ELECTRICAL SAFETY

IN

ONSHORE DRILLING AND WORKOVER RIGS

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ELECTRICAL SAFETY

IN

ONSHORE DRILLING AND WORKOVER RIGS

Prepared by:
COMMITTEE ON
“ELECTRICAL SAFETY IN ONSHORE DRILLING AND WORKOVER RIGS”

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Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve Nil incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director

Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is over 100 years old. As such, various practices have been in vogue because of collaboration/association with different foreign companies and governments. Standardisation in design philosophies, operating and maintenance practices remained a grey area. This, coupled with feedback from some serious accidents that occurred in the past in India and abroad, emphasised the need for the industry to review the existing state-of-the-art in designing, operating and maintaining of oil and gas installations.

With this in view, the Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council, assisted by Oil Industry Safety Directorate (OISD) staffed from within the industry for formulating and implementing a series of self regulatory measures aimed at removing obsolescence, standardising and upgrading existing standards to ensure safer operations. Accordingly, OISD constituted a number of functional committees comprising of experts nominated from industry to draw up standards and guidelines on various subjects.

For some time, a need had been felt for a simple yet comprehensive document to provide basic information on electrical safety in areas related to onshore drilling / workover rigs. This document has been prepared keeping this objective in view.

This document will be reviewed periodically for improvement based on the new experiences and better understanding. Suggestions may be addressed to:

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These documents are intended only to supplement rather than replace the prevailing statutory requirements.
COMMITTEE ON STANDARD “ELECTRICAL SAFETY IN ONSHORE DRILLING AND WORKOVER RIGS”

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In addition to the above, various other experts from the industry contributed in the preparation, review and finalisation of this document.
## ELECTRICAL SAFETY IN ONSHORE DRILLING AND WORKOVER RIGS

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Electrical Safety in Onshore Drilling and Workover Rigs

1.0 INTRODUCTION:

Safety in Electrical System deserves maximum attention especially in the hydrocarbon industry, where hazardous atmosphere is normally encountered. Electricity constitutes one of the major sources of ignition by arcs, sparks and hot surfaces. Electrical hazards may cause injuries and fatalities to personnel due to electric shock and burn besides equipment damage and property loss. Electrocution of personnel associated with road transportation of rigs needs to be prevented through an appropriate system of checks and control measures.

The primary objective of preparing this standard is to ensure electrical safety in onshore drilling and work over rigs.

2.0 SCOPE:

This standard lays down the minimum requirements for commissioning, operation, maintenance and repair of electrical equipment / systems on onshore drilling and workover rigs in exploration and production industry.

3.1 DEFINITIONS:

(1) **Approved**: Approved by the Chief Electrical Inspector by a general or special order in writing and subject to such conditions as he may specify therein;

(2) **Authorized person**: a person authorized under rule-3 of IER, 1956;

(3) **Circuit**: an arrangement of conductor or conductors for the purpose of conveying energy and forming a system or a branch of a system;

(4) **Circuit breaker**: a device, capable of making and breaking the circuit under all conditions and unless otherwise specified, so designed as to break the current automatically under abnormal conditions;

(5) **Cut-out**: any appliance for automatically interrupting the transmission or energy through any conductor when the current rises above a pre-determined amount, and shall also include fusible cut-out;

(6) **Cable tray**: a horizontal or vertical metal support for a cable run. A cable tray may support one or more cables;

(7) **Dead**: at or about earth potential and disconnected from any live system; provided that apparatus separated from a live conductor by a spark gap shall not be deemed to be “dead”;

(8) **Earthed or Earth connection**: connected with the general mass of earth in such manner as to ensure at all times an immediate discharge of energy without danger;

(9) **Earth Electrode**: a metal plate, pipe or other conductor embedded in the soil that makes a direct contact to the general mass of the earth;

(10) **Electrical-in-charge**: a person in charge of the electrical department/section of the owner organization responsible for safe operation and maintenance of all electrical systems. He shall also ensure the system of issuing electrical clearance as detailed in various sections, and conformity of installations with statutory requirements from time to time;

(11) **Flameproof (FLP) enclosure**: an enclosure, surrounding the parts which can ignite a potentially explosive atmosphere, which withstands the pressure of an explosive mixture exploding inside the enclosure and prevents the propagation of the explosion to the atmosphere surrounding the enclosure.

