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Compendium of Regulations by Central Electricity Authority

Central Electricity Authority
Government of India
Web.: www.cea.nic.in

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Central Electricity Authority

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Disclaimer:

All efforts have been made to ensure that the contents of the Compendium are free from editorial mistakes. However, the versions of the Regulations in the Gazette Notifications are authentic and binding and shall prevail in the event of the discrepancies with the Regulations in the Compendium.

Central Electricity Authority

Sewa Bhawan, R.K. Puram,
Sector-1, New Delhi-110 066

मनोहर लाल
MANOHAR LAL

सत्यमेव जयते

विद्युत मंत्री एवं
आवासन और शहरी कार्य मंत्री
भारत सरकार
Minister of Power and
Minister of Housing and Urban Affairs
Government of India

MESSAGE

The power sector in India has undergone significant transformation in the last few years. In an era marked by rapid advancements, need for comprehensive and updated information cannot be overemphasized.

I am pleased to introduce "Compendium of Central Electricity Authority Notified Regulations". This document serves as a comprehensive reference guide to the technical regulations framed under the Electricity Act, offering valuable insights into the framework that governs India's power sector.

It also serves as a testament to our commitment to provide easy access to information thereby facilitating ease of doing business.

I am sure that this compendium will be a useful reference material for all stakeholders associated with the power sector.

मनोहर लाल

(MANOHAR LAL)

Shram Shakti Bhawan, New Delhi-110 001 Phone : +91-11-23717474, 23710411, Fax : +91-11-23710065

पंकज अग्रवाल, भा.प्र.से.
सचिव
Pankaj Agarwal, I.A.S.
Secretary

भारत सरकार
विद्युत मंत्रालय
श्रम शक्ति भवन, नई दिल्ली-110001
Government of India
Ministry of Power
Shram Shakti Bhawan, New Delhi - 110001
Tele : 23710271/23711316
Fax : 23721487
E-mail : secy-power@nic.in

सत्यमेव जयते

MESSAGE

The Power Sector in India has seen landmark enactments, new policies & schemes, which have helped its speedy development. The Central Electricity Authority has taken many initiatives in respects to various aspects of Power Sector, which have acted as great enablers in this growth.

Central Electricity Authority has been mandated under section 73 of the Electricity Act 2003, to specify technical standards related to various aspects of the power system. These standards in form of regulations are essential for development and functioning of the power system in the country, for which it is imperative that such regulations are available to the stakeholders in a consolidated form. I compliment the Central Electricity Authority for publishing this compendium of Regulations.

In an era marked by rapid technological advancements and a growing focus on renewable energy, the regulations outlined in this compendium are vital for ensuring they provide the guidance needed to navigate the complexities of the electricity ecosystem while upholding the principles of fairness, sustainability, and accountability.

This compendium is a testament to the concerted efforts of countless individuals, organizations, and government bodies that have worked tirelessly to make these technical regulations encompassing different areas of the electricity sector.

As you explore this Compendium, I encourage you to use it as a valuable resource in your endeavors. I congratulate, Shri Ghanshyam Prasad, Chairperson, Central Electricity Authority and his team of officers for bringing out a valuable guide for stakeholders of power sector.

(Pankaj Agarwal)

स्वच्छ भारत
एक कदम स्वच्छता की ओर

आज़ादी का अमृत महोत्सव

घनश्याम प्रसाद
अध्यक्ष तथा पदेन सचिव भारत सरकार
GHANSHYAM PRASAD
Chairperson & Ex-officio Secretary
To the Government Of India

सत्यमेव जयते

आज़ादी का अमृत महोत्सव

केन्द्रीय विद्युत प्राधिकरण
भारत सरकार
विद्युत मंत्रालय
सेवा भवन, आर.के. पुरम
नई दिल्ली–110066
Central Electricity Authority
Ministry of Power
Sewa Bhawan, R. K. Puram
New Delhi-110066

FOREWORD

It is with a sense of great privilege and responsibility that I introduce the "Compendium of Regulations by Central Electricity Authority". The electricity sector, often referred to as the lifeblood of our modern society, plays a paramount role in driving India's progress, economic growth, and overall well-being. The Electricity Act, a pivotal piece of legislation, has been the foundation upon which we have built a dynamic and robust electricity ecosystem.

This Compendium represents a significant milestone in our journey to clarify and spread the regulations notified by Central Electricity Authority that govern the electricity sector in India. It has been designed to serve as a comprehensive reference guide, enabling stakeholders, policymakers, regulators and industry professionals to better understand and navigate the framework of electricity regulation that underpins our nation's power supply.

I extend my heartfelt appreciation to all those who have contributed to the development and maintenance of these regulations. Your dedication to the growth and transformation of the power sector is commendable, and your efforts are essential in shaping India's energy future.

As we stand on the cusp of an energy transition towards cleaner and more sustainable sources of power, these regulations will guide us through the challenges and opportunities that lie ahead. They will empower consumers, facilitate investments, and reinforce the responsible growth of our electricity sector.

I encourage all stakeholders to make full use of this compendium. Together, we can ensure that the power sector in India continues to be a catalyst for economic growth, innovation, and sustainability.

(Ghanshyam Prasad)

दूरभाष / Telephone : 011-26732201, 26732222, ईमेल / Email : chair@nic.in, वेबसाईट / Website : www.cea.nic.in

Preface

The Electricity Act 2003 consolidates the laws relating to Generation, Transmission, Distribution, Trading and use of Electricity and generally for taking measures conducive to development of Electricity Sector, Promoting Competition, protecting interest of consumers, supply of electricity to all areas, rationalisation of Electricity tariff, ensuring transparent policies.

These Central Electricity Authority has acknowledged that Stakeholders require a compressive compendium consisting of all the Regulations with amendments which act as a useful source for reference.

Accordingly, this compendium of Regulation by the Central Electricity Authority framed Under Electricity Act 2003 is brought out in association with Excellence Enhancement Centre For Indian Power Sector (EEC). This Compendium under Electricity Act 2003 wishes to bridge the gap between the Electricity Act 2003 and its practical implementation by consolidating and presenting the regulation notified by the Authority.

As you explore this Compendium, we hope that this will be a valuable resource for reference for the stakeholders.

Place: New Delhi
Date:

Compendium of Central Electricity Authority, Regulations

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(Published in the Gazette of India, Extraordinary, Part III, section iv)

Central Electricity Authority

New Delhi, dated the 17th March, 2006

NOTIFICATION

No. 502/70/CEA/DP&D In exercise of the powers conferred by sub-section (1) of section 55 and clause (e) of section 73 read with sub-section (2) of section 177 of Electricity Act, 2003, the Central Electricity Authority hereby makes the following regulations for regulating the installation and operation of meters, namely :-

1. Short title and commencement. -

(1) These regulations may be called the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

(2) These Regulations shall come into force on the date of their publication in the Gazette of India.

[ ][1]

2. Definitions. -

(1) In these regulations, unless the context other wise requires, -

(a) 'Act' means the Electricity Act, 2003;

(b) 'Accredited Test Laboratory' means a test laboratory accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL);

(c) 'Active Energy' means the electricity supplied or consumed during a time interval, being the integral of Active Power with respect to time, measured in the units of 'Watt – hours' or standard multiples thereof. One 'kilowatt – hour' (kWh) is one unit;

(d) 'Active Power' means the electrical power, being the product of root mean square (rms) voltage, root mean square (rms) current and cosine of the phase angle between the voltage and current vectors and measured in units of 'Watt' (W) or in standard multiples thereof;

[(da) 'Advanced Metering Infrastructure' is an integrated system of smart meters, communication networks and data management systems that enables two way communication between the utilities and energy meters, and the functional blocks of Advanced Metering Infrastructure typically include Head end system, Wide area network, Neighborhood area network, Data concentrator unit and Home area network;

(db) 'Advanced Metering Infrastructure Service Provider' is a person appointed by the distribution licensee, for owning, operating, and maintaining Advanced Metering

[1] Inserted vide Amendment, 2014 w.e.f. 26.11.2014, and later omitted vide Amendment, 2019 w.e.f. 23.12.2019.

Infrastructure or a part of the Advanced Metering Infrastructure, till its transfer to the licensee;][2]

(e) 'Appropriate Load Despatch Centre' means 'National Load Despatch Centre' (NLDC) or 'Regional Load Despatch Centre' (RLDC) or the 'State Load Despatch Centre' (SLDC) as the case may be;

(f) 'Appropriate Transmission Utility' means the 'Central Transmission Utility' (CTU) or the 'State Transmission Utility' (STU), as the case may be;

(g) [ ][3]

(h) 'Buyer' means any generating company or licensee or consumer whose system receives electricity from the system of generating company or licensee;

[(i) 'Check Meter' means a meter, which shall be connected to the same core of the Instrument Transformer to which main meter is connected and shall be used for accounting and billing of electricity in case of failure of main meter;][4]

[(j) 'Consumer Meter' means a meter used for accounting and billing of electricity supplied to or from the consumer but excluding those consumers covered under Interface Meters;][5]

[(k) 'Correct Meter' means a meter, complying the standards as specified in the Schedule to these regulations;][6]

(l) 'Energy Accounting and Audit Meters' means meters used for accounting of the electricity to various segments of electrical system so as to carry out further analysis to determine the consumption and loss of energy therein over a specified time period;

[(m) 'Instrument Transformer' means the 'Current Transformer' (CT) or 'Current Transformer' (CT) and 'Capacitor Voltage Transformer' (CVT) or 'Current Transformer' (CT) and 'Inductive Voltage Transformer' (IVT);][7]

[(n) 'Interface Meter' means a meter used for accounting and billing of electricity, connected at the point of interconnection between electrical systems of generating company, licensee and consumers, directly connected to the Inter-State Transmission System or Intra-State Transmission System or Distribution System and who have been permitted open access by the Appropriate Commission;][8]

(o) 'Main Meter' means a meter, which would primarily be used for accounting and billing of electricity;

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[2] Inserted vide Amendment, 2022 w.e.f. 28.02.2022.
[3] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.
[4] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[5] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[6] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[7] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[8] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

[(p) 'Meter' means a device suitable for measuring, indicating and recording the conveyance of electricity or any other quantity related with electrical system and shall include, wherever applicable, other equipment such as Instrument Transformer necessary for the purpose of measurement and also mean 'Correct Meter', if it complies with the standards as specified in the Schedule to these regulations;][9]

(q) 'Power Factor' means the cosine of the electrical angle between the voltage and current vectors in an AC electrical circuit;

(r) [ ][10]

(s) 'Reactive Energy' means, the integral of Reactive Power with respect to time and measured in the units of 'Volt-Ampere hours reactive (VARh) or in standard multiples thereof;

(t) 'Reactive Power' means the product of root mean square (rms) voltage, root mean square (rms) current and the sine of the electrical phase angle between the voltage complex or and current complex or, measured in 'Volt – ampere reactive' (VAr) and in standard multiples thereof;

(ta) 'Smart Meter' means a meter as specified in IS 16444 and as amended from time to time;][11]

(u) 'Standards' means 'Standards on Installation and Operation of Meters' given in the Schedule of these Regulations unless otherwise any other standard specifically referred;

[(v) 'Standby Meter' means a meter connected to Instrument Transformer, other than those used for main meter and check meter and shall be used for accounting and billing of electricity in case of failure of both main meter and check meter;][12]

(w) 'Supplier' means any generating company or licensee from whose system electricity flows into the system of another generating company or licensee or consumer;

(x) [ ][13]

[(y)][14]

(2) The words and expressions used and not defined in these Regulations but defined in the Act shall have the meaning assigned to them in the Act.

3. Applicability of regulations. -

(1) These Regulations shall be applicable to meters installed and to be installed by all the generating companies and licensees who are engaged in the business of generation,

[9] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[10] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.
[11] Inserted vide Amendment, 2019 w.e.f. 23.12.2019.
[12] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[13] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.
[14] Initially Inserted vide Amendment, 2014 w.e.f. 26.11.2014 and later Omitted vide Amendment, 2019 w.e.f. 23.12.2019.

transmission, trading, distribution, supply of electricity and to all categories of consumers.

(2) After coming into force of these regulations, the provisions of the Indian Electricity Rules, 1956 relating to installation and operation of meters in this regard shall not be applicable.

(3) These regulations provide for type, standards, ownership, location, accuracy class, installation, operation, testing and maintenance, access, sealing, safety, meter reading and recording, meter failure or discrepancies, anti tampering features, quality assurance, calibration and periodical testing of meters, additional meters and adoption of new technologies in respect of following meters for correct accounting, billing and audit of electricity:

(i) Interface meter

(ii) Consumer meter

(iii) Energy accounting and audit Meter

4. Type of meters. -

(1) [(a) all new Interface Meters and Energy Accounting and Audit Meters shall be of static type and shall have automatic remote meter reading facility;

(b) [All consumers in areas with communication network, shall be supplied electricity with Smart Meters working in prepayment mode, conforming to relevant IS, within the timelines as specified by the Central Government:

Provided that all consumer connections having current carrying capacity beyond that specified in relevant IS, shall be provided with meters having automatic remote meter reading facility or Smart Meters as per relevant IS.

Provided further that in areas which do not have communication network, installation of prepayment meters, conforming to relevant IS, shall be allowed by the respective State Electricity Regulatory Commission.][15]][16]

(2) The meters not complying with these regulations shall be replaced by the licensee on his own or on request of the consumer. The meters may also be replaced as per the regulations or directions of the Appropriate Commission or pursuant to the reforms programme of the Appropriate Government.

5. Standards. -

All interface meters, consumer meters and energy accounting and audit meters shall –

(a) [comply with the relevant standards of Bureau of Indian Standards (BIS). If BIS

[15] Substituted vide Amendment, 2022 w.e.f. 28.02.2022.

[16] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

Standards are not available for a particular equipment or material, the relevant International Electro-technical Commission (IEC) Standards, or any other equivalent Standard shall be followed:

Provided that whenever an IEC Standard or any other equivalent Standard is followed, necessary corrections or modifications shall be made for nominal system frequency and nominal system voltage prevailing in India before actual adoption of the said Standard:

Provided further that necessary corrections or modifications for ambient temperature and humidity shall be made as per the range specified in the Schedule to these regulations.][17]

(b) conform to the standards on 'Installation and Operation of Meters' as specified in Schedule annexed to these regulations and as amended from time to time.

6. Ownership of meters. -

(1) **Interface meters**

(a) All interface meters installed at the points of interconnection with Inter-State Transmission System (ISTS) for the purpose of electricity accounting and billing shall be owned by CTU.

(b) All interface meters installed at the points of interconnection with Intra-State Transmission System excluding the system covered under sub-clause (a) above for the purpose of electricity accounting and billing shall be owned by STU.

(c) All interface meters installed at the points of inter connection between the two licensees excluding those covered under sub-clauses (a) and (b) above for the purpose of electricity accounting and billing shall be owned by respective licensee of each end.

(d) All interface meters installed at the points of inter connection for the purpose of electricity accounting and billing not covered under sub-clauses (a), (b) and (c) above shall be owned by supplier of electricity.

(2) **Consumer meters**

(a) [Consumer meters shall generally be owned by the licensee:

Provided that in case the licensee has engaged the services of Advanced Metering Infrastructure Service Provider to provide Advanced Metering Infrastructure services for an Advanced Metering Infrastructure project area, the ownership of meters shall remain with Advanced Metering Infrastructure Service Provider during the contract period.][18]

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[17] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[18] Substituted vide Amendment, 2022 w.e.f. 28.02.2022.

(b) [If any consumer opts to purchase a meter, the same may be purchased by him as per the technical specifications laid down by the licensee in compliance with these regulations and meter purchased by the consumer shall be tested, installed and sealed by the licensee:

Provided that the consumer shall claim the meter purchased by him as his asset only after it is permanently removed from the system of the licensee.][19]

(c) All consumer meters shall bear BIS mark, meet the requirements of these regulations and have additional features as approved by the Appropriate Commission or pursuant to the reforms programme of the Appropriate Government. To facilitate this, the licensee shall provide a list of makes and models of the meters.

(3) **Energy accounting and audit meters**

Energy accounting and audit meters shall be owned by the generating company or licensee, as the case may be.

[7. Locations of meters.- (1) Interface meter.- (a) The location of interface meters shall be as specified in Table -1

Provided that the location of main, check and standby meters installed at the existing generating stations shall not be changed unless permitted by the Authority:

Provided further that the generating companies or licensees may install meters at additional locations in their systems depending upon the requirement

[[Table -1

Sl. No	Stages	Main Meter	Check Meter	Standby Meter
(1)	(2)	(3)	(4)	(5)
1.	Generating Station	On all outgoing feeders including bus sectionalizer or tie line between two stages of generating stations having different tariffs or different	On all outgoing feeders including bus sectionalizer or tie line between two stages of generating stations having different tariffs	(i)High Voltage (HV) side of Generator Transformers (ii) High Voltage side of all Station Auxiliary Transformers

[19] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

		ownership or both	or different ownership or both	
2.	Transmission and Distribution System	(i) At one end of the line between the substations of the same licensee; (ii) At both ends of the line between substations of two different licensees: Provided that meters at both ends shall be considered as main meters for respective licensees.	-	(i) There shall be no separate standby meter. (ii)Meter installed at other end of the line in case of two different licensees shall work as standby meter.
3.	Inter-Connecting Transformer (ICT)	High Voltage (HV) side of ICT.	-	Low Voltage (LV) side of ICT.
4.	Consumer directly connected to the Inter- State Transmission System or Intra-State Transmission System or Distribution	As decided by the Appropriate Commission.”.		

	System who has been permitted open access by the Appropriate commission or any other system not covered above	

][20]

(b) The scheme for location of interface meters shall be submitted to the Central Transmission Utility or the State Transmission Utility or the licensee by owner of the meter in advance, before the installation of the scheme.

2. **Consumer meter.-** (a) The consumer meter shall be installed by the licensee either at the consumer premises or outside the consumer premises:

Provided that where the licensee installs the consumer meter outside the premises of the consumer then the licensee on a request from consumer shall provide [in home display unit][21] at the premises of the consumer for his information to indicate the electricity consumed by the consumer:

Provided further that for the purpose of billing, the reading of consumer meter shall be taken into account.

(b) [The location of meter and height of meter display from the floor shall be as specified in IS 15707 and as amended from time to time.][22]

(c) [For outdoor installations, the meters shall be protected by appropriate enclosure of level of protection as specified in the IS 15707 and as amended from time to time.][23]

[(d)][24]

3. **Energy accounting and audit meter.-** The Energy accounting and audit meters shall be installed at following locations to facilitate the accounting of the energy generated, transmitted, distributed and consumed in various segments of the power system and the energy loss, namely:-

(i) **Generating Stations.-** (a) at a point after the generator stator terminals and before the tap-off to the unit auxiliary transformer(s),

[20] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[21] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[22] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[23] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[24] Initially Inserted vide Amendment, 2014 w.e.f. 26.11.2014 and later Omitted vide Amendment, 2019 w.e.f. 23.12.2019

[Provided that in case of Renewable energy generating station, the meter shall be installed at the inverter Alternating Current (AC) output terminals.][25]

(b) on each incoming feeder of 3.3 kV and above.

(c) low voltage side of each incoming transformer feeder of low voltage (415 V) buses, and

(d) on all high tension motor feeders.

Provided that in case, numerical relays having built-in feature of energy measurement of requisite accuracy are provided in high voltage or low voltage switchgear, separate energy meter is not necessary.

