



Electrical Safety Policy

Health and Safety FCX-HS03 | Release 08/2019 | Version 1.1

POTENTIAL FATAL RISKS

Exposure to Electrical Hazards

CRITICAL CONTROLS

- Access Control
- Barriers and Segregation
- Electrical PPE
- Energized Electrical Work Permit Execution
- Energy Isolation/LOTOTO
- Engineering Controls

ELECTRICALLY QUALIFIED INDIVIDUAL

Only Electrically Qualified Individuals will perform de-energizing process to bring equipment to electrically safe work condition.

An Electrically Qualified Individual:

- Has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations
- Has received safety training to identify the hazards and reduce the associated risk
- Is approved to perform energy isolation and dissipation
- Is approved to perform energy measurement/testing and/or tryout
- Qualified non-electrical personnel with the proper training may operate a disconnecting means under certain conditions and approvals - Reference **Switching for Non-Electrical Personnel Technical Supplement**

LABELING REQUIREMENTS

- Electrical gear (breakers, cabinets, switches, panels etc.) must have labels that indicate:
 - Voltage
 - Equipment being powered or fed
- Reference **Arc Flash Management Technical Supplement** for arc flash labeling requirements

POLICY

This policy intends to protect employees and contractors from the hazards of work around electrical installations and equipment.

1. Manage and reduce arc flash levels to the lowest possible.
2. Reduce exposure to electrical shock.
3. Provide protection to personnel when electrical work is performed.
4. Maintain electrical equipment and installations as safe and serviceable

ACTIONS TO STAY SAFE

- Electrical risk assessment is required before starting the work.
- Review SOPs for specific task before starting electrical work.
- Equipment must be de-energized except under exceptional conditions or trouble shooting.

ELECTRICALLY SAFE WORKING 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 to verify the absence of voltage, and, if possible, temporarily grounded for personnel protection.

Procedures to De-energize Electrical Equipment must include:

1. Determine all possible sources of electrical supply to the specific equipment. This may include: drawings, diagrams, and identification tags.
2. Shutdown all electrical loads from each source.
3. Open disconnecting devices for each source wearing the proper personal protective equipment for the task.
4. Whenever possible, visually verify a physical disconnection
5. Lock out sources of energy following Control of Hazardous Energy Policy (FCX_HS04).
6. Release any stored electrical energy.
7. Release any stored mechanical energy.
8. Use an adequately rated portable test instrument to test each phase conductor or circuit part, where work is to be performed, to verify it is de-energized. Verify the testing unit before and after testing to determine the test instrument is operating correctly using a known voltage source.

Required personal protective equipment shall be worn while testing.

Tests to perform include:

- o Each phase to each other phase
- o Each phase to ground
- o Neutral to ground, if present

NOTE: Where the possibility of induced voltage or stored energy exists, physically ground the phase conductors or circuit parts before touching them. Install grounding clusters for work on medium voltage equipment when possible, and when doing so would not create additional exposure.

TECHNICAL SUPPLEMENTS & REFERENCES

Energized Electrical Work Supplement
Energized Work Permit
Arc Flash Management
Personal Protective Clothing and Equipment
Switching for Non-Electrical Personnel
NFPA 70E

TRAINING REQUIREMENTS & AVAILABLE COURSES

SFT_FCX1013C LOTOTO Initial and Refresher
NFPA 70E
CPR / First Aid
Contact Release
Electrical Safety for Mining
600V Switching for Non-Electricians

ADDITIONAL SAFETY REQUIREMENTS

- Never assume that an electrical circuit is de-energized
- Only use serviceable electrical equipment, tools, appliances and extension cords.
- Maintain clearances around electrical panels (30in. (.7m) wide, or as wide as the equipment and 36in. (1m) in front).
- Always use approved insulated tools to move trailing power cable, unless proper LOTOTO procedures have been followed to de-energize the trailing power cable.
- Do not drive over unprotected power cables.
- Maintain minimum clearance from overhead power lines:

Voltage (KV)	Minimum Clearance
Up to 50 KV	10 ft (3.3m)
50-200 KV	15 ft (4.6m)
200-350 KV	20 ft (6.1m)
350-500 KV	25 ft (7.6m)
500-750 KV	35 ft (10.6m)
750-1,000 KV	45 ft (13.7m)

Important Terms:

Arc Flash Boundary - When an arc flash hazard exists, an approach limit from an arc source at which incident energy equals 1.2 cal/cm² (5 J/cm²)

Incident Energy – The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. Incident energy is typically expressed in calories per square centimeter (cal/cm²).

