



Lusail Real Estate Development Company

Health, Safety, Security, Environment, Logistics & Quality Department

Lusail Construction Safety Management Procedure – Electrical Safety

Document No	<u>LUS-HSE-WG3-446-024.01</u>	Rev	<u>1</u>
Uncontrolled Copy	<input type="checkbox"/>	Controlled Copy	<input checked="" type="checkbox"/>
		Date	<u>01-Apr-2015</u>

COMPANY PROPRIETARY INFORMATION

Prior to use, ensure this document is the most recent revision by checking the Master Document List. To request a change, submit a Document Change Request to the Document Control Representative. Master copy of this document will be maintained by the LREDC QA/QC Manager. Not controlled if printed.

CONTENTS

- 1.0 DESCRIPTION**
- 2.0 DEFINITIONS**
- 3.0 RESPONSIBILITITES**
- 4.0 ASSURED GROUNDING PLAN**
- 5.0 GENERAL PRECAUTIONS FOR AFFECTED EMPLOYEES**
- 6.0 PROTECTIVE CLOTHING**
- 7.0 REQUIREMENTS FOR WORK ADJACENT TO ENERGIZED CIRCUITS**
- 8.0 REQUIREMENTS FOR WORK ADJACENT TO POWER LINES**
- 9.0 TEMPORARY LIGHTING**
- 10.0 CORDS AND PORTABLE TOOLS**
- 11.0 IDENTIFICATION OF ELECTRICAL EQUIPMENT**
- 12.0 WORK ON ENERGIZED EQUIPMENT**
- 13.0 GUARDING ELECTRICAL EQUIPMENT**
- 14.0 OVER-CURRENT PROTECTION**
- 15.0 DISCONNECTS**
- 16.0 LOW-VOLTAGE LIGHTING SYSTEMS**
- 17.0 RED CONCRETE**
- 18.0 GROUNDING CONDUCTORS**

- 19.0 GROUND FAULT PROTECTION**

- 20.0 CONFINED SPACE**

- 21.0 GROUND CONDUCTOR TESTING**

- 22.0 GROUND CONDUCTOR TEST VERIFICATION**

- 23.0 USE AND CARE OF VOLTAGE TESTER**

- 24.0 CHANGING AND CHARGING STORAGE BATTERIES**

- 25.0 PERIODIC INSPECTION**

- 26.0 TRAINING**
 - 26.1 QUALIFIED ELECTRICIAN**
 - 26.2 RETRAINING**

- 27.0 DOCUMENTATION**

- 28.0 REFERENCES**

- 29.0 ATTACHMENTS**

1. Description

This element of the LCSMP readers with the Lusail Construction HSE requirements designed to ensure the proper installation, maintenance, inspection, and testing of any electrical circuit, equipment, and equipment-grounding conductors on the project to avoid injuries from electrical incidents. This element applies to all Lusail personnel, Contractors, Developers, Consultants and subcontractors working on the Lusail project.

This element does not address lockout/tagout, which is covered in [LUS-HSE-WG3-446-023](#), Lockout/Tagout (LOTO).

2. Definitions

Term	Description
Job Hazard Analysis (JHA)	A process used to identify the hazards or potential hazards associated with each step of a particular job or work plan in order to uncover hazards and then eliminate, control, or remove them before the work is started.
Electrical Equipment	Wiring, circuits, switches, switchgear, fuses, breakers, distribution systems, buss bars, and any other equipment or system capable of containing or conducting electrical energy.
Energized	Containing electrical energy, or having the potential to contain electrical energy.
Exposure	Where hazards are present or could be created that might result in harm to personnel, equipment, or the environment if not properly controlled.
Isolating Device	Device that prevents the transmission or release of hazardous energy or hazardous materials. Examples include restraint blocks, electrical circuit breakers, disconnect switches, slide gates, slip blinds, or line valves. For LOTO purposes, isolating devices that provide visible indication of the device's position are desirable.
Lockout/Tagout (LOTO)	Installation of lock and tag on the isolating devices to ensure that work can be performed safely. The lock and tag ensure that the isolating device and the equipment or system they isolate or control cannot be operated until the lock and tag are removed.
Potentially Energized	Electrical equipment capable of containing electrical energy that has not been locked out, tagged, and verified as de-energized by proper testing methods.
Qualified Electrician	One who has received training and been qualified and authorized by Lusail Construction HSE to perform work on energized or potentially energized electrical equipment.
Red Concrete	Concrete that is colored red and applied over underground electrical installations as a warning for future excavations.
Servicing and Maintenance	Workplace activities such as reconstructing, installing, setting up, adjusting, inspecting, modifying, and maintaining or servicing machines or equipment. These activities include lubricating, cleaning, or un jamming machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy. This applies to all personnel regardless of job title (operator, researcher, maintenance crafts, engineer, or construction personnel).