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(12) **Flammable**: capable of being easily ignited, burning intensely or having a rapid rate of flame spread;

(13) **Flash point**: will have the same meaning as is assigned to that term in the Petroleum and Natural Gas Rules, 1950 framed under the Oil field (Regulation and Development) Act 1948;

(14) **Guarded**: covered, shielded, fenced or otherwise protected by means of suitable casings, barriers, rails or metal screens to remove the possibility of dangerous contact or approach by persons or objects to a point of danger;

(15) **Hand-held portable apparatus**: an apparatus which is so designed as to be capable of being held in the hands and moved while connected to a supply of electricity;

(16) **Hazardous atmosphere**: an atmosphere containing any flammable gas in a concentration capable of ignition;

(17) **Hazardous area**: an area where hazardous atmosphere exists or is likely to occur;

(18) **IER, 1956**: The Indian Electricity Rules, 1956 as amended from time to time;

(19) **Intrinsically safe**: as applied to apparatus or associated circuits shall denote that any sparking that may occur in normal working is incapable of causing explosion of inflammable gas or vapour;

(20) **Installation Manager / Drilling-in-charge (DIC)**: the person appointed by the owner or agent or mines manager of the Drilling / workover rig to be in-charge of and responsible for all operation and activities on or in connection with the rig;

(21) **Linked switch**: a switch with all the poles mechanically linked so as to operate simultaneously;

(22) **Live**: electrically charged;

(23) **Metallic covering**: mechanically strong metal covering surrounding one or more conductors;

(24) **Neutral conductor**: that conductor of a multi-wire system, the voltage of which is normally intermediate between the voltages of the other conductors of the system and shall also include return wire of the single phase system;

(25) **Occupier**: the owner or person in occupation of the premises where energy is used or proposed to be used;

(26) **Official**: a person appointed in writing by the owner, agent or mines manager to perform duties of supervision in mine or part thereof and includes installation manager, safety officer and fire officer;

(27) **OMR, 1984**: The Oil Mines Regulation, 1984 as amended from time to time;

(28) **Open sparking**: sparking which owing to the lack of adequate provisions for preventing the ignition of inflammable gas external to the apparatus would ignite such inflammable gas;

(29) **Portable apparatus**: an apparatus which is so designed as to be capable of being moved while in operation;

(30) **Street box**: a totally enclosed structure, either above or below ground containing apparatus for transforming, switching, controlling or otherwise regulating energy;

(31) **Shall**: indicates a mandatory requirement;

(32) **Should**: indicates a requirement, which is recommendatory in nature;

(33) **Switch Gear**: denote circuit breakers, cut outs and other apparatus used for the operation, regulation and control of circuits.

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(34) **Switch Boards:** mean an assembly including the switchgear for the control of electrical circuits, electrical connections and supporting frame.

(35) **Zone 0:** An area in which a hazardous atmosphere is continuously present.

**Zone 1:** An area in which a hazardous atmosphere is likely to occur under normal operating condition.

**Zone 2:** An area in which a hazardous atmosphere is likely to occur only under abnormal operating conditions.

**4.0 HAZARDOUS AREA CLASSIFICATION:**

In order to determine the type of electrical equipment suitable for use in different conditions of hazardous atmosphere, the area shall be classified into three zones viz. Zone-0, Zone-1 and Zone-2.

**5.1 EARTHING & BONDING:**

i) The following shall be earthed by means of double and distinct earth connections in accordance with the IER, 1956, IS 3043 & IS 7689:

- System neutral.
- Metallic non-current carrying parts of all electrical apparatus.
- All enclosures, mounting structures, skids etc. e.g. Rig Mast and sub-structure, Diesel oil storage tanks, power control rooms (PCR), bunk houses (crew huts).
- Cable trays and racks, lighting mast and poles.
- Cable shields and armour.

ii) Refer **Annexure-1** for Minimum size of earthing conductors.

iii) All connections of earthing system shall have clean surfaces and free from paints, enamels, grease or other materials of poor conductivity.

iv) All electrical equipment, mast and skids shall be earthed by two separate and distinct connections with earth through an earth electrodes in accordance with IS-3043.

v) Each pit location shall be identified by permanent marker; its surroundings must be kept neat & clean and easily accessible.

vi) Earth resistance & continuity of connection shall be tested at each rig-up or every six months whichever is earlier and records thereof shall be maintained.

vii) The double and distinct earthing connections of all diesel storage tanks shall be placed at the diagonally opposite extremities of the tanks.

viii) Lighting fixtures and other LT equipment shall be earthed through the extra core provided in the cable for this purpose.

ix) Two numbers earth conductors of flexible cable with sturdy crocodile clips near diesel tank (connected to the nearest electrode) shall be provided for earthing diesel trucks during unloading of diesel in tank.

x) All conductors of an earthing system shall have conductivity at all parts and all joints ‘at least equal to 50% of that of largest conductor used solely to supply the apparatus, a part of which it is desired to earth.

xi) No switch, fuse or circuit breaker shall be inserted in any earth conductor.

xii) In case of grounded neutral system, each of the transformer LT side neutral and generator neutrals, if any, shall be earthed by two distinct electrodes.

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xiii). Ensure that all portable appliances are provided with 3-pin plug and socket connections and that the metal work of the apparatus is effectively earthed.

xiv). Earth electrodes shall be placed as per the earthing layout drawing of the rig. Otherwise, as built drawing shall be available.

xv). All earth electrodes (except instrumentation earth) shall be interconnected to form an earth grid.

xvi). The resistance value of an earthing system to general mass of the earth shall not exceed:
- 4 ohms in case of electrical systems and equipment or a value that ensures the operation of the protective device in the electrical circuit, whichever is lower;
- 10 ohms in case of all non current carrying metallic parts of major electric apparatus or any major metallic object;
- 1 ohm for main earth grid and bonding connections;
- 7 ohms for storage tanks and 2 ohms for any part of the fittings of the tank to earth plate.

xvii). All joints in pipelines, valves, storage tanks and associated facilities and equipment for petroleum shall be made electrically continuous by bonding or otherwise; the resistance value between each joint shall not exceed 1 ohm.

xviii). The lightening protection network shall be interconnected with main earth grid at minimum two locations below the ground.

6.1 CABLE LAYING AND CABLE CONNECTION:

All the above ground cables shall be laid in trays, duly covered. The underground cable shall be shrouded by hume pipe and buried under earth at 30 cms or more. Care should be taken to avoid any transit damage to the trays/ cables.

A. Tray Placing:

i) Ensure level of the trays.

ii) Place prefabricated steps or sand bags near cable tray along the walkway, as required.

iii) All cable trays shall be bonded and connected to the earthing system.

B. Cable laying:

i) During laying, pull the cables uniformly. Properly align and dress the cables.

ii) Check the cables for any deformation, deterioration in insulation and screen condition and replace the defective cables accordingly.

iii) Adjust the extra length of cables inside the trays in coils in such a way that it can be extended without any difficulty, if required.

iv) Where provided, armour of the cable shall be connected with earth through glands or clamps at both ends.

iv) Route of the underground cables shall be marked.
C. Cables and Plugs / Sockets:

i) Check the insulation resistance (IR) value of cable insulation for HT and LT cables as under:
   a) Each core to ground (for this, earth reference to be taken from a properly grounded system).
   b) Between any two cores.
   c) Every Core cable to sheath / screen

   Minimum IR values shall be 5 MEGA-OM and 1 MEGA-OM for HT and LT cables respectively.

ii) No water / moisture shall be permitted in the plug / sockets.

iii) Ensure the integrity of plug, sockets and their connections.

iv) Mark the cables at both the ends with appropriate numbers (as in cable schedule diagrams).

7.0 OPERATION, MAINTENANCE AND REPAIR PRACTICES:

7.1 General:

i). Recommended practices of OEM of respective equipment shall be followed and records maintained thereof.

ii). Pre-spud / Pre-workover electrical safety check list, as per Annexure-2 shall be followed.

iii). The following tools/ Instruments conforming to BIS specifications or equivalent shall be made available, for electrical jobs:
   a) Multi-meter;
   b) Insulation tester- intrinsically safe mega meter shall be used in Zone 1 & 2;
   c) Earth tester;
   d) Tong tester;
   e) Electrical tool box containing various general tools like Insulated pliers, Insulated screw drivers etc;
   f) Test lamp;
   g) HT Discharge stick;
   h) Double ladder;
   i) Insulated Hand gloves;
   j) Lux meter;
   k) Cell Tester;
   l) Tachometer;
   m) Thermometer;
   n) FLP Torch;
   o) Fuse puller

iv). Authorised person shall supervise the electrical work.

v). Work Permit System shall be followed as per OISD STD 105 on “Work Permit System”. Electrical Isolation / energization permit format of OISD-STD 105 is given in Annexure-3. Alternatively, electrical isolation/ energisation permit format of IS:5216 can be used provided it is interfaced with Hot/ Cold work permit of OISD-STD-105. Detailing in respect of de-energization and energization shall also be available in the shift logbook.

vi). Temporary connections, naked joints & wiring shall be avoided.

vii). On primary side of the transformer, a linked switch with fuses or circuit breaker of adequate capacity as per IER, 1956 shall be provided.

viii). Shoes with nailed soles shall not be worn.

