

	<h1>ELECTRICAL SAFETY</h1>	Doc No:	5101 - 5022
		Issue Date:	19 Jun 2023
		Revision Date	N/A
		Revision:	0
<i>SAFETY OPERATING PROCEDURE (SOP)</i>		Page 1 of 26	
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1.0 PURPOSE

- 1.1 To establish safe practices and procedures in order to protect employees from the hazards of electrical work appropriate for the voltage, energy level and circuit conditions. This procedure outlines protective measures to reduce the potential for injury from electric shock and arc flash which are the two greatest concerns when working with electricity.

2.0 DEFINITIONS

- **Arc Flash:** phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. The results are often violent and when a human is in close proximity to the arc flash, serious injury and even death can occur.
- **Arc Blast Hazard:** source of possible injury or damage to health from the energy deposited into acoustical shock wave and high-velocity shrapnel.
- **Arc Flash Hazard:** source of possible injury or damage to health associated with the release of energy caused by an electric arc.
- **Arc Flash Suit:** complete arc-rated clothing and equipment system that covers the entire body, except for the hands and feet.
- **Arc Flash Boundary:** when an arc flash hazard exists, an approach limit from an arc source at which incident energy equals 1.2 cal/cm^2 (5J/cm^2). Second degree burns are likely to occur on unprotected skin exposed to 1.2 cal/cm^2 (5J/cm^2) for one second. Any body part inside this boundary shall be protected by proper arc flash protection PPE.
- **Arc Rating:** value attributed to materials that describes their performance to exposure to an electrical arc charge.
- **Arc-Resistant Equipment:** equipment designed to withstand the effects of an internal arcing fault and that directs the internally released energy away from the employee.
- **Barricade:** physical obstruction such as tapes, cones, or A-frame type wood or metal structures intended to provide a warning and limit access.
- **Barrier:** physical obstruction that is intended to prevent contact with equipment or energized electrical conductors and circuit parts.
- **Bonded:** connected to establish electrical continuity and conductivity.
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- **Circuit Breaker:** device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.
- **Competent Person:** meets all the requirements of a qualified person, and who, in addition, is responsible for all work activities or safety procedures related to custom or special equipment and has detailed knowledge regarding the exposure to electrical hazards, the appropriate control methods to reduce the risk associated with those hazards, and the implementation of those methods.
- **De-Energized:** free from any electrical connection to a source of potential difference and from electrical charge; not having a potential difference from that of the earth.
- **Electrical Safety:** identifying hazards associated with the use of electrical energy and taking precautions to reduce the risk associated with those hazards.
- **Electrically Safe Work Condition (ESWC):** state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged out in accordance with established standards, tested for the absence of energy, and, if necessary, temporarily grounded for personnel protection.
- **Energized:** electronically connected to, or is, a source of voltage.
- **Fuse:** over-current protective device with a circuit-opening fusible part that heated and severed by the passage of over-current through it.
- **Ground-Fault Circuit Interrupter (GFCI):** device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device.
- **Hearing Protection Boundary:** distance at which a 1% probability of ear damage exists from a 20 kPa (3.0 psi) shock wave as result of arc flash/blast.
- **Limited Approach Boundary:** approach limit at a distance from an exposed energized electrical conductor or circuit part within which an electric shock hazard exists.
- **Lung Protection Boundary:** distance at which a 1% probability of lung damage exists from a 70 kPa (10 psi) shock wave as result of arc flash/blast.

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- **Overcurrent:** any current in excess of the rated current of equipment or the ampacity of a conductor which may result from an overload, short circuit, or ground fault.
- **Protective Barrier:** prevents users from access to hazardous voltage, current, or stored energy areas.
- **Qualified Person:** has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risks.
- **Raceway:** enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables, or busbars with additional functions as permitted in this procedure.
- **Restricted Approach Boundary:** 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.
- **Risk Assessment:** process that identifies hazards, estimates the likelihood of occurrence of injury or damage to health, estimates the potential severity of injury or damage to health, and determines if protective measures are required.
- **Safeguarding:** consistent administrative enforcement of safe work practices.
- **Shock Protection Boundaries:** limited approach and restricted approach two imaginary boundaries around an exposed energized electrical conductor or circuit part to define approach limits to avoid electric shock:
- **Unqualified Person:** person who is not a *qualified* person.