Incident Energy Analysis – A component of an arc flash risk assessment used to predict the incident energy of an arc flash for a specified set of conditions.

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

De-energized - Disconnected from external sources of voltage, locked, tagged, and measured for absence of voltage. There should be no source of potential difference between any metallic surfaces or ground. Personal protective grounds may be required.

Energized Electrical Work - When working within the restricted approach boundary or the arc flash boundary of exposed energized electrical conductors or circuit parts that are not placed in an electrically safe work condition. Requires an Energized Electrical Work Permit in some cases.

Exposed - Capable of being inadvertently, accidentally, unintentionally 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.

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

Low Voltage- Any circuit greater than 50 volts but less than 1000 volts is considered to be low voltage.

Medium Voltage - Any circuit greater than 1000 volts but less than 34.5KV is considered to be medium voltage.

Repair Work - Any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.).

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



TECHNICAL SUPPLEMENT

ELECTRICAL SAFETY FCX-HS03 | LINE WORK | Version 2 | Release 10/23

A. General Requirements for Line Work

1. Only qualified line workers with recent (within 12 months) energized line work experience or training will perform this work.
2. All line electrical work shall follow applicable regional regulatory requirements.
3. New employees, even though experienced, will not be permitted to engage in any energized line work until they have demonstrated their qualifications for hot line work on de-energized system and evaluation completed by department.
4. No line work when under red alert or if lightning is visible unless it is to eliminate hazard for personnel protection.
5. Sites shall have a detailed process for communication of switching status (switching program) between all departments and affected groups. (See figure 1 Freeport Switching Program).
6. Always wear proper personal protective equipment (PPE) including arc rated fall protection and other required PPE.
7. Radio communication is preferred for line work, must be tested before use and messages must be three point (message of sender, repeat of receiver, verification of sender).
8. When an unqualified person is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object they may contact cannot come closer to any unguarded, energized overhead line than 10 feet for voltages to ground 50kV and below.

Minimum Approach Distances Table Below:

Voltage (KV)	Minimum Clearance
Up to 50 KV	10 ft (3.3m)
50-200 KV	15 ft (4.6m)
200-350 KV	20 ft (6.1m)
350-500 KV	25 ft (7.6m)
500-750 KV	35 ft (10.6m)
750-1,000 KV	45 ft (13.7m)

Additional minimum approach distances for higher voltage is in the Appendix A

9. In inclement weather or at night, no employee shall work alone outdoors on or within the minimum approach distance of energized conductors or parts of more than 600 volts between conductors.
10. At least two qualified line workers shall be present while performing energized work **except** for the following:
 - a. Routine circuit switching
 - b. Work performed with live line tools when the position of the worker is neither within reach of, nor otherwise exposed to contact with energized parts
 - c. Emergency repairs to the extent necessary to safeguard the public.

B. De Energized work

1. Each site shall complete switching program form (See Appendix for example) that includes procedures for switching more than 3 switches for specific task.
2. Switching platforms are required at all switches above 35kV line to line. For switching 35kV and below use the appropriate rated rubber gloves. For switching over 35kV class IV gloves must be worn.
3. Circuits and equipment disconnects shall only be opened and closed using live line tools and/or appropriate methods.
4. Disconnects and cut-outs not designed to open under load (non-load break switches) shall be verified not under load before opening.
5. Treat all conductors and equipment as energized until tested and grounded.
6. Before attaching protective grounds (equi-potential and tripping grounds), verify zero energy state with voltage detector.
7. Use grounding cables and clamps rated for the available fault current to ground phases, neutrals, and static conductors.
8. Use properly rated and maintained energized line tools to install ground sets.
9. The ground connection will be made first, then the line connections, closest first, farthest last.
10. Install equi-potential grounds: between the worker and each source of energy, within sight of the worker, and at the location of work. During construction or decommissioning, if not possible to ground at location of work, ground at the nearest location possible and complete a risk assessment to eliminate or control any potential hazard.
11. Install equi-potential grounds between the working area and all foreign power crossings, regardless of which line crosses the other, equi-potential grounds must be rated for available fault current.
12. When two or more crews are working on the same line independently, each crew is responsible for its own equi-potential ground protection. The crews will coordinate work to eliminate the potential for error.
13. When removing grounds, disconnect the line first, then the farthest, followed by the closest, and the ground connection last.
14. Maintain a safe distance from conductors and other equipment while placing and removing protective grounds.
15. Delta-connected lines are considered shorted only when all primary conductors are connected to a low resistance (<5 ohm) temporary or permanent ground with a properly rated ground cable.
16. Wye-connected lines are considered shorted when all primary conductors are connected to the primary neutral with an approved ground cable.
17. Remove and destroy all ground cables that have been exposed to fault current.