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ix). Suitable discharge rods shall be used to ensure that the electrical circuit is completely dead before commencing work on it.

x). Single pole switch or fuse in a neutral circuit shall not be connected.

xi). Extra precautions shall be taken when working in damp areas.

xii). Water and foam shall not be used for extinguishing electrical fire unless the equipment is de-energised.

xiii). Fire fighting facilities shall be provided as per OISD-STD-189 on “Fire Fighting Equipment For Drilling Rigs, Work Over Rigs And Production Installations”.

xiv). Insulation resistance of motors and other electrical equipment shall be measured regularly with the help of suitable insulation tester once every six months or every rig-up whichever is earlier and records shall be maintained.

xv). The switchgears & protective devices shall be checked once every three months and results thereof shall be recorded in separate register.

xvi). Functional testing of Earth Leakage Relays (ELR) and Earth Leakage Circuit Breakers (ELCB) as per IER, 1956 shall be ensured.

xvii). All interlocks shall be maintained in working condition.

xviii). Integrity of flameproof equipment shall always be maintained.

xix). Portable appliances shall be provided with 3-pin plug and socket connections, and metallic body of the apparatus shall be earthed.

xx). Standard and proper size/rated cables, glands, plugs, sockets, fuses, relays and circuit breakers shall be used.

xxi). All transformers, batteries, stationary & rotating electric equipment etc. including portable/ hand held electrical apparatus shall be inspected as specified in OISD-STD-137 on “Inspection Of Electrical Equipment” and records maintained thereof.

xxii). During maintenance, if any equipment is removed from panel etc. which leaves an open cut-out of the equipment, the same, shall be promptly sealed. Blanking plates or other means shall be used to ensure that there is no loss of degree of ingress protection. It shall be ensured that all unused cable entries are blanked off.

xxiii). DC-PCR/AC-PCR room shall be provided with emergency lights.

xxiv). Smoke detection system shall be installed in DC-PCR / AC-PCR room.

xxv). List of authorized persons to work on electrical systems, duly signed by the Maintenance In-charge shall be displayed in Power Control Room.

7.2 Isolation / energization of electrical equipment:

7.2.1 Before job is taken up:

Necessary isolation procedure shall be followed, before issuing the electrical isolation permit, as below:

a). Switch off the field supply isolator (also put the field AUTO/ HAND switch in OFF position).

b). Switch off the space heater supply MCB.

c). Discharge all terminals to ground with a discharge stick.

d). Remove the control cable plug of the motor at motor end (if available),
e). Check with a multimeter for any voltage between armature, field, other terminals & ground. Check for any residual voltage on all terminals with the help of multimeter.

f). Connect both the armature terminals to motor earth point with a standard shorting loop.

g). Display caution boards on the panels and equipment.

h). Cover the heat sinks with an insulating sheet. Take shut down of the other energized field supply in case the live heat sink is close to the working area.

i). In case of transformer, switch off the secondary side breaker, followed by primary side breaker. Also, ensure, de-energization of bus sections.

7.2.2 After completion of job:

Necessary energization procedure shall be followed before issuing the electrical energization permit, as below:

a) Remove shorting loop from armature terminals & re-fix terminal box cover & inspection covers. Check tightness of gaskets of the covers.

b) Reconnect back the control cable plug of the motor at motor end, if provided at motor end.

c) Replace the control fuses in the isolators in switch fuse unit (SFU) or reset MCCB before switching on the starters.

d) Replace the control fuses in the starters & switch on the isolators.

e) Switch on the field supply isolator & put the field AUTO/HAND switch in AUTO position.

f) Switch on the space heater supply MCB.

g) Remove all the caution boards from isolators.

h) Record in the log book & maintenance register.

i) In the event of the job being incomplete at the time of shift change, the status shall be mentioned in the instruction register.

7.2.3 Equipment connected with Electrical motors:

a) For carrying out any specific job in the equipment connected with the electrical motor, electrical isolation permit shall be issued after ensuring positive isolation of electrical power by electrical personnel in the following manner:

i). Switch off the isolators in blower & auxiliary motor starters and remove the control fuses.

ii). Attach caution boards on the blower & auxiliary motor starter panel isolator handles.

iii). Switch off the field supply isolator & put the field AUTO/ HAND switch in OFF position.

iv). Display caution board on the field supply isolator handle.

v). Put the local interlock switch in OFF mode.

b) After completion of the job, the electrical personnel shall ensure the following, before issuing the electrical energization permit:

i). Replace the control fuses in the starters & switch on the isolators.

ii). Switch on the field supply isolator & put the field AUTO/HAND switch in AUTO position.

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7.2.4 Generator:

Necessary isolation procedure shall be followed before issuing the electrical isolation permit as below:

i). Isolate the generator breaker.

ii). Ensure positive isolation of voltages at various check points.

iii). Take complete shut down of incoming supply voltage bus in case of any job on the backside of breaker cradle.

iv). Check for residual voltage in the bus and naked metal parts.

v). Discharge the bus and all exposed metal parts to ground.

7.2.5 Silicon Control Rectifier (SCR) Panel:

Exercise extreme care while working in SCR panel due to presence of un-insulated high voltage parts & buses.

i) For working on DC module, control transformers etc:

   • Isolate the power supply before working on control system and transformer.
   • Ensure positive isolation of voltages at various check points.

ii) For working on SCRs or assignment contactors:

   • Take complete shut down of incoming bus and control supplies.
   • Check for residual voltage.
   • Discharge the bus and all exposed metal parts to ground.
   • Short all the three phases of incoming bus to ground in the SCR panel under repair.
   • While replacing SCR blower, switch off and rack the ACB out of chassis and remove associated fuses.

7.3 Rig dragging operations:

i). Ensure sufficient length of power cables & control cables etc. is available before dragging.

ii). Remove earth electrodes (if any) falling in the path of dragging or working area.

iii). Isolate power supply to mast lights and other electrical system not required in dragging operation.

iv). Cables shall be checked after completion of dragging operation.

v). Prior to re-energization, ensure health of all electrical equipment connected with rig mast & substructures.

7.4 Rig up & down and transportation:

i). Ensure no energized HT/LT overhead transmission line passes through the drill / workover site.
ii). Route survey shall be carried out to ensure minimum clearance from overhead lines of the equipment to be transported, as per IER, 1956. In case, minimum clearance requirement can not be met, then power lines shall be de-energized in coordination with State Electricity Board.

iii). Power supply to all the electrical equipment not required during rig down operations shall be de-energized.

iv). Care shall be taken to avoid ingress of moisture to the electrical machines and components during transit and storage.

v). Care shall be taken while handling and placing PCRs as described in OISD-STD-218 on “Guidelines For Safe Rig- Up And Rig- Down Of Drilling And Workover Rigs”.

7.5 Rig lighting system:

i) The voltage of lighting system shall be max. 250 volts phase to phase in accordance with IER, 1956. The neutral or mid points should also be connected to earth as per the requirements of IER.

ii) All connections to the light fitting in hazardous area shall be through double compression flameproof glands.

iii) Each circuit shall be protected / controlled by ELR / ELCB as per IER, 1956.

iv) Aviation warning lights shall be fixed on top of the mast through a separate circuit.

v) Adequate illumination levels shall be ensured in all areas.

8.0 WELL LOGGING OPERATIONS:

Following precautions related to electrical equipment / procedures during logging shall be followed:

i). Hold Safety meeting with Installation Manager.

ii). All the arc/gas welding machines and cathodic protection equipment to be turned off.

iii). Radio Transmitters/ Receivers, mobile phones and all generators to be turned off within 300 m. of work area well before arming the explosive device and shall remain switched off till the device is 200 m. down inside the well.

iv). Power supply to SRP (Sucker Rod Pump) within 30 m. from Well Head, shall be switched off.

v). Do not carry out any electrical testing (I.R. tester) discharging etc. during Well Logging operation.

vi). AC power of the logging unit can be restored after running the device inside the well at least 100 m. below ground level.

For details, refer OISD-STD-183 on “Standard On Logging Operations”

9.0 CLUSTER WELL LOCATIONS:

When the cluster wells are situated at a distance of less than or equal to 9 meters, the following shall be followed:

i). Prior to switching on power supply, it shall be ensured that the gas concentration is below the lower explosive limit at the drill site.

ii). If any Non FLP motor/other electric driven appliances is within 15 m radius from the well to be scrapped by mechanical means, then these motors shall be shut down during the period of scrapping.

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iii). No electrical cables shall pass over the producing well. All the cables shall run through the cable tray maintaining a minimum safe distance of 3 meters from the producing well.

iv). During scraping operation, hot work permit system shall be followed.

v). During scrapping, no electrical test shall be carried out using electrical test equipment unsuitable for hazardous area.

For details, refer OISD-STD-186 on “Combined Operations”.

10.0 WELDING OPERATIONS:

i). Issue the hot work permit before starting the job and follow all conditions stipulated in the permit.

ii). Work piece shall be connected directly to proper earthing in line with OISD-GDN-192 on “Safety Practices During Construction” and OISD-GDN-207 on “Contractor Safety”.

iii). Three core cable with proper colour code shall be used for single phase connection in line with OISD-STD-173 on “Fire Protection System for Electrical Installations”.

iv). Work shall be carried out under supervision during odd hours.

v). Welder shall be imparted training about hazards associated with welding and electric shocks.

vi). Ensure use of PPE like welding suits, leather gloves, safety shoes, safety goggles, helmets etc by the welder while working.

11.1 PRE-COMMISSIONING CHECKS:

Inspect the electrical equipment for any transit damage and take corrective actions if necessary. Before start up, ensure the following:

11.2 Rig Alternator / Power Packs:

i). Proper and tight connections.

ii). Proper functioning of exciter/field/stator coils, AVR, rectifier bridge, brushes, surge suppressor or variable resistor (varistor) etc.

iii). No blockage of ventilator openings.


v). Proper alignment of coupled machines.

vi). Proper fitment of coupling guards.

vii). Proper earthing connections.

viii). Healthy protection circuits.

ix). Proper glanding.

x). Compliance with OEM requirements for actuator, magnetic pick-up, exciter and resistance temperature detector (RTD).

xi). Proper functioning of space heaters.

xii). The IR values of HT & LT equipment conform to stipulated values.

xiii). Compliance with manufacturer’s recommendations for the idle run, test run and parallel run.

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11.3  **Electrical Motors:**
   i) Proper and tight connections.
   ii) Proper functioning of motor lock-out switch, blower and air flow switch.
   iii) No blockage of ventilator openings.
   iv) Proper fitting of coupling guards and chain guards.
   v) Proper Earthing connections
   vi) Healthy protection circuits.
   vii) Proper glanding.
   viii) IR values of HT & LT equipment conforms to stipulated values.
   ix) Functioning of space heaters.
   x) Compliance with OEM recommendation for the idle run, test run and parallel run.

11.4  **Driller’s Console:**
   i) Proper mounting of Driller’s Console on Vibration dampener blocks.
   ii) Ingress protection.
   iii) Proper and tight connections.
   iv) Proper functioning of emergency shut down system.
   v) Proper functioning of indicator lamps and meters.

11.5  **Eddy Current Brake:**
   i) Compliance with OEM recommendations for IR values of all coils.
   ii) Integrity of Brake control panel.
   iii) Proper glanding.
   iv) Proper and tight connections.
   v) Proper water flow to brake before switching on.
   vi) Proper functioning of alarm system for loss of cooling water flow.
   vii) Proper functioning of the electronic circuit breaker (ECB).

11.6  **PCR Panels:**
   i) Proper functioning of all relays timers, interlocks and other associated safety devices.
   ii) Integrity of connections, relays and contractors.
   iii) Integrity of indicating lamps and functioning of meters.
   iv) IR test values of the panel confirm to stipulated values.

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11.7 B.O.P. Control Unit:

Proper functioning of:

i) Starter and motor of accumulator charge pump.

ii) Hydro-electric switch.

iii) Indicator lamps of all BOP control panels.

The Pre-commissioning checks for electrical system of rig prescribed by OEM are to be carried out in addition to the above and those mentioned in Annexure-4.

12.0 DOCUMENTATION:

Documentation shall be maintained as detailed out in Pre-spud / Pre-workover electrical safety check list as depicted in Annexure-2.

13.0 REFERENCES:

The Indian Electricity Rules 1956
Oil Mines Regulations 1984
API RP 500-B,

IS-2148, 3043, 5216, 15652, 9570, 8280, 5571, 7389, 8224, 5780, 8289, 6381, 8985, 2206, 5572, 3682, 4051, 4691/2147, 9628, 7693, 7724, 58241, 11333, 3646.

OSHAS standard – 1910.302-308
OISD STDs-105, 137,149,173, 174, 183, 186, 189, 207 and 218.

Recommended Code of practices of ONGC and OIL.