(ii) **Transmission system.-** all incoming and outgoing feeders (if the interface meters do not exist)

(iii) **[Distribution system.-**

(a) all incoming feeders (3.3 kV and above);

(b) all outgoing feeders (3.3 kV and above);

(c) sub-station transformer including distribution transformer – Licensee may provide the meter on primary or secondary side or both sides depending upon the requirement for energy accounting and audit:

Provided that all feeders and distribution transformers shall be provided with meters having automatic remote meter reading facility or Smart Meters as per relevant IS, as per the timelines specified by the Central Government:

Provided further that distribution transformer level energy accounting data shall be uploaded by the distribution licensees on quarterly basis on National Power Portal as per the format prescribed in Bureau of Energy Efficiency (Manner and Intervals for Conduct of Energy Audit in electricity distribution companies) Regulations, 2021.][26]][27]

8. Accuracy Class of meters. -

Every meter shall meet the requirement of accuracy class as specified in the standards given in the Schedule.

9. Installation of meters. -

(1) Generating company or licensee, as the case may be, shall examine, test and regulate all meters before installation and only correct meters shall be installed.

(2) The meter shall be installed at locations, which are easily accessible for installation, testing, commissioning, reading, recording and maintenance. The place of installation

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[25] Inserted vide Amendment, 2019 w.e.f. 23.12.2019.
[26] Substituted vide Amendment, 2022 w.e.f. 28.02.2022.
[27] Substituted vide Amendment, 2010 w.e.f. 04.06.2010.

of meter shall be such that minimum inconvenience and disruptions are caused to the site owners and the concerned organizations.

(3) [In case of single phase meters, the consumer shall ensure that there is no common neutral or phase or looping of neutral or phase of two or more consumers on consumers' side wiring:

Provided that, if such common neutral or phase or looping of neutral or phase comes to the notice of licensee, it shall suitably inform the consumer through installation report or regular electricity bills or meter test report or SMS as applicable, as soon as it comes to it's notice and the same shall be rectified by the consumer within 15 days from such notice by the licensee.][28]

(4) Consumer shall install the Earth Leakage Protective Device (ELPD) in accordance with the provisions of the rules or regulations in this regard.

(5) [If the earth leakage indication is displayed in the meter, the licensee shall suitably inform the consumer through installation report or regular electricity bills or meter test report or SMS as applicable, as soon as it comes to it's notice and the same shall be rectified by the consumer within 15 days from such notice by the licensee.][29]

(6) [In case Instrument Transformer form part of the meters, the meter shall be installed as near as possible to the Instrument Transformer to reduce the potential drop in the secondary leads.][30]

10. Operation, Testing and Maintenance of meters. -

The operation, testing and maintenance of all types of meters shall be carried out by the generating company or the licensee, as the case may be.

11. Access to meter. -

The owner of the premises where, the meter is installed shall provide access to the authorized representative(s) of the licensee for installation, testing, commissioning, reading and recording and maintenance of meters.

12. Sealing of meters. -

(1) **Sealing Arrangements**

(a) All meters shall be sealed by the manufacturer at its works. In addition to the seal provided by the manufacturer at its works, the sealing of all meters shall be done as follows at various sealing points as per the standards given in the Schedule:

(i) Sealing of interface meters, shall also be done by both the supplier and the buyer.

[28] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[29] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[30] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

(ii) Sealing of consumer meters shall be done by the licensee.

(iii) Sealing of energy accounting and audit meters shall be done by the licensee or generating company as the case may be.

(b) [A tracking and recording mechanism for all seals shall be maintained by the licensee so as to track total movement of seals starting from procurement (with manufacturer's details), storage, record keeping, installation, series of inspections and removal.][31]

(c) Seal shall be unique for each utility and name or logo of the utility shall be clearly visible on the seals.

(d) Only the patented seals (seal from the manufacturer who has official right to manufacture the seal) shall be used.

(e) Polycarbonate or acrylic seals or plastic seals or holographic seals or any other superior seal shall be used.

(f) Lead seals shall not be used in the new meters. Old lead seals shall be replaced by new seals in a phased manner and the time frame of the same shall be submitted by the licensee to the Appropriate Commission for approval.

(2) **Removal of seals from meters**

(a) **Interface meters**

Whenever seals of the interface meters have to be removed for any reason, advance notice shall be given to other party for witnessing the removal of seals and resealing of the interface meter. The breaking and re-sealing of the meters shall be recorded by the party, who carried out the work, in the meter register, mentioning the date of removal and resealing, serial numbers of the broken and new seals and the reason for removal of seals.

(b) **Consumer meters**

Seal of the consumer meter shall be removed only by the licensee. No consumer shall tamper with, break or remove the seal under any circumstances. Any tampering, breaking or removing the seal from the meter shall be dealt with as per relevant provisions of the Act.

(c) **Energy accounting and audit meters**

Seal of the energy accounting and audit meter shall be removed only by the generating company or the licensee who owns the meter.

13. Safety of meters. -

(1) The supplier or buyer in whose premises the interface meters are installed shall be

[31] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

responsible for their safety.

(2) The consumer shall, as far as circumstances permit, take precautions for the safety of the consumer meter installed in his premises belonging to the licensee.

(3) Licensee shall be responsible for the safety of the [Consumer Meter][32] located outside the premises of the consumer and the consumer shall be responsible for the safety of the [in home display][33] unit installed by the licensee in consumer premises.

(4) The generating company or the licensee who owns the energy accounting and audit meters shall be responsible for its safety.

14. Meter reading and recording. –

(1) **[Interface Meters:**

(a) It shall be the responsibility of the Generating Company or the licensee, in whose premises the meter has been installed, to download the meter data, record the metered data and furnish such data to various agencies as per the procedure laid down by the Appropriate Commission:

Provided that the responsibility of maintaining database of all the information associated with the Interface Meters and verifying the correctness of the metered data shall be in accordance with the procedure laid down by the Appropriate Commission.

(b) The metered data shall be communicated to the respective Load Despatch Centre by using a secured and dedicated communication system.

(2) **Consumer Meters:**

(a) It shall be the responsibility of the licensee to download the Meter data either locally or remotely, record the metered data, maintain database of all the information associated with the Consumer Meters and verify the correctness of the metered data:

Provided that the Appropriate Regulatory Commission shall specify suitable time frame for ensuring electronic meter reading of all consumer meters by the licensees.

(b) The licensee shall maintain accounts for the electricity consumption and other electrical quantities of its consumers:

Provided that the licensee shall provide information to the consumer related to his energy consumption through Mobile App or Web application or in home display or any other suitable means.

(c) Brief history, date of installation and details of testing, calibration and replacement

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[32] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

[33] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

of meters shall be maintained by the licensee.

(3) **Energy Accounting and Audit Meters.-**

(a) It shall be the responsibility of the generating company or licensee to download the meter data locally or remotely, record the metered data, maintain database of all the information associated with the energy accounting and audit meters and verify the correctness of the metered data.

(b) Each generating company or licensee shall prepare quarterly, half-yearly and yearly energy account for its system for taking appropriate action for efficient operation and system development.][34]

15. Meter failure or discrepancies. -

(1) **Interface meters**

(a) [Whenever difference between the readings of the Main Meter and the Check Meter for any month is more than 0.5%, the following steps shall be taken:

(i) checking of Instrument Transformers connections;

(ii) testing of accuracy of Interface Meter at site with a reference standard meter of accuracy class higher than the meter under test;

(iii) based on the test results as specified in items (i) and (ii), corrective action shall be taken to replace the defective meter.

(b) In case of conspicuous failures like burning of meter and erratic display of metered parameters and when the error found in testing of meter is beyond the permissible limit of error provided in the relevant standard, the meter shall be replaced immediately:

Provided that whenever an Interface Meter is replaced, it shall be ensured that Interface Meter at the other end, if any, of the transmission or distribution system, shall have same accuracy class.][35]

(c) In case where both the Main meter and Check meter fail, at least one of the meters shall be immediately replaced by a correct meter.

(d) Billing for the Failure period:

(i) The billing for the failure period of the meter shall be done as per the procedure laid down by the Appropriate Commission.

(ii) Readings recorded by Main, Check and Standby meters for every time slot shall be analysed, crosschecked and validated by the Appropriate Load Despatch Centre (LDC). The discrepancies, if any, noticed in the readings shall be informed by the LDC in writing to the energy accounting agency for proper

[34] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

[35] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

accounting of energy. LDC shall also intimate the discrepancies to the Appropriate Transmission Utility or the licensee, who shall take further necessary action regarding testing, calibration or replacement of the faulty meters in accordance with the provisions laid down.

(e) The defective meter shall be immediately tested and calibrated

(2) **Consumer meters**

In case the consumer reports to the licensee about consumer meter readings not commensurate with his consumption of electricity, stoppage of meter, damage to the seal, burning or damage of the meter, the licensee shall take necessary steps as per the procedures given in the Electricity Supply Code of the Appropriate Commission read with the notified conditions of supply of electricity.

(3) **Energy accounting and audit meters**

Energy accounting and audit meters shall be rectified or replaced by the generating company or licensee immediately after notice of any of the following abnormalities:

(a) the errors in the meter readings are outside the limits prescribed for the specified Accuracy Class;

(b) meter readings are not in accordance with the normal pattern of the load demand;

(c) meter tampering, or erratic display or damage.

[(d) readings not in conformity with the readings of Interface Meters.][36]

16. Anti-tampering features of meters. -

The meters shall be provided with such anti-tampering features as per the Standards on Installation and Operation of Meters given in the Schedule.

17. Quality assurance of meters. -

(1) The distribution licensee shall put in place a system of quality assurance and testing of meters with the approval of Appropriate Commission.

(2) [(a) The licensee shall set up accredited testing laboratories or utilise the services of other accredited testing laboratories.

(b) The licensee shall take immediate action to get the accreditations for their existing meter testing laboratories from NABL, if not already done.

(3) The generating company or licensee shall ensure that all type, routine and acceptance tests are carried out by the manufacturer complying with the requirement of the relevant Indian Standards.][37]

18. Calibration and periodical testing of meters. –

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[36] Inserted vide Amendment, 2019 w.e.f. 23.12.2019.
[37] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

(1) **Interface meter**

(a) At the time of commissioning, each interface meter shall be tested by the owner at site for accuracy using standard reference meter of better accuracy class than the meter under test.

(b) [All Interface Meters shall be tested on-site using accredited test laboratory for routine accuracy testing at least once in five years and recalibrated if required.

Provided that these meters shall also be tested whenever the energy and other quantities recorded by the meter are abnormal or inconsistent with electrically adjacent meters.

(c) Testing and calibration of Interface Meters shall be carried out in the presence of the representatives of the supplier and buyer by giving the advance notice to the other party regarding the date of testing.][38]

(2) **[Consumer Meters:**

The testing of Consumer Meters shall be done at site through accredited test laboratory at least once in five years and recalibrated, if required:

Provided that the licensee instead of testing the meter at site can remove the meter and replace the same by a meter duly tested in an accredited test laboratory:

Provided further that meter shall be tested if the consumption pattern changes drastically from the similar months or seasons of the previous years or if there is consumer's complaint pertaining to a meter:

Provided also that the meter used for testing shall be of better accuracy class than the meter under test.

(3) **Energy Accounting and Audit Meters:**

Energy Accounting and Audit Meters shall be tested at site through accredited test laboratory at least once in five years or whenever the accuracy is suspected or whenever the readings are inconsistent with the readings of other meters, e.g., Check Meters, Standby Meters and defective meters shall be recalibrated, if required:

Provided that the testing shall be carried out without removing the Instrument Transformers connection.][39]

19. Additional meters. -

In addition to any meter which may be placed for recording the electricity consumed by the consumer, the licensee may connect additional meters, maximum demand indicator or other apparatus as he may think fit for the purposes of ascertaining or regulating either the

[38] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[39] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

quantity of electricity supplied to the consumer, or the number of hours during which the supply is given, or the rate per unit of time at which energy is supplied to the consumer, or any other quantity or time connected with the supply to consumer:

Provided that the meter, indicator or apparatus shall not, in the absence of an agreement to the contrary, be placed otherwise than between the distributing mains of the licensee and any meter:

Provided further that, where the charges for the supply of energy depend wholly or partly upon the reading or indication of any such meter, indicator or apparatus as aforesaid, the licensee shall, in the absence of an agreement to the contrary, keep the meter, indicator or apparatus correct.

20. [ ][40]

[**21. Cyber Security. –**

Generating Company and licensee shall comply with cyber security guidelines issued by the Central Government, from time to time, and the technical standards for communication system in Power Sector laid down by the Authority.

22. Relaxation of Regulations. -

The Authority, by order in writing and the reasons to be recorded, may relax any provision of these regulations in respect of any matters referred to the Authority on case to case basis.][41]

[40] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.
[41] Inserted vide Amendment, 2019 w.e.f. 23.12.2019.

SCHEDULE

(see regulations 2,5,8,12 and 16)

Standards on Installation and Operation of Meters Part I Standards Common To All Type of Meters

(1) [These standards provide for specification of meters, immunity to external factors, sealing points and functional requirements that are required from regulatory perspective:

Provided that, detailed technical specifications shall be prepared by the Generating Company or licensee, as the case may be.][42]

[(2) Specifications of meters

1.	Standard Reference Voltage, Voltage Range, Standard Frequency, Starting Current and Maximum Current, Power Factor Range, Power Frequency withstand voltage, Impulse voltage withstand test for 1.2/50 micro sec, Power Consumption	As per relevant Indian Standards (IS).	
2.	Standard Basic Current	As per relevant IS. Current range of consumer meters shall be so chosen as to record the load current corresponding to the sanctioned load.	
3.	Accuracy class	Meters shall meet the following requirements of Accuracy Class:	
		(a) Interface Meters	0.2S
		(b) Consumer Meters	
		(i) Upto 650 Volts Direct Connected	1.0

[42] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

		(ii) Upto 650 volts CT Connected	Class 0.5S as per relevant IS where separate CTs are used Or Class 1.0 as per relevant IS for terminal less direct connected long current range meters.
		(iii) Above 650 volts and up to 33 kilo volts	0.5S
		(iv) Above 33 kilo volts	0.2S
		(c) Energy Accounting and Audit Meters (i) In generating stations, the accuracy class of meter(s) at a point after the generator stator terminals, before the tap off to the unit auxiliary transformer(s) and at the inverter AC output terminals in case of Renewable Energy generating station, shall not be inferior to that of 0.2S accuracy class: Provided that, the accuracy class of other meters shall not be inferior to that of 1.0S accuracy class. (ii) The accuracy class of meters in transmission system shall not be inferior to that of 0.2S accuracy class. (iii) The accuracy class of meters in distribution system shall not be inferior to that of 0.5S accuracy class where separate CTs are used with meter:	

		Provided that in case of terminal less direct connected long current range meters accuracy class shall not be inferior to class 1.0. (iv) The accuracy class of Energy accounting and Audit Meters for renewable energy generating station located at consumer premises shall be same as that of consumer meter.
4.	Ambient Temperature and Humidity (in case an International Standard or an IEC Standard is followed)	Temperature range: Limit range of operation: -10 °C to +70 °C Limit range for storage and transport: -10 °C to +70 °C Relative Humidity: up to 100% Note: (1) For Special applications other temperature values can be used according to agreement between manufacturer and purchaser. (2) Operation, storage and transport of the meter at the extremes of the temperature range should be for a maximum period of six hours.
5.	Only fundamental frequency quantities shall be measured and computed while measuring Wh and VArh.";	

][43]

(3) [Meter shall have one port for downloading facilities of metered data through Common Meter Reading Instrument (CMRI) and another port/system for remote communication.][44]

(4) **Immunity to External Factors**

The meter shall be immune to external influences like magnetic induction, vibration, electrostatic discharge, switching transients, surge voltages, oblique

[43] Initially substituted vide Amendment, 2010 w.e.f. 04.06.2010 and later Omitted vide Amendment, 2019 w.e.f. 23.12.2019.
[44] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

suspension and harmonics and necessary tests shall be carried out in accordance with relevant standard.

(5) **[Sealing Points:**

Sealing shall be done at the following points (as applicable):

(a) Meter body with cover (Not applicable if integrated body is used),

(b) Meter terminal cover ,

(c) Meter test terminal block ,

(d) Meter cabinet/ panel,

(e) Instrument Transformer(s) terminal box for metering purpose, and junction box, if any.][45]

(6) [(a) The accuracy class of Instrument Transformer shall not be inferior to that of associated meters.

(b) The Instrument Transformer shall comply with relevant Indian Standards.

(c) The existing Instrument Transformer not complying with these regulations shall be replaced by new Instrument Transformer, if found defective or non-functional.][46]

(7) [ ][47]

Part II Standards for interface meters

(1) **Functional Requirements:**

(a) [The Interface Meters shall be three phase four wire static type, composite meters, self–contained devices for measurement of active and reactive energy, and certain other parameters as described in the following paragraphs:

Provided that, the meters shall be suitable for being connected directly to voltage transformers (VTs) having a rated secondary line-to-line voltage of 110 V, and to current transformers (CTs) having a rated secondary current of 1A or 5A:

Provided further that, the reference frequency shall be 50Hz.

(b) The meters shall have a non-volatile memory capable of storing data for a period of at least last ten days and shall be able to measure following parameters in the manner specified, in addition to those specified in the relevant Indian Standards:

(i) average frequency for each successive time block upto 2 decimal truncation;

(ii) net Wh transmittal during each successive time block upto two decimal, with plus sign for active power sent out from station busbars and minus sign for active power received into the busbars;

[45] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[46] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[47] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.

(iii) cumulative Wh transmittal at each midnight, in eight digits including one decimal;

(iv) cumulative VArh transmittal for voltage high condition, at each midnight, in eight digits including one decimal;

(v) cumulative VArh transmittal for voltage low condition, at each midnight, in eight digits including one decimal;

(vi) date and time blocks of failure of VT supply on any phase, as a star(*) mark and (Z) mark in case of complete voltage failure;

(vii) net VArh transmittal during each successive time block upto two decimal with plus sign for reactive power sent out from station busbars and minus sign for reactive power received into the busbars;

(viii) average voltage upto 2 decimal truncation:

Provided that the time block for recording of meter data by the meter shall be 15 minutes or as specified by the Central Commission.][48]

(c) [ ][49]

(d) [ ][50]

(e) [There shall be two reactive energy registers, one for the period when average RMS voltage is above 103% and the other for the period when the voltage is below 97%

(f) The Wh recording shall have a +ve sign when there is a net Wh export from substation busbars, and a –ve sign when there is a net Wh import:

Provided that the integrating (cumulative) registers for Wh and VArh shall move forward when there is Wh or VArh export from substation busbars, and backward when there is an import.

(g) The meters shall also display (on demand), by turn, the following parameters :

(i) Unique identification number of the meter,

(ii) Date,

(iii) Time,

(iv) Cumulative Wh register reading,

(v) Average frequency of the previous time block,

(vi) Net Wh transmittal in the previous time block, with +/-sign,

(vii) Average percentage voltage,

(viii) Reactive power with +/- sign,

(ix) Voltage-high VArh register reading,

(x) Voltage-low VArh register reading,

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[48] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[49] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.
[50] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.

(xi) Net VArh transmittal in the previous time block, with +/-sign.