3. Responsibilities

The Contractor is fully responsible for the pre-planning, development of Method Statements, Job Hazard Analysis, overall safe work planning and implementation. The Contractor's Project Management is responsible for the assurance that all work is planned and conducted according to Contractor and Lusail Health Safety & Environment (HSE) procedures and the Qatar Construction Specifications 2010. Should a conflict occur between procedures/standards or requirements the more stringent will apply.

4. Assured Grounding Plan

The Contractor develops and implements of a project-specific assured grounding plan in accordance with Qatari Law and this LCSMP element. The assured grounding plan covers all cord sets, receptacles that are not part of the building or structure, and equipment connected by cord and plug that are available for employee use.

The Project Manager reviews and approves the plan and designates a competent person. The competent person must be able to identify hazards relating to grounding and have the authority to see that any corrections made are so that each item on a given jobsite is adequately grounded.

The Contractor facilitates implementation and compliance with the plan.

The Contractor monitors the activities of their employees and subcontractors to ensure compliance.

At a minimum, the project assured grounding plan will include the following information:

- Name of the competent person
- Provisions for identifying electrical work on or near live circuits during the 2-week look-ahead
- JHA
- Required PPE, in accordance with [LUS-HSE-WG3-446-006](#), Personal Protective Equipment
- Grounding
- Ground fault circuit interrupters (GFCIs)
- Provisions for identification of electrical equipment
- Provisions for testing electrical equipment and ground conductor test log
- Training procedures for qualified electricians and affected employees
- Lockout/ Tagout procedures for specific equipment, in accordance with [LUS-HSE-WG3-446-023](#), Lockout/Tagout (LOTO)
- No person may install or maintain electrical equipment unless that person has been properly trained or is closely supervised by a qualified person. Only qualified electricians authorized by the project manager can perform the following functions/duties:
 - Operate any circuit switching device of 480 V or greater, except motor starters and valve operators from pushbutton stations
 - Test or troubleshoot electrical equipment
 - Repair or alter electrical equipment
 - Remove or install fuses
 - Change bulbs in low-voltage systems
 - Climb electrical poles
 - Perform work on non-insulated energized circuits and apparatus over fifty (50) V.
 - Perform work within ten (10) feet of non-insulated energized circuits and apparatus that are not barricaded, covered, or otherwise guarded to prevent electrical shock hazards and contact by tools, equipment, or personnel.

- Enter energized electrical substations and motor control centers. A qualified electrician must accompany unauthorized employees.

5. General Precautions for Affected Employees

Accidents involving electricity occur most frequently when the work is performed on or near live circuits, and when manual switching operations are performed. All employees must make every effort not to work on or near any electrical circuits that are energized.

Always assume that exposed de-energized electrical lines and equipment are energized until the circuits have been properly isolated, grounded (if appropriate), tagged, locked out, and tested. Strictly follow all procedures in [LUS-HSE-WG3-446-023](#), Lockout/Tagout (LOTO).

Superintendents and supervisors must notify the Project Manager of any potential work on or near live circuits during the 2-week look-ahead. The project manager adds the work to the schedule.

If a circuit cannot be de-energized, or if clearances cannot be met, qualified electricians are consulted during the JHA to determine potential hazards and necessary precautions.

The JHA describes the safe work practices required for the safe installation of conduit, cable tray, buss duct, and pulling wire. These systems are possible conductors in areas of exposed de-energized and energized parts. All shielding, barricading and guarding of exposed conductors precede each task. Proper PPE, dielectric tools, and equipment are used in these areas in accordance with [LUS-HSE-WG3-446-006](#), Personal Protective Equipment.