14.1 ANNEXURES:

1. Minimum size of earthing conductors.
2. Pre-spud / Pre workover electrical safety check list
3. Electrical Isolation / Energization Permit
4. Pre-commissioning checks for electrical system of rig.
## MINIMUM SIZE OF EARTHING CONDUCTORS

<table>
<thead>
<tr>
<th><strong>Type of Equipment</strong></th>
<th><strong>Bare G.I. Strip/GI Wire Rope / G.I Wire</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Lighting poles</td>
<td>Through 3rd core of the cable or 8 SWG GI wire</td>
</tr>
<tr>
<td>b) Motor upto 3.7 KW and all PBS and instrumentation boxes</td>
<td>8 SWG GI wire</td>
</tr>
<tr>
<td>c) Cable trays (Loop connection)</td>
<td>8 SWG GI wire</td>
</tr>
<tr>
<td>c) Motors above 3.7 KW upto 30 KW and generators/alternators including welding receptacle</td>
<td>25 mm x 4 mm GI strip</td>
</tr>
<tr>
<td>d) Motors and Generators/Alternators above 30 KW upto 100 KW</td>
<td>40mm x4mm GI Strip</td>
</tr>
<tr>
<td>e) Generators/Alternators/DC Motors above 100 KW</td>
<td>50mmx4mm GI strip or equivalent multi strand cable</td>
</tr>
<tr>
<td>f) All Metallic Structures</td>
<td>40mmx4mm GI strip or equivalent multi strand cable</td>
</tr>
<tr>
<td>f) Power Transformer (Body)</td>
<td>50mmx4mm strip or equivalent multi strand cable</td>
</tr>
<tr>
<td>g) PCR</td>
<td>50mmx4mm strip or equivalent multi strand cable</td>
</tr>
</tbody>
</table>

Note: All earthing connections to the earth electrode by GI strip of size 50 mm x 4 mm
PRE-SPUD / PRE-WORKOVER ELECTRICAL SAFETY CHECK LIST

1. DISPLAY OF CAUTION BOARDS:
   a) Electrical Caution Board on all electrical equipment.
      "DO NOT OPERATE, MEN WORKING ON LINE" wherever applicable.
   b) Notice forbidding entry of unauthorized persons in Electrical PCR / Switch Board Room.
      "ENTRY OF UNAUTHORISED PERSONS STRICTLY PROHIBITED".

2. DISPLAY AT STRATEGIC LOCATIONS:
   i) Power flow diagram.
   ii) Cable Lay out and Earthing Drawing.
   iii) Hazardous area classification of the location.
   iv) Electrical Shock Treatment Chart.
   v) Fire Extinguishers for electrical fire.
   vi) Do’s & Don’ts.
   vii) Role and responsibility of electrical personnel during emergency.
   viii) Important/emergency telephone numbers.

3. RECORD KEEPING (AS APPLICABLE):
   i) Employee’s Bio- Data.
   ii) Shift Roster.
   iii) List of trained MVT, First Aid & Fire fighting personnel.
   iv) List of persons with Electrical License.
   v) Accident Records.
   vii) Commissioning Record.
   viii) Earth Resistance & Insulation Resistance Record.
   x) Work Permits.
   xi) Daily check list of electrical equipment.
   xii) Periodical check list (including R/up & R/down).

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4. **EARTHING**:
   i) Total No. of earth electrodes /pits.
   ii) Condition of earth electrodes, G.I. strips & earthen wires.
   iii) 2 Separate & independent earthing exists for all electrical equipments.
   iv) 2 Separate & independent earthing exists for substructure for lightening protection.
   v) Value of earth resistance.
   vi) Equipment, cable tray & C.G.I sheet roof etc. connected to earthing system – Yes / No.
   vii) 2 Separate & independent earthing exists for Transformer body.
   viii) 2 Separate & independent earthing exists for neutral.

5. **PROTECTIVE EQUIPMENT**:
   i) Emergency tripping system at Drillers console exist & functional.
   ii) Automatic disconnection facility as applicable for drilling motors/main generators and other motors under the fault condition available.

6. **ELECTRICAL EQUIPMENTS FOR HAZARDOUS AREA APPLICATION**:
   i) Condition of FLP equipment.
   ii) Any modification in the electrical equipment used in hazardous area carried out in approved/suitable manner.

7. **VOLTAGE RESTRICTION**:
   230 volts Phase to Phase and 110 Volts Phase to Earth voltage system for lighting.

8. **USE OF PERSONAL PROTECTIVE EQUIPMENT**:
   i) Insulating Hand Glove.
   ii) Insulating mat.
   iii) Insulated Shoes.
   iv) Helmet, safety belt, goggles, masks etc.

9. **AVAILABILITY OF INSULATED ELECTRICAL TOOLS AND INSTRUMENTS**.

10. **RECOMMENDED CODE OF SAFE PRACTICES**.

11. **AVIATION WARNING LIGHT FITTINGS AT THE TOP OF THE MAST**.

12. **SUFFICIENT ILLUMINATION LEVEL**.

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13. **AVAILABILITY OF THE FOLLOWING AT SITE AS APPLICABLE:**

i) Double ladder.
ii) First Aid box and stretcher.
iii) FLP torch.
iv) Stand by / emergency generator set.
v) Emergency lighting inside Control Room.

This checklist shall be a part of Pre-spud / Pre-work over check list of drilling and workover rigs.
Annexure-3

(Name of Company)
(Location)

Electrical Isolation / Energization Permit

Section-A: Isolation Permit.

Request for Isolation:

Sl.No. __________________

Date: ____________________  Time: ____________________

Department / Section / Area issuing the permit: ________________________________

Equipment number to be isolated:

Name of the equipment / circuit to be isolated:

The above-mentioned equipment / circuit shall be de-energized and isolated from all live conductors to carry out the maintenance work by ______________________________ section / for operational requirement.

_________________________  __________________________  ____________________
Issuer Name  Designation  Signature

Certificate of Isolation:

Date: ____________________  Time: ____________________

Certified that Equipment / Circuit no. ____________________ of ____________________ rig has been electrically isolated by switches / isolators / links / fuses (tick as applicable) and the danger tag is put on the supply panel. Actions in respect of electrical isolation have been recorded in the electrical shift logbook.

_________________________  __________________________  ____________________
Name of Authorized Person  Designation  Signature

Section-B: Energization Permit.

Request for Energization:

Sl.No. __________________

Date: ____________________  Time: ____________________

Department / Section / Area issuing the permit: ________________________________

Equipment number to be energized:

Name of the equipment / circuit to be energized: ________________________________
Work on the above mentioned equipment / circuit has been completed and all the applicable permits closed. This equipment / circuit may be energized.

<table>
<thead>
<tr>
<th>Issuer Name</th>
<th>Designation</th>
<th>Signature</th>
</tr>
</thead>
</table>

Certificate of Energization:  
Date: ____________________ Time: ____________________

Certified that Equipment / circuit no. ____________________ of ____________________ rig has been electrically energized and the danger tag removed from the supply panel. This is also recorded in the electrical shift logbook.

<table>
<thead>
<tr>
<th>Name of Authorized Person</th>
<th>Designation</th>
<th>Signature</th>
</tr>
</thead>
</table>
PRE-COMMISSIONING CHECKS FOR ELECTRICAL SYSTEM OF RIG:

1. Proper numbering on all cables & light fittings.
2. Clean plugs, sockets of all power cables and tighten the screws.
3. Connect all plugs to the respective sockets.
4. Record earth resistance of each electrode and ensure proper earth connection.
5. Clean all the AC & DC panels with vacuum cleaner.
6. Clean all SCR filters.
7. Clean all filters of air conditioning units.
8. Replace defective carbon brushes of all DC motors.
9. Service mast lights and replaces all the defective bulbs & defective holders.
10. Service other light fittings.
11. Open terminal boxes of AC & DC motors, generators & service the terminals & tighten the connections.
12. Proper jointing of all cables as required. Replace the defective cables.
13. Take IR values of all motor and generators & record.
14. Open back side covers of panels and tighten the nuts/bolts.
15. Check for direction of rotation of all rotating equipments.
16. Check proper functioning of ELCB & ELR in all panels of AC motors.
17. Check for tightness & proper connections of all cable glands.
18. Check function testing of all PBS.
19. Ensure functioning of Indication lamps and meters
20. Ensure availability of insulating mats conforming to IS:15652:2006 having ISI mark in all electrical panel rooms.
21. Ensure Danger/Caution boards near all electrical equipment are fixed.
22. Ensure electric shock treatment chart and single line diagrams are displayed in strategic locations.
23. Ensure availability of fire fighting equipment near electrical equipment.
24. Ensure earthing of diesel tanker, diesel tank and LWC tank.
25. All batteries are kept in battery boxes.
26. Separate earthing for welding transformer is done & two cables for earthing to be used instead of one.
27. Ensure cable compound in terminal boxes of Motors in hazardous area.
28. Ensure that flameproof features of motors in hazardous area are maintained.
29. Availability and functioning of emergency lights.
30. Availability of fan & fan cover in all motors.
BEFORE CHARGING OF BUS AND OPERATION OF TRANSFORMERS AND ALTERNATORS

1. Check for continuity and phase sequence of incoming supply.
2. Check for all safety devices of the engine such as over speed, low lube oil and high temperature trips.
3. Off load assignments of DC motors.
4. Functioning of emergency push button on driller’s console.