

Electrical Safety

A Purpose/Scope

This chapter specifies minimum requirements for the control of electrical energy and should be used in conjunction with Energy Isolation (Lockout/Tagout (LO/TO) and isolation) procedures.

B Acronyms and Definitions

Acronyms Table

Acronym	Definition
AC	Alternating Current
ASTM	American Society for Testing and Materials
DC	Direct Current
GFCI	Ground Fault Circuit Interrupter
GoM	Gulf of Mexico
NEC	National Electric Code
PPE	Personal Protective Equipment

Definitions Table

Term	Definition
Explosion Proof Apparatus	An apparatus enclosed in a case that is capable of withstanding an explosion of a gas or vapor that may occur within it and preventing the ignition of a gas or vapor surrounding the enclosure.
Grounding	A safe pathway for electricity to follow to the ground in the event of electrical leakage in circuits and/or equipment.
Intrinsically Safe Equipment	Equipment and wiring which is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture in its most easily ignited concentration.
Qualified Person	One familiar with the construction and operation of the equipment and the hazards involved and who is permitted to work on or near exposed energized parts.
Service Point	The point of connection between the facilities of the serving utility and the premises wiring.
Unqualified person	One who is working in the area of equipment with exposed energized parts but is not a qualified person.

C Overview

These Electrical Safety requirements apply to all operations involving work on or near an energized installation. Only qualified personnel may work on exposed electrical equipment.

D Procedures

D.1 Testing Equipment

Rated test equipment shall be checked before and after a test to confirm reliability. When working on motor control centers and high voltage switchgears, a non-contact voltage proximity meter with warning light indicator and audible alarm and that is rated for the voltage being tested is recommended.

D.2 Verification of Electrical Isolation When Performing Lockout/Tagout

When exposed parts are de-energized and locked and tagged out, only a qualified person shall be permitted to use test equipment on exposed circuit elements and electrical parts of equipment to verify complete de-energization. This test also determines if any energized condition exists due to inadvertently induced voltage or unrelated voltage backfeed.

D.3 De-Energizing Live Parts

Whenever possible and practical, live parts shall be de-energized and locked and tagged out before they can be worked on. Examples of impossibility or impracticability include the following situations:

- De-energizing would introduce additional or increased hazards (such as deactivation of emergency alarm systems, shutdown of hazardous location ventilation equipment, or removal of critical illumination from an area).
- It is not feasible due to equipment design or operational limitations (i.e., testing of electrical circuits that can only be performed when energized or working on circuits that form an integral part of a continuous industrial process that otherwise requires a complete shutdown in order to permit work on one circuit or piece of equipment).

If the exposed live parts are not de-energized, the following practices shall be used to protect exposed personnel:

- Only qualified persons may perform the work.
- Proper electrical PPE shall be worn.
- When overhead lines are involved, guarding, isolating, or insulating materials shall be used to protect the individual from direct body contact or indirect body contact via tools, equipment, and other conductive materials.
- Sufficient illumination shall be provided.
- When confined spaces such as manholes or vaults are involved, protective shields, barriers, or insulating materials shall be used to avoid inadvertent contact with energized parts.
- All doors, hinged panels, etc. shall be secured to prevent their swinging into personnel.

- Handle conducting materials in contact with the employee appropriately to prevent them from contacting energized parts.
- Use only portable ladders with nonconducting side rails (fiberglass).
- Conductive clothing or jewelry (i.e., watch bands, bracelets, rings, key chains, necklaces, metallic aprons, or metal headgear) shall not be worn.
- Conductive cleaning materials (i.e., steel wool, metallic cloth, silicon carbide, or any conductive liquid solutions) shall not be used in proximity to energized parts unless processes or procedures are put in place and followed to prevent contact with energized parts.

D.4 Circuit Breakers

Only load-rated switches, circuit breakers, or other devices specifically designed for the purpose of disconnecting energy sources may be used for opening, reversing, or closing circuits under load conditions.

After a circuit is automatically de-energized by a fuse or circuit breaker, it shall not be re-energized until the equipment and circuit have been identified as safe for energizing. Manual re-closing of circuit breakers or re-energizing circuits by replacing a fuse more than once is prohibited until the underlying problem is identified and corrected.