3.0 RESPONSIBILITIES

3.1 Directors/Managers/Supervisors:

- 3.1.1 Shall ensure all applicable employees are trained on this procedure and that they use appropriate Personal Protective Equipment (PPE) when performing electrical work as well as promote safe work practices.

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3.2 Employees:

- 3.2.1 All employees shall be aware of the potential hazards of electricity. Qualified personnel will comply with this procedure when performing electrical work. Personnel unqualified in electrical work, such as trainees and management personnel, should be familiar with this procedure and be watchful for and avoid potential electrical hazards in their work areas.

4.0 ELECTRICALLY SAFE WORK CONDITION (ESWC)

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

- 4.1.1 Employee is within the limited approach boundary.
- 4.1.2 Employee interacts with equipment where conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash exists.

4.2 Verification of ESWC

- 4.2.1 Establishing and verifying and ESWC shall include all of the following steps, which shall be performed in the order presented:
 - 4.2.1.1 Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams and identification tags.
 - 4.2.1.2 After properly interrupting the load current, open the disconnecting device(s) for each source.
 - 4.2.1.3 Whenever possible, visually verify that all blades of the disconnecting devices are fully open or that draw-type circuit breakers are withdrawn to the test or fully disconnected position.
 - 4.2.1.4 Release stored electrical energy.
 - 4.2.1.5 Block or relieve stored nonelectrical energy in devices to the extent the circuit parts cannot be unintentionally energized by such devices.

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4.2.1.6 Apply LO/TO in accordance with SOP 5101-5018 *Control of Hazardous Energy - LO/TO*.

4.2.1.7 Use an adequately rated portable test instrument to test each phase conductor or circuit part at each point of work to test for the absence of voltage. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the instrument is operating satisfactorily through verification on any known source voltage.

4.2.1.8 Where the possibility of induced voltages or stored electrical energy exists, ground all circuit conductors and circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply temporary protective grounding equipment in accordance with the following:

4.2.1.8.1 Placement:

4.2.1.8.1.1 Temporary protective grounding equipment shall be in place at such locations and be arranged in such a manner as to prevent each employee from being exposed to an electric shock hazard. The location, sizing, and application of temporary protective grounding equipment shall be identified as part of the job planning.

4.2.1.8.2 Capacity:

4.2.1.8.2.1 Temporary protective grounding equipment shall be capable of conducting the maximum fault current that could flow at the point of grounding for the time necessary to clear the fault.

4.2.1.8.3 Impedance:

4.2.1.8.3.1 Temporary protective grounding equipment and connections shall have an impedance low enough to cause immediate operation of protective

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devices in case of unintentional energizing of the electric conductors or circuit parts.

5.0 EXTENSION CORDS & GFCI's

5.1 Extension Cords

- 5.1.1 Shall only be used for short-term electrical needs and not in lieu of permanent wiring.
- 5.1.2 Cords with 3-pin connections shall be used when operating equipment or tools with the same 3-pin power cord.
- 5.1.3 Shall not be altered or modified from the original manufacturers design. Cords shall be used in accordance with the manufacturer's instructions and safety warnings.
- 5.1.4 Adapters that interrupt the continuity of the equipment grounding conductor shall not be used.
- 5.1.5 Shall be inspected prior to use and defective cords shall be removed from service and replaced.
- 5.1.6 When using in conductive or wet environments, a GFCI shall be used.

5.2 Ground-Fault Circuit Interrupter (GFCI)

- 5.2.1 GFCI's shall be used when an employee is operating or using extension cords or cord-and plug-connected tools related to maintenance and construction activity supplied by 120-volt, 15-, 20-, or 30-ampere circuits.
- 5.2.2 When operating or using extension cords or cord-and plug-connected tools supplied by greater than 120-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.
- 5.2.3 Outdoors
 - 5.2.3.1 GFCI's shall be used when an employee is outdoors and operating or using extension cords or cord-and plug-connected tools supplied by 120-volt, 15-, 20-, or 30-ampere circuits.

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5.2.3.2 When employees working outdoors operate or use extension cords or cord-and plug-connected tools supplied by greater than 120-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

6.0 LOCKOUT/TAGOUT (LO/TO)

6.1.1 Refer to SOP 5101-5018 *Control of Hazardous Energy - LO/TO* for safeguarding employees from electrical hazards.

7.0 ENERGIZED ELECTRICAL WORK

7.1 This section covers the requirements for work involving electrical hazards such as the electrical safety-related work practices, assessments, precautions, and procedures for when an electrically safe work condition cannot be established.

7.2 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.

7.3 When energized electrical conductors and circuit parts operating at voltages equal to or greater than 50 volts, are not put into an electrically safe work condition, the following requirements shall apply:

7.3.1 Only qualified persons shall be permitted to work on electrical conductors or circuit parts that have not been put into an electrically safe work condition.

7.3.2 An energized electrical work permit shall be completed.

7.3.3 An electric shock risk assessment shall be performed.

7.3.4 An arc flash risk assessment shall be performed.

7.4 Energized Electrical Work Permit

7.4.1 When work is performed in accordance with section 9.0 of the procedure, an energized electrical work permit shall be required and documented under any of the following conditions:

7.4.1.1 When work is performed within the Restricted Approach Boundary.

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7.4.1.2 When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.

7.4.2 Energized Electrical Work Permit Exemptions

7.4.2.1 Electrical work shall be permitted without an energized electrical work permit if a qualified person is provided with and uses appropriate safe work practices and PPE, under any of the following conditions:

7.4.2.1.1 Testing, troubleshooting, or measuring voltage.

7.4.2.1.2 Thermography, ultrasound, or visual inspections if the restricted approach boundary is not crossed.

7.4.2.1.3 Access to and egress from an area with energized electrical equipment, if no electrical work is performed and the restricted approach boundary is not crossed.

7.4.2.1.4 General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed.

7.5 Electric Shock Risk Assessment

7.5.1 An electric shock risk assessment shall be performed:

7.5.1.1 To identify electric shock hazards.

7.5.1.2 To estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health.

7.5.1.3 To determine if additional protective measures are required.

7.5.1.4 The results of the electrical shock risk assessment shall be documented.

7.6 Arc Flash Risk Assessment

7.6.1 An arc flash risk assessment shall be performed:

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- 7.6.1.1 To identify arc flash hazards.
- 7.6.1.2 To estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health.
- 7.6.1.3 To determine if additional protective measures are required, including the use of PPE.

8.0 ELECTRICAL SHOCK PROTECTION BOUNDARIES

8.1 Electrical shock boundaries are applicable when personnel are approaching exposed energized electrical conductors or circuit parts.

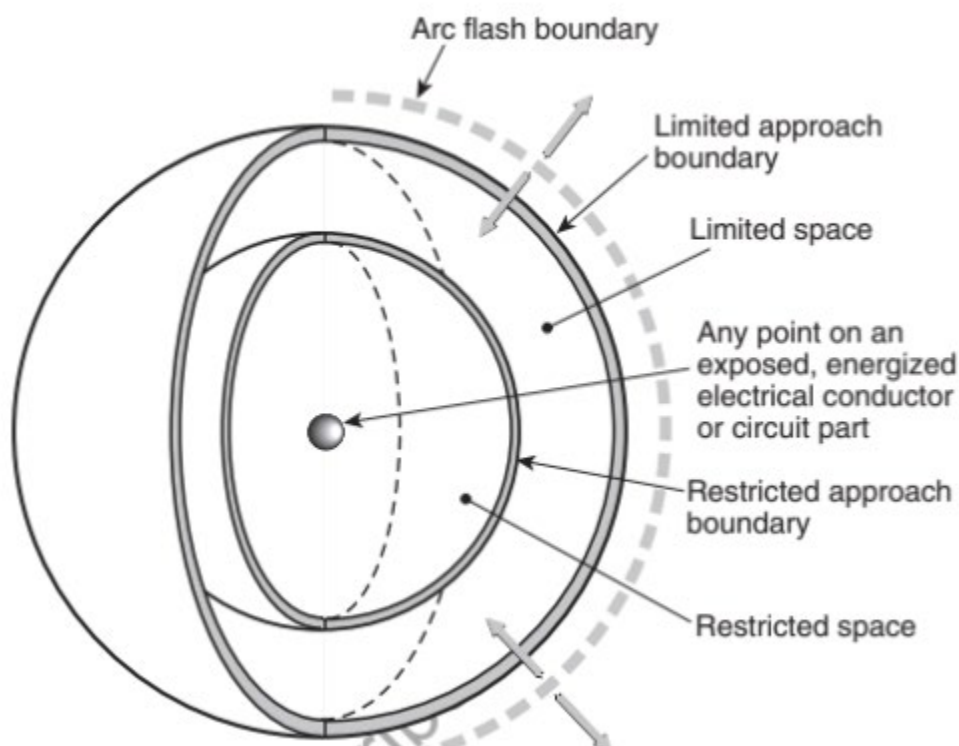


FIGURE 8.1 APPROACH LIMITS

8.2 There are 2-types of electrical shock protection boundaries: limited approach and restricted approach.

8.2.1 Limited Approach Boundary

8.2.1.1 Unqualified Persons:

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8.2.1.1.1 Unqualified persons shall not be permitted any closer to exposed energized electrical conductors or circuit parts than the limited approach boundary.

