सत्यमेव जयते

आज़ादी का अमृत महोत्सव

भारतसरकार / Government of India
श्रमएवंरोजगारमंत्रालय/ Ministry of Labour & Employment
खानसुरक्षामहानिदेशालय / Directorate General of Mines Safety

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dated : 23/08/2024

DGMS Circular No. 06 of 2024

To
The Owner/Agent/Manager of all Coal/Metal/Oil/Gas Mines

Subject: Training Syllabus for Electrical Engineers, Electrical supervisors and Electricians who have been engaged for operation and maintenance of electrical installations in mines and oilfields. [Regulation (118) of CEAR - 2023]

An engineer, electrical supervisor, or electrician working in a mine must be familiar with various types of electrical installations, components, and their functions. This knowledge is crucial for efficiently supervising electrical system installation, maintenance, and repairs, while ensuring the highest safety and performance standards. Staying updated on advancements in electrical systems and technologies enables them to provide effective guidance to the personnel under their supervision.

According to regulation 118 of the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023, significant updates were introduced over the previous CEAR 2010 regulations, specifically a new regulation has been added for training of personnel engaged for operation and maintenance of electrical installations in mines and oilfields. This syllabus aims to ensure that all personnel engaged in electrical work in mines possess the necessary knowledge and skills. The updates were enacted in the newly notified Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2023, and Directorate General of Mines Safety was bestowed with the power of formulating the guidelines regarding this.

To develop the syllabus, numerous meetings were held with stakeholders and experts from the coal, metal, and oil mining sectors, and their feedback was incorporated into the draft. Key components of the syllabus include fundamental concepts, theories, and principles; advanced electrical systems such as control systems and automation; comprehensive safety procedures, risk assessment, and mitigation; familiarization with CEAR 2023 regulations and other relevant standards; and practical training.

In accordance with sub-regulation (1) of regulation 118 of the Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2023, the following syllabus

has been developed for training electrical engineers, supervisors, and electricians involved in the operation and maintenance of electrical installations in mines and oilfields.

TRAINING SYLLABUS FOR ELECTRICAL SUPERVISOR AND ELECTRICIANS OF MINES

General Instructions

1) The content of training courses and on-the-job training / practical training may be designed keeping in view the technical requirements as applicable.

2) The periodical refresher training may be customized as per the assessment and requirement.

3) After the lecture course is completed, the trainees are required to be taken on visit to a few modern power stations, testing labs, mechanized mine, manufacturer facilities of transformer, motors, switchgears etc.,

4) Facilities of training institute / for creation of training institute:

a) The training institute shall have devoted facilities -building, residential and recreation facilities.

b) The training institute shall have a full time Head of institute and adequate number of teaching faculty /staff. The institute may engage visiting faculty who are having experience in mining operations/OEMs/PSUs/Private Sector in order to enhance the operating skills of the trainee and for the chapters related to mining operations faculty having experience in mining operations shall be engaged.

c) The training institute shall have facilities such as, adequate number of lecture halls, seminar and conference hall/ auditorium, library, computer center, workshop, laboratories, Simulators, Virtual Reality (VR) labs, animation videos etc.,

d) The institute shall have facilities to arrange refresher courses to Electrical Persons such as Engineer, Electrical Supervisor and Electricians.

e) The institute shall fill up the Assessment form towards the performance of each participant.

5) The threshold marks for passing through the evaluation test, inclusive of written and practical test shall not be less than 50% of total marks.

Part-I

TRAINING SYLLABUS FOR ELECTRICAL SUPERVISOR OF MINES (FOR COAL OR METAL MINES)