Bypassing protective devices or using a fuse or circuit breaker with a rating too high to protect the circuit or equipment involved is prohibited.

The following procedures shall be followed when working at electrical control panels:

- Proper PPE designed to provide thermal protection from arcing shall be worn (see Protective Equipment section in this chapter).
- Before touching an electrical control panel, check it with a voltage meter (contact or non-contact).
- Before operating switches or breakers, confirm all protective panels are closed and fastened.
- To disconnect the electrical power from the equipment, always move the control switch to the off position before moving the main switch to the off position.
- To connect the electrical power, always confirm all control switches are off before engaging the master switch.
- When operating the control or main switch, **NEVER STAND IN FRONT** of the electrical panel. Always stand to the side of the panel to operate the switch. Never look at the control panel. Should the panel explode, your eyes and body must not be in a direct line with the explosion.

D.5 Labeling of Electrical Systems

All components of electrical systems shall be legibly marked indicating voltage, source of power, and what the component feeds. The electrical distribution system (service, feeder, and branch

circuits) shall also be legibly marked and cross referenced between components to indicate their purposes. The markings shall be sufficiently durable to withstand the service environment.

The covers on pull and junction boxes over 600 volts shall be permanently marked 'High Voltage'.

Where doors are used for access voltage of 600 volts (AC or DC) or above, either door locks or interlocks shall be provided.

Use of switches, controllers, and circuit breakers shall be limited to those that can be mechanically locked out in the off position.

D.6 General Grounding

Confirm that the manufacturer's grounding recommendations are followed when installing or using any electrical equipment or devices.

The grounding conductor should be the first to be connected and the last to be disconnected.

D.6.a Equipment Inspection, Testing, and Ground Fault Circuit Interrupter (GFCI) Usage

Electrical equipment shall be protected by using either ground fault circuit interrupters (GFCI) or an assured grounding conductor program. Double insulated tools are not required to be grounded or tested.

All permanent 120-volt single-phase receptacles with a potential to be exposed to water must have a GFCI or be protected by a ground fault breaker.

GFCIs may be of the portable, receptacle, or circuit breaker type and shall be tested periodically (not to exceed three months) to confirm operability. Documentation of this test is not required.

CAUTION: When electrical equipment is used in potentially wet areas and connected to a circuit that does not have a GFCI incorporated, it shall be protected by a portable GFCI.

D.6.b Assured Equipment Grounding Conductor Inspection Program

Grounding conductors shall be tested periodically for electrical continuity. Tests shall be performed by the person responsible for maintaining the equipment as follows:

- Before first use.
- Before equipment is returned to service following any repairs.
- Before equipment is used after an incident that is suspected to have potentially caused damage to equipment, i.e., when a cord is run over.
- At intervals not to exceed three months.

Tests performed under the assured grounding conductor testing program shall be documented and kept on file at the applicable field or plant location. Test documentation shall identify each item of equipment tested and indicate the last date it was tested.

Equipment found to be defective shall immediately be tagged out of service and not used until repaired.

D.7 Portable Electrical Equipment

Follow the guidelines below for portable electrical equipment:

- Portable equipment shall be properly handled to avoid damage to the equipment. Electrical cords shall not:
 - Be used for raising or lowering equipment.
 - Be fastened by staples.
 - Be hung in a manner which could cause damage to the outer insulation.
- Extension cords and equipment cords shall be visually inspected before use for damage (loose parts, deformed or missing pins, damage to the outer cover or insulation, or pinched/crushed outer jacket). All defective or damaged cords and equipment shall be removed from service and tagged out immediately. They shall not be used until repaired and tested.
- Grounding type cords shall be used with grounding type equipment. Receptacles and plugs may not be altered such that proper continuity cannot be achieved. Adapters cannot be used that defeat the grounding connection of equipment.
- In areas with potential exposure to conductive liquids, only equipment and cords approved for use in wet locations shall be used.
- Hands shall be dry when plugging or unplugging energized equipment. If energized plugs or receptacles are wet or could otherwise provide a conducting path, only insulating protective equipment shall be used for handling the connection devices.
- Locking type connectors shall be properly locked after connection.

D.8 Personal Safety Measures

WARNING: Do NOT perform any work that you are not trained and qualified to undertake.

Hands, shoes, and clothing shall be dry when any energized electrical equipment is handled. Jewelry shall be removed prior to working on energized electrical equipment.

All protective equipment shall be inspected before each task.

When it is necessary to work on an energized circuit, always use approved rubber gloves and stand on a rubber mat. Rubber insulating blankets and other insulating materials appropriate

for the voltage involved must adequately cover the conductors in the work area. **Never depend on insulated tools as a first line of protection to prevent electrocution.**

Do not touch the metal frame of a case if it is ungrounded and you are in contact with the ground or a grounded object.

Tag, mark, and post suitable signs to warn other workers of possible dangers involved in the work.

Barricades and barriers shall be used in accordance with the chapter entitled Barricades and Barriers.

D.9 Protective Equipment

Thermal protection from electrical arc flash must be used when qualified persons are working on live overhead transmission lines or other exposed live energy sources of 480 volts or greater.

An electrical flash suit made of 10 ounce, 50 percent Nomex/50 percent Kevlar brand fabric equipped with hood and polycarbonate view plate shall be worn even if other electrical protective equipment, such as rubber insulating aprons and leather gloves, are worn. The flash suit must conform to current NFPA standards.

Only rubber insulating protective equipment, such as insulating blankets, matting, covers, line hoses, gloves, and sleeves, that are manufactured and tested per the specifications in the applicable American Society for Testing and Materials (ASTM) standard shall be used.

Refer to OSHA Standard [29 CFR 1910.137](#) for additional guidance.

D.9.a Requirements for In-Service Care and Use of Rubber Insulating Equipment

Electrical protective equipment shall be maintained in a safe, reliable condition through proper usage, inspections, cleaning, storage, and testing. Insulating equipment shall be inspected for damage before each day's use and after any incident that may have caused damage. These inspections do not require documentation.

Insulating equipment shall not be used on voltages higher than those listed in their design or manufacturer's specifications.

Rubber insulating gloves shall be air tested. A visual inspection alone will not reveal 'pin hole' defects in gloves. Even a 'pin hole' will allow current to pass through the glove and cause electrical injury. The cuff of the rubber glove shall be rolled to create an airtight seal during inflation of the glove. If the glove deflates or will not hold air, it shall be destroyed.

Leather gloves properly matched with rubber insulating gloves shall be worn to:

- Provide abrasion resistance.
- Provide puncture resistance.
- Prevent arcing to skin.

Insulating equipment containing any defect or excessive wear that would degrade the insulating properties shall not be used and shall be destroyed.

The insulating equipment shall be kept properly cleaned of foreign substances. The insulating equipment shall be stored to protect it from light, temperature extremes, excessive humidity, ozone, and other damaging conditions.

Electrical protective equipment shall be electrically tested per the intervals described below, in accordance with the requirements of the applicable ASTM standard. Insulating equipment failing to pass inspections or electrical tests shall not be used and shall be destroyed, unless repaired in accordance with manufacturer specifications. Repaired equipment shall be electrically re-tested before use.

Refer to OSHA standard [29 CFR 1910.137](#) for applicable ASTM standards.

D.9.b Rubber Insulating Equipment Test Intervals

Test Interval Table

Rubber Insulating Equipment	Test Interval
Rubber insulating line hose	Test every 12 months and following any incident that can reasonably be suspected of causing damage.
Rubber insulating covers	Test every 12 months and following any incident that can reasonably be suspected of causing damage.
Rubber insulating blankets	Test before first issue and every 12 months thereafter*
Rubber insulating gloves	Test before first issue and every 6 months thereafter*
Rubber insulating sleeves	Test before first issue and every 12 months thereafter*

OSHA standard [29 CFR 1910.137](#) (Electrical Protective Devices) stipulates the requirements for periodic testing of personal protective equipment.

***CAUTION:** If the insulating equipment has been electrically tested but not issued for service, it shall not be placed into service unless it has been electrically tested within the previous 6 months for rubber insulating gloves and 12 months for rubber insulating sleeves.

Certification that the equipment has been tested per these requirements shall be maintained at the site for the life of the equipment. To provide the required certification of the electrical tests, invoices or the equivalent identifying the equipment and the test date or purchase date, shall be maintained.

D.9.c Restrictions on Personal Equipment

Only non-conductive hard hats (ANSI Z87 Class E) shall be allowed for use where there is a potential for injury from electric shock or burns due to contact with energized parts.

Only insulated tools or handling equipment shall be used when working near energized equipment if the tools or equipment might come in contact with the parts. The insulating materials of the tools shall be protected against damage and rated for the voltage that may be encountered.

- Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the terminals are energized.
- Ropes and hand lines used near exposed energized parts shall be non-conductive and kept clean.
- Protective shields, barriers, or insulating materials shall be used to protect personnel from shock, burns, or other electrical injuries while the worker is working near energized parts that may be accidentally contacted. This includes guarding the exposed energized parts from access by unauthorized personnel.

D.10 Overhead Lines

When an unqualified person is working in the vicinity of an overhead line, the person, and any object the person is in contact with which could contact the overhead line, shall not come closer to the overhead line than:

- For voltages to ground 50kv or below — 10 ft.
- For voltages to ground over 50kv — 10 ft. plus 4 in. for every 10kv over 50kv.

CAUTION: For voltages encountered with overhead power lines, objects that do not have an insulating rating for the voltage involved are considered conductive.

Guidance for qualified persons can be found in [29 CFR 1910.333\(c\)\(2\)](#).

Any vehicle or mechanical equipment capable of having structure parts elevated near energized overhead lines of 50kv or less shall be operated so that a clearance of 10 ft. is maintained. If the voltage is greater than 50kv, the clearance shall be increased 4 in. for every 10kv.

Conditions that may reduce these clearance requirements can be found in [29 CFR 1910.333\(c\)\(3\)](#).

D.11 Classified Areas

In Class 1 Areas, only intrinsically safe or explosion-proof equipment shall be approved for use. Refer to NEC and API RP 500B for further guidance on Area Classifications. If the electrical equipment is not Class 1 rated, a hot work permit shall first be obtained.

NOTE: Hazardous areas most likely encountered at BP AE locations will be designated according to the following classes:

- Class I, Division 1 is designated as a location where:
 - Ignitable concentrations of flammable gases or vapors exist under normal operating conditions.
 - Ignitable concentrations of gases may exist frequently due to repairs, maintenance, or leakage.
 - Breakdowns or malfunctioning equipment or processes might release ignitable concentrations of flammable gases or vapors, and might also cause simultaneous failure of electrical equipment.
- Class I, Division 2 is designated as a location where:
 - Volatile flammable liquids or vapors are handled, processed or used and are normally confined within closed containers or systems.
 - Ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation and which may become hazardous if this ventilation failed.
 - The location is adjacent to a Class 1, Division 1 location which might communicate ignitable concentrations of flammable gases or vapors unless prevented, by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

Hazard classed areas are also organized into groups. The group most inherent to BP AE operations is Group D (hydrocarbons, fuels, and solvents), which includes flammable liquids, vapors, and gases (hydrocarbons, fuels, and solvents).

Equipment installed in classified areas shall be legibly marked by the manufacturer or the testing agency, indicating in what areas it is approved for use.

E Key Documents

[NFPA Standards 70 E](#)- Standard for Electrical Safety in the Workplace

OSHA standard [29 CFR 1910.137](#) – Electrical Protective Devices

OSHA [29 CFR 1910.333](#) – Selection and Use of Work Practices

OSHA [1910 Subpart S](#) – Electrical

OSHA [1926 Subpart V](#) – Power Transmission and Distribution

OSHA [1910.137](#) -- Electrical Protective Devices

OSHA [1926](#) – Safety and Health Regulations for Construction

OSHA [1910](#) – Occupational Safety and Health Standards

A copy of this chapter can be found online at the official BP AE HSSE SharePoint.