(1)	(2)	(3)	(4)
Nominal System Voltage Range, Phase to Phase ^a	Limited Approach Boundary ^b		Restricted Approach Boundary ^{b,d} ; Includes Inadvertent Movement Adder
	Exposed Movable Conductor ^c	Exposed Fixed Circuit Part	
Less than 50 V	Not specified	Not specified	Not specified
50 V–150 V ^e	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact
151 V–750 V	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.31 m (1 ft 0 in.)
751 V–5 kV	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.63 m (2 ft 1 in.)
5.1 kV–15 kV	3.1 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.65 m (2 ft 2 in.)
15.1 kV–36 kV	3.1 m (10 ft 0 in.)	1.8 m (6 ft 0 in.)	0.77 m (2 ft 7 in.)
36.1 kV–46 kV	3.1 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	0.84 m (2 ft 10 in.)
46.1 kV–72.5 kV	3.1 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 4 in.)
72.6 kV–121 kV	3.3 m (10 ft 8 in.)	2.5 m (8 ft 0 in.)	1.2 m (3 ft 9 in.)
121.1 kV–145 kV	3.4 m (11 ft 0 in.)	3.1 m (10 ft 0 in.)	1.3 m (4 ft 4 in.)
145.1 kV–169 kV	3.6 m (11 ft 8 in.)	3.6 m (11 ft 8 in.)	1.5 m (4 ft 10 in.)
169.1 kV–242 kV	4.0 m (13 ft 0 in.)	4.0 m (13 ft 0 in.)	2.1 m (6 ft 8 in.)
242.1 kV–362 kV	4.7 m (15 ft 4 in.)	4.7 m (15 ft 4 in.)	3.5 m (11 ft 2 in.)
362.1 kV–420 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	4.3 m (14 ft 0 in.)
420.1 kV–550 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	5.1 m (16 ft 8 in.)
550.1 kV–800 kV	7.2 m (23 ft 9 in.)	7.2 m (23 ft 9 in.)	6.9 m (22 ft 7 in.)

FIGURE 8.1: ELECTRICAL SHOCK PROTECTION BOUNDARIES FOR ALTERNATING-CURRENT (AC) SYSTEMS

(1)	(2)	(3)	(4) ^b
Nominal Potential Difference	Limited Approach Boundary		Restricted Approach Boundary; Includes Inadvertent Movement Adder
	Exposed Movable Conductor ^a	Exposed Fixed Circuit Part	
Less than 50 V	Not specified	Not specified	Not specified
50 V–300 V	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact
301 V–1 kV	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.3 m (1 ft 0 in.)
1.1 kV–5 kV	3.1 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.5 m (1 ft 5 in.)
5.1 kV–15 kV	3.1 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.7 m (2 ft 2 in.)
15.1 kV–45 kV	3.1 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	0.8 m (2 ft 9 in.)
45.1 kV– 75 kV	3.1 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 6 in.)
75.1 kV–150 kV	3.3 m (10 ft 8 in.)	3.1 m (10 ft 0 in.)	1.2 m (3 ft 10 in.)
150.1 kV–250 kV	3.6 m (11 ft 8 in.)	3.6 m (11 ft 8 in.)	1.6 m (5 ft 3 in.)
250.1 kV–500 kV	6.0 m (20 ft 0 in.)	6.0 m (20 ft 0 in.)	3.5 m (11 ft 6 in.)
500.1 kV–800 kV	8.0 m (26 ft 0 in.)	8.0 m (26 ft 0 in.)	5.0 m (16 ft 5 in.)

FIGURE 8.2: ELECTRICAL SHOCK PROTECTION BOUNDARIES FOR DIRECT-CURRENT (DC) SYSTEMS

8.2.1.2 Working at or Close to the Limited Approach Boundary

8.2.1.2.1 When one or more unqualified persons are working at or close to the limited approach boundary the following alerting methods shall be applied to warn the unqualified person(s) of

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electrical hazards and to stay outside the limited approach boundary:

8.2.1.2.1.1 Safety Signs & Tags:

8.2.1.2.1.1.1 Safety signs, safety symbols or tags shall be used to warn employees about electrical hazards that may endanger them. Such signs shall meet the requirements of applicable state, federal or local codes and standards.

8.2.1.2.1.2 Barricades:

8.2.1.2.1.2.1 Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas containing energized electrical conductors or circuit parts. Electrically conductive barricades shall not be used where they might increase the likelihood of exposure to an electrical hazard. Barricades shall not be placed no closer than the limited approach boundary tables listed in section 10.2.1.1.1. In instances where the arc flash boundary is greater than the limited approach boundary, barricades shall not be placed closer than the arc flash boundary.

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8.2.1.2.1.3 Attendants:

8.2.1.2.1.3.1 If signs or barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees. The primary duty and responsibility of an attendant providing manual signaling and alerting shall be to keep unqualified employees outside a work area where the unqualified employee might be exposed to electrical hazards. An attendant shall remain in the area as long as there is a potential for employees to be exposed to electrical hazards.

8.2.2 Restricted Approach Boundary

8.2.2.1 No qualified persons shall approach or take any conductive object closer to exposed energized electrical conductors or circuit parts than the restricted approach boundary listed in section 10.2.1.1.1 unless one of the following conditions applies:

8.2.2.1.1 The qualified person is insulated or guarded from energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves and sleeves are considered insulating only with regard to the energized parts upon which work is performed.

8.2.2.1.2 The energized electrical conductors or circuit parts are insulated from the qualified person and from any other conductive object at a different potential.

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9.0 ARC FLASH PROTECTION BOUNDARY

9.1 The arc flash boundary shall be the distance at which the incident energy equals 1.2 cal/cm^2 (5 J/cm^2).

9.2 The arc flash boundary shall be determined using the following tables:

Equipment	Arc Flash PPE Category	Arc Flash Boundary
Panelboards or other equipment rated 240 volts and below Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	1	485 mm (19 in.)
Panelboards or other equipment rated greater than 240 volts and up to 600 volts Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	900 mm (3 ft)
600-volt class motor control centers (MCCs) Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	1.5 m (5 ft)
600-volt class motor control centers (MCCs) Parameters: Maximum of 42 kA available fault current; maximum of 0.33 sec (20 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	4.3 m (14 ft)
600-volt class switchgear (with power circuit breakers or fused switches) and 600-volt class switchboards Parameters: Maximum of 35 kA available fault current; maximum of up to 0.5 sec (30 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	6 m (20 ft)
Other 600-volt class (277 volts through 600 volts, nominal) equipment Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	1.5 m (5 ft)
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Metal-clad switchgear, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Metal enclosed interrupter switchgear, fused or unfused type construction, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Other equipment 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Arc-resistant equipment up to 600-volt class Parameters: DOORS CLOSED and SECURED; with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment*	N/A	N/A
Arc-resistant equipment 1 kV through 15 kV Parameters: DOORS CLOSED and SECURED; with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment*	N/A	N/A

FIGURE 9.1: ARC FLASH BOUNDARY DISTANCES & PPE REQUIREMENTS FOR ALTERNATING-CURRENT (AC) SYSTEMS

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Equipment	Arc Flash PPE Category	Arc Flash Boundary
Storage batteries, dc switchboards, and other dc supply sources Parameters: Greater than 150 volts and less than or equal to 600 volts Maximum arc duration and minimum working distance: 2 sec @ 455 mm (18 in.)		
Available fault current less than 1.5 kA	2	900 mm (3 ft)
Available fault current greater than or equal to 1.5 kA and less than 3 kA	2	1.2 m (4 ft)
Available fault current greater than or equal to 3 kA and less than 7 kA	3	1.8 m (6 ft.)
Available fault current greater than or equal to 7 kA and less than 10 kA	4	2.5 m (8 ft)

FIGURE 9.2: ARC FLASH BOUNDARY DISTANCES & PPE REQUIREMENTS FOR DIRECT-CURRENT (DC) SYSTEM

9.3 Arc Flash PPE:

9.3.1 One of the following methods shall be used for selection for selection of arc flash PPE:

9.3.1.1 Incident Energy Analysis Method in accordance with the following table:

<p>Incident energy exposures equal to 1.2 cal/cm² up to and including 12 cal/cm² Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy^a Arc-rated long-sleeve shirt and pants or arc-rated coverall or arc flash suit (SR) Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR)^b Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner, high-visibility apparel) (AN)^c Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with protectors (SR)^c Hard hat Safety glasses or safety goggles (SR) Hearing protection Leather footwear^d</p> <p>Incident energy exposures greater than 12 cal/cm² Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy^a Arc-rated long-sleeve shirt and pants or arc-rated coverall or arc flash suit (SR) Arc-rated arc flash suit hood Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner, high-visibility apparel) (AN)^c Arc-rated gloves or rubber insulating gloves with protectors (SR)^c Hard hat Safety glasses or safety goggles (SR) Hearing protection Leather footwear^d</p>
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FIGURE 9.3: PPE SELECTION USING THE INCIDENT ENERGY ANALYSIS METHOD

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9.3.1.2 Arc Flash PPE Category Method in accordance with the following table:

Arc-Flash PPE Category	PPE
1	<p>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (16.75 J/cm²)^a Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated face shield^b or arc flash suit hood Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)^g Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with protectors (SR)^d Leather footwear^e (AN)</p>
2	<p>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (33.5 J/cm²)^a Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated flash suit hood or arc-rated face shield^b and arc-rated balaclava Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)^g Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with protectors (SR)^d Leather footwear^e</p>
3	<p>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (104.7 J/cm²)^a Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves or rubber insulating gloves with protectors (SR)^d Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)^g Leather footwear^e</p>
4	<p>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (167.5 J/cm²)^a Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves or rubber insulating gloves with protectors (SR)^d Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)^g Leather footwear^e</p>

FIGURE 9.4.:3 PPE SELECTION USING THE ARC FLASH PPE CATEGORY METHOD

9.3.2 Either, but not both, methods shall be permitted to be used on the same piece of equipment. The results of an incident energy analysis shall not be used to specify and arc flash PPE category.

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10.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

10.1 Employees exposed to electrical hazards when the risk associated with that hazard is not adequately reduced by the by the applicable electrical installation requirements, shall be provided with and shall use protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

10.2 Care & Maintenance

10.2.1 PPE shall be maintained in a safe, clean, and reliable condition and in accordance with the manufacturer's instructions. A visual inspection shall be performed prior to each use. PPE shall be stored in a manner to prevent damage from physical conditions, moisture, dust, or other deteriorating agents.

10.3 Movement & Visibility

10.3.1 When arc rated PPE is worn, it shall cover all ignitable clothing and shall allow for movement and visibility.

10.4 Head, Face, Neck, and Chin Protection

10.4.1 Employees shall wear non-conductive head protection whenever there is a danger of head injury from electric shock or burns due to contact with energized electrical conductors or circuit parts or from flying objects resulting from electrical explosion. Employees shall wear non-conductive PPE for the face, neck, and chin whenever there is danger of injury from exposure to electric arcs or flashes or from flying objects resulting from electrical explosion. If employees use hairnets or beard nets, or both, these items shall be arc rated.

10.5 Eye Protection

10.5.1 Employees shall wear protective equipment for the eyes whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

10.6 Hearing Protection

10.6.1 Employees inside the arc flash boundary shall wear hearing protection.

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10.7 Body Protection

10.7.1 Employees shall wear arc-rated clothing whenever there is possible exposure to an arc flash above the threshold incident energy level for a second degree burn [1.2 cal/cm² (5j/cm²)].

10.8 Hand & Arm Protection

10.8.1 Electric Shock Protection

10.8.1.1 Employees shall wear rubber insulating gloves with protectors, where there is a danger of hand injury from electric shock due to contact with exposed energized electrical conductors or circuit parts. Employees shall wear rubber insulating gloves with protectors and rubber insulating sleeves where there is a danger of hand and arm injury from electric shock due to contact with exposed energized electrical conductors or circuit parts. Rubber insulating gloves shall be rated for the voltage for which they will be exposed to.

10.8.1.2 Rubber insulating gloves shall be permitted to be used without protectors under the following conditions:

10.8.1.2.1 There shall be no activity performed that risks cutting or damaging the glove.

10.8.1.2.2 Rubber insulating gloves shall be electrically retested before reuse.

10.8.1.2.3 Voltage rating of the rubber insulating gloves shall be reduced by 50% for class 00 and by one whole class for classes 0 through 4.