C. Energized work

1. The minimum approach distance (MAD) for voltages 72kV and below shall be 4 feet.
2. All energized line work which requires any part of a line workers body to be inside the minimum approach distance or MAD requires an Energized work permit and specific training.
3. For 72kV and below, hot stick length shall be no shorter than 6 ft. For voltages above 72kV, hot stick length shall be adjusted using minimum approach distance table 1.
4. Live line work shall not be performed in fog, snow, rain, or high winds.
5. A minimum of two qualified individuals are required for energized work, one qualified line worker and at least one other qualified individual, will be on the ground at all times, within line of sight and ability to communicate with them at all times.
6. At least two qualified line workers will be present for work on a pole or energized overhead line over 600 volts or where an employee is inside the minimum approach distance to parts energized at more than 600 volts.

7. Cover energized equipment with rubber goods (sleeves, mats, covers, hose blankets, etc. that provide an insulating shield). Once covered, avoid intentional contact with energized, covered parts.
8. All sources, including grounds, within reaching or falling distance, except the portion of line being worked on, will be covered with insulating corona-resistant cover up material. Wood poles and cross-arms are considered to be at ground potential.
9. Workers will avoid differences in potential by physically limiting work to one potential at a time.
10. Voltage rated gloves shall be worn while switching and using live line tools. Any work performed over 35kV; class IV gloves shall be worn.
11. Energized insulator cleaning shall be considered energized work and must follow this policy.

D. PPE/Arc Flash Protection

1. Minimum 8 cal/cm² or above arc flash protection is required for arc flash daily wear.
2. If the clothing required has the potential to create additional or greater hazards than the possible exposure to the heat energy of the electric arc, then the work shall be completed in a de-energized state.
3. Fall arrest systems (fall harness, positioning gear) shall be Arc rated.
4. Harness/belt must be designed for pole climbing with wood pole fall restriction devices.
5. Foot and leg straps of climbers will receive the care given to body and safety belts.

E. Tools & Equipment Line Work

1. Inspect and clean tools before each use.
2. Tools will be electrically tested annually, with documentation of testing, and always stored properly.
3. Tools shall be replaced or repaired if they fail testing/calibration. Destroy tools that cannot be repaired when they become damaged or fail to pass testing/calibration. If they can be repaired, they must be repaired by a certified company.
4. Use high dielectric rope (e.g. poly, nylon, etc.) for pulling new lines.
5. Hang hand lines only from structures, not basket or boom.
6. Replace defective or damaged body belts.
7. Inspect and maintain climbing equipment per manufacturer recommendations.
8. Sharpen gaffs to manufacturer's recommendations and cover when stored.
9. Remove climbers when working or moving about on the ground, when climbing ladders and when riding in motor vehicles or baskets of aerial devices.

F. Bucket Trucks

1. **Do not** ride in the bucket of a truck while vehicle is moving.
2. While working inside the minimum approach distance of energized conductors, truck shall be grounded with a properly rated ground cable with clamps, to the system neutral or screw ground.
3. Barricade or guard truck to prevent unnecessary contact with the equipment.
4. All personnel will stay clear of the vehicle during the period when it is grounded.
5. Do not place materials in the bucket/vehicle so that the controls are blocked or inaccessible.
6. Operate all units from upper controls except in emergency situations.
7. Trucks shall be considered energized while performing energized work.
8. Aerial trucks with an insulated jib or telescoping boom are acceptable, provided the insulated portion is a minimum of nine feet long with the baskets on the outer portion and dielectrically tested annually. The

preferred option is an articulating unit with the upper boom entirely insulated and an insulated section in the lower boom or pylon.

9. Follow manufacturer's maximum wind limits for operation.
10. Bucket trucks shall have falling objects Fatal Risk Management icon placard installed on rear of truck.
11. When bucket trucks are used, a qualified groundman shall be present and compliant in bucket truck rescue.
12. Groundman primary focus is safety of line workers and keep unqualified personnel clear of the work area.