Do not use metal ladders or scaffolds in or around high voltage areas. All ladders must have nonconductive side rails and footing. Use fiberglass ladders rated for electrical tasks.

Do not wear jewelry, or conductive clothing, or use tools and equipment that have been altered to be nonconductive by covering, wrapping, or other insulating means when working on or near exposed energized or de-energized electrical parts or equipment.

If an electrical circuit breaker trips, do not reset that breaker until a qualified electrician has investigated the tripping of the breaker.

Never direct a stream of water on electrical conductors without approval of a qualified electrician who can confirm that all circuits are de-energized.

Do not work within 10' (3 m) of bare live circuits above 50 V that are not barricaded or covered. The 10' (3 m) measurement must be from the nearest part of the body or hand-held object.

Even when working distances meet or exceed 10' (3 m), exercise good judgment to ensure that all appropriate precautions are considered. When issuing work permits, always identify and discuss any electrical power lines, tag and lock procedures, and effective communications. Consult a qualified electrician when appropriate.

Avoid contact with insulated aerial conductors. Never assume that insulation on conductors is intact or that it provides adequate personnel protection from a shock hazard. The aerial conductors must be de-energized, grounded and guarded to prevent exposure to personnel and/or vehicular equipment i.e., trucks, cranes, aerial lifts etc., working in the area.

Always replace and tighten all bolts and covers on electrical housings, especially on explosion proof equipment. These covers and bolts must be in place and tight to maintain the explosion proof character of the equipment. If this is not done, the equipment could become a source of ignition. Never operate electrical equipment in a hazardous area if the enclosure cover is not properly bolted (or screwed) in place.

Do not rush to the aid of the victim of electrical shock before considering the source of the problem. Immediately de-energize the circuit if possible or if there is no doubt as to whether the circuit is still energized, carefully approach the victim, and remove the victim from the circuit using insulated materials so as to not endanger the rescuers. Insulated materials include dry lumber, a leather belt, a rubber hose, and other non-conducting items. The effect of electrical shock on an individual depends upon the type of circuit, the voltage, resistance, amperage, and pathway through the body. Electric shock normally stops the heart and voluntary breathing reflex. Call for help immediately and respond in accordance with [LUS-HSE-WG3-446-002](#), First Aid.

6. Protective Clothing

The Contractor shall purchase and maintain required personal protective clothing in accordance with [LUS-HSE-WG3-446-006](#), Personal Protective Equipment. The following PPE is recommended for electrical switching or emergencies:

- Nomex jacket with double Nomex front
- Nomex #115 face shield hood or equivalent
- KV rubber gloves with leather protectors

Protective clothing for flash protection must be worn when performing the following functions:

- Racking in and out breakers and/or starters 480 V or above
- Removing and replacing potential transformers in metal switchgear
- Phase testing circuits 2,400 V and above
- Operating emergency stop pushbuttons on doors of 2,400 V and above

Dielectric switchboard matting is recommended on the floors surrounding fuse boxes and control panels where electrical work is frequently performed.

All high-voltage protective clothing must be stored, maintained, inspected, and tested according to the manufacturer's recommendations. Each item must also be visually inspected immediately before use.

7. Requirements for Work Adjacent To Energized Circuits

Affected employees must not work so close to an electric circuit that they could contact the circuit in the course of their work, unless they are protected against electric shock by de-energizing and using a LOTO procedure in accordance with [LUS-HSE-WG3-446-023](#), Lockout/Tagout (LOTO), or by guarding it by effective insulation or other means.

Before starting work in an area, conduct a JHA to ascertain by inquiry, direct observation, or by testing whether any part of an electric power circuit, exposed or concealed, is so located that the performance of the work could bring any person, tool, or machine into physical contact with the circuit or within acceptable clearance distances.

Whenever possible, de-energize and ground the circuit(s). Otherwise, protect employees by isolation, insulation, warning signs, or other methods commensurate with the hazard.

Do not perform any drilling, augering, or material excavating operation within 6' (1.8m) of underground lines unless the lines have been de-energized and rendered inoperative in accordance with [LUS-HSE-WG3-446-033](#), Excavations.

8. Requirements for Work Adjacent To Power Lines

The minimum working space in front of or near electrical equipment may not be less than those stated in the table below.

Nominal voltage to ground	Conditions ^a (ft)		
	A	B	C
601 to 2,500	3	4	5
2,501 to 9,000	4	5	6
9,001 to 25,000	5	6	9
25,001 to 75,000 ^b	6	8	10
Over 75,000 ^b	8	10	12

^a Conditions are defined as follows:

A. Exposed live parts on one side and no live or grounded parts on the other side of the working space, or

exposed live parts on both sides effectively guarded by suitable wood or other insulating materials. Insulated wire or insulated buss-bars operating at ≤ 300 V are not considered live parts.

- B. Exposed live parts on one side and grounded parts on the other side. Concrete, brick, or tile walls will be considered as grounded surfaces.
- C. Exposed live parts on both sides of the workspace not guarded as provided in Condition A with the operator between.

^b Minimum depth of clear working space in front of electric equipment with a nominal voltage to ground above 25,000 V may be the same as for 25,000 V under Conditions A, B, and C for installations built before April 16, 1981.

When working with cranes and other motorized equipment near live electrical lines or circuits, refer to [LUS-HSE-WG3-446-025](#), Motor Vehicles and Equipment; and [LUS-HSE-WG3-446-026](#), Cranes, Hoists, and Lifts.

High voltage overhead power lines are considered energized unless the utility company or owner of the line has been notified, the line de-energized and grounded, and positive control measures taken to prevent energization of the line prior to completion of work in accordance with [LUS-HSE-WG3-446-023](#), Lockout/Tagout (LOTO).

No equipment or machinery may be moved under energized overhead high voltage lines unless the following clearances are maintained and any installed boom or mast is unloaded and lowered to transport position:

Normal Voltage (kV) phase-to-phase	Minimum Required Clearance (ft)
0 to 0.75	4
> 0.75 to 50	6
> 50 to 345	10
> 345 to 750	16
> 750 to 1,000	20

All crossovers where equipment or machinery is moved under energized high voltage line(s) must be posted with signs. The signs must be located 50 feet from, and on each side of, the line(s). Signs must provide the following information:

- Warning of the high-voltage line.
- Line voltage.
- Maximum height of equipment that can pass under the line. (The maximum height of equipment is determined by subtracting the applicable clearance distance shown above from the actual line to ground distance during maximum sag conditions.)

Electrical power lines must be insulated or located away from water lines, telephone lines, air lines, or other conductive materials so that a damaged circuit does not energize the other systems.

9. Temporary Lighting

Temporary lights must be equipped with guards to prevent accidental contact with the bulb. Broken or defective bulbs must be replaced promptly.

Lighting circuits must be located so that movement of personnel or equipment does not damage the circuits or disrupt service. Working spaces, walkways, and similar locations must be kept clear of cords.

Portable electrical lighting used in moist or explosive atmospheres (drums, tanks, vessels, pipes, etc.) must be operated at a maximum of twelve (12) V.

Temporary lighting strings consist of nonconductive lamp sockets and connections permanently molded to the conductor insulation.

10. Cords and Portable Tools

- If equipment is energized, do not plug or unplug equipment or extension cords with wet hands.
- All extension cords, portable electric tools, and equipment must be of the three-wire type. The rated load cannot be exceeded.
- Remove any trigger lock devices from portable tools.
- Use flexible cords only in continuous lengths without splices, unless the insulation is equal to the cable being spliced and wire connections soldered. A No. 12 or larger flexible cord may be repaired or spliced only if the repair maintains the outer sheath's properties.
- Do not use worn or frayed electric cables.
- Temporary wiring must be guarded, buried, or isolated by elevation to prevent accidental contact by personnel or equipment. Vertical clearance above walkways cannot be less than 10' (3 m) for circuits rated 600 V or less. All temporary wiring must be supported on insulators.
- Do not fasten or hang cords and equipment in any way that could cause damage to the outer jacket or insulation of the cord. Do not fasten extension cords fastened with staples, hang them from nails, or suspend them by wire.
- Ensure that flexible cords and electrical cords used on a temporary basis are protected from accidental damage:
 - Ensure that the cords avoid sharp corners and projections.
 - Ensure that the cords are protected if they pass through doorways or other pinch points.
- Ensure that flexible cords and electrical cords are connected to devices and fittings so that any pulling force on the cord cannot be directly transmitted to joints or terminal screws on the plug.
- Ensure that flexible cords and cables are approved and suitable for the method and location where they are used. Flexible cords and cables are used only for the following equipment or purpose:
 - Wiring or equipment and appliances
 - Data processing cables approved as a part of the data processing system
 - Pendants
 - Wiring for fixtures
 - Appliances that have been designed to permit removal for maintenance and repair if the appliance is equipped with an attachment plug energized from an approved outlet
 - Elevator cables
 - Wiring of cranes and hoists
 - Connecting portable lamps or appliances to an approved outlet with an attachment plug
 - Connecting stationary equipment that is frequently charged with an attachment plug energized from an approved outlet
 - Preventing noise or vibration transmission
- Do not use flexible cords in any of the following ways:
 - As a substitute for fixed wiring of a structure
 - To run through holes in walls, ceilings, floors, doorways, windows, or similar openings unless protected
 - To attach to building surfaces
 - To conceal behind building walls, ceilings, or floors
 - To raise or lower equipment
 - For carrying or lowering (use a tag line)