Class Designation of Glove or Sleeve	Maximum ac Use Voltage rms, volts	Maximum dc Use Voltage avg, volts	Distances Between Protector Cuff and Rubber Insulating Glove Cuff, minimum
00	500	750	13 mm (0.5 in.)
0	1,000	1,500	13 mm (0.5 in.)
1	7,500	11,250	25 mm (1 in.)
2	17,000	25,500	51 mm (2 in.)
3	26,500	39,750	76 mm (3 in.)
4	36,000	54,000	102 mm (4 in.)

FIGURE 10.1: MAXIMUM USE VOLTAGE FOR RUBBER INSULATING GLOVES

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10.8.2 Arc Flash Protection

10.8.2.1 Hand and arm protection shall be worn where there is a possible exposure to arc flash burns.

10.8.2.1.1 Hand Protection:

10.8.2.1.1.1 Heavy-duty leather gloves or arc-rated gloves shall be worn when required for arc flash protection.

10.8.2.1.1.2 Where insulating rubber gloves are used for electric shock protection, protectors shall be worn over the rubber gloves.

10.8.2.1.2 Arm Protection:

10.8.2.1.2.1 Employees shall wear arc-rated clothing whenever there is possible exposure to an arc flash above the threshold incident energy level for a second degree burn [1.2 cal/cm^2 (5j/cm^2)].

10.8.3 Maintenance & Use

10.8.3.1 Electrical protective equipment shall be maintained in a safe and reliable condition. Insulating equipment shall be inspected for damage before each day's use and immediately following an incident that can reasonably be suspected of having caused damage. In addition, insulating gloves shall be given an air test to inspect for holes as part of the pre-use inspection.

10.8.3.2 Maximum use voltages for rubber gloves shall not exceed those listed in figure 10.1.

10.8.3.3 The top of the cuff of the protector glove shall be shorter than the rolled top of the cuff of the insulating glove by at least the distance specified in figure 10.1.

10.8.4 Periodic Electrical Testing

10.8.4.1 Rubber insulating equipment shall be subjected to periodic electrical tests. Test voltages shall be in accordance with the

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applicable state, federal, or local codes and standards. The maximum intervals between testing shall not exceed those specified in table 11.8.4.

Rubber Insulating Equipment	When to Test
Blankets	Before first issue; every 12 months thereafter*
Covers	If insulating value is suspect
Gloves	Before first issue; every 6 months thereafter*
Line hose	If insulating value is suspect
Sleeves	Before first issue; every 12 months thereafter*
*New insulating equipment is not permitted to be placed into service unless it has been electrically tested within the previous 12 months. Insulating equipment that has been issued for service is not new and is required to be retested in accordance with the intervals in this table.	

FIGURE 10.2: MAXIMUM TEST INTERVALS FOR RUBBER INSULATING EQUIPMENT

10.9 Foot Protection

10.9.1 Where insulated footwear is used as protection against step and touch potential, dielectric footwear shall be required. Insulated soles shall not be used as the primary electrical protection.

10.10 For more in-depth information in relation to PPE for electrical hazard protection see NFPA 70E.

11.0 TRAINING

11.1 The training requirements listed in this procedure shall apply to all Okaloosa County employees exposed to an electrical hazard when the risk associated with that hazard is not reduced to a safe level by the applicable electrical installation requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy.

11.2 Employees shall be trained in safety-related work practices and procedural requirements, as necessary to provide protection from electrical hazards associated with their respective jobs or task assignments. Employees shall be trained to identify and understand the relationship between hazards and possible injury.

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11.3 Electrical safety awareness training shall be incorporated into the new employee's safety orientation briefing.

11.4 Retraining

11.4.1 At the discretion of a director, manager, or supervisor; retraining of employees may be required if:

11.4.1.1 An employees' actions indicate that they're not clear on electrical safety, or if their duties have changed, and now they work with electrical equipment that they did not work with previously.

11.4.1.2 New technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use.

11.4.1.3 Periodic inspections reveal deviations in an employee's or work site's compliance with this procedure.

11.4.1.4 A supervisor believes there are deviations from, or inadequacies in, the employee's knowledge or use of the electrical safety procedures.

12.0 RECORD KEEPING

12.1 Training records shall be maintained at the department in which the employee is working and a copy of the training certificate will be sent to Human Resources for their permanent file.