G. Fall Protection

1. Elevated work shall follow requirements of the Working at Heights policy (FCX-HSO2), employees shall use fall protection system while working on poles, towers, or similar structures, or while working at elevated locations from aerial lifts, bucket trucks, or similar devices.
2. Employees shall use appropriate fall protection equipment while climbing, transferring, or transitioning across obstacles on poles or structures, unless doing so is not feasible or creates a greater hazard than doing so unattached.

H. Rubber Gloves

1. Rubber gloves are required within 5 ft. when working on or near energized overhead lines, equipment, poles, or structures carrying or supporting energized conductors up to 72kV. For voltages higher than 72kV refer to minimum approach distance (table 1 on this document).
2. Wear rubber gloves at all times when operating "ground operated switches."
3. Rubber gloves will be worn by all persons on the ground working on energized structures, operating a wire reel, or otherwise handling a conductor to an energized structure, setting and removing poles in or adjacent to an energized overhead line, or when working with machines under or near energized overhead lines or apparatus.
4. Rubber gloves and sleeves will be the appropriate class voltage rated by the manufacturer and be of the correct hand size.
5. Visually inspect rubber gloves and air test before use.
6. Wear leather protectors over rubber gloves at all times when the voltage is above 250 volts. The gauntlet of the protectors will not cover the top 2 inches of the rubber gloves on Class II, 3 inches on Class III, and 4 inches on Class IV.
7. Test rubber gloves at least every six months and document the date issued; test date must be on the cuff. Refer to **ASTM D120-22** Standard for requirements.

I. Neutral and Ground Wires

1. Where applicable, sites with switch houses will use a visually unique wire for equipment safety ground to avoid confusing wire with other phases.
2. Conductor size for bridging shall be at least one size larger than the conductor being bridged.
3. Before cutting or opening any ground conductors, wear rubber gloves and bridge the following:
 - a. Overhead grounds or neutral wires
 - b. Pole ground wires
 - c. Transformer neutrals and grounds
 - d. Substation ground wires

J. Stringing, Sagging, and Salvaging

1. Ground the payout reel when stringing wire over or near energized conductors.
2. Insulate the reel attendant as appropriate.
3. Conductors being pulled are considered grounded when:
 - a. A ground is installed at the point of temporary dead end
 - b. Stringing sheaves are grounded every mile and on both sides of a hot crossing
 - c. And/or running grounds are installed at the payout reels on spans less than a mile in length.
6. After sagging, the neutral ground rule would apply.
7. Where there is danger of wire interfering with or falling into traffic, use warning signs and spotters/flaggers to control traffic.
8. Pull conductors to a safe clearance height above grade and secured in a safe manner when left un-sagged and untied without supervision.
9. Salvaging wires requires the same precautions as stringing operations.
10. Remove and dispose of any abandoned overhead wire, guywire, conductor, or hardware.

K. Fallen Wires

1. Guard fallen primary conductors until they can be tested, grounded, and made safe.
2. De-energize, test, and ground fallen wires before making repairs.
3. Do not repair breaks in the neutral of a wye-connected system while the primary is energized.

L. Control of Electrical Energy (CoHE)

To define specific requirements as referenced in the Control of Hazardous Energy Policy (HS-04) for the following: fuse cutouts, power line jumpers, and utility work.

Fuse Cut Outs – The use of fuse cut outs as safe means for electrical lockout is an acceptable method for locking equipment in an area when the following actions are met:

- Fuses will be locked at the base of the pole and access restricted
- Uniquely identifiable energy Control for lockout and tagout is present
 - Sites will use one of the following: Pole Strap, flags, or banners
 - Banners or Pole straps must consist of: weather resistant, visible, and indicate work happening or Hazard.



Blade Cut Outs- The use of blade cut outs is an acceptable method for isolating electrical energy from equipment when the following actions are met:

- Uniquely identifiable energy Control for tagout is present for each Card Holding Tag “birdie” being installed on blades
- ECC Tags for each birdie will be placed inside the lock box to be locked near the equipment
- Sites will use birdies for blade cut out to indicate work is taking place



Power Line Jumpers – A removed jumper, and when a power line has been properly tested and grounded is an acceptable means of de-energizing the powerline for work to take place. This air gaps the line being worked on from the energized system.

- Grounds installed on a powerline will be attached with Tag indicating the work and another tag will be created for a lock box for the ground cluster that is installed

Utility Work / Transmission / Utility Lines – Incoming transmission lines from a utility requires a coordinated switching process with FMI and the utility including a Line Clearances number.

Appendix A

Table 1 Minimum Approach Distance Continued

- Voltages over 72.6kV use altitude correction factor in Table 2.