11. Identification of Electrical Equipment

Clearly visible identification plates must be provided for each permanent electrical device located in the work area. The competent person ensures that unmarked electrical equipment is not used.

Use identical nomenclature on all isolating devices coinciding with the equipment served. Attach identification plates and lettering in the best practical manner so as not to change the electrical classification. Ensure that markings are durable and appropriate to the environment. Appropriate markings include:

- Manufacturer's name.
- Trademark.
- Organization responsible for the product.
- Voltage, current and wattage, or other ratings, as necessary.
- Equipment having auxiliary circuit must have "Has Auxiliary Circuit" on the identification plate.

12. Work On Energized Equipment

All methods of performing the work on a de-energized circuit must be attempted before seeking approval to work on energized circuits.

JHA must be completed for any proposed energized electrical work, and must be approved and signed by the competent person and HSE Representative.

Before work, the competent person inspects electrical equipment to ensure that no recognized hazards are likely to cause employees' death or serious physical harm.

13. Guarding Electrical Equipment

- Guard live parts on electrical equipment operating at fifty (50) V or greater against accidental contact by any of the following methods:
 - Using approved cabinets or enclosures.
 - Locating the equipment in a limited access room or enclosure, accessible only to qualified electricians. Entrances to limited access rooms containing exposed live parts conspicuously marked forbidding unqualified persons to enter.
 - Installing permanent, substantial partitions so that only qualified electricians have access within reach of the live parts. Any openings must prevent accidental contact with live parts by employees or objects employees carry.
 - Locating equipment on a balcony, gallery, or platform that excludes unqualified persons.
 - Locating equipment 8' (2.4m) or more above the working surface.
- Rosettes and cleat-type lamp holders at least 8' (2.4m) feet above the ground may have exposed parts.
- In locations where electric equipment would be exposed to physical damage, enclosures or guards must prevent damage.
- Do not use oil-filled transformers underground unless they are located in a fire-resistant enclosure suitably vented to the outside and surrounded by a dike to retain the contents of the transformers in the event of rupture.
- Fixtures and receptacles located in wet or damp locations must be approved for such use.
 - Fixtures and receptacles must be constructed or installed so that water cannot enter wire ways, lamp holders, or other electrical parts.
 - Cabinets, fittings, boxes, and other enclosures must be weatherproof.
 - Switches, circuit breakers, and switchboards must be in weatherproof enclosures.

14. Over-Current Protection

- Electrical circuits rated at 600 V or less must have over-current protection. Protect conductors and equipment according to their ability to safely conduct electrical current.

-
- Provide easy access to over-current devices for each employee or qualified electrician. Protect over-current devices by locating them away from easily ignitable material.
 - Over-current devices cannot interrupt the continuity of grounded conductors unless:
 - All conductors are opened at the same time, OR
 - Over-current devices protect from overload when running motors
 - Ensure that circuit breakers and fuses:
 - Clearly indicate when they are open (off) and closed (on)
 - That operate vertically are installed so the handle is in the “up” position when the breaker is closed (on)
 - Used as switches in 120 V, fluorescent lighting circuit must be approved for that purpose and marked “SWD”
 - That arc or have suddenly moving parts are shielded or located so that employees are not burned or injured by the operation of the circuit breaker.

15. Disconnects

- Install disconnecting mechanisms so the fuses or thermal cutouts can be disconnected without disrupting service to equipment and circuits unrelated to those protected by an over-current device. Ensure that the following fuses and thermo cutouts have disconnecting mechanisms:
 - Cartridge fuses accessible to nonqualified persons
 - Fuses on circuits over 150 V to ground
 - Thermal cutouts on circuits over 150 V to ground
- Locate the disconnecting means so they are readily accessible; they must have a label that clearly indicates what the switch controls.
- Ensure that disconnect boxes are securely fastened and fitted with covers.
- Use waterproof disconnect boxes must be used in damp and wet locations.
- Use your left hand when operating any disconnect switch. This will offset your body in case of malfunction in the switch.

16. Low-Voltage Lighting Systems

- Only qualified electricians may change the bulbs in low-voltage lighting systems.
- Only low-voltage explosion-proof lighting can be used inside a vessel where flammables may be present. The transformer must always remain outside of the vessel or hazardous area and must be protected from moisture and rain.

17. Red Concrete

Never cut red concrete containing a known live circuit in a nonmetallic duct. Red concrete is poured around underground electrical conduits to indicate their location and to protect them from damage. Refer to [LUS-HSE-WG3-446-033](#), Excavations, for further information.

When red concrete is encountered during excavation, the job is stopped until a decision is made on how to handle the red concrete. If possible, the job will be changed to avoid the red concrete duct bank.

When digging around a red concrete duct bank, assume that the duct bank contains live circuits in nonmetallic ducts at the surface, on the top and sides, and that is completely exposed on the bottom. If it is necessary to trench under a red concrete duct bank, de-energize the circuits, if possible.

If de-energizing is not feasible, excavation will proceed well below the concrete and with caution until it is certain that no exposed conduits are present. Never use a duct bank as a walkway across an excavation.

If it appears that red concrete must be cut, take the following steps in the order shown:

-
- Contact the project engineer assigned to the excavation project to see if the job can be changed to avoid the red concrete, if not, proceed to the next step.
 - Trace all conduits in the concrete duct bank as completely as possible and arrange to have the circuits de-energized. If all circuits are positively identified and de-energized, work may proceed without further approval.
 - Before cutting red concrete containing a known live circuit, the project manager must decide that the equipment cannot be shut down. The qualified electrician must review the job. The project manager must conduct and approve a detailed JHA, if the job must be done and if it can be done safely.

18. Grounding Conductors

Install equipment grounding conductors in accordance with the following requirements:

- Portable electric tools and appliances, except double insulated tools, must be grounded.
- All 230-V, single-phase, 15- and 20-A receptacles must be of a grounding type, and their ground contacts must be grounded by connection to the equipment grounding conductor of the circuit supplying the receptacles in accordance with requirements o.
- All 110-V flexible cord sets (extension cords) must have an equipment grounding conductor that is connected to the grounding contacts of the connector(s) on each end of the cord.
- Exposed noncurrent-carrying metal parts of 110-V cord and plug-connected tools and equipment that are likely to become energized must be grounded in accordance with applicable requirements of NEC Article 250-45 and 250-59.

19. Ground Fault Protection

Lusail Construction HSE uses GFCIs as specified below:

- On jobsites, all 230-V, single-phase, 15- and 20-A receptacle outlets that are not a part of the permanent wiring of the building or structure and that are in use by employees, must have approved GFCIs for personnel protection.
- All 115-, 120-, and 230-V, single-phase receptacle outlets used for construction operations will be protected by an Underwriters Laboratories (UL)-listed GFCI.
- GFCIs are required on receptacles on stationary and portable systems. However, receptacles on a two-wire, single-phase portable or vehicle-mounted generator rated at not more than 5 kW, where the circuit conductors of the generator are insulated from the generator frame and all other grounded surfaces, need not be protected with GFCIs.
- The GFCI must open the circuit on a ground current of 6 mA or greater and is equipped with an integral pushbutton test circuit. Such systems must be installed in strict compliance with the manufacturer's specifications and must be tested before initial use and at the beginning of each shift.

20. Confined Space

Work in confined spaces may involve a permit and will be conducted in accordance with [LUS-HSE-WG3-446-015](#), Confined Space Entry.

Do not enter confined spaces, switchgear rooms, motor control centers, or other spaces containing exposed energized circuits unless the illumination in the area enables employees to work safely. JHAs will outline the use of proper PPE, signs, guards, and barricades in these areas.

Explosion proof hand lamps, floodlights, and extension cords (i.e., plug boards) with explosion proof fixtures are required in confined spaces of the site. Hand lights carried into vessels must not exceed twelve (12) V unless they are protected by a GFCI.

21. Ground Conductor Testing

All 230-V, single-phase, 15- and 20-A receptacles, 230-V equipment connected by cord and plug that are not part of the permanent wiring of a building or structure must be tested to ensure that electrical continuity is maintained through all required equipment grounding conductors and their connectors. Tests must be conducted as follows:

- Test all equipment grounding conductors for electrical continuity.
- Test receptacles of cord sets for correct attachment of equipment grounding conductors. Equipment grounding conductors must be connected to the proper terminals during testing.

Test each outlet receptacle or power source to ensure proper polarity. Test all receptacles, attachment caps, and plug receptacles of cord sets as follows:

- With receptacle circuit tester while in service
- With a continuity tester when not in service

All equipment connected by cord and plug must be tested for ground wire continuity with a volt-ohm meter or a continuity tester. All required tests must be performed as follows:

- Before the first use.
- Before equipment is returned to service following any repairs.
- Before equipment is used after an incident suspected to have caused damage (e.g., when a cord set is run over).
- At intervals not to exceed three (3) months (cord sets and receptacles that are fixed and not exposed to damage are to be tested at intervals not to exceed six (6) months).

Equipment that has not passed the required tests will not be made available for use by employees until it has passed all required tests.

Qualified electricians conduct the ground conductor tests and add them to the Ground Conductor Test Log (Attachment [LUS-HSE-FM4-446-049](#)). The competent person ensures that aforementioned tests are recorded and retained at the jobsite.

22. Ground Conductor Test Verification

Mark all receptacles, cords, and tools with colored tape to designate the period in which the inspections and tests are conducted. Use the color coding system in the table below to verify that testing is current; and that all receptacles, portable cords, and tools have been inspected and tested, as required.

Month of Quarter	Quarter	Month
January	White	White
February		Yellow
March		Blue
April	Green	Green
May		Yellow
June		Blue
July	Red	Red
August		Yellow
September		Blue
October	Orange	Orange
November		Yellow
December		Blue

Because all receptacles, cord sets, and cord and plug connected equipment cannot be tested overnight, such a test may begin one (1) month before the end of a quarter and continue for one (1) month into the following quarter. During this interval, either quarter's color can be used.

An adequate supply of waterproof tape in white, green, yellow, black, red and orange must be on hand at all times.

23. Use and Care of Voltage Tester

- Keep all voltage testers clean and in good operating condition. Keep voltage tester leads in a separate pouch (other than tool pouch) to prevent damage by other tools in the tool pouch.
- Before using the voltage tester, a qualified electrician must test it on a known live source to ensure that it is operating correctly. If a circuit tests dead, check the voltage tester again on a live source to ensure a correct reading.
- Always make sure that voltage being tested does not exceed the meters rating.
- When using the meter to check any voltage over 500 V, use high-voltage rubber gloves.
- Use phasing sticks when verifying that circuits 1,000 V or greater are de-energized. Test the phasing sticks before and after use.

24. Changing and Charging Storage Batteries

- Locate battery charging installations in areas designated for that purpose and provided with a means for each of the following:
 - Flushing and neutralizing spilled electrolyte
 - Fire protection, in accordance with [LUS-HSE-WG3-446-012](#), Fire Protection
 - Protection of charging apparatus from damage by trucks
 - Adequate ventilation for dispersal of fumes from gassing batteries, in accordance with [LUS-HSE-WG3-446-037](#), Ventilation
- If racks are used to support batteries, they must be made of materials nonconductive to spark generation or be coated or covered to achieve this objective.
- Provide a conveyor, overhead hoist, or equivalent material handling equipment to handle batteries.
- Properly position reinstalled batteries and secure them in the truck.
- To minimize potential for spillage, provide a carboy tilter or siphon to handle electrolyte.
- When charging batteries, pour acid into water; do not pour water into acid.
- Before attempting to change or charge batteries, properly position the truck and apply the brake.
- When charging batteries, keep the vent caps in place to avoid electrolyte spray and take care to ensure that vent caps are functioning. The battery (or compartment) cover(s) must be open to dissipate heat.
- Do not smoke in the charging area.
- Take precautions to prevent open flames, sparks, or electric arcs in battery charging areas.
- Keep tools and other metallic objects away from the top of uncovered batteries.

25. Periodic Inspection

Visually inspect high-voltage protective clothing immediately before use.

Employees must visually inspect cords, plug-connected equipment, and extension cords before use on each work shift. The exception is cord sets and receptacles that are fixed and not exposed to damage. Remove from service any defective or damaged cord until repaired and tested. Look for the following defects and damage:

- Loose parts
- Deformed or missing pins

-
- External defects and damage
 - Damage to the outer covering or insulation that reveals the internal conductors
 - Pinched or crushed covering or insulation that might indicate internal damage

The competent person inspects all energized electrical systems before work is started to ensure that there are no recognized hazards. Verify that the equipment:

- Is labeled with complete identification plates
- Has been approved or listed by UL or other approving agency
- Is approved for the purpose it is being used
- Is properly guarded
- Is grounded and equipped with a GFCI, if necessary
- Is insulated
- Will not overheat under conditions of use
- Will not produce arcs during normal use

Qualified electricians conduct ground conductor tests and add them to the Ground Conductor Test Log (Attachment [LUS-HSE-FM4-446-049](#)). The competent person reviews and maintains logs and submits them to the HSE Representative each quarter.

The Contractor reviews the logs and monitors the effectiveness of the assured grounding plan.

26. Training

The Contractor trains affected employees, subcontractors and qualified electricians in electrical safety precautions to be used on the worksite. The Contractor arranges employee training at the time of initial assignment. Project Managers are responsible for identifying additional employee training needs during risk mitigation planning (2-week look-ahead). Training can be organized and presented to groups or on a work area by work area basis, depending on the operation.

26.1 Qualified Electrician

No person may install or maintain electrical equipment unless he has been properly trained as a qualified electrician or is closely supervised by a qualified electrician. The project manager authorizes qualified in writing in accordance with the Qualified Electrician Certification (Attachment [LUS-HSE-FM4-446-050](#)).

Qualified electricians are instructed in electrical safety precautions and the details of the project assured grounding plan.

Before performing work on energized or potentially energized electrical equipment, all candidates for qualified electrician status must successfully complete all required electrical training courses. Qualified electricians must complete this required training at regular intervals not to exceed twelve (12) months.

Qualified electricians must be trained in electrical codes in the type and magnitude of energy at the project site, and must understand the hazards.

26.2 Retraining

Retraining is provided for all authorized and affected employees when there is a change in their job assignments; a change in machines, equipment, or processes that present a new hazard; or when there is a change in the energy control procedures.

Additional retraining is conducted when there are deviations from or inadequacies in the employee's knowledge or use of electrical safety precautions.

Using an acceptable training form, the records custodian maintains a record of all training or instruction given to employees.

27. Documentation

The records custodian documents all electrical instruction, training, and retraining records. Records verifying completion of training are kept in the individual employee's training files.

The competent person maintains the project assured grounding plan and ground conductor test logs on site during the project.

The Contractor maintains relevant project records at the site for the duration of the project and archives them for a minimum retention time of 10 years from creation date.

28. References

Qatar Construction Specifications 2010 Section 1 Part 10.3.14 "Electrical"

Qatar Construction Specifications 2010 Section 11 Part 1.5.3 "Electrical Safety on Site"

Qatar Construction Specifications 2010 Section 11 Part 2.3.4 "Electricity at Work"

NFPA 70E Standard for Electrical Safety in the Workplace (NFPA NEC 70E) – Electrical Safety Related Work Practices

29. Attachments

[LUS-HSE-FM4-446-049](#) Ground Conductor Test Log

[LUS-HSE-FM4-446-050](#) Qualified Electrician Certification