Sl.No	Particulars	Number of Hours
1	Electrical Machineries: I. Operation, maintenance and pre-commissioning test of different types of motors (AC&DC). II. Operation, maintenance and pre-commissioning test of different types of generators. III. Operation, maintenance and pre-commissioning tests of different types of transformers. IV. Machineries/Equipment related to renewable generating stations. V. Battery operated vehicles and Locomotives.	3
2	Electric Drives and Control: I. Operation maintenance of Different types of starters including AC Drives such as VFDs etc., DC Drives, soft starters etc., II. PLC, SCADA and DCS	2
3	Switchgear and protective devices: I. Operation maintenance, pre-commissioning tests of different types of circuit breakers. II. Different types of protective schemes/protective devices and their operation maintenance and relay co-ordination.	2
4	Earthing system: Requirements, types of earthing, maintenance, chemical earthing and relevant provisions of IS - 3043.	2
5	Neutral system of power supply: I. solid neutral earthing, restricted neutral earthing, isolated neutral earthing, advantages /disadvantages. II. provisions of the Regulation for suitably designed restricted neutral system of power supply including neutral-ground monitoring protection system.	3
6	Design and layout of sub-station, Safety in sub-station, switchyard and switchboards: i. Safe working clearance. ii. Guarding of live apparatus. iii. Standard Operating Procedure (SOP) operation/maintenance of circuit breakers, transformers, isolators, surge arresters, instrument transformers, storage tanks etc.,	2
7	Operation and maintenance of substations and generating stations including maintenance of storage battery and related auxiliaries.	2
8	Operation, maintenance of overhead lines and underground cables I. Safety measures in over headlines II. Types of stays, its markings, grouting, stay insulator, binding etc., III. Types of guarding and clearances, earth/neutral wire, anti- climbing devices, and their erection. IV. Selection and fixing of control devices viz. Linked switches, fuses,	3

	isolators, earthing switches and lightning arrestors/surge diverters etc. V. SOPs for safe working on over headlines. VI. Cables and conductors, their classification, construction, insulation types, laying, mining type cables and the related standards, cable jointing techniques, terminations and junction boxes	
9	Electrical apparatus and machinery for mine installation (as applicable for a particular type of mine Oil/Coal/Metal) I. Winders, man riding system, cranes, EOTs etc., II. Electrically operated HEMM, portable transportable machinery, dragline, bucket wheel excavator, SDL, LHD, Road header, shearer, continuous miner, UDMs etc., III. Salient features of explosion proof protections like, Flameproof, intrinsically safe, increased safety, pressurized enclosure apparatus etc., for use in hazardous atmosphere of mine (coal/Oil) and relevant provisions of the IS/IEC 60079 series of standards, operation and maintenance of the flameproof and intrinsically safe apparatus. IV. Use of RF Electrical equipment in hazardous areas. V. LMD, Environment monitoring system VI. Circuit diagram of Drill control panel, GEB, different types of circuit breakers, starters, Lighting & Signaling unit. VII. Safety requirement of belt conveyor system installed in the belowground mine, OCP. VIII. Safety requirements of Drilling Rig in oil mine IX. Any other special type of Electrical machinery / apparatus used in mines(coal/oil/metal)	5
10	General safety: I. Procedure for obtaining permission to work for carrying out operations and maintenance of electrical equipment (permit to work as per**IS:5216)**. II. Safety in electrical workshop III. Firefighting equipment, their type, use and periodical maintenance, indicators, recorders etc. IV. First aid training, resuscitation of persons suffering from electric shock etc., V. Various Lightning protections.	3
11	Legislation/statutes as amended from time to time: I. Provisions of Central Electricity Authority (Measures relating to safety and electric supply), Regulations 2023. II. Provisions of ElectricityAct,2003 III. Relevant provisions of the mines Act,1952 IV. Relevant provisions of the Coal MinesRegulation,2017. V. Relevant provisions of Metalliferous Mines Regulation,1961	3

12	On-Site emergency management plan in case of contingency related to electricity: I. Emergency response procedure including response to off-site emergency management plan and crisis and disaster management plan;	2
	II. Risk assessment information giving possible nature of incidents and events giving rise to emergency conditions, risk analysis and impact assessment;	
13	Testing and Record keeping I. Maintenance of Supervisors log sheet II. Register of designated persons III. History sheets of the electrical equipment/apparatus with regard to the repair/maintenance IV. Preparation, Maintaining and updating the circuit diagram/Electrical Plan of the installations and electrical apparatus like breakers, starters etc. V. Testing and recording of CTs, relays using primary and secondary injection kit. VI. Register for maintenance of flameproof and intrinsically safe apparatus (coal/Oil mine). VII. Testing and recording of Earthing system. VIII. Measurement of Insulation Resistance, earth electrode resistance IX. Maintenance of Battery bank	4
14	On Job training/ Practical/Laboratory Training I. Practical tests (type, routine) of transformer, motors, cables, switchgears etc., II. Testing of CTs and relays through primary and secondary injection kits. III. First aid training IV. Operation of different types of fire extinguishers.	4
15	Case studies related to Electrical accidents	1
16	Field Visit	6
17	Written Examination to evaluate performance, feedback on training	1
Duration of the training course in hours		48

PART-II

TRAINING SYLLABUS FOR ELECTRICAL SUPERVISOR OF MINES (FOR OIL MINES)

Sl. No.	Particulars	Number of Hours
1	Brief introduction of AC/DC Motors, alternators, transformers and their application, operation and maintenance.	3
2	Brief Introduction of Switchgear, Protection techniques, operation and maintenance.	3
3	I. Earthing system: Requirements, types of earthing, maintenance, chemical earthing and relevant provisions of IS -3043. II. Neutral system of power supply: Solid neutral earthing, restricted neutral earthing, isolated neutral earthing, advantages/ disadvantages;	4
4	Hazardous area classification and selection of equipment for hazardous area. Salient features of Flameproof and intrinsically safe apparatus for use in hazardous area and relevant provisions of the IS/IEC 60079 series of standards, operation and maintenance of the flameproof, intrinsically safe apparatus and other apparatus conforming to the relevant Ex standards	3
5	Design layout, Safety in sub-station, switchyard and switchboards i. Safe working clearance. ii. Guarding of live apparatus. Standard Operating Procedure (SOP) of circuit breakers, transformers, isolators, surge arresters, instrument transformers, storage tanks etc.	4
6	a) Operation, maintenance of overhead lines and underground cables b) Safety measures in over headlines c) Types of stays, its markings, grouting, stay insulator, binding etc., d) Types of guarding and clearances, earth/neutral wire, anti- climbing devices, and their erection. e) Selection and fixing of control devices viz. Linked switches, fuses, isolators, and earthing switches, lightning arrestors and surge diverters. f) Cables and conductors, their classification, construction, insulation types, laying, mining type cables and the related standards, cable jointing techniques and junction boxes	4
7	General safety: I. General Safety to be observed in oil and gas mine and adherence to operator's Safety Rules. II. Firefighting equipment, their type, use and periodical maintenance, indicators, and recorders etc. III. First aid training, resuscitation of persons suffering from electric shock etc. IV. Salient features of explosion proof protections like, Flameproof, intrinsically safe, increased safety, pressurized enclosure apparatus etc., for use in hazardous atmosphere of mine (coal/Oil) and relevant provisions of the IS/IEC 60079 series of standards,	4

	operation and maintenance of the flameproof and intrinsically safe apparatus. V.Lock-out/Tag out (permit to work as per IS:5216) and PTW system	
8	Legislation: I. Provisions of Central Electricity Authority (measures relating to safety and electric supply), Regulations2023. II. Provisions of ElectricityAct,2003 III. Relevant provisions of the mines Act,1952 IV. Relevant provisions of Oil Mines Regulation, 1984 (amended version)	4
9	Testing and Record keeping I. Maintenance of Supervisors log sheet II. Register of designated persons III. History sheets of the electrical equipment/apparatus with regard to the repair/maintenance IV. Preparation, Maintaining and updating the circuit diagram/Electrical Plan of the installations and electrical apparatus like breakers, starters etc. V. Testing and recording of CTs, relays using primary and secondary injection kit. VI. Register for maintenance of flameproof and intrinsically safe apparatus (coal/Oil mine). VII. Testing and recording of Earthing system. VIII. Measurement of Insulation Resistance, earth electrode resistance IX. Maintenance of Battery bank	4
10	Case Studies related to Electrical accidents.	3
11	On Job training/ Practical/Laboratory Training I. Practical tests (type, routine) of transformer, motors, cables, switchgears etc., II. Testing of CTs and relays through primary and secondary injection kits. III. First aid training I. Operation of different types of fire extinguishers.	5
12	Field Visit	6
13	Written examination to evaluate the performance for awarding the License	1
	Total	48

PART-III

TRAINING SYLLABUS FOR ELECTRICIANS OF MINES

Sl. No	Particulars	Number of Hours
1	Basic Electrical Engineering: (i) Symbols of various electrical items/machines/elements (ii) Sketches and circuit diagrams for the electrical systems/installations i.e. different types of distribution networks, starters and other electrical apparatus (iii) Different types of PPEs, tools, and devices being used to maintain the electrical installations/apparatus such as Insulation tester, earth tester, multimeter etc.,	3
2	Electrical Machineries: I. Different types of motors (AC &DC), their applications, operation and maintenance II. Different types of generators, operation and maintenance. III. Different types of transformers, cooling of transformers, transformer oil, protective devices in the transformer, the common causes of failures, operation &maintenance. IV. Renewable Energy Generation.	3
3	Electric Drives and Control: Starting and speed control of motors, different types of starters and their operation maintenance	2
4	Switchgear and protective devices: a) General Idea on Operation & Maintenance of different types of circuit breakers, CT/PTs, b) General idea on different types of relays such as over-current, earth fault relays, broken conductor/negative sequence/ unbalance/single phasing preventer, Differential protection etc., c) Various protective schemes with circuit diagram: for motors, generators, transformers, capacitor banks etc.,	3
6	Earthing system: Requirements, types of earthing, maintenance, chemical earthing and relevant provisions of IS - 3043.	2
7	Neutral system of power supply: I. Solid neutral earthing, restricted neutral earthing, isolated neutral earthing, advantages /disadvantages II. provisions of the Regulation for suitably designed restricted neutral system of power supply including neutral-ground monitoring protection system.	2
9	Operation and maintenance of substations and generating stations including maintenance of storage battery and related auxiliaries	3
10	Protection against voltage surges and lightning	1

11	Operation, maintenance of overhead lines and underground cables I. Safety measures in over headlines II. Types of stays, its markings, grouting, stay insulator, binding etc., III. Types of guarding and clearances, earth / neutral wire, anti-climbing devices and their installation /erection. IV. Selection and fixing of control devices viz. Linked switches, fuses, isolators, and earthing switches, lightning arrestors etc., V. Cables and conductors, their classification, construction, insulation types, laying, mining type cables and the related standards, cable jointing techniques and junction boxes	4
12	Electrical apparatus and machinery for mine installation (as applicable for a particular type of mine like Coal/Metal/Oil) I. Winders, man riding system, cranes II. Electrically operated HEMM, portable transportable machinery, dragline, bucket wheel excavator, SDL, LHD, Road header, shearer, continuous miner III. Salient features of Flameproof and intrinsically safe apparatus for use in hazardous atmosphere of mine (coal/Oil) and relevant provisions of the IS/IEC 60079 series of standards, operation and maintenance of the flameproof and intrinsically safe apparatus IV. LMD, Environment monitoring system V. Circuit diagram of Drill control panel, GEB, different types of circuit breakers, starters, Lighting & Signaling unit. VI. Safety requirements of belt conveyor system installed in the belowground coal mine, OCPs etc., VII. Safety requirements of Drilling Rig in oil mine VIII. Any other special type of Electrical machinery / apparatus used in mines (coal / oil / metal)	8
13	General safety: I. Procedure for obtaining permission to work for carrying out operations and maintenance of electrical equipment (Permit to work as per**IS:5216)**; II. Safety in electrical workshop III. Firefighting equipment, their type, use and periodical maintenance, indicators, and recorders etc., IV. First aid training, resuscitation of persons suffering from electric shock etc.,	4
14	Legislation/statutes as amended from time to time: Relevant regulations of Provisions of Central Electricity Authority (measures relating to safety and electric supply) Regulations, 2023	4
15	On Job training/ Practical/Laboratory Training I. Erection and pre commissioning testing of transformers, motors, generators, switchgear II. Measurement of earth resistance, insulation resistance etc., III. Testing of CTs, relays etc., IV. First aid training V. Operation of different types of fire extinguishers	7

16	Case Studies related to Electrical accidents	1
17	Written Examination to evaluate performance, feedback on training	1
Duration of the training course in hours		48

Part-IV

TRAINING SYLLABUS FOR ELECTRICAL ENGINEERS

Sl. No	Particulars	Number of Hours
1	**Power Transmission** **a.** Different types of Electric towers/poles. **b.** Conductors/Earth-wire and their accessories, types, configuration, transposition, selection criteria **c.** Insulators and hardware fittings: types, strength, details **d.** Right of way, CEA (Measures relating to Safety and Electric Supply) Regulations, 2023 and Acts, statutory clearances from other agencies, compensation, etc. **e.** Operation and Maintenance of Transmission Line: line patrolling, routine checks, filling logbooks, T & P, thermo-vision scanning, fault failure analysis, hot line maintenance, case studies.	2
2	**Sub - Stations (220kV/132kV/33kV)** (i)Types: generation sub-station, grid sub-station, mobile sub-station, gas insulated sub-station, indoor/outdoor, etc., ii)General arrangement and layout of switchyard, switching schemes, single line diagram. (iii) Power Transformers and Reactors: (a) Types: major components, constructional details, functions (b) Design and selection, specification and rating (c)Bushings, On Load Tap Changers (OLTC), Buchholz relay, conservator, breather, thermo syphon filter, indicators, etc. (d)Cooling arrangements - methods of cooling, pumps, fans, radiators, etc. (e) Transformer tests (f) Introduction to relevant Indian Standards **(iv)Switchgears and Introduction to relevant Indian Standard** (a) Circuit Breaker: Different types of circuit breakers and starters, selection parameters, ratings/ specifications, interlocks and introduction to relevant Indian Standard (b) Isolator: Types, earth switch, interlocks and Bus bar types, (d) CT/CVT/Lightning Arrestor/Lightning Mast: Types, constructional details, use, location, selection/design, ratings/specifications (f) Instrumentation and Protective Relays: types, functions, selection, ratings/ specifications, testing and setting of relays and knowledge of relevant Indian Standard. (h) Protection System Philosophy: types, design, protection schemes, tripping schemes, protection of transformers/reactors, motors, feeders, generator bus etc. and relay co-ordination.	5

	v)Grounding: types of grounding, earth testing and treatment, earth mat design, step potential, touch potentials, transfer potentials, neutral grounding factor. (vi)Auxiliary facilities (a) DG set (b) Firefighting system (c) Sub-Station Battery System and different types of auxiliary power supply (vii)Cables: types, control cables, power cables, layout, trench/gallery arrangement, cable ratings, selection, and cable termination and jointing. (viii) Compensating devices: shunt reactor/capacitor, series reactor/ capacitor, static var compensators (SVC) (ix) (a)Sub-station, Transformer and Reactor Maintenance: - Factors affecting the life of transformer/reactor, types of faults that can occur, reasons for breakdown, visual checks/ inspection/ preliminary testing of various components- oil sampling and testing, oil filtration, Dissolved Gas Analysis (DGA), maintenance Schedule, fault rectification, need for major overhaul and methods (b)Switchgear and Protection Maintenance : maintenance of CB, isolator, earth-switch, support insulators, CT/CVT, LA. Lightning Mast (LM), meters/ recorders, PLCC, protective relay maintenance, protection system maintenance (c) Maintenance of auxiliaries and other systems- battery and charging system, DG set, air conditioning plant, compressed air system, fire-fighting system, switchyard – lighting, control room, earth resistance testing, cables, compensating devices.	
3	Electrical Machineries: i. Operation, maintenance and pre-commissioning test of different types of motors (AC&DC). ii. Operation, maintenance and pre-commissioning test of different types of generators. iii. Operation, maintenance and pre-commissioning tests of different types of transformers. iv. Machineries/Equipment related to renewable generating stations. v. Battery operated vehicles and Locomotives.	2
4	Electric Drives and Control: (i) Operation maintenance of Different types of starters including AC Drives such as VFDs etc., DC Drives, soft starters etc., (ii) PLC, SCADA and DCS-Application in mines.	2
5	Earthing system: Requirements, types of earthing, maintenance, chemical earthing and relevant provisions of IS - 3043.	2
6	Neutral system of power supply: a. solid neutral earthing, restricted neutral earthing, isolated neutral earthing, advantages /disadvantages. b. provisions of the Regulation for suitably designed restricted neutral system of power supply including neutral-ground monitoring protection system.	3

7	Cables and conductors, their classification, construction, insulation types, laying, mining type cables and the related standards, cable jointing techniques, terminations and junction boxes.	
8	Electrical apparatus and machinery for mine installation (as applicable for a particular type of mine Oil/Coal/Metal) I. Winders, man riding system, cranes, EOTs etc., II. Electrically operated HEMM, portable transportable machinery, dragline, bucket wheel excavator, SDL, LHD, Road header, shearer, continuous miner, UDMs etc., III. Salient features of explosion proof protections like, Flameproof, intrinsically safe, increased safety, pressurized enclosure apparatus etc., for use in hazardous atmosphere of mine (coal/Oil) and relevant provisions of the IS/IEC 60079 series of standards, operation and maintenance of the flameproof and intrinsically safe apparatus. IV. Use of RF Electrical equipment in hazardous areas. V. LMD, Environment monitoring system VI. Circuit diagram of Drill control panel, GEB, different types of circuit breakers, starters, Lighting & Signaling unit. VII. Safety requirement of belt conveyor system installed in the belowground mine, OCP. VIII. Safety requirements of Drilling Rig in oil mine IX. Any other special type of Electrical machinery / apparatus used in mines(coal/oil/metal)	8
9	General safety: I. Procedure for obtaining permission to work for carrying out operations and maintenance of electrical equipment (permit to work as per**IS:5216)** and LOTO system. II. Safety in electrical workshop. III. Firefighting equipment, their type, use and periodical maintenance, indicators, recorders etc. IV. First aid training, resuscitation of persons suffering from electric shock etc., V. Lightning Phenomenon and various lightning protections. VI. Mine Lighting – design and layout methods.	4
10	Legislation/statutes as amended from time to time: I. Provisions of Central Electricity Authority (Measures relating to safety and electric supply), Regulations 2023. II. Provisions of ElectricityAct,2003 III. Relevant provisions of the mines Act,1952 IV. Relevant provisions of the Coal MinesRegulation,2017. V. Relevant provisions of Metalliferous Mines Regulation,1961 VI. Relevant provisions of the Oil MinesRegulation,2017. VII. Relevant Technical circulars of DGMS issued from time to time.	4

11	On-Site emergency management plan in case of contingency related to electricity: I. Emergency response procedure including response to off-site emergency management plan and crisis and disaster management plan. II. Risk assessment information giving possible nature of incidents and events giving rise to emergency conditions, risk analysis and impact assessment;	2
12	Testing and Record keeping a) Maintenance of Supervisors log sheet b) Register of designated persons c) History sheets of the electrical equipment/apparatus with regard to the repair/maintenance d) Preparation, Maintaining and updating the circuit diagram/Electrical Plan of the installations and electrical apparatus like breakers, starters etc. e) Testing and recording of CTs, relays using primary and secondary injection kit. f) Register for maintenance of flameproof and intrinsically safe apparatus (coal/Oil mine). g) Testing and recording of Earthing system. h) Measurement of Insulation Resistance, earth electrode resistance i) Maintenance of Battery bank j) Form I, II, III and IV as per CEAR-2023. k) Approval/Permission related documents l) Annual returns, Notices,	4
13	Case studies related to Electrical accidents	2
14	Field Visit	6
15	Written Examination to evaluate performance, feedback on training	2
Duration of the training course in hours		48

Therefore, the owner, agent, and manager of all mines and oilfields where electricity is used are advised to arrange training for their personnel involved in the operation and maintenance of electrical installations, in accordance with the syllabus outlined above.

23/8/2024

Director General of Mines Safety.