Voltage in kilovolts phase-to-phase	Distance to employee from energized part ④ ⑤ ⑥ ⑩					
	Without tools phase-to-ground		With tools phase- to-ground ⑦ ⑨		Without tools phase- to-phase ⑧	
	(m)	(ft-in)	(m)	(ft-in)	(m)	(ft-in)
72.6 to 121	1.82	6.0	1.82	6.0	1.82	6.0
121.1 to 145	1.82	6.0	1.82	6.0	1.82	6.0
145.1 to 169	1.82	6.0	1.82	6.0	1.94	6-5
169.1 to 242	1.87	6-2	2.01	6-8	3.08	10-2
242.1 to 362	3.19	10-6	3.41	11-3	5.52	18-2
362.1 to 420	3.99	13.2	4.25	14-0	6.81	22-5
420.1 to 550	4.78	15-9	5.07	16-8	8.24	27-1
550.1 to 800	6.53	21-6	6.88	22-7	11.38	37-5

Table 2 : Altitude correction factor

Altitude		Correction factor
(m)	(ft)	
Sea level to 900	Sea level to 3000	1.00
901 to 1,200	3001 to 4000	1.02
1201 to 1500	4001 to 5000	1.05
1501 to 1800	5001 to 6000	1.08
1801 to 2100	6001 to 7000	1.11
2101 to 2400	7001 to 8000	1.14
2401 to 2700	8001 to 9000	1.17
2701 to 3000	9001 to 10 000	1.20
3001 to 3600	10 001 to 12 000	1.25
3601 to 4200	12 001 to 14 000	1.30

Definitions

1. **Energized**-Electrically connected to a source of potential difference, or electrically charged to have a potential significantly different from that of the earth in the vicinity.
2. **Qualified Line worker or lineman**- an individual who has formal training for electrical overhead line work and documented experience with the field skills verification. Understands the hazards of overhead line work and required PPE. Is trained in pole top rescue, bucket truck rescue, first aid, CPR, contact release and other emergency procedures.
3. **Grounded**- Connected to or in contact with earth or connected to some extended conductive body that serves instead of earth.
4. **Guarded**-Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats or platforms, designed to limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects.
5. **Minimum Approach Distance (MAD)**-The closest distance a qualified employee is permitted to approach either an energized or a grounded object, as applicable for the work method being used.

References

1. National Electrical Safety Handbook 2017
2. OSHA 1910.269 Electric power generation, transmission, and distribution
3. FCX-HS02 Working at Heights policy

Figure 1

FREEPORT MCMORAN						
SWITCHING PROGRAM FORM						
TRANSMISSION/DISTRIBUTION SYSTEM						
SWITCHING PROGRAM NUMBER:					PAGE 1 OF:	
REQUEST FOR:	CL	HLO	GS	DATE REQUIRED:		
STATION/EQUIP:						
PURPOSE:						
DURATION:						
REQUESTED BY:						
PREPARED BY:					DATE:	
REVIEWED BY:					DATE:	
ISSUED TO:					DATE:	
RELEASE:					DATE:	
SWITCHMAN:						
DISPATCHER:						
ENERGY CONTROL COORDINATOR:						
STEP NO	DEVICE	LOCATION	OPERATION PERFORMED	TIME	PERFORMED BY	TASK DONE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

13						
14						
15						
16						
17						
18						
19						
20						

Figure 2

OUTAGE REQUEST FORM

TRANSMISSION/DISTRIBUTION SYSTEM

AFFECTED POWER LINE(s) / SUBSTATION (S):

REQUESTOR: REASON FOR OUTAGE:

DATE OF OUTAGE:

TIME OF OUTAGE:

LENGTH OF OUTAGE:

IS OUTAGE FLEXIBLE? DATE: () No, () Yes TIME: () No, () Yes

RESPONSIBLE PERSON TO CONTACT DURING OUTAGE:

PHONE#

RADIO #

ALTERNATE PERSON TO CONTACT DURING OUTAGE:

PHONE#

RADIO#

AREAS AFFECTED BY OUTAGE:

PERMITS THAT MAY BE REQUIRED BY REQUESTOR

BLUE STAKE: () No, () Yes

HOT WORK: () No, () Yes

ENVIORNMENTAL: () No, () Yes

CONFINED ENTRY: () No, () Yes

SWITCHING PROGRAM FORM: () No, () Yes

LIST PERSONNEL WHO REQUIRE KNOWLEDGE OF THE OUTAGE: