

SAFETY CODE FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	Electrical Safety	Doc. No: SC/15
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1. OBJECTIVE

The objective of this code is to provide a generic guideline for electrical safety practices to be observed in Iron & Steel Industries.

Associated Hazard:Electrical Shock, Electrical Flash, Electrical Burn, Fire, Slip/ Trip/ Fall, Hit/ Press/ /Cut hazard, Fall ofPerson or materials from height etc.

2. SCOPE

This code of practice is applicable to all location of Iron and Steel Industries for generic electrical safety purpose.

3. PROCEDURE

Electrical work can be performed safely if the rules are followed, right precautions are taken and one stay aware of the surroundings.

3.1 Definitions

- i) Low Voltage: Where the voltage does not exceed 250 V under normal conditions.
- ii) Medium Voltage: Where voltage does not exceed 650 V under normal conditions.
- iii) High Voltage: Where voltage does not exceed 33 KV under normal conditions.
- iv) Extra High Voltage: Where the voltage exceeds 33 KV under normal conditions.
- v) PPE- Personal Protective Equipment
- vi) ATPV- Arc Thermal Performance Value
- vii) FR- Flame Resistant
- viii) RCBO- Residual Current Breaker with Overload
- ix) DCP- Dry Chemical Powder
- x) CPR - Cardio-Pulmonary Resuscitation

3.2 All Electrical Installations shall be installed and maintained in compliance with the Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations.

3.2.1 Electrical Room Related Safety Measures-

- i) The Electrical Installations for Medium, High and Extra high voltage shall have a danger notice both in English or Hindi and local language of the district with a sign of skulls and bones.
- ii) Minimum PPE requirement, Hazards & precautions to be taken, Unauthorized Access Prohibited Signage, Schematic layout of the Electrical Area with emergency Equipment location etc. are to be displayed at the entrance of Electrical Room.
- iii) Electrical Shock Chart with instructions in English or Hindi and the local language of the district and where Hindi is the local language, in English and Hindi for the restoration of persons suffering from electric shock have to be affixed in a conspicuous place.
- iv) Single Line Diagram to be displayed inside Electrical rooms.
- v) The Emergency Action Plan with Emergency contact numbers, Employees' name who are trained on CPR & first aid to be displayed in Electrical rooms.
- vi) First aid boxes, stretchers, Oxypack, Gas Mask etc to be made available in Electrical rooms or near vicinity.
- vii) The Electrical Installations for high and extra high voltage shall have a running tap of drinking water and Emergency Safety shower with drinking water connection and proper drainage facility. In case of electric burns, the burnt portion should be cooled down using drinking water. In every manned high and extra high voltage sub section, an artificial respirator to be provided.
- viii) Good housekeeping to be maintained within the electrical room. The floor of Electrical Substation should be kept free from slip/ trip/ fall hazard like open cable riser, moving checker plate or floor board etc.
- ix) Along with the main exit door, Emergency Exit door is to be provided and should be in accessible safe condition in the 415V and above electrical rooms.

3.2.2 PPEs to be used for Electrical Job:

PPEs to be used as per electrical job requirement at different voltage level are given below

Voltage level	PPE to be used
Upto 650V Electrical job	Safety shoes, Safety helmet, Safety Goggles, 8.5 ~ 9 Calories /cm ² ATPV LV Arc flash suit, 12 Calories /Cm ² ATPV Hand gloves, 12 Calories /Cm ² ATPV Arc Face Shield
Above 650 V Electrical jobs	Safety shoes, Safety helmet, Safety Goggles, 40 Calories/ cm ² ATPV HT Kool coat (FR pant and FR shirt and Double layer switching coat, Hand gloves (Inner & Outer),

	Hard Hat is included in the HTKool Coat Kit)
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3.2.3 Electrical Equipment related Safety Measures:

- i. All the equipment used in the Electrical room shall be of sufficient current rating for its normal duty as well as during the fault current. The equipment shall be of sufficient mechanical strength to with stand the fault condition to ensure human safety.
- ii. Every switch board of Medium, high or extra high voltage shall comply the following provisions-
A clear space of not less than 1 meter in width shall be provided in front of the switch board. If there is any attachment at the back of the switchboard, the space shall be either less than 20cm or more than 75cm in width from the farthest outstanding part of the switchgear. If the space behind the switchboard exceeds 75 cm in width, there shall be passage-way from either end of the switchboard clear to height of 1.8 meters.
- iii. All disconnect switches are to be identified and labelled stating the source of the circuit and the equipment / circuit it is feeding.
- iv. Electrical equipment, machinery and work areas to be kept clean. Access to panels and junction boxes to be kept clear.
- v. Insulation mat of proper grade to be used in front of 415V & above electrical switchgears.
- vi. All panel doors must be locked, made vermin proof by sealing entry holes specially from cable entry points
- vii. Bus coupler panel and its cubicle shall be handled with utmost care. Red painting of Bus coupler, Adaptor panel & Tie feeder panel from all sides (front, top and back) for easy identification and treat Adaptor panel as a part of Bus coupler.
- viii. Incoming barrier of power supply and phase barrier inside the switchgear panel to be ensured
- ix. There should not be any loose wirings, exposed joints, Distribution Box or Junction box in cover open condition in the workplace.
- x. No High Voltage and Extra High Voltage system/switchgear which has been kept disconnected, for period of six months or more for any maintenance job shall be energized without Testing.
- xi. All apparatus, cables and supply lines shall be maintained in healthy conditions and tests shall be carried out periodically as per the relevant code of practice of the Bureau of Indian Standards.
- xii. Records of all Tests, repairs, maintenance work of all the Equipment in the Electrical room shall be duly kept in the history registers /SAPPM system so that these records can be compared with earlier ones.
- xiii. Over Current Protection to be provided to disconnect the supply automatically if the rated current of the equipment, cable or supply line is

- exceeded for a time which the equipment, cable or supply line is not designed to withstand.
- xiv. Earth fault or Earth leakage protection to disconnect the supply automatically if the earth fault current exceeds the limit of current for keeping the contact potential within the reasonable value.
 - xv. Gas pressure type (Buchholz relay), winding and oil temperature protection to give alarm and tripping shall be provided on all oil type transformers of rating 1000 KVA and above.
 - xvi. Transformers of capacity 10MVA and above shall be protected against incipient faults by differential protection. For the special Transformers (like furnace Transformers / Converter Transformers) of the same rating, "ON LINE DGA" system shall be used and its contact shall be wired for the alarm of the transformer.
 - xvii. Where a sub-station or a switching station with apparatus having more than 2000 litres of oil is installed, whether indoor or outdoors following precautions to be taken-
 - a) the baffle walls of four hours- fire rating shall be provided between the apparatus-
 - i. where there is a single phase transformer banks in the switch-yards of generating stations and sub-stations
 - ii. on the consumer premises;
 - iii. where adequate clearance between the units is not available
 - b) provision shall be made for suitable oil soakpit. Where use of more than 9000 litres of oil in any one oil tank, receptacle or chambers involved, provision shall be made for the draining away or removal of any leaked/escaped oil and special precautions shall be taken to prevent the spread of any fire resulting from the ignition of the oil from any cause and adequate provision shall be made for extinguishing any fire which may occur
 - c) Spare oil shall not be stored in the vicinity of any oil filled equipment in any such substation or switching station.
 - d) All the transformers and switchgears shall be maintained in accordance with the maintenance schedules prepared in accordance with the relevant codes of practice of Bureau of Indian Standards.
 - e) The transformers of 10 MVA and above rating or in case of oil filled transformers with oil capacity of more than 2000 litres are to be provided with fire fighting system as per IS - 3034: 1993 or with Nitrogen Injection Fire Protection system
 - xviii. Dry type of transformers only shall be used for installations inside the residential and commercial buildings.
 - xix. All the generators with rating of 100KVA and above shall be protected against earth fault leakage.
 - xx. All the generators of rating 1000KVA and above shall be protected against faults within the generator winding using restricted earth fault protection or differential protection or both.

- xxi. Following safety interlocks are essential for the safe operation of the switchgears:-
 - a. Isolators and controlling circuit breaker shall be interlocked so that isolators cannot be operated unless the corresponding breaker is in open position.
 - b. Isolator and corresponding earthing switches shall be interlocked so that no earthing switch can be closed until the corresponding, isolator is in open condition.
 - c. Where two or more supplies are not intended to be operated in parallel, the respective circuit breakers or linked switches controlling the supplies shall be interlocked (Electrically and mechanically to extent possible) to prevent possibility of any inadvertent paralleling or back feed.
 - d. When two or more transformers are operated in parallel, the system shall be so arranged as to trip the secondary breaker of transformer in case the primary breaker of that transformer trips.
 - e. Where two or more generators are operated in parallel and neutral switching is adopted, interlock shall be provided to ensure that generator breaker cannot be closed unless one of the neutrals is connected to the earthing system.

3.2.4 Safety Measures to be adopted by persons working on Electrical equipment:

- i. Only authorized /qualified personnel to be allowed to work on electrical job. Relevant certification to be obtained from Electrical Inspectorate as applicable.
- ii. No one should wear loose clothing, metal watch straps, bangles or finger rings while working on electrical appliances.
- iii. Any electrical appliance or machinery never to be used by user while in wet condition.
- iv. The tools & tackles like screw drivers, pliers, cleaning brushes, Handlamps, torches etc should be properly insulated.
- v. Cords or tools with worn insulation or exposed wires should not be used.
- vi. Only double-sided steps or stable ladders of FRP (dual support) to be used for maintenance of panels and Bus-bar.
- vii. Before any maintenance job is carried out on or near the live parts the power source should be proved dead. All voltage indicators should always be tested on a known "Live" source immediately before and after use.
- viii. No person should carry out work including maintenance, repairs, cleaning and testing etc on any parts of apparatus which are normally live unless such parts are proved to be dead and Permit is taken in appropriate Work Permit form & Lock Out Tag Out done.
- ix. Before touching any equipment, which has been energized and after taking precautions regarding switching off supplies, the equipment shall be earthed.
 - a. Many makes of the switchgear have special arrangements fitted to the switchgear so that bus bars or feeders may be earthed through the circuit

breaker. This is the safest method and should always be used if the equipment is available.

- b. If the above equipment is not available, earthing should be carried out using a covered flexible earthing lead which has been first clamped to earth bar and then touched on the parts to be earthed by a suitably insulating rod. The earthing lead shall have the cross-section area commensurate with the short circuit rating of the switchgear.
- x. During inspection or maintenance of mechanism of Circuit breaker care should be taken to avoid fingers being trapped in any part of the mechanism and avoid the possibility of anyone being struck by moving parts of the mechanism or the moving contacts. It is recommended to discharge the stored energy in the mechanism like release of the spring etc.
- xi. Test should be made for the correct operation and calibration of protective devices periodically and particularly after faults. It is essential that the settings should be restored to the correct values after the test.
- xii. In no circumstances should attempts be made to rewire a non-rewire able fuse.

3.2.5 Electrical Earthing Requirement:

- i) System Earthing: Neutral conductor of a 3-phase, 4-wire system and the middle conductor of a 2-phase, 3-wire system, one point of single phase supply or artificial neutral point created by having earthing transformer in 3 phase 3 wire system shall be earthed by not less than two separate and distinct connection with a minimum of two different earth electrodes or such large number as may be necessary to bring the earth resistance to a satisfactory value both at the generating station and at the sub-station. The earth electrodes so provided, shall be interconnected to reduce earth resistance.
- ii) Equipment Earthing: The frame of every generator, stationary motor, portable motor, and the metallic parts (not intended as conductors) of all transformers and any other apparatus used for regulating or controlling energy and energy consuming apparatus shall be earthed by two separate and distinct connections with earth.
- iii) All earthing systems shall be tested for resistance with the help of an "Earth Tester" on a dry day during the dry season, not less than once a year for high and extra high voltages (>650 Volts) and not less than once every two years for low, medium voltages (<=650 Volts). The combined value of resistance to earth should not exceed 1 Ohm for all voltages.
- iv) The earth pit identification number, latest earth resistance, date of testing and due date of testing shall be displayed on every earth pit name plate.
- v) Earth pits to be properly maintained and chemical treatment of soil to be done as per requirement to keep the earth resistance to a satisfactory value.
- vi) Earth pits should be properly covered.
- vii) No material shall be allowed to be stacked/ dumped/ accumulate and debris shall not be deposited near/within the earthing station area.

- viii) Protection against lightning shall be provided in accordance with specific guidelines given in IS:2309 (Code of practice for the protection buildings and allied structure against lightning).

3.2.6 Safety Measures in Temporary Electrical Wiring

- i) Temporary electrical wiring is permitted only during the period of construction, remodeling, maintenance, repair, demolition and similar activities. It shall be removed immediately upon completion of the purpose for which the wiring was installed.
- ii) The temporary electrical wiring shall be installed in such a manner that it is not subjected to physical damage. The sharp corners and projections should be avoided while laying the cable. The wiring shall be adequately protected while passing through the door ways or other pinch points.
- iii) The metallic case of temporary lighting & Lighting Distribution Board (DB)s to be separately earthed.
- iv) Precaution to be taken so that temporary electrical cable laying at worksite should not interfere with normal Human and Equipment & machineries movement creating hazards like electrocution, electrical fire, Slip/ Trip/ Fall etc.
- v) All hand-held tools (eg hand held drill machine, hand held grinder etc) shall be protected through 30mA earth fault protection (RCBO etc) with 200 milli Seconds fault clearance time and Overcurrent setting as per Equipment requirement.
- vi) All Portable equipment/ tools which are not hand held (like submersible pumps, dewatering pump, 415V & 240V welding set etc.) shall be protected through 100mA earth fault protection (RCBO etc) with 100 milli Seconds fault clearance time and Overcurrent setting as per Equipment requirement.
- vii) Periodic checking of RCBO to be conducted by trip test
- viii) Earth leakage protection is not compulsory for double insulated tools

3.2.7 Electrical Fire Safety:

- i) Any combustible materials like grease, paint etc should not be present in close proximity with live electrical equipment.
- ii) Fire buckets with clean dry sand and ready for immediate use for extinguishing fires in addition to fire extinguishers suitable for dealing with electrical fires (CO₂ or DCP), shall be conspicuously marked and kept in all generating stations, enclosed substations and switching stations in convenient location.
- iii) Fire alarms to be provided in all Electrical rooms, man approachable cable vaults, cable tunnels, analyser rooms, PRS rooms and its hooter are sounded at a 24x7 manned area like control room, shift office etc and checked on regular interval.
- iv) Fire Retardant painting to be provided on Electrical cables to stop propagation of fire.
- v) Training to be provided on Fire Safety & CPR to electrical personnel.

- vi) Regular mock drill to be conducted for total power failure, electrocution, electrical fire etc as per the electrical area's emergency preparedness plan and record to be maintained.

3.2.8 Rescue & First Aid Measures for Electrical shock

- i) The victim usually gets stuck to the source of the electricity, and it is important that the victim should be first separated from the electrical source.
- ii) The main power supply switch to be adequately turned off.
- iii) In certain circumstances, it may be quicker to simply pull the victim away from the electrical source.
- iv) The victim should not be touched with bare hands, or the electric current will pass through the rescuer as well. Some dry, nonconductive material such as a wood, insulated rod etc. to be used to separate the victim from the live current whatever is handy.
- v) Once the victim has been separated, it is to be checked to see if he is breathing.
- vi) If breathing has stopped or seems slow, CPR (Cardio-Pulmonary Resuscitation) to be administered immediately by a trained person.
- vii) The victim should be moved as little as possible because the person may have suffered injuries to spine and neck.
- viii) If the victim has an electric burn, the clothing from the burned area to be removed gently (unless it's stuck to the skin) and the burned area to be rinsed in cool, running drinking water.
- ix) Emergency medical attention to be called as soon as possible

REFERENCES

1. Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations, 2010 with up to date amendments.
2. Tata Steel India Safety Standard: Working in Electrical Room (SS/ELEC-08), Electric Flash Suit (SFT/PRO-04), Inspection Testing and Maintenance of Earthing system (SS/ELEC-03), Temporary Electrical Wiring (SS/ELEC-01)