained and be familiar with electrical safety-related practices necessary for their safety.
26.	Requirement:	Documentation associated with Electrical work shall be in accordance with the record retention requirements detailed in the Control of Work Process.

Appendix A: Electrical Permitting Process Flow



Appendix B: Overhead Powerline – Minimum Clearance Distances

During the planning of any elevated work near overhead powerlines, it is important to determine if any part of the equipment or materials could come close or in contact with the power line. If so, consider the following options:

Option 1: De-energize and ground the power lines. Confirm from the utility owner/operator that the power line has been deenergized and visibly grounded at the worksite.

Option 2: Ensure sufficient clearance in consultation with the utility owner/operator and in compliance with regional regulations.

Option 3: Use the Table below to determine if any part of the equipment or materials, while operating up to the equipment’s maximum working radius in the work zone, could get closer than the minimum approach distance of the power line. If tag lines are used, they must be nonconductive.

This table is provided for guidance only; consult a Qualified Electrical Person and confirm clearance distances and encroachment hazard controls in compliance with local regulations.

Environmental conditions such as fog, smoke, or precipitation may require increased clearances.

Minimum clearance distances

Voltage (nominal, kV, alternating current)	Minimum clearance distance in meters (Feet)
up to 50	3 (10)
over 50 to 200	4.5 (15)
over 200 to 350	6 (20)
over 350 to 500	7.5 (25)
over 500 to 750	10.5 (35)
over 750 to 1,000	13.5 (45)
over 1,000	(As established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).

Note: The upper-end value of the ranges listed above are included in each range. For example, “over 50 to 200” means up to and including 200kV.

This section has been adapted from Occupational Safety and Health Administration Cranes and Derricks in Construction; Final Rule - Federal Register/Vol. 75, No. 152/Monday, August 9, 2010, which is available from <https://www.govinfo.gov/content/pkg/FR-2010-08-09/pdf/2010-17818.pdf>.

Appendix C: Roles and responsibilities

Role	Definition	Responsibilities
Authorized Electrical Person	An individual who is competent in isolation of hazardous energy and capable of identifying potential electrical hazards. The person is given training, authority, and responsibility to perform specific assignments or tasks before being assigned to any electrical work. Examples of personnel who might be authorized electrical persons for specific assignments are electricians, mechanics, supervisors, operators, engineers, custodians, painters, etc. An authorized electrical person is not necessarily competent to perform the duties of a qualified electrical person.	<ul style="list-style-type: none"> • Knowledgeable about potential electrical hazards • Performs isolation of (electrical) hazardous energy • Understands the planned work and emergency notification procedures • Only performs electrical work within authorization scope (e.g., electricians vs. mechanics vs. operators, etc.) • Understands when to stop work
Electrical Standby Person	An electrically qualified or authorized person whose responsibilities are to observe the actions of a person performing a task, ensure his or her safety, assist if in danger, and to exercise stop work authority.	<ul style="list-style-type: none"> • Knowledgeable about potential electrical hazards • Performs isolation of (electrical) hazardous energy • Understands the planned work and emergency notification procedures • Observes the person performing electrical work and assist in emergency situations • Monitors aerial lifting equipment minimum clearance distance to energized overhead power lines or exposed electrical equipment. • Understands when to stop work
Qualified Electrical Person	An individual 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	<ul style="list-style-type: none"> • Knowledgeable about the construction and operation of electrical equipment and installations (e.g., certified electricians, etc.) • Conduct shock and arc flash hazard analyses • Review shock and arc flash hazard analyses

Role	Definition	Responsibilities
	<p>avoid the potential hazards involved.</p> <p>NOTE: A qualified electrical person's qualification is specific to certain equipment and tasks to be performed.</p>	<ul style="list-style-type: none"> • Tests for absence of voltage to ensure an electrical safe work condition • Barricades electrical work areas. • Performs isolation of (electrical) hazardous energy • Performs electrical work • Understands when to stop work
<p>High-Level Approver</p>	<p>An individual with the competency and authority to make a risk-based evaluation and determine whether proposed deviations from a CoW requirement and alternate controls adequately reduce risk and allow safe execution of work.</p> <p>WJO shall determine the appropriate organizational level of "high-level approvers" based upon the risk of the task, requirement, and/or deviation. For example, a Head Operator may not be the appropriate high-level approver for a lift over live critical process equipment.</p>	<ul style="list-style-type: none"> • Review and approve work for high-consequence work identified by BU leadership, or for work that requires deviations from safe work procedures

Appendix D: Terms and Definitions

Term	Definition
Arc Flash Boundary	When a potential 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. (Incident Energy equals 1.2 cal/cm ²)
Arc Flash Hazard	A dangerous condition associated with the possible release of energy cause 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 is not likely to pose an arc flash hazard. (See Requirement 2.)
Arc Flash Hazard Assessment	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 implementation of the appropriate risk control methods in accordance with the hierarchy of controls.
Arc Flash PPE Category	Is the designated protection level of the treated clothing as defined in NFPA 70E. There are four category ratings from, 1 to 4, and is the minimum required arc rating of arc flash protection clothing that must be worn to mitigate thermal burns resulting from the exposure to the estimated incident energy measured in cal/cm ² .
Arc Rating	The value attributed to materials that describe their performance to expose 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 breakopen threshold (EBT) (should a material system exhibit a breakopen response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value.
Barricade	A physical obstruction such as tapes, cones, frame-type wood or metal structures intended to provide a warning and to limit access.
Barrier	A physical obstruction that is intended to prevent contact with equipment or energized electrical conductors and circuit parts or to prevent unauthorized access to a work area.
De-energized	Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.
Ground or Grounding (Earthed or Earthing)	Providing an intentional connection to earth through an electrically conductive connection means of sufficiently low impedance and with sufficient current carrying capacity as to prevent voltage build-up that can create electrical hazard exposures to persons or damage connected electrical equipment.
Electric Diagnostic Testing	Work performed by qualified electrical person on energized conductors or circuit parts related to tasks such as testing, troubleshooting and voltage measuring.
Electrically Safe Work Condition	A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested for the absence of voltage, and temporarily grounded if determined necessary for personnel protection.
Electrical Work	Any task that involves an exposure to energized conductors or circuit parts greater than or equal to 50V that involves, or has the potential to created, a shock or arc flash hazard. Electrical work must be performed by a Qualified Electrical Worker (QEW).

Term	Definition
Energized Electrical Work Permit	A special permit process applied any time justified energized work is to be performed on or near electrical equipment that is in an energized state. May be a subset of the Permit to Work system and includes additional safety requirements and approvals.
Exposed	As applied to energized electrical conductors or circuit 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, insulated, or whose insulation is damaged or in questionable condition due to excessive heat (discoloration or cracking), signs of previous arcing, abrasions, or environmental stresses.
Hazardous (Classified) Location	An area that is classified as posing a potential fire or explosion hazard due to flammable gases or vapors, flammable liquids, combustible dust or ignitable fibers and flyings. This includes areas classified as a hazardous zone (i.e., Zone 0, 1 or 2) or division (i.e., Division 1 or 2) in accordance with the American Petroleum Institute Recommended Practices (API RP) 505/API RP 500.
Limited Approach Boundary	An approach limit at a distance from an exposed energized electrical conductor or circuit part within which an electric shock hazard exists.
Restricted Approach Boundary	An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of an electric shock, due to electrical arc fault combined with inadvertent movement.
Shock Hazard	A dangerous condition associated with the possible release of energy caused by contact or approach to energized conductors or circuit parts.

Appendix E: References

Internal References

CES ELS-SC-6206 Electrical Safe Work Practices Exception to NFPA 70E

External References

American Petroleum Institute (API)

Recommended Practice 500 Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2

Recommended Practice 505 Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, and Zone 2

Underwriters Laboratories, Inc. (UL)

UL 943 Ground-Fault Circuit-Interruption

American Ladder Institute (ALI)

ALI A14.1 Safety Requirements for Portable Wood Ladders

ALI A14.3 Safety Requirements for Fixed Ladders

ALI A14.4 Safety Requirements for Job-Made Ladders

ALI A14.5 Safety Requirement for Portable Reinforced Plastic Ladders

Code of Federal Regulations (CFR) of the United States

29 CFR Part 1926. 1408 Power line safety (up to 350 kV)—equipment operations

National Fire Protection Association (NFPA)

NFPA 70E Standard for Electrical Safety in the Workplace

NFPA 70 (NEC) NFPA 70 (NEC) National Electrical Code. Article 250.52, Grounding Electrodes