13.0 ABBREVIATIONS

ABBREVIATION	DESCRIPTION
AC	Alternating Current
ESWC	Electrically Safe Work Condition
GFCI	Ground-Fault Current Interrupter
LO/TO	Lockout / Tagout
NFPA	National Fire Protection Association
PPE	Personal Protective Equipment

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SOP	Safety Operating Procedure
cal/cm ²	Calories per Centimeter Squared
5J/ cm ²	Joules per Centimeter Squared
kPa	Kilopascal

14.0 DOCUMENT HISTORY

DATE	TYPE	DESCRIPTION OF CHANGE
19 Jun 2023	Initial	New Document
	Revision 1	

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ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTOR

Job / Work Order Number:	Planned Work Date:
1. Description of Circuit / Equipment / Job Location:	
2. Description of Work to Be Done:	
3. Justification of Why the Circuit / Equipment Cannot be De-Energized or the Work Deferred Until the Next Scheduled Outage:	
Requestor Name (Print):	Date of Request:

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSON	CHECK WHEN COMPLETED
1. Detailed Description of the Job Procedures to be Used in Performing the Above Detailed Work:	<input type="checkbox"/>
2. Description of the Safe Work Practices to be Employed:	<input type="checkbox"/>
3. Results of the Shock Risk Assessment:	
3(a). Voltage to Which Personnel will be Exposed:	<input type="checkbox"/>
3(b). Limited Approach Boundary:	<input type="checkbox"/>
3(c). Restricted Approach Boundary:	<input type="checkbox"/>
3(d). Necessary Shock, Personal and Other Protective Equipment to Safely Perform Assigned Task:	<input type="checkbox"/>
4. Results of the Arc Flash Risk Assessment:	
4(a). Available Incident Energy at the Working Distance or Arc Flash PPE Category:	<input type="checkbox"/>
4(b). Necessary Arc Flash Personal and Other Protective Equipment to Safely Perform the Assigned Task:	<input type="checkbox"/>
4(c). Arc Flash Boundary:	<input type="checkbox"/>
5. Means Employed to Restrict the Access of Unqualified Persons from the Work Area:	<input type="checkbox"/>
6. Evidence of Completion of a Job Safety Briefing, Including Discussion of Any Job-Related Hazards:	<input type="checkbox"/>

7. Do You Agree the Above Work can be Done Safely: Yes No (If No, Return to Requestor)

Electrically Qualified Person(s):

Name (Print): _____ Sign: _____ Date: _____

Name (Print): _____ Sign: _____ Date: _____

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED

Site Supervisor:

Name (Print): _____ Sign: _____ Date: _____

Director:

Name (Print): _____ Sign: _____ Date: _____

Safety Coordinator:

Name (Print): _____ Sign: _____ Date: _____

NOTE: ONCE THE WORK IS COMPLETE, FORWARD THIS COMPLETED FORM TO THE RISK MANAGEMENT / SAFETY COORDINATOR OFFICE



ELECTRIC SHOCK / ARC FLASH RISK ASSESSMENT

PART I: TASK / JOB INFORMATION

1. Description of Circuit / Equipment:	2. Location:	3. Date:
3. Description of Work to Be Done:		

PART II: PREPARED BY:

1. Name (Print):	2. Job Title:	3. Department:
4. Phone Number:	5. Email Address:	

PART III: RISK ASSESSMENT MATRIX

SEVERITY OF HARM		PROBABILITY OF HARM				
		Frequency of Occurrence				
		A Frequent (Continuously)	B Likely (Frequently)	C Occasional (Periodically)	D Seldom (Unlikely)	E Rarely (Improbable)
Catastrophic (Death or Loss of Life)	I	EH	EH	H	H	M
Critical (Severe Injury or Damage)	II	EH	H	H	M	L
Moderate (Minor Injury or Damage)	III	H	M	M	L	L
Negligible (Minimum Injury of Damage)	IV	M	L	L	L	L

RISK ASSESSMENT LEVELS

EH: Extremely High H: High M: Medium L: Low

No.	Hazard	RISK LEVEL (Before Control Measures)	Control Measures	RISK LEVEL (After Control Measures)
1				
2				

3				
4				
5				
6				

Hierarchy of Controls

Elimination

Substitution

Engineering Controls

Awareness

Administrative Controls

Personal Protective Equipment

PART IV: RISK ACCEPTANCE / APPROVAL AUTHORITY

Site Supervisor:

Name (Print): _____ Sign: _____ Date: _____

Director:

Name (Print): _____ Sign: _____ Date: _____

Safety Coordinator:

Name (Print): _____ Sign: _____ Date: _____