(h) (i) the three line-to-neutral voltages shall be continuously monitored, and in case any of these falls below 80%, the same shall be suitably indicated and recorded in the meter memory.

(ii) the meters shall normally operate with the power drawn from the VT secondary circuits:

Provided that there shall be provision to operate the meters from AC and DC auxiliary power supply.

(iii) each meter shall have a built-in calendar and clock and shall have facility of automatic time synchronisation.

(iv) the meters shall be properly sealed and tamper evident with no possibility of any adjustment at site.][51]

(i) [ ][52]

(j) [The Main Meter and the Check Meter shall be connected to same core of Instrument Transformer.][53]

[(k) All new meters shall have capability of recording frequency in steps of 0.01 Hz.

(l) All new meters shall be re-configurable at site for change of time block as specified by the Central Commission.][54]

Part III Standards for consumers meters

(1) [The Consumer Meter shall have the facilities to measure, record and display parameters depending upon the tariff requirement for various categories of consumers in line with the relevant Indian Standards:

Provided that the consumer meter shall also have facility to log and display tamper related events as per the requirement of licensee.

(2) All meters shall have data storage capacity for at least 35 days in a non-volatile memory.][55]

(3) Anti-Tampering Features

(a) The meter shall not get damaged or rendered non-functional even if any phase and neutral are interchanged.

(b) The meter shall register energy even when the return path of the load current is not terminated back at the meter and in such a case the circuit shall be completed through the

[51] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[52] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.
[53] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[54] Inserted vide Amendment, 2019 w.e.f. 23.12.2019.
[55] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

earth. In case of metallic bodies, the earth terminal shall be brought out and provided on the outside of the case.

(c) The meter shall work correctly irrespective of the phase sequence of supply (only for poly phase).

(d) In the case of 3 phase, 3 wire meter even if reference Y phase is removed, the meter shall continue to work. In the case of 3 phase, 4 wire system, the meter shall keep working even in the presence of any two wires i.e., even in the absence of neutral and any one phase or any two phases.

(e) In case of whole current meters and LV CT operated meter, the meter shall be capable of recording energy correctly even if input and output terminals are interchanged.

(f) The registration must occur whether input phase or neutral wires are connected properly or they are interchanged at the input terminals.

(g) The meter shall be factory calibrated and shall be sealed suitably before dispatch.

(h) The meter shall be capable of recording occurrences of a missing potential (only for VT operated meters) and its restoration with date and time of first such occurrence and last restoration along with total number and duration of such occurrences during the above period for all phases.

(i) [Additional anti-tampering features including logging of tampers such as current circuit reversal, current circuit short or open and presence of abnormal magnetic field may be provided as per the regulations or directions of the Appropriate Commission.

NOTE.- Smart Meter is bi-directional and therefore anti tamper feature stipulated at (3) (e) above shall not be applicable.][56]

Part IV Standards for energy accounting and audit meters

(1) [ ][57]

(2) [The Energy Accounting and Audit Meters shall have the facility to measure, record and display parameters depending upon the energy accounting and audit requirement of the respective Generating Company or licensee in line with relevant Indian Standards.][58]

(3) The energy accounting and audit meter shall have data storage capacity for at least 35 days in a non-volatile memory.

(4) Energy accounting and audit meters shall have facility to download the parameters through meter reading instruments as well as remote transmission of data over communication network.

[56] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.
[57] Omitted vide Amendment, 2019 w.e.f. 23.12.2019.
[58] Substituted vide Amendment, 2019 w.e.f. 23.12.2019.

Central Electricity Authority

NOTIFICATION

New Delhi, the 18th August, 2006

No.CEA/5-28/Secy/2006.– In exercise of the powers conferred by sub-section (9) of section 70 and sub-section (1) and clause (d) of sub-section (2) of section 177 of the Electricity Act, 2003 (36 of 2003), the Central Electricity Authority, after following the procedure of previous publication in accordance with Electricity (Procedure for Previous Publication) Rules, 2005, makes the following regulations, namely:-

CHAPTER I

General

1. **Short title and commencement** .-

    (1) These regulations may be called The Central Electricity Authority (Procedure for Transaction of Business) Regulations, 2006.

    (2) They shall come into force on the date of their publication in the Official Gazette.

2. **Definitions** .-

    (1) In these regulations, unless the context otherwise requires,-

    (a) "Act" means the Electricity Act, 2003;

    (b) "agenda" means the list of business proposed to be transacted at a meeting of the Authority;

    (c) "Authority" means the Central Electricity Authority established under sub-section (2) of section 70 of the Act;

    (d) "Chairperson" means the chairperson of the Authority appointed under sub-section (2) of section 70 of the Act;

    (e) "meeting" means a meeting of the Authority convened by the Chairperson or any Member authorised to convene a meeting in the absence of the Chairperson;

    (f) "Member" means a Member of the Authority appointed under sub-section (3) of section 70 of the Act;

    (g) "Secretary" means the Secretary of the Authority appointed under section 72 of the Act.

    (2) Words and expressions used but not defined in these regulations shall have the same meanings respectively assigned to them in the Act.

3. **Duties of the Secretary** .-

    (1) The Secretary shall perform his duties under the control of the Chairperson.

    (2) The Authority, in discharge of its functions under the Act, may take such assistance from the Secretary as it may deem fit and the Secretary shall be bound to assist the Authority.

(3) In particular and without prejudice to the generality of the above provisions, the Secretary shall perform the following duties, namely:-

   (a) he shall have custody of the records of proceedings of meetings of the Authority;

   (b) he shall receive or cause to receive all correspondence related to the Authority;

   (c) he shall prepare or cause to be prepared briefs and summaries of proceedings of all meetings of the Authority;

   (d) he shall assist the Authority in the proceedings relating to the power exercisable by the Authority;

   (e) he shall authenticate the orders and resolutions passed by the Authority;

   (f) he shall ensure compliance of the orders and resolution passed by the Authority; and

   (g) he shall collect from the Central or the State Governments or other offices, companies and firms or any other party as may be directed by the Authority, such information as may be considered useful for the purpose of efficient discharge of the functions of the Authority under the Act and place the information before the Authority.

4. Power to designate officers .-

In the absence of the Secretary, the Chairperson, or in the absence of Chairperson, the senior most Member present in office may designate such other officer of the Authority, who may exercise any or all of the functions of the Secretary.

5. Power to review, revoke, etc., orders made or action taken .-

The Authority shall have the power either on an application made by any interested or affected party or suo motu , to review, revoke, revise, modify, amend, alter or otherwise change any order made or action taken by the Secretary or any officer of the Authority, if the Authority considers the same to be appropriate.

CHAPTER II

Meetings

6. Place and time of Meetings .-

All meetings of the Authority shall ordinarily be held at the office of the Authority in New Delhi or any other place at such time as the Chairperson may direct. The Authority shall ordinarily meet once in a month.

7. Notice for Ordinary Meetings .-

The Secretary, for every ordinary meeting of the Authority shall send a notice in writing of at least seven days in advance to all Members, including the Chairperson.

8. Agenda and notes for the meeting .-

The Secretary shall invariably send the agenda for the meeting together with notes, statements and reports, if any, along with notice of the meeting.

9. Special Meeting .-

(1) The Chairperson may, at his discretion, call for a special meeting either on his own or on receipt of a requisition in writing from any Member, specifying the subject for consideration at the said meeting.

(2) In case a special meeting is called by the Chairperson under sub-section (1) above, the notice period of seven days, stipulated under regulation 7, shall not apply.

10. Presiding of meetings in the absence of Chairperson .-

The Chairperson shall preside over the meetings and the conduct of business of the Authority. If for any reason the Chairperson is unable to be present at the meeting, any other Member nominated by the Chairperson in this behalf and in the absence of such nomination or when there is no Chairperson, any Member present at the meeting shall be elected by the Members present, to preside over the meeting and perform the duties of the Chairperson.

11. Effect of Non-receipt of notice of Meeting by a Member .-

The non-receipt of a notice of meeting by any Member shall not invalidate the proceedings of the meetings or any resolution passed or decision taken at such meetings.

12. Quorum .-

(1) The quorum for the meeting shall be four full-time Members, including the Chairperson. If the Chairperson is unable to attend the meeting for any reason, the quorum shall be four full-time Members.

(2) In the absence of a quorum, the meeting of the Authority shall stand adjourned.

(3) In case of adjournment, the Chairperson shall decide the date, time and place of meeting for transacting the business of the Authority which could not take place due to adjournment and notice for such meeting shall be sent by the Secretary to all the Members including the Chairperson, in writing. In such cases, the notice period of seven days stipulated under regulation 7 shall not apply.

13. Decisions of the Authority .-

All decisions of the Authority shall be taken on the basis of the majority of Members present and voting and in the event of an equality of votes, the Chairperson or a Member presiding over the meeting shall have the right to exercise a second or casting vote.

14. Discussion on matters not included in the Agenda .-

Any Member of the Authority may propose for discussion of any matter which is not included in the agenda, with the permission of the Chairperson, and the decision taken at the meeting on such item shall be deemed to be a decision of the Authority.

15. Decision of Authority by circulation .-

The Chairperson or any Member with the permission of the Chairperson, may propose any matter of importance to be circulated for a decision to all the Members of the

Authority and in case the majority of the Members are agreed on a matter, it shall be construed as a decision of the Authority.

16. Ratification of decisions taken by circulation .-

All matters, on which decision has been taken by circulation by majority of the Members including the Chairperson, shall be placed in the succeeding meeting of the Authority, for ratification by the Authority.

CHAPTER III

RECORDING OF MINUTES OF MEETINGS AND COMMUNICATION

17. Recording of Minutes .-

(1) The Secretary or any other person authorised by the Chairperson shall be responsible for recording the minutes of the meeting which shall contain a fair, concise and correct summary of the proceedings at the meeting and which shall mention the following, among other:-

(a) the name and designation of Members and invitees present in the meeting, and

(b) notes of dissent, if any.

(2) The draft minutes shall, as soon as possible after conclusion of the meeting, be sent to the Chairperson and the Members who have attended the meeting for approval.

(3) The approved minutes shall be communicated to the Chairperson and Members and only the relevant portion of the minutes shall be communicated to other concerned officers for implementation.

18. Confirmation of Minutes of Meeting of Authority .-

The minutes of the previous meeting of the Authority shall be placed in its next meeting for confirmation.

19. Register of Minutes of Meetings of the Authority .-

The Secretary or any person authorised in this behalf shall maintain a register for recording the minutes of the meetings of the Authority and shall record therein the minutes of each meeting and shall be responsible for getting the minutes of each meeting authenticated by the person who presided over the meeting.

20. Minutes in the form of resolutions .-

All the minutes of the decisions taken at the meeting of the Authority shall be recorded in the form of resolutions in clear and concise manner to facilitate implementation.

21. Compilation of Resolutions .-

The Secretary shall codify and compile subject-wise all resolutions and decisions taken in the meetings of the Authority and shall, at the end of the calendar year, make it available to all Members of the Authority.

CHAPTER IV
MISCELLANEOUS

22. Power to relax .-

(i) Nothing in these regulations shall bar the Authority from adopting in conformity with the provisions of the Act, a procedure, which is at variance with any of the provisions of these regulations, if the Authority, in view of the special circumstances of a matter or class of matters and for reasons to be recorded in writing, deems it necessary or expedient for dealing with such a matter or class of matters.

(ii) Nothing of these regulations shall, expressly or impliedly, bar the Authority to deal with any matter or exercise any power under sub-section (9) of section 70 the Act for which no regulations have been framed, and the Authority may deal with such matters, powers and functions in accordance with the provisions of the Act.

CENTRAL ELECTRICITY AUHORITY

NOTIFICATION

New Delhi, the 21st February, 2007

No. 12/X/STD(CONN)/GM/CEA- Whereas the draft of the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2006 were published as required by Sub-suction (2) of Section 177 of the Electricity Act, 2003 (36 of 2003) read with rule 3 of the Electricity (Procedure for previous Publication) Rules, 2005.

Now, therefore, in exercise of powers conferred by Section 7 and clause (b) of Section 73 read with Sub-section (2) of Section 177 of Electricity Act, 2003, the Central Electricity Authority hereby makes the following Regulations for regulating the technical standards for connectivity to the grid, namely :—

1. Short title and commencement:-

(1) These Regulations may be called the Central Electricity Authority (Technical Standards for Connectivity to the Grid), Regulations, 2007

(2) These Regulations shall come into force on the date or their publication in the Official Gazette.

2. Definitions:-

In these regulations, unless the context otherwise requires:-

(1) “Act" means The Electricity Act, 2003 (No. 36 of 2003);

(2) "Appropriate Load Despatch Centre" means the National Load Despatch Centre (NLDC), Regional Load Despatch Centre (RLDC) or State Load Despatch Centre (SLDC) or Area Load Despatch Centre as the case may be;

(3) "Area Load Despatch Centre" means the centre as established by the state for load despatch and control in a particular area of the state;

(4) "Appropriate Transmission Utility” means the Central Transmission Utility or State Transmission Utility as the case may be;

(5) "Automatic Generation Control" (AGC) means capability to regulate the power output of selectable units in response to total power plant output, tie-line power flow, and power system frequency;

(6) “Automatic Voltage Regulator” (AVR) means a continuously acting automatic excitation control system to regulate a generating unit terminal voltage;

(7) "British Standards” (BS) means those standards and specifications approved by the British Standards Institution;

(8) "Bulk consumer" means a consumer who avails supply at voltage of 33 kV or above;

(9) "Earth Fault Factor" at a location in a three-phase system means the ratio of 'the highest root mean square(r.m.s.)phase-to-earth power frequency voltage on a sound phase during a

fault to earth (affecting one or more phases)' to 'the r.m.s. phase-to-earth power frequency voltage which would be obtained at the selected location without the fault'';

(10) ["Earthing" means electrical connection between non-energized conducting parts and the general mass of earth by an earthing device;][1]

(11) "Energy Management System" (EMS) means a complete system comprising software for facilitating operation of a power system, maintaining safety, reliability and economy;

(12) "Event Logging Facilities" means a device provided to record the chronological sequence of operations of the relays and other equipment;

(13) "Frequency" means the number of alternating cycles per second [expressed in Hertz (Hz)];

(14) "Generating Unit" means an electrical Generator coupled to a prime mover within a Power Station together with all Plant and Apparatus at that Power Station (up to the Connection Point) which relates exclusively to the operation of that generator;

[In case of Solar Photo voltaic generating station, each inverter along with associated modules will be reckoned as a separate generating unit;][2]

(15) "IEC Standard " means a standard approved by the International Electrotechnical Commission;

(16) "Indian Standards" (IS) means standards specified by Bureau of Indian Standards;

[(16A) "installed capacity",-

(i) in case of coal, lignite, gas engines and hydro stations, means the summation of the name plate capacities of all the units of the generating station or Maximum Continuous Rating of the generating station; and

(ii) in case of wind generating stations and generating stations using inverters, means the summation of the name plate capacities of wind turbines or solar generating units, as the case may be;][3]

(17) ["Interconnection point" means a point on the grid, including a sub-station or a switchyard, where the interconnection is established between the facility of the requester and the grid and where electricity injected into -or drawn from the grid can be measured unambiguously for the requester;][4]

[(17A) "Inverter" means a device that changes direct current power into alternating current power;][5]

(18) "Isolator" means a device for achieving isolation of one part of an electrical system from the rest of the system:

(19) ["Maximum Continuous Rating" (MCR) will carry same meaning as defined in the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010;][6]

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[1] Substituted vide First amendment, 2013 w.e.f. 15.10.2013
[2] Added vide First amendment, 2013 w.e.f. 15.10.2013
[3] Inserted vide Second amendment, 2019 w.e.f. 06.02.2019
[4] Substituted vide First amendment, 2013 w.e.f. 15.10.2013
[5] Inserted vide First amendment, 2013 w.e.f. 15.10.2013
[6] Substituted vide First amendment, 2013 w.e.f. 15.10.2013

(20) [ ][7]

(21) "Power Factor" means the cosine of the electrical angle between the voltage and current complexors in an AC electrical circuit;

(22) "Power System Stabilizer" (PSS) means controlling equipment which receives input signals of speed, frequency and power to control the excitation via the voltage regulator for damping power oscillations of a synchronous machine;

(23) "Protection System" means the equipment by which abnormal conditions in the grid are detected and fault clearance, actuating signals or indications are initiated without the intervention by the operator;

(24) "Reactive Power" means in relation to an AC electrical system, the product of root mean square (r.m.s.)voltage, root mean square (r.m.s.) current and the sine of the electrical phase angle between the voltage complexor and current complexor, measured in volt-amperes reactive (VAr);

(25) [“requester” includes a generating company, captive generating plant, energy storage system, transmission licensee (other than Central Transmission Utility and State Transmission Utility), distribution licensee, solar park developer, wind park developer, wind-solar photo voltaic hybrid system, or bulk consumer seeking connection for its new or expanded electrical plant to the Grid at voltage level 33 kV and above;][8]

(26) "SCADA" means Supervisory Control and Data Acquisition System that acquires data from remote locations over communication links and processes it at centralised control location for monitoring, supervision, control as well as decision support;

(27) "Site Common Drawing" means a drawing prepared for a connection site, which depicts layout of connection site, electrical layout, common protection and control drawings and common services;

(28) "Site Responsibility Schedule" (SRS) means a Schedule for demarcating the ownership, responsibility for control, operation and maintenance of the equipment at the interconnection point;

[(28A) "Standard Protection" means electrical protection functions specified in Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010;][9]

(29) "System Protection Scheme" means a scheme designed to detect abnormal system conditions and take predetermined, corrective action to preserve system integrity and provide acceptable system performance;

(30) "Thermal Generating Unit" means a generating unit using fossil fuels such as coal, lignite, gaseous and liquid fuel;

(31) "Total Harmonic Distortion" (THD) means a measure of distortion of the voltage or current wave form (which shall ideally be sinusoidal) and is the square root of the sum of squares of all voltage or current harmonics expressed as a percentage of the magnitude of

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[7] Omited vide First amendment, 2013 w.e.f. 15.10.2013
[8] Substituted vide Second amendment, 2019 w.e.f. 06.02.2019
[9] Inserted vide First amendment, 2013 w.e.f. 15.10.2013

the fundamental;

(32) "Transmission System" means a network of transmission lines and sub-stations;

(33) "Under Frequency Relay" means a relay which operates when the system frequency falls below a preset value;

(34) ["user" includes a generating company, captive generating plant, energy storage system, transmission licensee (other than the Central Transmission Utility and State Transmission Utility), distribution licensee, solar park developer, wind park developer, wind-solar photo voltaic hybrid system, or bulk consumer whose electrical plant is connected to the Grid at voltage level 33 kV and above;][10]

(35) "Voltage Unbalance" means the deviation between highest and lowest line voltage divided by Average Line Voltage of the three phases,

[(36) "wind farm developer" means a person who has developed or proposes to develop the wind generating station or wind generating farm comprising more than one wind generating unit owned by the developer or any other person;';

(37) "solar park developer" means a person who has developed or proposes to develop the solar park or solar generating station comprising more than one solar generating unit owned by the developer or any other person;';

(38) "wind - solar photo voltaic hybrid system" means a system of electricity generation, which has combination of wind and solar photo voltaic resources, with or without storage system;][11]

The words and expressions used and not defined in these regulations but defined in the Act shall have the meanings assigned to them in the Act.

3. Applicability of the Regulations

These regulations shall be applicable to all the users, requesters, Central Transmission Utility and State Transmission Utility.

4. Objectives

(1) The aim of these regulations is to ensure the safe operation, integrity and reliability of the grid.

(2) The new connection shall not cause any adverse effect on the grid. The grid shall continue to perform with specified reliability, security and quality as per the [Central Electricity Authority (Grid Standards) Regulations, 2010][12]. However, these regulations are not to be relied upon to protect the plant and equipment of the requester or user.

(3) A requester is required to be aware, in advance, of the standards and conditions his system has to meet for being integrated into the grid.

5. Standards

The equipment shall meet the requirements in accordance with the provisions of Technical Standards for Connectivity to the Grid as given in the Schedule of these regulations and [Central

[10] Substituted vide Second amendment, 2019 w.e.f. 06.02.2019
[11] Inserted vide Second amendment, 2019 w.e.f. 06.02.2019
[12] Substituted vide First amendment, 2013 w.e.f. 15.10.2013

Electricity Authority (Grid Standards) Regulations, 2010][13] and Grid Code and the State Grid Code(s) as specified by the appropriate Commission.

6. General Connectivity Conditions

(1) The requester shall be responsible for the planning, design, construction, reliability, protection and safe operation of its own equipment subject to the regulations for construction operation and maintenance and connectivity and other statutory provisions,

(2) The requester and user shall furnish data as required by the Appropriate Transmission Utility or by the licensee or generating station with whose system the inner-connection is proposed, for permitting inter connection with the grid,

(3) The requester and user shall provide necessary facilities for voice and data communication and transfer of on-line operational data, such as voltage, frequency, line flows, and status of breaker and isolator position and other parameters as prescribed by the Appropriate Load Despatch Centre.

(4) The requester and user shall cooperate with the Regional Power Committee, and Appropriate Load Despatch Centres in respect of the matters listed below, but not limited to :—

(a) protection coordination and settings of its protective relays accordingly;

(b) agree to maintain meters and communication system in its jurisdiction in good condition;

(c) participate in contingency operations such as load shedding, increasing or reducing generation, islanding, black start, providing start-up power and restoration as per the procedure decided by the Appropriate Load Despatch Centre;

(d) furnish data as required by Appropriate Transmission Utility or Transmission Licensee, Appropriate Load Despatch Centre, Appropriate Regional Power Committee, and any committee constituted by the Authority at appropriate Government for system studies or for facilitating analysis of tripping or disturbance in power system;

(e) carryout modifications in his equipment with respect to short circuit level, protection coordination and other technical reasons considered necessary due to operational requirements;

(f) abide by the coordinated outage plan of the state and region in respect of generating units and transmission lines as approved by the Regional Power Committee; and

(g) cooperate with the Regional Power Committee for tuning of Power System Stabilizer provided in the excitation system of the generating unit.

(5) The requester and user shall make arrangements for integration of the controls and tele-metering features of his system into the Automatic Generation Control,

[13] Substituted vide First amendment, 2013 w.e.f. 15.10.2013

Automatic Load Shedding, Special Protection System, Energy Management Systems and Supervisory Control and Data Acquisition System of the respective state or region.

(6) For inter-connection studies the requester shall make a request for connection in the planning stage to the Appropriate Transmission Utility. In case a requester is seeking inter-connection to a distribution system such a request will be made to the distribution licensee. The Appropriate Transmission Utility or distribution licensee shall carry out the inter-connection study to determine the point of inter-connection, required inter-connection facilities and modifications required on the existing grids, if any, to accommodate the interconnection. The study may also address the transmission system capability, transient stability, voltage stability, losses, voltage regulation, harmonics, voltage flicker, electromagnetic transients, machine dynamics, ferro resonance, metering requirements, protective relaying, sub-station grounding and fault duties, as the case may be.

[Provided that in order to carry out the said study, the requester shall present the mathematical model of the equipment in accordance with the requirements as stipulated by the Appropriate Transmission Utility or distribution licensee, as the case may be.][14]

(7) (1) Every connection of a requester's system to the grid shall be covered by a connection agreement between the requester and

(a) Appropriate Transmission Utility in case of connection to Inter-state transmission system or intra state transmission system as the case may be,

(b) Distribution licensee in case of inter-connection to distribution licensee's system; and

(c) Transmission licensee and Appropriate Transmission Utility, in case of inter-connection to a transmission licensee (Tri-partite agreement).

(2) The connection agreement shall contain general and specific technical conditions, applicable to that connection.

[(8) The State Transmission Utility shall inform the Central Transmission Utility and the Authority, within thirty days of acceptance of application for connectivity of a generating station to electricity system operating at 110 kV and above.][15]

7. Site Responsibility Schedule

(1) A Site Responsibility Schedule (SRS) for every connection point shall be prepared by the [generating company or licensee operating the electricity system to which][16] connection is taking place.

(2) Following information shall be included in the Site Responsibility Schedule, namely,—

(a) Schedule of electrical apparatus services and supplies;

[14] Inserted vide First amendment, 2013 w.e.f. 15.10.2013
[15] Inserted vide First amendment, 2013 w.e.f. 15.10.2013
[16] Substituted vide First amendment, 2013 w.e.f. 15.10.2013

(b) Schedule of telecommunications and measurement apparatus; and

(c) Safety rules applicable to each plant and apparatus.

(3) Following information shall also be furnished in the Site Responsibility Schedule for each item of equipment installed at the connection site, namely :—

(a) the ownership of equipment;

(b) the responsibility for control of equipment;

(c) the responsibility for maintenance of equipment;

(d) the responsibility for operation of equipment;

(e) the manager of the site;

(f) the responsibility for all matters relating to safety of persons at site; and

(g) the responsibility for all matters relating to safety of equipment at site.

8. Access at Connection Site

The requester or user, as the case may be owning the electrical plant shall provide reasonable access and other required facilities to the licensee or Appropriate Transmission Utility or Appropriate Load Despatch Centre, whose equipment is installed or proposed to be installed at the Connection Site for installation, operation and maintenance, etc. of the equipment.

9. Site Common Drawings

Site Common Drawings shall be prepared for each connection point by the owner of the Sub-station where connection is taking place.

[10. Cyber security.-

The requester and the user shall comply with cyber security guidelines issued by the Central Government, from time to time, and the technical standards for communication system in Power Sector laid down by the Authority.

11. Registration in the Registry maintained by the Authority.-

The user or the requester, as the case may be, shall get its generating unit or station, of such capacity and with effect from such date as specified by the Authority, registered and get an online generated Unique Registration Number from the Authority:

Provided that no generating unit or generating station shall be granted connectivity with the grid without the unique registration number with effect from the date specified by the Authority.

12. Compliance of regulations.-

(1) The licensee shall ensure that before connectivity to the grid, all the provisions with regard to the connectivity specified under these regulations are complied with by the requester.

(2) Before allowing connectivity to the requester, the compliance of the provisions laid down under sub-regulations (2), (3) and (5) of regulation 6 shall be verified by the licensee and the verification of compliance of provisions of other regulations shall be in the form of self-declaration in the proforma of connection agreement which shall be checked and verified by the concerned licensee on sample basis.

(3) The user may be disconnected from the Grid by the licensee for non-compliance of any provision of these regulations and any non-compliance of the provisions of these regulations shall be reported by the licensee or the State Load Dispatch Centre or the Regional Load Dispatch Centre, as the case may be, to the appropriate Commission.][17]

SCHEDULE

(See Regulation No. 5)

Standards for Connectivity to the Grid

Part I General

1. Standards and Codes of Practice

(1) The requester shall follow the industry best practices and applicable industry standards in respect of the equipment installation and its operation and maintenance.

(2) The equipment including overhead lines and cables shall comply with the relevant Indian Standards, British Standard (BS) or International Electrotechnical Commission (IEC) Standard, or American National Standards Institute (ANSI) or any other equivalent International Standard:

Provided that whenever an International Standard or International Electrotechnical Commission Standard is followed, necessary corrections or modifications shall be made for nominal system frequency, nominal system voltage, ambient temperature, humidity and other conditions prevailing in India before actual adoption of the said Standard.

(3) The effects of wind, storms, floods, lightening, elevation, temperature extremes, icing, contamination, pollution and earthquakes must be considered in the design and operation of the connected facilities.

(4) Installation, operation and maintenance of the equipment by the requester shall conform to the relevant standards specified by the Authority under Section 177, and Section 73 of the Act, as and when they come into force.

2. Safety

The requester shall comply with the Indian Electricity Rules, 1956 till such time Central Electricity Authority (Safety and Electric Supply) Regulations come into force.

3. Sub-station Grounding

Each transmission sub-station must have a ground mat solidly connected to all metallic structures and other non-energised metallic equipment. The mat shall limit the ground potential gradients to such voltage and current levels that will not endanger the safety of people or damage equipment which are in, or immediately adjacent to, the station under normal and fault conditions. The ground mat size and type shall be based on local soil conditions and available electrical fault current magnitudes. In areas where ground mat voltage rises would not be within acceptable and safe limits (for example due to high soil resistivity or limited sub-station space), grounding rods and

[17] Inserted vide Second Amendment, 2019 w.e.f. 06.02.2019

ground wells may be used to reduce the ground grid resistance to acceptable levels. Sub-station grounding shall be done in accordance with the norms of the Institute of Electrical and Electronics Engineers (IEEE)- 80.

4. Metering

Meters shall be provided as specified in the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

5. Basic Insulation Level and Insulation Co-ordination

(1) Basic Insulation Level (BIL) of various items of equipment and ratings of surge arresters for generating stations, lines and sub-stations shall be decided on the following order of priority, namely :—

(a) ensure safety to public and operating personnel;

(b) avoid permanent damage to plant;

(c) prevent failure of costly equipment;

(d) minimise circuit interruptions; and

(e) minimise interruptions of power supply to consumers.

(2) Insulation co-ordination of equipment and lines on both sides of a connection point belonging to the requester and the grid shall be accomplished and the co-ordination shall be done by the AppropriateTransmission Utility.

6. Protection System and Co-ordination

(1) Protection system shall be designed to reliably detect faults on various abnormal conditions and provide an appropriate means and location to isolate the equipment or system automatically. The protection system must be able to detect power system faults within the protection zone. The protection system should also detect abnormal operating conditions such as equipment failures or open phase conditions.

(2) Every element of the power system shall be protected by a standard protection system having the required reliability, selectivity, speed, discrimination and sensitivity. Where failure of a protective relay in the requester's system has substantial impact on the grid, it shall connect an additional protection as back up protection besides the main protection.

(3) Notwithstanding the protection systems provided in the grid, the requester and user shall provide requisite protections for safeguarding his system from the faults originating in the Grid.

(4) Bus Bar Protection and Breaker Fail Protection or LocaI Breaker Back Up Protection shall be provided wherever stipulated in the regulations.

(5) Special Protection Scheme such as under frequency relay for load shedding, voltage instability, angular instability, generation backing down or Islanding Schemes may also be required to be provided to avert system disturbances.

(6) Protection co-ordination issues shall be finalized by the Regional Power Committee.

(7) The requester and user shall develop protection manuals conforming to various standards for the reference and use of its personnel.

7. Disturbance Recording and Event Logging Facilities

Every generating station and sub-station connected to the grid at 220 kV or above shall be provided with disturbance recording and event logging facilities. All such equipment shall be provided with time synchronization facility for global common time reference.

8. Schematic Diagrams

The requester and user shall prepare single line schematic diagrams in respect of its system facility and make the same available to the Appropriate Transmission Utility or licensee through which his system is connected and the Appropriate Load Despatch Centre.

9. Inspection, Test, Calibration and Maintenance prior to connection

Before connecting, the requester shall complete all inspections and tests finalised in consultation with the Appropriate Transmission Utility or licensee or generating station to which his equipment is connected. The requester shall make available all drawings, specifications and test records of the project equipment pertaining to integrated operation to the Appropriate Transmission Utility or licensee or generating station as the case may be.

[Part II

Connectivity Standard applicable to the generating stations

A. Connectivity Standards applicable to the Generating Stations other than wind and generating stations using inverters

These generating stations shall comply with the following requirements besides the general connectivity conditions given in the said regulations and Part I of the schedule:-

A1. For Generating stations which are connected on or after the date on which Central Electricity Authority (Technical Standards for Connectivity of the Grid) Regulation, 2007 became effective

(1) The excitation system for every generating unit:--

(a) shall have state of the art excitation system;

(b) shall; have Automatic Voltage Regulator (AVR). Generators of 100 MW rating and above shall have Automatic Voltage Regulator with digital control and two separate channels having independent inputs and automatic changeover;

and

(c) The Automatic Voltage Regulator of generator of 100 MW and above shall include Power System Stabilizer (PSS).

(2) The Short-Circuit Ratio (SCR) for generators shall be as per IEC-34.

(3) The generator transformer windings shall have delta connection on low voltage side and star connection on high voltage side. Star point of high voltage side shall be effectively (solidly) earthed so as to achieve the Earth Fault Factor of 1.4 or less.

(4) All generating machines irrespective of capacity shall have electronically controlled governing system with appropriate speed/load characteristics to regulate frequency. The governors of thermal generating units shall have a droop of 3 to 6% and those of hydro generating units 0 to 10%.

(5) Generating Units located near load centre, shall be capable of operating at rated output for power factor varying between 0.85 lagging (over-excited) to 0.95 leading (under-excited) and Generating Units located far from load centres shall be capable of operating at rated output for power factor varying between 0.9 lagging (over-excited) to 0.95 leading (under-excited).

Provided that all generating units commissioned on or after 01.01.2014, [Provided also that all hydro-electric generating units, where Techno-Economic Concurrence has been accorded by the Authority under section 8 of the Act, shall be capable of operating at the rated output at the power factor as specified in such techno-economic concurrence.][18] shall be capable of operating at rated output for power factor varying between 0.85 lagging (over-excited) to 0.95 leading (under-excited).

Provided further that the above performance shall also be achieved with voltage variation of± 5% of nominal, frequency variation of+ 3% and -5% and combined voltage and frequency variation of ±5%. However, for gas turbines, the above performance shall be achieved for voltage variation of ±5%.

(6) The coal and lignite based thermal generating units shall be capable of generating up to 105% of Maximum Continuous Rating (subject to maximum load capability under Valve Wide Open Condition) for short duration to provide the frequency response.

(7) The hydro generating units shall be capable of generating up to 110% of rated capacity (subject to rated head being available) on continuous basis.

(8) Every generating unit shall have standard protections to protect the units not only from faults within the units and within the station, but also from faults in transmission lines. For generating units having rated capacity greater than 100 MW, two independent sets of protections acting on two independent sets of trip coils fed from independent Direct Current (DC) supplies shall be provided. The protections shall include but not be limited to the Local Breaker Back-up (LBB) protection.

(9) Hydro generating units having rated capacity of 50 MW and above shall be capable of operation in synchronous condenser mode, wherever feasible.

Provided that hydro generating units commissioned on or after 01.01.2014 and having rated capacity of 50 MW and above shall be equipped with facility to operate in synchronous condenser mode, if necessity for the same is established by the interconnection studies.

(10) Bus bar protection shall be provided at the switchyard of all generating station.

[18] Inserted vide Second Amendment, 2019 w.e.f. 06.02.2019

(11) Automatic synchronisation facilities shall be provided in the requester's Project.

(12) The station auxiliary power requirement, including voltage and reactive requirements, shall not impose operating restrictions on the grid beyond those specified in the Grid Code or state Grid Code as the case may be.

(13) In case of hydro generating units, self-starting facility may be provided. The hydro generating station may also have a small diesel generator for meeting the station auxiliary requirements for black start.

Provided that hydro generating units shall have black start facilities in accordance with provisions of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 from the date of publication of these Regulations.

(14) The standards in respect of the switchyard associated with the generating stations shall be in accordance with the provisions specified in respect of 'Sub-stations' under Part III of these Standards.

A2. Generating stations which were already connected to the grid on the date on which Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 became effective

For thermal generating units having rated capacity of 200 MW and above and hydro units having rated capacity of 100 MW and above, the following facilities would be provided at the time of renovation and modernization.

(1) Every generating unit shall have Automatic Voltage Regulator. Generators having rated capacity of 100 MW and above shall have Automatic Voltage Regulator with two separate channels having independent inputs and automatic changeover.

(2) Every generating unit of capacity having rated capacity higher than 100 MW shall have Power System Stabilizer.

(3) All generating units shall have standard protections to protect the units not only from faults within the units and within the station but also from faults in transmission lines. The protections shall include but not limited to the Local Breaker Back-up (LBB) protection.

B. [Connectivity standards applicable to the wind generating stations, generating stations using inverters, wind - solar photo voltaic hybrid systems and energy storage systems.

The generating stations shall comply with the following requirements in addition to the general connectivity conditions specified under Part 1:

Provided that the energy storage systems shall comply, only with the requirements specified under clause B1 in addition to the general connectivity conditions specified under Part 1.;][19]

B1. Requirements with respect to Harmonics, Direct Current (DC) Injection and Flicker

(1) Harmonic current injections from a generating station shall not exceed the limits specified in Institute of Electrical and Electronics Engineers (IEEE) Standard 519.

(2) The Generating station shall not inject DC current greater than 0.5 % of the full

[19] Substituted vide Second amendment, 2019 w.e.f. 06.02.2019.

rated output at the interconnection point.

(3) The generating station shall not introduce flicker beyond the limits specified in IEC 61000.

Provided that the standards for flicker will come into effect from 1st April 2014.

(4) Measurement of harmonic content, DC injection and flicker shall be done at least once in a year in presence of the parties concerned and the indicative date for the same shall be mentioned in the connection agreement;

Provided that in addition to annual measurement, if distribution licensee or transmission licensee or the generating company, as the case may be, desires to measure harmonic content or DC-injection or flicker, it shall inform the other party in writing and the measurement shall be carried out within 5 working days.

B2. For generating station getting connected on or after completion of 6 months from date of publication of these Regulations in the Official Gazette.

(1) The generating station shall be capable of supplying dynamically varying reactive power support so as to maintain power factor within the limits of 0.95 lagging to 0.95 leading.

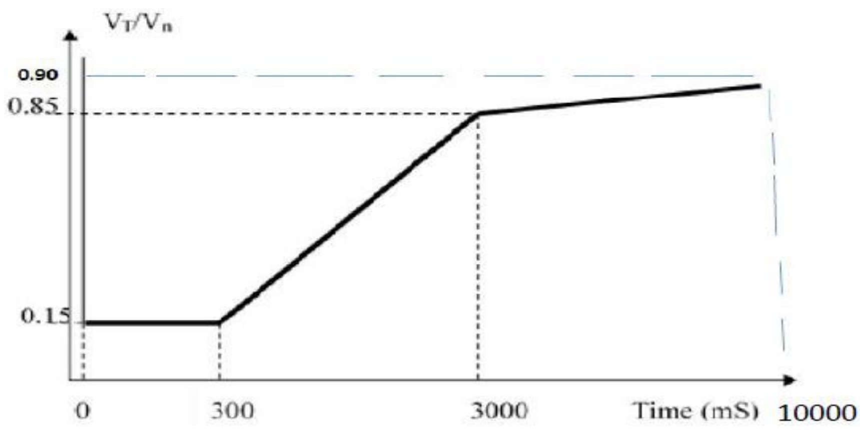
[(2) The generating unit shall be capable of operating in the frequency range 47.5 to 52 Hz and be able to deliver rated output in the frequency range of 49.5 Hz to 50.5 Hz:

Provided that in the frequency range below 49.90 Hz and above 50.05 Hz, or, as prescribed by the Central Commission, from time to time, it shall be possible to activate the control system to regulate the output of the generating unit as per frequency response requirement as provided in sub-clause (4):

Provided further that the generating unit shall be able to maintain its performance contained in this subclause even with voltage variation of up to + 5% subject to availability of commensurate wind speed in case of wind generating stations and solar insolation in case of solar generating stations.

(3) The generating station connected to the grid, shall remain connected to the grid when voltage at the interconnection point on any or all phases dips up to the level depicted by the thick lines in the following curve, namely: —

V_T : Actual Voltage; Vn: Nominal Voltage—



Provided that during the voltage dip, the supply of reactive power has first priority, while the supply of active power has second priority and the active power preferably be maintained during voltage drops, provided, a reduction in active power within the plant's design specifications is acceptable and active power be restored to at least 90% of the pre-fault level within 1 sec of restoration of voltage.

(4) The generating stations with installed capacity of more than 10 MW connected at voltage level of 33 kV and above –

(i) shall be equipped with the facility to control active power injection in accordance with a set point, capable of being revised based on directions of the State Load Dispatch Centre or Regional Load Dispatch Centre, as the case may be;

(ii) shall have governors or frequency controllers of the units at a droop of 3 to 6% and a dead band not exceeding ±0.03 Hz:

Provided that for frequency deviations in excess of 0.3 Hz, the Generating Station shall have the facility to provide an immediate (within 1 second) real power primary frequency response of at least 10% of the maximum Alternating Current active power capacity;

(iii) shall have the operating range of the frequency response and regulation system from 10% to 100% of the maximum Alternating Current active power capacity, corresponding to solar insolation or wind speed, as the case may be;

(iv) shall be equipped with the facility for controlling the rate of change of power output at a rate not more than ± 10% per minute.

(5) The generating stations of aggregate capacity of 500 MW and above shall have the provision to receive the signal from the State Load Dispatch Centre or Regional Load Dispatch Centre, as the case may be, for varying active and reactive power output.

(6) The standards in respect of the switchyard associated with the generating stations shall be in accordance with the provisions specified in respect of 'Sub-stations' under Part III of these Standards.

(7) The generating station connected to the grid, shall remain connected to the grid when voltage at the interconnection point, on any or all phases (symmetrical or asymmetrical overvoltage conditions) rises above the specified values given below for specified time—

Over voltage (pu)	Minimum time to remain connected (Seconds)
$1.30 < V$	0 Sec (Instantaneous trip)
$1.30 \geq V > 1.20$	0.2 Sec
$1.20 \geq V > 1.10$	2 Sec
$V \leq 1.10$	Continuous

(8) Short Circuit Ratio at the interconnection point where the generating resource is proposed to be connected shall not be less than 5.][20]

[20] Substituted vide Second amendment, 2019 w.e.f. 06.02.2019

B3. [Special provision for certain Generating stations :

The generating stations commissioned before the commencement of the Central Electricity Authority (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2018 or commissioned within six months of such commencement shall comply with the provisions of these regulations as if they were not amended.][21]][22]

Part III

Grid Connectivity Standards applicable to the Transmission Line and Sub-Station

The transmission lines and sub-stations connected to the grid shall comply with the following additional requirements besides the general connectivity conditions under these regulations and General Standards for Connectivity to the Grid as specified in Part I of the Schedule.

(1) Bus bar protection shall be provided on all sub-stations at and above 220 kV levels for all new sub-stations. For existing sub-stations, this shall be implemented in a reasonable time frame.

(2) Local Breaker Back-up (LBB) protection shall be provided for all sub-stations of 220kV and above.

(3) Two main numerical Distance Protection Schemes shall be provided on all the transmission lines of 220 kV and above for all new sub-stations. For existing sub-stations, this shall be implemented in a reasonable time frame.

(4) Circuit breakers, isolators and all other current carrying equipment shall be capable of carrying normal and emergency load currents without damage. The equipment shall not become a limiting factor on the ability of transfer of power on the inter-state and intra-state transmission system.

(5) All circuit breakers and other fault interrupting devices shall be capable of safely interrupting fault currents for any fault that they are required to interrupt. The Circuit Breaker shall have this capability without the use of intentional time delay in clearing the fault. Minimum fault interrupting requirement need be specified by the Appropriate Transmission Utility. The Circuit Breaker shall be capable of performing all other required switching duties such as, but not limited to, capacitive current switching, load current switching and out-of-step switching. The Circuit Breaker shall perform all required duties without creating transient over-voltages that could damage the equipment provided elsewhere in the grid. The short circuit capacity of the circuit breaker shall be based on short-term and perspective transmission plans as finalized by the Authority.

(6) Power Supply to Sub-Station Auxiliaries, shall:

(a) for alternating current (AC) supply (Applicable to new sub-stations):

220 kV and above: Two high tension (HT) supplies shall be arranged from

[21] Substituted vide Second amendment, 2019 w.e.f. 06.02.2019
[22] Substituted vide First amendment, 2013 w.e.f. 15.10.2013

independent sources. One of the two high tension supplies shall be standby to the other. In addition, an emergency supply from diesel generating (DG) source of suitable capacity shall also be provided.

66 kV and below 220 kV: There shall be one HT supply and one diesel generating source.

33 kV and below 66 kV: There shall be one HT supply.

(b) for direct current (DC) Supply (Applicable to new sub-stations): Sub-stations of transmission system for 132 kV and above and sub-stations of all generating stations: There shall be two sets of batteries, each equipped with its own charger.

For sub-stations below 132 kV: there shall be one set of battery and charger.

(7) Earth Fault Factor for an effectively earthed system shall be not more than 1.4.

Part IV

Grid Connectivity Standards applicable to the Distribution Systems and Bulk Consumers

The following additional requirements shall be complied with, besides the connectivity conditions in these regulations and general Standards for Connectivity to the Grid given in Part-I and those applicable to transmission lines and sub-stations in Part -III.

1. Under Frequency/df/dt Relays

Under frequency and df/dt (rate of change of frequency with time) relays shall be employed for automatic load control in a contingency to ensure grid security under conditions of falling grid frequency in accordance with the decision taken in the Regional Power Committee.

2. [(i) The distribution licensee and bulk consumer shall provide adequate reactive compensation to compensate reactive power requirement in their system so that they do not depend upon the grid for reactive power support.

(ii) The power factor for distribution system and bulk consumer shall be within ± 0.95;

3. Voltage and Current Harmonics. –

(i) The limits of voltage harmonics by the distribution licensee in its electricity system, the limits of injection of current harmonics by bulk consumers, point of harmonic measurement, i.e., point of common coupling, method of harmonic measurement and other related matters, shall be in accordance with the IEEE 519-2014 standards, as amended from time to time;

(ii) Measuring and metering of harmonics shall be a continuous process with meters complying with provisions of IEC 61000-4-30 Class A.

(iii) The data measured and metered as mentioned in sub-paragraph (ii) with regard to the harmonics, shall be available with distribution licensee and it shall also be shared with the consumer periodically.

(iv) The bulk consumer shall install power quality meter and share the recorded data thereof with the distribution licensee with such periodicity as may be specified by the appropriate Electricity Regulatory Commission:

Provided that the existing bulk consumer shall comply with this provision within twelve months from the date of commencement of the Central Electricity Authority (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2018.

(v) In addition to harmonics, periodic measurement of other power quality parameters such as voltage sag, swell, flicker, disruptions shall be done as per relevant International Electrotechnical Commission Standards by the distribution licensee and the reports thereof shall be shared with the consumer.

(vi) The distribution licensee shall install power quality meters in a phased manner within three years from the date of commencement of the Central Electricity Authority (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2018 covering at least 33% of the 33 kV substations each year.][23]

4. Voltage Unbalance

The Voltage Unbalance at 33 kV and above shall not exceed 3.0%.

5. Voltage Fluctuations

(1) The permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5%

(2) For occasional fluctuations other than step changes the maximum permissible limit is 3%.

(3) The limits prescribed in (1) and (2) above shall come into force not later than five years from the date of publication of these regulations in the Official Gazette.

6. Back-energization

[The bulk consumer shall not energize transmission or distribution system by injecting supply from his generators or any other source either by automatic controls or manually unless specifically provided for in the connection agreement with the Transmission or Distribution Licensee.][24]

[23] Substituted vide Second amendment, 2019 w.e.f. 06.02.2019
[24] Substituted vide First amendment, 2013 w.e.f. 15.10.2013

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the10th April, 2007

F.No. CEA/PLG/LF/9/40/07. – Whereas the draft of the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2006 were published, as required by Sub-section (3) of Section 177 of the Electricity Act, 2003 (36 of 2003), read with rule 3 of the Electricity (Procedure for Previous Publication) Rules, 2005;

Now, therefore, in exercise of the powers conferred by Section177, read with Section 74 and clause (i) of Section 73 of the Electricity Act, 2003, the Central Electricity Authority hereby Makes the following regulations, namely:-

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CENTRAL ELECTRICITY AUTHORITY (FURNISHING OF STATISTICS, RETURNS AND INFORMATION) REGULATIONS, 2007.

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1. Short title and commencement - (1) These regulations may be called the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007.

(2) These regulations shall come into force on the date of their publication in the official Gazette.

2. Definitions - unless the context otherwise requires, in these regulations,-

(1) "Act" means the Electricity Act, 2003 (36 of 2003);

(2) "Voltage" means the difference of electric potential measured in volts, between any two conductors or between any part of either conductor and the earth as measured by a suitable voltmeter and is said to be –

(a) "high voltage" where the voltage exceeds 650 volts but does not exceed 33000 volts under normal condition; and

(b) "extra high voltage" where the voltage exceeds 33000 volts under normal condition;

(3) [All other words and expressions used and not defined in these regulations but defined in the Act, Rules made by the Government of India, other Regulations of CEA and Regulations of CERC assigned to them, shall have the meanings respectively assigned to them in the Act, Rules and Regulations.][1]

3. Applicability of the regulations - These regulations shall be applicable to all the licensees, generating companies, person(s) generating electricity for its or his own use and person(s) engaged in generation, transmission, distribution, trading and utilization of electricity.

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[1] Substituted vide addition/ revision of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 25.07.2023.

4. Sources of statistics, returns and information - All licensees, generating companies and person(s) mentioned below, but not limited to, shall furnish to the Authority such statistics, returns or other information relating to generation, transmission, distribution, trading and utilization of electricity at such times and in such form and manner as specified under these regulations-

(1) Licensees

(i) Transmission Licensees;

(ii) Distribution Licensees;

(iii) Trading Licensees;

(iv) Central Transmission Utility;

(v) State Transmission Utilities;

(vi) Appropriate Governments who are responsible for transmitting, distributing or trading of electricity;

(vii) Damodar Valley Corporation established under sub-section (1) of section 3 of the Damodar Valley Corporation Act, 1948 (14 of 1948);

(viii) Any person engaged in the business of transmission or supply of electricity under the provisions of the repealed laws or any act specified in the Schedule;

(ix) Any person who intends to generate and distribute electricity in a rural area as notified by the State Government;

(x) State Electricity Boards;

(xi) Local authorities including Cantonment Boards;

(xii) Deemed licensees and entities exempted from licence.

(xiii) Bhakra Beas Management Board.

(2) Generating companies

(i) Generating companies established by appropriate Governments;

(ii) Independent Power Producers;

(iii) Appropriate Governments responsible for generating electricity;

(iv) Bhakra Beas Management Board;

(v) Any person engaged in the business of generating electricity under the provisions of the repealed laws or any act specified in the Schedule;

(vi) Damodar Valley Corporation.

(3) Person(s) generating electricity for own use:

(i) All captive power producers;

(ii) Any other person including Co-operative Society, Association of persons, body of individuals, etc. engaged in generating electricity for its or his own use.

(4) Other entities

(i) National Load Despatch Centre;

(ii) Regional Load Despatch Centre(s);

(iii) State Load Despatch Centre(s);

(iv) Regional Power Committee(s);

(v) High voltage or extra high voltage consumers of electricity.

[(vi) Electricity Regulatory Commissions (i.e. CERC, SERCs, JERCs);

(vii) Power Exchanges;

(viii) State Nodal Agency; recognized agency for renewable energy projects.][2]

5. Formats for furnishing of statistics, returns or information - The entities shall furnish the statistics, returns and information as per the formats annexed to these regulations and the list of format is as per Annexure-I titled "List of formats, frequency (ies) and target date(s)". These formats can also be obtained from the website of the Central Electricity Authority. The formats may be sent by mail or media, to the source (s) of the statistics, returns or information, as and when required.

6. Time schedule for furnishing of statistics, returns or information -The time schedule or targets for furnishing of statistics, returns or information shall be as specified by the Authority on its prescribed formats. A consolidated list of time Schedule format-wise is given at Annexure-I titled "List of formats, frequency (ies) and target date (s)".

7. Frequency of submission of statistics, returns or information - The frequency of submission i.e. daily, weekly, monthly, quarterly or annually shall be as specified by the Authority in its prescribed formats. A consolidated list of frequency of submission format-wise is given in Annexure-I titled "List of formats, frequency (ies) and target date(s)".

8. Manner of furnishing the statistics, returns or information – (1) The statistics, returns or information in the prescribed formats shall be furnished to the Authority preferably electronically or by post or courier or fax.

(2) The entities shall supply complete and correct statistics, returns and information to the Authority.

(3) Any provisional data supplied by the entities shall be finalized and furnished within the period communicated by the Authority.

9. Addition and deletion in formats, time schedule, periodicity or furnishing method - (1) The

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[2] Added vide addition/ revision of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 25.07.2023.

Authority may revise format(s), time schedule(s), frequency (ies) or manner of furnishing the data or may add or delete format(s) as and when necessary to carry out its functions under clause (i) of section 73 of the Electricity Act, 2003.

(2) The Authority shall, before making change(s) in the format(s), time schedule(s), frequency (ies), data furnishing manner or addition or deletion of format(s) prescribed by the Authority under regulation 5 shall place a draft of changes in format(s) in the website of the Central Electricity Authority for the information of persons likely to be affected thereby. A notice in this regard inviting objections or suggestions shall be published in the widely circulated daily news papers specifying the date of expiry of the notice period which shall not be less than thirty days, on or after which the proposed changes will be taken into consideration by the Authority. The Authority shall consider the objections or suggestions received on or before the date so specified, from any person in respect of the proposed addition or deletion or changes in the format (s). After revision (s) / change (s) and completion of above procedure, the format (s) shall be notified by the Authority.

10. Right of access to records or documents - The Authority or any person authorized by it in writing on its behalf shall, for the purposes of the collection of any statistics under these regulations, have access to any relevant record or document in the possession of any person required to furnish any information or return under these regulations and may enter at any reasonable time any premises where he believes such record or documents to be available and may inspect or take copies of relevant records or documents or ask any question necessary for obtaining any information required to be furnished under these regulations.

11. Restriction on publication of information and returns - (1) No information, no individual return and no part thereof with respect to any particular industrial or commercial concern, given for the purposes of these regulations shall, without the previous consent in writing of the owner for the time being of the industrial or commercial concern in relation to which the information revealing the commercial and technical confidentiality, be published in such manner as would enable any particulars to be identified as referring to a particular concern.

(2) Except for the purposes of these regulations, no person who is not engaged in the collection of statistics under these regulations shall be permitted to see any information or individual return referred to in sub-section (1).

12. Non-compliance and penalty – (1) If any person, -

(a) required to furnish any information or return-

(i) Willfully refuses or without lawful excuse neglects to furnish such information or return as may be required under these regulations; or

(ii) Willfully furnishes or causes to be furnished any information or return which he knows to be false; or

(iii) refuses to answer or willfully gives a false answer to any question necessary for obtaining any information required to be furnished under these regulations;

OR

(b) impedes the right of access to relevant records or documents or the right of entry conferred by these regulations,

shall attract the relevant provisions under section 142 and 146 of the Act.

(2) No proceeding for an offence under these regulations shall be initiated except by or with the approval of the Authority.

B.K. MISHRA, Secy.

[ADVT 111/1V/186 B/2007/Exty.]

ANNEXURE-I

LIST OF FORMATS, FREQUENCY (IES) AND TARGET DATE (S)			
Title of Format	**Frequency of data furnishing**	**Format No.**	**Target Date (By)**
Generation of Electricity	Annual	1	30-Jun
Transmission of Electricity	Annual	2	30-Jun
Distribution of Electricity	Annual	3	30-Jun
Trading of Electricity	Annual	4	30-Jun
Details of actual sale and purchase of Gross Electrical Energy	Annual	5	30-Jun
Installed Electricity Generating Capacity	Annual	6	30-Jun
Details of electricity generating capacity added	Annual	7	30-Jun
Details of electricity generating sets retired from service	Annual	8	30-Jun
Details of derations of electricity generating sets	Annual	9	30-Jun
Details of fuel consumption	Annual	10	30-Jun
Details of step-up transformers in service at the power stations and various sub-stations as on 31.03.20..	Annual	11	30-Jun
Details of step-down transformers in service as on 31.03.20..	Annual	12	30-Jun
Details of distribution transformers in service as on 31.03.20..	Annual	13	30-Jun
Details of transmission and distribution lines as on 31.03.20..	Annual	14	30-Jun
Details of electricity consumers, connected load and consumption	Annual	15	30-Jun
Details of manpower	Annual	16	30-Jun
Training Facilities/Training Capacity in the Power Sector (Man-days of year)	Annual	17	30-Jun
Details of theft of electricity	Annual	18	30-Jun
Statistics on electrical accidents	Annual	19	30-Jun
Reasons for electrical accidents	Annual	20	30-Jun

Title of Format	Frequency of data furnishing	Format No.	Target Date (By)
Annual data of HV/EHV industry having electricity demand of 1 MW or above	Annual	21	30-Jun
Daily Operational Data of Thermal Power Stations and Nuclear Power Stations	Daily	22	1030 hrs
Daily Operational Data of Hydro Power Stations	Daily	23	1030 hrs
Monthly Operational Data of Thermal Power Stations and Nuclear Power Stations	Monthly	24	7th day
Monthly Operational Data of Hydro Power Stations	Monthly	25	7th day
Data for fixation of annual targets of electricity generation for year 20--- 20---	Annual	26	30-Nov
Regional Power Supply Position (Daily Operation Report)	Daily	27	0900 hrs
Provisional Power Supply Position	Monthly	28	5th day
Revised Power Supply Position	Monthly	29	18th day
[ ][3]			
Monthly Data regarding Loss of Generation on account of shortage of coal, gas, unrequisitioned liquid fired capacity & backing down due to system constraints	Monthly	31	10th day
Data for load generation balance report (LGBR)	Annual	32	End February
Unscheduled Interchange (UI) Status	Monthly	33	10th day
Details of Power Traded by the Trading Company	Monthly	34	10th day
Progress of capacitor installation programme	Monthly	35	20th day
Daily Coal Report	Daily	36	1500hrs.
Coal Report	Monthly	37	15th day
Generation Loss due to fuel shortage	Monthly	38	7th day
[			

[3] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

			][4]
Proposed Coal Allocation for Short Term Linkages for Thermal Power Stations	Quarterly	41	40 days before the commencement of the quarter
Monthly Fuel Supply Data of Gas Based Thermal Power Stations	Monthly	42	15th day
Monthly Fuel Supply Data of Liquid Fuel Based Thermal Power Stations	Monthly	43	15th day
Monthly Fuel Supply Data of DG Power Stations	Monthly	44	15th day
[			
			][5]
District wise Monthly Progress of Inhabited Village Electrification	Monthly	48	3rd day
[IRRIGATION PUMPSETS ENERGIZATION - PROGRESS][6]	Monthly	49	3rd day
[ ][7]			
Metering Status for the Month---------year---------	Monthly	51	3rd day
[ ][8]			
[Reliability Indices (SAFI, SAIDI, CAIDI & MAIFI) - Consumer Affected/ Load Interrupted basis on the feeder	Quarterly	53	30th day after the end of quarter
Reliability Indices (SAIFI, SAIDI, CAIDI & MAIFI) for Urban/ Rural areas - Load Affected/ Load Interrupted basis on the feeder	Quarterly	54	30th day after the end of quarter]9
[ ][10]			

[4] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[5] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[6] Substituted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[7] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[8] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[9] Substituted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[10] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

Aggregate Technical & Commercial (A T & C) Losses for the Financial Year------------	Annual	56	30th April
[ ][11]			
Heat Rate Data of Coal/Lignite Based Thermal Power Stations for Month --------- Year	Monthly	58	20th day
Heat Rate Data of Combined Cycle Gas Turbine Power Stations for Month-------- 20----------	Monthly	59	20th day
Monthly Environmental Data of Thermal Power Plants	Monthly	60	20th day
[			
			][12]
Power Distribution Company Data for Financial Study	Annually	64	30th June
Monthly Abstract of Ash Generation and Utilisation	Monthly	65	20th day.
[Report on Long-term & Medium-term power purchase agreement by Independent Power Producers	Six month	66	31st October & 30th April
Details of Area Clearing Prices (Rs/MWh) - Time block wise on daily basis for DAM/ RTM/ GDAM	Monthly	67	05th day
Details of electricity transacted in Power Exchanges- time block wise for DAM/ RTM/ GDAM	Monthly	68	05th day
Details of electricity transacted in Power Exchanges for DAM/RTM/ GDAM (or any other product/contract as introduced in future)	Monthly	69	05th day
Term Ahead Market (TAM) / Green-TAM (GTAM) - Data for Intraday/ Daily/Anyday/ Day Ahead Contingency (DAC)/ Weekly contracts. (On Trade Date Basis)	Monthly	70	05th day
Term Ahead Market (TAM) / Green-TAM (GTAM) - Data for Intraday/ Daily/Anyday/ Day Ahead Contingency (DAC)/ Weekly contracts. (On Delivery Date Basis)	Monthly	71	05th day
Details of electricity transacted in Power Exchanges in DAM/RTM/ GDAM	Annual	72	15th May
Intraday/ Daily-Anyday/ Day Ahead Contingency/ Weekly contract wise TAM and Green - TAM data. (On Trade date basis)	Annual	73	15th May
Intraday/ Daily-Anyday/ Day Ahead Contingency/ Weekly contract wise TAM and Green - TAM data.	Annual	74	15th May

[11] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[12] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

(On Delivery date basis)			
Bilateral Transaction data (to be furnished by NLDC)	Monthly	75	05th day
Cross border trade details (to be furnished by NLDC)	Monthly	76	05th day
Details of entities purchasing and selling on Power Exchanges in DAM/ TAM/ GTAM/ RTM/ GDAM markets (to be furnished by NLDC)	Daily	77	10:00 Hrs of next day
Details of tariff order and truing up order (to be furnished by CERC/ JERCs/ SERCs)	Annual	78	15th May
Details of Deviation Settlement Mechanism (DSM) volume (to be furnished by NLDC)	Daily	79	10:00 Hrs of next day
Details of despatch under Reserve Regulations Ancillary Services (RRAS) (to be furnished by NLDC)	Daily	80	10:00 Hrs of next day
Details of Un-Requisitioned Surplus (URS) from the generations being scheduled by the RLDCs (to be furnished by NLDC)	Daily	81	10:00 Hrs of next day
Monthly Renewable Energy Generation	Monthly	82	10th day of following month
Details of Monthly Plant wise Renewable Energy Generation and Curtailment	Monthly	83	10th day of following month
Details of Renewable Energy Plants commissioned during the Month	Monthly	84	10th day of following Month][13]

[13] Added vide addition/ revision of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 25.07.2023.

Annexure-II

Statement of Specific Applicability of formats

[Title of format	Format No.	Genco	Transco	Discom	Traders/ PXs	SEBs/ Licensees/ ED /SNAs	NLDC/ RLDCs	SLDCs	RPCs	CPPs/ Industries	[CERC/ JERC/ SERCs
Generation of Electricity	1	Y				Y					
Transmission of Electricity	2		Y			Y					
Distribution of Electricity	3			Y		Y					
Trading of Electricity	4				Y						
Details of actual sale and purchase of Gross Electrical Energy	5	Y		Y	Y	Y					
Installed Electricity Generating Capacity	6	Y				Y					
Details of electricity generating capacity added	7	Y				Y					
Details of electricity generating sets retired from service	8	Y				Y					
Details of derations of electricity generating sets	9	Y				Y					
Details of fuel consumption	10	Y				Y					
Details of step-up transformers in service at the power stations and various sub-stations as on 31.03.20..	11	Y	Y	Y		Y					
Details of step-down transformers in service as on 31.03.20..	12	Y	Y	Y		Y					
Details of distribution transformers in service as on 31.03.20..	13	Y		Y		Y					
Details of transmission and distribution lines as on 31.03.20..	14	Y	Y	Y		Y					
Details of electricity consumers, connected load and consumption	15			Y		Y					
Details of manpower	16	Y	Y	Y		Y					
Training Facilities/Training Capacity in the Power Sector (Man-days of year)	17	Y	Y	Y		Y					
Details of theft of electricity	18			Y		Y					
Statistics on electrical accidents	19	Y	Y	Y		Y	Y	Y			
Reasons for electrical accidents	20	Y	Y	Y		Y	Y	Y			
Annual data of HV/EHV industry having electricity demand of 1 MW or above	21									Y	
Daily Operational Data of Thermal Power Stations and Nuclear Power Stations	22	Y				Y	Y	Y			

Title of format	Format No.	Genco	Transco	Discom	Traders/ PXs	SEBs/ Licensees/ ED /SNAs	NLDC/ RLDCs	SLDCs	RPCs	CPPs/ Industries	CERC/ JERC/ SERCs
Daily Operational Data of Hydro Power Stations	**23**	**Y**				**Y**	**Y**	**Y**			
Monthly Operational Data of Thermal Power Stations and Nuclear Power Stations	**24**	**Y**				**Y**	**Y**	**Y**			
Monthly Operational Data of Hydro Power Stations	**25**	**Y**				**Y**	**Y**	**Y**			
Data for fixation of annual targets of electricity generation for year 20---20…..	**26**	**Y**				**Y**			**Y**		
Regional Power Supply Position (Daily Operation Report)	**27**						**Y**				
Provisional Power Supply Position	**28**						**Y**		**Y**		
Revised Power Supply Position	**29**						**Y**		**Y**		
[ ][14]											
Monthly Data regarding Loss of Generation on account of Shortage of Coal, Gas, Unrequisitoned Liquid Fired Capacity & Backing Down due to System Constraints	**31**	**Y**				**Y**					
Data for load generation balance report (LGBR)	**32**	**Y**		**Y**		**Y**					
Unscheduled Interchange (UI) Status	**33**						**Y**		**Y**		
Details of Power Traded by the Trading Company	**34**				**Y**						
Progress of capacitor installation programme	**35**								**Y**		
Daily Coal Report	**36**	**Y**				**Y**					
Coal Report	**37**	**Y**				**Y**					
Generation Loss due to fuel shortage	**38**	**Y**				**Y**					
[											
										][15]	
Proposed Coal Allocation for Short Term Linkages for Thermal Power Stations	**41**	**Y**				**Y**					

[14] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.
[15] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

Title of format	Format No.	Genco	Transco	Discom	Traders/ PXs	SEBs/ Licensees/ ED / SNAs	NLDC/ RLDCs	SLDCs	RPCs	CPPs/ Industries	CERC/ JERC/ SERCs
Monthly Fuel Supply Data of Gas Based Thermal Power Stations	**42**	**Y**				**Y**					
Monthly Fuel Supply Data of Liquid Fuel Based Thermal Power Stations	**43**	**Y**				**Y**					
Monthly Fuel Supply Data of DG Power Stations	**44**	**Y**				**Y**					
[											
										][16]	
District wise Monthly Progress of Inhabited Village Electrification	**48**			**Y**		**Y**			**Y**		
District-Wise Monthly Progress of Energisation of Irrigation Pump sets	**49**			**Y**		**Y**					
[ ][17]											
Metering Status for the Month---------year---------	**51**			**Y**		**Y**					
[ ][18]											
Reliability Index at Customer Level for the Month-----,year------	**53**			**Y**		**Y**					
Reliability Indices(11KV Feeders) for the Month----,Year-----	**54**			**Y**		**Y**					
[ ][19]											
Aggregate Technical & Commercial (A T & C) Losses for the Financial Year------------	**56**			**Y**		**Y**					
[ ][20]											
Heat Rate Data of Coal/Lignite Based Thermal Power Stations for Month-----Year…..	**58**	**Y**				**Y**					
Heat Rate Data of Combined Cycle Gas Turbine Power Stations for Month----------20----------	**59**	**Y**				**Y**					
Monthly Environmental Data of Thermal Power Plants	**60**	**Y**				**Y**					

[16] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.
[17] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.
[18] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.
[19] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.
[20] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

Title of Format	Format No.	Genco	Transco	Discom	Traders	SEBs / Licensees/Elecy. Deptts.	RLDCs	SLDCs	RPCs	CPPs/ Industries	CERC/ JERC/ SERCs
[											
][21]											
Power Distribution Company Data for Financial Study	**64**			**Y**		**Y**					
Monthly Abstract of Ash Generation and Utilisation	**65**	**Y**				**Y**					
[Report on long-term & medium term Power Purchase Agreement by Independent Power Producers	**66**	**Y**									
Details of Area Clearing Prices (Rs/MWh) - Time block wise on daily basis for DAM/ RTM/ GDAM	**67**				**Y**						
Details of electricity transacted in Power Exchanges- time block wise for DAM/ RTM/ GDAM	**68**				**Y**						
Details of electricity transacted in Power Exchanges for DAM/ RTM/ GDAM (or any other product/ contract as introduced in future)	**69**				**Y**						
Term Ahead Market (TAM) / Green-TAM (GTAM) - Data for Intraday/ Daily/Anyday/ Day Ahead Contingency (DAC)/ Weekly contracts. (On Trade Date Basis)	**70**				**Y**						
Term Ahead Market (TAM) / Green-TAM (GTAM)- Data for Intraday/ Daily/Anyday/ Day Ahead Contingency (DAC)/ Weekly contracts. (On Delivery Date Basis)	**71**				**Y**						
Details of electricity transacted in Power Exchanges in DAM/RTM/GDAM	**72**				**Y**						
Term Ahead Market (TAM) / Green-TAM (GTAM)- Data for Intraday/ Daily/Anyday/ Day Ahead Contingency (DAC)/ Weekly contracts. (On Trade date basis)	**73**				**Y**						
Term Ahead Market (TAM) / Green-TAM (GTAM)- Data for Intraday/ Daily/Anyday/ Day Ahead Contingency (DAC)/ Weekly contracts. (On Delivery date basis)	**74**				**Y**						
Bilateral Transaction Data	**75**						**Y**				

[21] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

Title of Format	Format No.	Genco	Transco	Discom	Traders	SEBs / Licensees/Elecy. Deptts.	RLDCs	SLDCs	RPCs	CPPs/ Industries	CERC/ JERC/ SERCs][22]
Cross Border Trade Details	**76**						**Y**				
Details of entities purchasing and selling on Power Exchanges in DAM/TAM/GTAM/ RTM/GDAM markets.	**77**						**Y**				
Details of tariff order and truing up order by the Electricity Regulatory Commission	**78**										**Y**
Details of Deviation Settlement Mechanism (DSM) volume.	**79**						**Y**				
Details of despatch under Reserve Regulations Ancillary Services (RRAS)	**80**						**Y**				
Details of Un-Requisitioned Surplus (URS) from the generations being scheduled by the RLDCs	**81**						**Y**				
Monthly Renewable Energy Generation	**82**	**Y**		**Y**		**Y**	**Y**	**Y**			
Details of Monthly Plant wise Renewable Energy Generation and Curtailment	**83**	**Y**		**Y**		**Y**	**Y**	**Y**			
Details of Renewable Energy Plants commissioned during the Month	**84**	**Y**		**Y**		**Y**	**Y**	**Y**			**][23]**

Genco: Generating Companies
Transco: Transmission Licensees
Discom: Distribution Licensees
Traders: Trading Licensees
PX: Power Exchanges
SEBs: State Electricity Boards
SNA: State Nodal Agency
NLDC: National Load Despatch Centre
RLDC: Regional Load Despatch Centre
SLDC: State Load Despatch Centre
RPCs: Regional Power Committees
CPPs: Captive Power Plants
ERCs: Electricity Regulatory Commissions
ED: Electricity Department][24]

Note: If certain items of a format are not applicable to an Entity, then 'Not Applicable' may be marked at appropriate places.
Y= Yes Applicable

[22] Added vide addition/ revision of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 25.07.2023.

[23] Added vide addition/ revision of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 25.07.2023.

[24] Substituted vide addition/ revision of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 25.07.2023.

FORMAT-1

PERIODICITY-ANNUAL

DATA OF YEAR 20……20….

Submission by 30th June

GENERATION OF ELECTRICITY

NAME AND ADDRESS OF UTILITY:

Sl. No.	Name of Power Station	Type of Prime-mover*	Installed Capacity of Power Station as at year end			Gross Electricity Generation in MkWh	Electricity Consumption in Unit & Stn. Auxiliaries in MkWh
			Nos. of Units	Unit Size in MW	Stn. Capacity in MW		
(A)	Owned by the Utility						
1	Station-1						
2	Station-2						
3	Station-3						
4	Station-4						
(B)	Jointly Owned by the Utility (in respect of its share)						
1	Station-1						
2	Station-2						

*Hydro turbine, Steam turbine (Coal), Steam turbine (Lignite), Steam turbine (Multifuel), Gas turbine, Diesel engine, Wind turbine, etc.

FORMAT-2
PERIODICITY- ANNUAL
DATA OF YEAR: 20…20….
SUBMISSION-BY 30th JUNE

TRANSMISSION OF ELECTRICITY

Figs. in MkWh

Name & Address of State Transmission Utility/SEB/ED:

1.	Electrical Energy imported from :		
	(a)	Within the State/UT/System – State/Pvt/Jt. Power Stations Captive Power Plants (CPPs)	
	(b)	Central Generating Stations (Station-wise)	
	(c)	Outside the State/UT/System (i) Utilities – State/Pvt.(Name-wise) – Jt.(Name-wise)	
	(d)	Outside the country	
2.	Total Electrical Energy Imported (1a+1b+1c+1d)		
3.	Electrical Energy exported to :		
	(a)	Licensees within the State/UT/System: (furnish break-up licensee wise)	
	(b)	Other State Electricity Boards/Electricity Departments (Outside the State/System but within the country)-give break- up entity wise	
	(c)	Outside the country	
	(d)	Any other entity within the State/UT/System- give break-up entity wise	
4.	Total electrical energy exported (3a+3b+3c+3d)		

FORMAT-3

PERIODICITY- ANNUAL
DATA OF YEAR : 20…20…
SUBMISSION-BY 30TH JUNE

DISTRIBUTION OF ELECTRICITY

Figs. in MkWh

Name & Address of the DISCOM/SEB/ED/Licensee :

1.	Electrical Energy imported from :		
	(a)	Within the State/UT/System	
	(b)	Captive power plants(from within or outside the State/UT/System)	
	(c)	Central generating stations (Station-wise)	
	(d)	Outside the State/UT/System(from within the country)	
	(e)	Outside the country	
2.	Total Electrical Energy Imported (1a+1b+1c+1d+1e)		
3.	Electrical Energy sold to :		
	(a)	Directly to consumers within the State/UT/System(Area of operation)	
	(b)	Licensees within the State/UT/system- furnish break-up licensee wise	
	(c)	Any other entity within the State/UT/System-furnish break-up entity wise	
4.	Total electrical energy sold (3a+3b+3c)		

FORMAT-4
PERIODICITY- ANNUAL
DATA OF YEAR 20…. 20….
SUBMISSION-BY 30TH JUNE

TRADING OF ELECTRICITY

Figs. in MkWh

Name & Address of the TRADING COMPANY Category of Licence:

1.	Electrical Energy purchased from :		
	(a)	State/Private./Joint Utility Power Stations (Station name-wise)	
	(b)	Captive power plants (Name-wise)	
	(c)	Central Generating Stations (Name-wise)	
	(d)	Outside the country (Name-wise)	
2.	Total electrical energy purchased (1a+1b+1c+1d)		
3.	Electrical Energy sold to :		
	(a)	Licensees (Licensee name-wise)	
	(b)	Outside the country (Name-wise)	
	(c)	Any other entity (Entity name-wise)	
4.	Total electrical energy sold (3a+3b+3c+)		

Note: Please furnish break-up of each of above for round the clock, off peak, peak and as & when required trading.

FORMAT-5
Periodicity-Annual
Data of year 20-- 20---
Submission by -30th June

DETAILS OF ACTUAL SALE AND PURCHASE OF GROSS ELECTRICAL ENERGY

Figures in MkWh

Name of Utility/Licensee:

Name of Utility/Non-Utility/Entity (To whom Sold /from whom purchased)	SALES (MkWh)	PURCHASES (MkWh)	REMARKS, IF ANY

Note:-
(i) Gross energy sale/purchase may be indicated utility/non-utility name-wise clearly & separately in this table.
(ii) Purchase of energy from captive power plant if any, may also be indicated.
(iii) Details of energy sold to licensees may be indicated Licensee-name wise.
(iv) Wheeling of energy should not be included in the above data.
(v) Energy imported/exported from /to Central Generating Stations may be given separately for each Power House.

FORMAT-6
Periodicity-Annual
Data of year 20--- 20---
Submission by—30th June

INSTALLED ELECTRICITY GENERATING CAPACITY

Figs. in MW

Name and address of the Utility:

Sl. No.	Type of Prime mover (Fuel base)	**AS AT THE BEGINNING OF THE YEAR**		New Capacity added (I.C)	Change in capacity during the year due to Re-ration*	Capacity Retired during the year	**AT THE END OF THE YEAR**		Remarks if any
		Installed Capacity	Re-rated Capacity				Installed Capacity	Re-rated Capacity	
1.	Hydro Turbine								
2.	Steam Turbine								
	Coal -								
	Lignite –								
	Gas/ Multifuel								
3.	Diesel Engine								
4.	Gas Turbine								
5.	Nuclear								
6.	Wind Turbine								
7.	Solar								
8.	Others, if any								

I.C = Installed Capacity
* Use (+) if due to up ration or (-) if due to deration.

FORMAT-7
Periodicity-Annual
Data of year 20---- 20---
Submission by -30th June

DETAILS OF ELECTRICITY GENERATING CAPACITY ADDED

Name and address of the GENCO/Utility:

Sl. No.	Name of Power House	Unit size in MW	Type of Prime mover (Fuel base)	MAKE			Date of Commissioning
				Boiler	Turbine	Generator	

Note: - **The details of each unit are to be furnished in this format. Indicate primary fuel within brackets along with type of prime-mover.**

FORMAT-8
Periodicity-Annual
Data of year 20--- 20---
Submission by- 30th June

DETAILS OF ELECTRICITY GENERATING SETS RETIRED FROM SERVICE

Name and address of the GENCO/Utility:

Sl. No.	Name of the Power House	Unit size in MW	Type of Prime mover	Date of Commissioning	Date of Retirement	Reason(s) for Retirement

FORMAT-9
Periodicity-Annual
Data of year 20--- 20---
Submission by 30th June

DETAILS OF DERATIONS OF ELECTRICITY GENERATING SETS

Name and address of the GENCO/Utility :

Sl. . No.	Name of the Power House	Unit No.	Date of Commissioning	Type of Prime mover	Rated Capacity (I.C) (MW)	Derated capacity (MW)	Date of Deration	Reason(s) for Deration

I.C. = Installed Capacity

FORMAT-10
Periodicity-Annual
Data of year 20--- 20---
Submission by -30th June

DETAILS OF FUEL CONSUMPTION

Name of the GENCO/Utility:

Sl. . No.	Name of Power House	Fuel Name	FUEL CONSUMED		Kilo calories per unit generated	Overall Thermal Efficiency
			Qty. used mt /kl / MMSCM	Average Calorific value in kilo calories per kg./litre		

Note :- - Fuel consumption details regarding Gas/Diesel stations are to be shown separately.
-Give details of all primary & secondary fuels consumed during the year.
-mt = Metric Tonne
-kl = Kilo Litre
-MMSCM = Million Metric Standard Cubic Metre

FORMAT-11
Periodicity-Annual
Data of year 20--- 20---
Submission by -30th June

DETAILS OF STEP-UP TRANSFORMERS IN SERVICE AT THE POWER STATIONS AND VARIOUS SUB-STATIONS AS ON 31-03-20..

Name of the Utility/Entity :

Sl. . No.	Name of Power House or Sub-station	No. of Transformers	Voltage Class* in use	Voltage Ratio in use	Different Capacity in use (kVA)	No(s). in each capacity size	Aggregate capacity (kVA)
							TOTAL

* State if voltage class is 400 kV,220kV,132kV,110kV,78kV,66kV,33kV,22kV,13.2kV,11kV,6.6kV,4.4kV,3.3kV and other voltage if any.

Note: - Power House/Sub-stations to be designated by the highest voltage that exists in the station.
Please ensure that only details of step-up transformers are indicated in this proforma.
Please indicate aggregate capacity along with total no. of transformers.

FORMAT-12
Periodicity-Annual
Data of year 20--- 20---
Submission by 30th June

DETAILS OF STEP-DOWN TRANSFORMERS * IN SERVICE AS ON 31-03-20…..

Name of the Undertaking

Sl. No.	Voltage Class	S T E P D O W N T R A N S F O R M E R S					Aggregate capacity (kVA)
		Total No. of Sub-stations	Different Voltage - ratio in use	Different Capacities in use (kVA)	No. in each capacity-size	Total No. of Transformers	
1.	400 kV						
2.	220 kV						
3.	132/110 kV						
4.	78/66 kV						
5.	44/33 kV						
6.	22 kV						
7.	13.2 kV						
8.	11 kV						
9.	6.6 kV						
10.	4.4 kV						
11.	3.3 kV						
12.	Any other (specify)						
						TOTAL	

(*) Secondary voltage above 500 volts.

FORMAT-13
Periodicity-Annual
Data of year 20--- 20---
Submission by -30th June

DETAILS OF DISTRIBUTION TRANSFORMERS * IN SERVICE AS ON 31-03-20..

Name of the Utility/Non-Utility/Entity:

Sl. . No.	Voltage Class	Voltage Ratio	Total No. of transformers	Different capacities in use (kVA)	No. in each capacity size	Aggregate capacity (kVA)
				Total :		

* Secondary voltage below 500 Volts.

FORMAT-14
Periodicity-Annual
Data of year 20--- 20---
Submission by -30th June

DETAILS OF TRANSMISSION AND DISTRIBUTION LINES AS ON 31-03-20---

Name and address of the Utility/Non-Utility/Entity:

Sl. No	Nominal Voltage	Length of line in km at the beginning of the year			Length of line added during the year in km at the beginning			Total Length of line in Ckt km at the end of the year			Remarks
		Single Ckt	Double Ckt	Multi Ckt*	Single Ckt	Double Ckt	Multi Ckt*	Single Ckt	Double Ckt	Multi Ckt*	
1.	EHV Lines: above 500kV										
2.	500 kV DC lines										
3.	400 kV										
4.	230 kV										
5.	220kV										
6.	132 kV										
7.	110 kV										
8.	78 kV										
9.	66 kV										
10.	33 kV										
11.	22 kV										
12.	11 kV										
13.	6.6 kV										
14.	4.4 kV										
15.	3.3 kV										
16.	2.2 kV										
17.	440/230 V, 3 phase, single phase if available										
18	* Direct current lines (volts)										
19	Any other (specify)										

. **Note: Give break-up for U.G. (Underground) & O.H. (Overhead).**
Indicate voltage of operation. * Mention no. of Ckts.

FORMAT-15
Periodicity-Annual
Data of year 20--- 20---
Submission by -30th June

DETAILS OF ELECTRICITY CONSUMERS, CONNECTED LOAD AND CONSUMPTION

Name of the Utility

Sl. No.	Consumer Category	NUMBER OF CONSUMERS						CONNECTED LOAD (kW)						Energy Consumption (kWh)		Remarks
		At the beginning of the year		Added during the year		At the end of the year		At the beginning of the year		Added during the year		At the end of the year				
		R	U	R	U	R	U	R	U	R	U	R	U	R	U	
1.	**Domestic**															
2.	**Commercial**															
3.	**Industrial**															
	a. Low & Medium Voltage															
	b. High Voltage with demand less than 1 MW															
	c. HV/EHV with demand of 1MW & above															
4..	**Railways**															
5.	**Irrigation**															
6.	**Public Lighting**															
7.	**Public Water works & Sewage disposal**															
8.	**Any other category**															
9.	**Pvt. Licensees*** (Licensee wise)															
10.	**Entities within State/U.T** (Entity wise)															
11.	**Entities outside State/U.T** (Entity wise)															
12.	**Total**															

Note :- Energy consumed through unmetered connection should be estimated and indicated clearly.
* Dealing in purchase and further sale of energy.
Give separate break-up for LT & HT supply for Item 7 to 11.
Give break-up for Rural (R) & Urban (U) areas separately

FORMAT-16 (page 1 of 2)
Periodicity-Annual
Data of year 20--- 20---
Submission by -30th June

DETAILS OF MANPOWER

Name of Utility:

Class of employment **(A) Regular (i.e. monthly paid)**	**NUMBER OF EMPLOYEES** As on 31-03-20.(Yr.Start)	 As on 31-03-20.(Yr.end)	**Training provided** No. of Personnel/Tech/Adm/Others	**Type of Training** Induction/Refresher/ Management/Others
1. Managerial and higher executives (Rank of Chief Engineer and above)				
2. Technical & Scientific Officers				
3. Non-technical: Executive, clerical, accounting, revenue collection, meter reading staff & officers, etc.				
4. Technical Supervisory staff in				
(a) Generation				
(b) Transmission				
(c) Distribution				
(d) Trading				
(e) Others				
5. Technicians and Operating Staff in				
(a) Generation				
(b) Transmission				
(c) Distribution				
(d) Trading				
(e) Others				
TOTAL REGULAR (1) to (5) = (A)				
(B) Non-Regular				
(a) Technical : Trainees & Apprentices				
(b) Work Charged Staff **(Monthly paid basis)**				
i. Skilled				
ii. Unskilled				
Total (b) = (i)+(ii)				
(c) Casual (daily paid basis)				
i. Skilled				
ii. Unskilled				
Total (c) = (i)+(ii) (i.e.=c)				
Sub-Total (a)+(b)+(c) = (B) Grand Total (A)+(B)				

General Guidelines for filling form for manpower in the electricity supply industry.

1. Managerial and higher executives: All engineering posts of the rank of Chief Engineer and above is to be included.

2. Technical and scientific officers: All engineering posts above the rank of supervisor/Junior Engineer/ Scientific Officer may be included.

3. Non-Technical : All regular non-technical employees i.e. Executive, clerical, accounting, revenue collection, meter reading staff and officers may be included.

4. Technical supervisory staff :

   a) Generation: All technical staff of the rank of supervisor/Section officer/Junior engineer/ Assistant Controller engaged at generating stations and those associated with planning of generation may be included.

   b) & c) Similar staff mentioned above engaged in transmission & distribution system.

   d) & e) Similar staff mentioned above engaged in trading & other activities.

5. a) Technicians and operation staff : All the technical staff below the rank of supervisor/Junior engineer engaged at generating stations.

   b) & c)Similar staff mentioned above engaged in Transmission and Distribution system.

   d) & e)Similar staff mentioned above engaged in other activities.

Training Facilities / Training Capacity in the Power Sector (Man-Days of Year)

Format-17
Periodicity-Annual
Submission by -30th June.

Name of Utility/Organisation Data of the Financial year
20--- 20---

Name of Institute	Field of Training (Thermal/Hydro/Transmission/ Distribution/ Management)	Induction Level Training (Man Days)					Management Training (Man Days)	Refresher Training (Man Days)	Total training (Man Days)	Total Training Capacity (Man Days)	Utilization of Training Capacity =Col. 10/11*100(%)
1	2	3	4	5	6	7	8	9	10	11	12
		Technical			Non-Technical						
		Engineers	Sup./Operators	Technicians	Executive	Non-Executive					

FORMAT-18
Periodicity-Annual
Data of year 20--- 20---
Submission by -30th June

DETAILS OF THEFT OF ELECTRICITY

Name and Address of Discom/Licensee/SEB/Electricity Deptt. =

---

i) No. of cases where inspection was carried out**:**

ii) No. of cases where theft of electricity was detected**:**

iii) Estimated quantity of electrical energy considered as theft in above cases for the period:

iv) Estimated cost of such energy**:**

v) No. of cases where penalties were imposed**:**

FORMAT-19
Periodicity Annual
Data of year 20--- 20---
Submission by - 30th June …..

S T A T I S T I C S   O N   E L E C T R I C A L   A C C I D E N T S

Name of Utility/Non-Utility/Entity:

Sl. No.	INSTALLATIONS	H U M A N		A N I M A L S	
		FATAL	NON-FATAL	FATAL	NON-FATAL
1.	Installations of suppliers of electricity including SEBs/Licensees/Generating Companies:				
	(a) Generating Station				
	(b) Transmission System (Lines, sub-stations, towers, etc.)				
	(c) Distribution system (Lines, sub-stations, poles, transformers, etc.)				
2.	Installations of industrial consumers:				
	(a) Owned by Govt./Semi -Govt. bodies/local authorities.				
	(b) Owned by private companies				
3.	Installations of consumers other than industrial consumers e.g. domestic/agriculture/commercial consumers, etc.:				
	(a) Owned by Govt./Semi Govt. bodies/ local authorities.				
	(b) Owned by private companies.				
	(c) Persons(s)				
	TOTAL (excluding suicides)				

N.B. :- Indicate the number of human/animal affected. Also show the corresponding number of accidents within brackets.

FORMAT-20
Periodicity-Annual
Data of year 20--- 20---
Submission by -30th June

R E A S O N S F O R E L E C T R I C A L A C C I D E N T S

Name of Undertaking:

Sl. No.	R E A S O N S	H U M A N		A N I M A L S		TOTAL
		FATAL	NON-FATAL	FATAL	NON-FATAL	
(i)	SNAPPING OF CONDUCTORS					
(ii)	ACCIDENTAL CONTACT WITH LIVE ELECTRIC WIRE / EQUIPMENT					
(iii)	VIOLATION / NEGLECT OF SAFETY MEASURES / LACK OF SUPERVISION					
(iv)	DEFECTIVE APPLIANCES/ APPARATUS / TOOLS					
(v)	INADEQUATE / LACK OF MAINTENANCE					
(vi)	UNAUTHORISED WORK					
(vii)	ANY OTHER REASONS TOTAL					

N.B. : Main reasons for accidents mentioned at Sl.No.(vii) are :- (Please specify)

[FORMAT-21
Periodicity-Annual
Data of previous year: ------
Submission by – 30th June

ANNUAL DATA OF CAPTIVE POWER PLANTS (CPP)

(Applicable to the entities having electricity demand/CPP capacity of 0.5 MW & above)

1. Name of the Entity (Industry/Non Industry/Group Captive):
2. Address:
   a. Postal Address :
   b. Contact No. :
   c. Email :
   d. Name & Designation of the contact person with contact No. :
3. If entity is an Industry, then type of Industry :
   (i.e. Steel, Textile, Jute, Aluminum etc.)
4. Demand contracted with electricity supplier (Discom): ....kVA / kW
5. Details of the CPP:

Sl. No.	Type of CPP (viz. Steam, Diesel, Gas, Hydro, solar, wind, etc.)	Base load/ Stand by	Installed capacity (kW)	Data of Electricity (in kWh)		
				Gross Generation (A)	Aux. Consumption (B)	Net Generation (C=A-B)
1						
2						
3						

6. Total electrical energy purchased from Discom/other sources:

Sl. No.	Name of the Source	Energy purchased in kWh (D)
1		
2		
3		

7. Total electrical energy sold to Discom/other sources:

Sl. No.	Name of the Source	Energy sold in kWh (E)
1		
2		
3		

8. Energy Consumed by the Industry in kWh [Total(C) +Total(D) -Total (E)]:

][25]

[25] Substituted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

Format No - 22 Page1 /2
Periodicity-Daily
Submission by 1030 hrs.

Daily Operational Data of Thermal Power Stations and Nuclear Power Stations (Generation and Outage data)

Generation data for the date:

Name of the organisation:

(A) UNIT WISE GENERATION

Name Of Station	Unit No.	Unit Capacity in MW	Gross Energy Generated during the day in MkWh	Peak load during the day (MW)	Remarks, if any	
Station 1						
Station 2						
Data for newly commissioned units (if any) *						

(B) UNIT WISE OUTAGES (Planned/Forced)

(i) Details of Units remained out of bars & Units tripped/ taken out of the bar during the day

Name Of Station	Unit No.	Outage Date & Time	Expected date of return	Outage Reason(s)	Reason(s) of extended outage, if any	Remarks
Planned outage						
Forced outage						

(ii) Details of Units revived during the day

Name Of Station	Unit No.	Outage Date & Time	Synchronization Date & Time	Outage Duration in Hours	Outage Reason(s)	Generation Loss MkWh
Planned outage						
Forced outage						

(C) <u>UNIT WISE PARTIAL ENERGY LOSS DATA (DAY WISE IN MkWh)</u>

Name Of Station	Unit No.	Unit Capacity in MW	Energy Loss due to fuel shortage	Energy Loss due to low system Demand	Energy Loss due to system constraints	Energy Loss due to Equipment Problems	Remarks, if any
Station 1							
Station 2							

(D) <u>ADDITIONAL INFORMATION IN BRIEF, IF ANY</u>

Partial loss in MkWh = $(Cr_1 \times Hr_1 + Cr_2 \times Hr_2 \ldots + Cr_n \times Hr_n)/1000$

Where Cr_1............ Cr_n are "the reduction in the output of the operating units in MW due to constraints in Auxiliaries/equipments or any other causes." and Hr_1……Hr_n are the duration in hours of operation of the units at reduced output during the period considered (day or month).

NOTE: (I) Following categories of capacities of units/stations are monitored:

a. Thermal (Steam) units having station capacity of more than 20 MW.

b. All gas/diesel units supplying committed power to grid.

c. Hydro stations having capacity of 2 MW and above.

(II) Wherever actual auxiliary consumption is not being metered, proportionate auxiliary consumption may be furnished.

(III) *From the date of synchronisation to the date of commercial operation

Format 23 Page1/2
Periodicity-Daily
Submission by- 1030 hrs

Daily Operational Data of Hydro Power Stations
(Generation, outage and reservoir level data)

Generation Data for the date:
Name of the organisation:

(A) UNIT WISE GENERATION

Name Of Station	Unit No.	Unit Capacity in MW	Gross Energy Generated during the day in MkWh	Peak Load during the day (MW)	Remarks, if any	
Station 1						
Station 2						
Data for newly commissioned units (if any)*						

(B) UNIT WISE OUTAGES (Planned/Forced)

(i)Details of Units remained out of bars & Units tripped/ taken out of the bars during the day

Name Of Station	Unit No.	Outage Date & Time	Expected date of return	Outage Reason (s)	Reason (s) of extended outage, if any	Remarks
Planned outage						
Forced outage						

(ii) Details of Units revived during the day

Name Of Station	Unit No.	Outage Date & Time	Synchronization Date & Time	Outage Duration in Hours	Outage Reason (s)	Generation Loss MkWh
Planned outage						
Forced outage						

(C) ENERGY LOSS DUE TO REASONS OTHER THAN FORCED OUTAGE AND PLANNED MAINTENANCE (DAY WISE IN MkWh)

Name Of Station	Unit No.	Unit Capacity in MW	Energy Loss due to flood	Energy Loss due to weeding	Energy Loss due to silt flushing	Energy Loss due to high silt content	Energy Loss due to reduced inflows	Energy Loss due to system constraint	Energy Loss due to Equipment Problems	Remarks, if any
Station 1										
Station 2										

(D) Hydro Reservoir levels:

Name Of Station/ Reservoir	**Full Reservoir level (FRL)****			**Minimum Draw Down level (MDDL)****	**Present Reservoir level**		
	Metres	**Gross Storage in MCM**	**Live Storage in MCM**	**Metres**	**Metres**	**Live Storage in MCM**	**Energy Contents in MkWh**

(E) Additional information in brief, if any

NOTE: (I) Following categories of capacities of units/stations are monitored

a. Thermal (Steam) units having station capacity of more than 20 MW.
b. All gas/diesel units supplying committed power to grid.
c. Hydro stations having capacity of 2 Mw or above.

(II) Wherever actual auxiliary consumption is not being metered, proportionate auxiliary consumption may be furnished.

(III) *From the date of synchronisation to the date of commercial operation

** data to be furnished in case of new units/stations and any changes in the existing units

Signature

Format : 24 Page 1/2

Periodicity-Monthly

Submission by-7th day

Monthly Operational Data of Thermal Power Stations and Nuclear Power Stations
(Generation and Outage data)

Data for the Month:
Name of the organization:

(A) UNIT WISE GENERATION, UNIT AUX . & STATION AUX. POWER CONSUMPTION

Name Of Station	Unit No.	Unit Capacity in MW	Gross Energy generated during the Month in MkWh	Unit Aux. Consumption in MkWh	Station Aux. Consumption in MkWh	Unit Peak Load during the month (MW)	Station Peak Load during the month (MW)
Station 1							
Station 2							
Data for newly commissioned units (if any)*							

(B) UNIT WISE OUTAGES (Planned/Forced)

(i) Details of Units remained out of bars & Units tripped/ taken out of the bars during the Month

Name Of Station	Unit No.	Tripping Date & Time	Expected date of return	Outage Reason (s)	Reason (s) of extended outage, if any	Remarks
Planned outage						
Forced outage						

(ii) Details of Units revived during the month

Name Of Station	Unit No.	Tripping Date & Time	Synchronization Date & Time	Outage Duration in Hours-Minutes	Outage Reason (s)	Generation Loss in MkWhs
Planned outage						
Forced outage						

(C) UNIT WISE PARTIAL ENERGY LOSS DATA (DAY WISE IN MkWh)

Name Of Station	Unit No.	Unit Capacity in MW	Reason(s) for partial energy loss	Generation loss (MkWh)	Remarks, if any
Station 1					
Station 2					

(D) ADDITIONAL INFORMATION IN BRIEF, IF ANY

Partial loss in MkWh = $(Cr_1 \times Hr_1 + Cr_2 \times Hr_2 \ldots + Cr_n \times Hr_n)/1000$

Where Cr_1 .... Cr_n are "the reduction in the output of the operating units in MW due to constraints in Auxiliaries/equipments
or any other causes." and Hr_1……Hr_n are the duration in hours of operation of the units at reduced output during the period considered (day or month).

NOTE: (I) Following categories of capacities of units/stations are monitored:

a. Thermal (Steam) units having station capacity of more than 20 MW.

b. All gas/diesel units supplying committed power to grid.

c. Hydro stations having capacity of 2 MW and above.

(II) Wherever actual auxiliary consumption is not being metered, proportionate auxiliary consumption may be furnished.

(III) *From the date of synchronisation to the date of commercial operation

Format no-25 Page 1/2
Periodicity- Monthly
Submission by- 7th day

Monthly Operational Data of Hydro Power Stations
(Generation, Outage and Reservoir Level data)

Data for the Month:

Name of the organization:

(A) UNIT WISE GENERATION, UNIT AUX. , STATION AUX. POWER CONSUMPTION & TRANSFORMATION LOSS

Name Of Station	Unit No.	Unit Capacity in MW	Gross Energy generated during the Month in MkWh	Unit Aux. Consumption in MkWh	Station Aux. Consumption in MkWh	Unit wise transformation loss in MkWh	Station wise transformation loss in MkWh	Peak Load reached during the month (MW)
Station 1								
Station 2								
Data for newly commissioned units (if any)*								

(B) UNIT WISE OUTAGES (Planned/Forced)

(i) **Details of Units remained out of bars & Units tripped/ taken out of the bars during the Month**

Name Of Station	Unit No.	Outage Date & Time	Expected date of return	Outage Reason(s)	Reason(s) of extended outage, if any	Remarks		
Planned outage								
Forced outage								

(ii) **Details of Units revived during the month**

Name Of Station	Unit No.	Outage Date & Time	Synchronization Date & Time	Outage Duration in Hours-Minutes	Outage Reason(s)	Generation Loss in MkWh		
Planned outage								
Forced outage								

(C) ENERGY LOSS DUE TO REASONS OTHER THAN FORCED OUTAGES & PLANNED MAINTENANCE

Name Of Station	Unit No.	Capacity (MW)	Energy Loss in MkWh	Reason(s) of Energy Loss	Remarks, if any
Station 1					
Station 2					

(D) ADDITIONAL INFORMATION IN BRIEF, IF ANY

(E) Hydro Reservoir Inflow data

Reservoir inflow data for the month- year (mm-yy):

Name Of Station/ Reservoir	Full Reservoir level (FRL)			Minimum Draw Down level (MDDL)	Inflows during the month (MCM)	Outflows during the month (MCM)
	Metres	Gross Storage in MCM	Live Storage in MCM	Metres		

(D) ADDITIONAL INFORMATION IN BRIEF, IF ANY

NOTE: (I) Following categories of capacities of units/stations are monitored:

a. Thermal (Steam) units having station capacity of more than 20 MW.
b. All gas/diesel units supplying committed power to grid.
c. Hydro stations having capacity of 2 MW and above.

(II) Wherever actual auxiliary consumption is not being metered, proportionate auxiliary consumption may be furnished.

(III) *From the date of synchronisation to the date of commercial operation

FORMAT-26
Periodicity-Annual
Data for year 20--- 20---
Submission by -30th Nov.

DATA FOR FIXATION OF ANNUAL TARGETS OF ELECTRICITY GENERATION FOR YEAR 20----- 20---

Name of Company:

Name of Station	Unit No.	Capacity (MW)	Station wise & Unit wise monthly and yearly targets for next year (MkWh)	Schedule of Planned Maintenance (Unit wise)	
				Start Date	End Date

FORMAT-27 Page 1/4
PERIODICITY- DAILY
SUBMISSION BY- 0900 HRS

Regional Power Supply Position (Daily Operation Report) in ________________ Region for ________________ (Date)
Date of Reporting ______________________ at ___________ (Time)

1. Regional Availability/ Demand/ Shortage

Particulars	*PEAK Hrs (Hrs) (MW)	**Off-Peak Hrs (Hrs) (MW)	DAY ENERGY (MkWh)
Regional Availability			
Regional Demand			
Regional Shortage			

2 A. State Requirement (Net Energy - MkWh)

States	Thermal	Hydro	IPPs	CPPs	Net Sch. (From Grid)	Drawl (From Grid)	Availability	Require me nt Met
Total								

2 B. State Demand (MW)

States	PEAK Hrs (____Hrs)		Off-Peak Hrs (___Hrs)		Day Peak		
	Demand Met	Shortage at 50.00 Hz	Demand Met	Shortage at 50.00 Hz	Demand Met	Time (Hrs)	Shortage at 50.00 Hz
________ Region							

3. Inter-Regional Exchanges - Physical Flows [Import(+)/ Export(-)]

Elements	Peak Hrs (___Hrs) (MW)	Off-Peak Hrs (Hrs) (MW)	Maximum Inter-Change Import (MW)	Time (Hrs)	Export (MW)	Time (Hrs)	Net Energy (MkWh)
A. Northern Region Links							
1.							
2.							
Sub Total NR Links							
B. Western Region Links							
1.							
2.							
Sub Total WR Links							
C. Southern Region Links							
1.							
2.							
Sub Total SR Links							
D. Eastern Region Links							
1.							
2.							
Sub Total ER Links							
Total (All Links)							

4. Short-Term Open Access Transaction for the Previous Day (MkWh)

S. No.	From (Including Region)	To (Including Region)	Name of the Trader	Net Exchange
1.				
2.				
4.				
5.				
6.				

5. Frequency Profile

% of Time							
Frequency Range	< 48.5 Hz	< 49.0 Hz	< 49.5 Hz	49.0 - 50.5 Hz	> 50.0 Hz	> 50.5 Hz	> 51.0 Hz
%							

Instantaneous Maximum		Instantaneous Minimum		15-Minutes Block Maximum		15-Minutes Block Minimum		Day Average	Frequency Variation Index (FVI#)
Hz	Time	Hz	Time	Hz	Time	Hz	Time	Hz	

6. Voltage Level at Critical Sub-Stations@

Sub-Stations	400 kV				22O KV			
	Maximum		Minimum		Maximum		Minimum	
	kV	Time	kV	Time	kV	Time	kV	Time

7. **Major Reservoir Particulars**

Reservoirs	Designed			Present		Last Year		Last Day		Month
	MDDL (metre)	FRL (metre)	Energy (MkWh)	Level (metre)	Energy (MkWh)	Level (metre)	Energy (MkWh)	Inflows (MkWh)	Uses (MkWh)	Programme Usage (MkWh)

8. **Grid Disturbance/ Significant Events (If Any)**

9. **System Constraints (If Any)**

10. **Weather Conditions Prevailed on the Day of Report & for the Following Day:**

11. **Generating Units Outage Status in ________________ Region**

As on Date **Time** **6:00 Hours**

11A. Generating Units Revived During Last 24 Hrs. (06:00 Hrs of (Date) to 06:00 Hrs (Date))

S.No.	Stations	Unit No.	Capacity (MW)	Outage		Revival		Reasons of outage
				Date	Time	Date	Time	
	Central Sector							
1.								
2.								
3.								
4.								
	State Sector							
1.								
2.								
3.								
4.								

11B. Generating Units Under Outage (Status at 06:00 Hrs of (Date))

S.No.	Station	Unit No.	Capacity (MW)	Outage		Revival		Reasons of outage
				Date	Time	Date	Time	
	Central Sector							
1.								
2.								
3.								
4.								
	State Sector							
1.								
2.								
3.								
4.								
	Total		(MW)					

12. Transmission Lines Outage Status in Southern Region

As on Date Time 6:00 Hours

12 A. Transmission Lines Revived During Last 24 Hrs. (06:00 Hrs of (Date) to 06:00 Hrs (Date))

S.No.	Element Name	Element Type	Outage		Revival		Reasons of outage
			Date	Time	Date	Time	
Central Transmission Utility							
1.							
2.							
3.							
4.							
State Transmission Utility							
1.							
2.							
3.							
4.							

12 B. Transmission Lines Under Outage (Status at 06:00 Hrs of (Date))

S.No.	Element Name	Element Type	Outage		Revival		Reasons of outage
			Date	Time	Date	Time	
Central Transmission Utility							
1.							
2.							
3.							
4.							
State Transmission Utility							
1.							
2.							
3.							
4.							

FORMAT-25 RLDCs

@Critical Sub-Station: Sub-Station Where the Steady-State Voltage Lies Outside the Limit of ± 10% of the Normal Value.

***Peak Hours:** The Designated Peak Hour of a Region.

****Off-Peak Hours:** The Designated Off-Peak Hour of a Region.

 # FVI = $$\sum_{1}^{n} \frac{\sqrt{(50 - x_n)^2}}{n}$$

where n= number of readings

x_n = frequency at n^{th} reading

Provisional Power Supply Position in ________________________Region for the Month of __________

A Generation Details

S.No.	Constituents	1	2	3	------	N	REGION
(I)	Gross Generation (MkWh)						
	Thermal						
	(i) Coal						
	(ii) Liquid						
	(iii) Gas Open Cycle						
	(iv) Gas Combined Cycle						
	(v) Nuclear						
	Hydro						
	IPPs						
	CPPs						
	Wind Mills						
	Total (MkWh) (I)						
(II)	Dedicated Power Stations#						
	(i)						
	(ii)						
	Total (MkWh) (I)+(II)						
(II)	Actual Demand Met (Gross MW)						

B Energy Availability / Requirement (Ex-Bus) (MkWh)

	Constituents	Constituents # 1	Constituents #2	Constituents # N	Region
1	Own Generation				
	Thermal				
	(i) Coal				
	(ii) Liquid				
	(iii) Gas Open Cycle				
	(iv) Gas Combined Cycle				
	(v) Nuclear				
	Hydro				
	IPPs*				
	CPPs**				
	Wind Mills				
	Total (1)				
2	Dedicated Power Stations#				
2.1					
2.2					
	Total Own Generation, IPPs*, CPPs** & Dedicated				
3	Net Drawl from Grid (including Bilateral)				
4	Total Availability				
5	Unrestricted Requirement (From Table C)				
6	Shortage (5-4)				
7	% Shortage [{(5-4)/5}*100]				

C Details of Calculations

1	Availability				
2	Frequency Correction				
3	Load Shedding				
4	Power Cuts				
5	Unrestricted Requirement (1+2+3+4)				

D Peak Demand/ Demand Met (Ex-Bus) (MW)

1	Peak Demand				
2	Demand Met				
3	Date & Time of Peak Demand Met				
4	Frequency Correction				
5	Load Shedding				
6	Power Cuts				
7	Shortage				
8	% Shortage				
9	Avg. of Daily Max. Shortage				
10	Max. of Daily Max. Shortage				

E Frequency Profile of ________Regional Grid

Frequency Range	Below 48.5 Hz	Between 48.5 Hz & 48.8 Hz	Between 48.8Hz & 49.0 Hz	Between 49.0 Hz & 49.5 Hz	Between 49.5 Hz & 49.8 Hz	Between 49.8 Hz & 50.2 Hz	Between 50.2 Hz & 50.5 Hz	Between 50.5 Hz & 51.0 Hz	Between 51.0 Hz & 51.5 Hz	Above 51.5 Hz
(% of time)										

INSTANTANEOUS MAXIMUM		INSTANTANEOUS MINIMUM		15-MINUTES BLOCK MAXIMUM		15-MINUTES BLOCK MINIMUM		MONTHLY AVERAGE	FREQUENCY VARIATION INDEX
Hz	Time	Hz	Time	Hz	Time	Hz	Time	Hz	

* IPP- Independent Power Producer ** CPP- Captive Power Plant

Dedicated Power Stations: Power Stations whose generation is solely meant for the concerned State(s).

FORMAT-26 RPCs

Power Cuts on Industries, Load Shedding & Power Supply to Agricultural Sector in ________________ Region During _____________(Month/Year)

I Power Cuts/ Restrictions on Industries, Load Shedding in the State:

S. No.	Particulars/ Name of States	Quantum of Power Cut (MW)	Restriction Timing From (Hrs)	Restriction Timing To (Hrs)	Total Energy Cut (MkWh/ Day)
1.	**State**				
(a)	Power Cuts/ Restrictions on HT/ LT Industries				
(b)	Load Shedding				
(c)	Any Other Information				
	(i) Weekly Off				
	(ii) Staggering of Power Supply				
2.	**State**				
(a)	Power Cuts/ Restrictions on HT/ LT Industries				
(b)	Load Shedding				
(c)	Any Other Information				
	(i) Weekly Off				
	(ii) Staggering of Power Supply				
3.	**State**				
(a)	Power Cuts/ Restrictions on HT/ LT Industries				
(b)	Load Shedding				
(c)	Any Other Information				
	(i) Weekly Off				
	(ii) Staggering of Power Supply				
.					
.					

II Power Supply to Agriculture Sector

S. No.	Particulars	From (Date)	To (Date)	Supply Hours /day Maximum (Hrs)	Supply Hours /day Minimum (Hrs)	Supply Hours /day Average (Hrs)
1.	**State**					
(a)	Three-Phase Supply					
(b)	Single Phase Supply					
(c)	Remarks/Notes/Any Other					
2.	**State**					
(a)	Three-Phase Supply					
(b)	Single Phase Supply					
(c)	Remarks/Notes/Any Other					
3.	**State**					
(a)	Three-Phase Supply					
(b)	Single Phase Supply					
(c)	Remarks/Notes/Any Other					
.						
.						

FORMAT-29 Page 1/4
PERIODICITY- MONTHLY
SUBMISSION BY- 18TH DAY

Revised Power Supply Position in __________________Region for the Month Of _________

A Generation Details

S.No.	Constituents	1	2	3	------	N	REGION
(I)	Gross Generation (MkWh)						
	Thermal						
	(i) Coal						
	(ii) Liquid						
	(iii) Gas Open Cycle						
	(iv) Gas Combined Cycle						
	(v) Nuclear						
	Hydro						
	IPPs						
	CPPs						
	Wind Mills						
	Total (I)						
(II)	Dedicated Power Stations#						
	(i)						
	(ii)						
	Total (MkWh) (I)+(II)						
(II)	Actual Demand Met (Gross MW)						

B Shared/ Common Projects Generation (MkWh)

S.No.	Station Name	Gross	Ex-Bus
1			
2			
3			
	Total		

C Energy / Availability / Requirement (Ex-Bus) (MkWh)

	Constituents	1	2	3	------	N	REGION
1.	Own Generation						
	Thermal						
	(i) Coal						
	(ii) Liquid						
	(iii) Gas Open Cycle						
	(iv) Gas Combined Cycle						
	(v) Nuclear						
	Hydro						
	IPPs						
	CPPs						
	Wind Mills						
	Total						
2	Dedicated Power Stations#						
2.1							
2.2							
	Total Own Generation, IPPs*, CPPs** & Dedicated						
3.	Share from Shared Projects						
(I)							
(II)							
4.	Bilateral Import						
5.	Bilateral Export						
6.	Total Drawl from Grid including bilateral (includes transmission losses)						
7.	Total Availability (1+3+6)						
8.	Unrestricted Requirement (From Table D)						
9.	Shortfall						

D Details of Calculations FORMAT-29 Page 2/4

S.No.	Constituents	1	2	3	------	N	REGION
1	Net Actual Energy Supplied						
2	Frequency Correction						
3	Unscheduled Load Shedding						
4	Scheduled Load Shedding/Power Cuts						
5	Unrestricted Requirement (1+2+3+4)						

E Peak Demand/ Unrestricted Peak Demand (Ex-Bus) (MW)

S.No.	Constituents	1	2	3	------	N	REGION
1	Peak Unrestricted Demand (from Table F)						
2	Peak Demand Met						
3	Shortfall						
4	% Shortfall						

F Details of Calculations for Unrestricted Peak Demand (MW)

S.No.	Constituents	1	2	3	------	N	REGION
1	Peak Demand Met						
2	Frequency Correction						
3	Unscheduled Load Shedding						
4	Scheduled Load Shedding						
5	Peak Unrestricted Demand (1+2+3+4)						

G Details of Gross Generation, Declared Capacity, Scheduled Generation and Injection from CGSs (MkWh)

S.No.	CGSs	Declared Capacity (Ex-Bus) (MkWh)	Scheduled Capacity (Ex-Bus) (MkWh)	Gross Generation (MkWh)	Injection (MkWh)
(i)					
(ii)					
(iii)					
.					
.					
	Total				

H Total Entitlement, Schedule and Drawl by Constituents (MkWh)

S.No.	Constituents	Entitlement (Ex-Bus) (MkWh)	Scheduled Drawl (Ex-Bus) (MkWh)	Actual Total Drawl from Grid including Grid Loss (MkWh)
(i)				
(ii)				
(iii)				
.				
.				
	Total			

I Frequency Profile of _Regional Grid

Instantaneous Maximum		Instantaneous Minimum		15-Minutes Block Maximum		15-Minutes Block Minimum		Monthly Average	Frequency Variation Index (FVI)
Hz	Time	Hz	Time	Hz	Time	Hz	Time	Hz	

J Frequency Profile (% of time)

Frequency Range	Below 48.5 Hz	Between 48.5 Hz & 48.8 Hz	Between 48.8Hz. & 49.0 Hz	Between 49.0 Hz & 49.5 Hz	Between 49.5 Hz & 49.8 Hz	Between 49.8 Hz & 50.2 Hz	Between 50.2 Hz & 50.5 Hz	Between 50.5 Hz & 51.0 Hz	Between 51.0 Hz & 51.5 Hz	Above 51.5 Hz
(% of time)										

Entitlement & Scheduled Drawl of Central Generating Stations in ________ Region for the Month of ______

I. Entitlement & Scheduled Drawl

(All figures in MkWh net)

		Constituents # 1		Constituents # N		Total	
		Entitlement	Scheduled Drawl	Entitlement	Scheduled Drawl	Entitlement	Scheduled Drawl
1	**Central Generating Stations :**						
1.1							
1.2							
1.3							
	Total (1)						
2	**Dedicated CG Stations :**						
2.1							
2.2							
	Total (2)						
3	**Supply from Jointly owned Projects:**						
3. 1							
3. 2							
	Total (3)						
	Total (1 + 2 + 3)						
	Note : Central Generating Station (CGSs) within the region and outside the region						

II. CGSs Availability, Schedule and Actual Generation (MkWh)

Sl.No.	Stations	Availability	Schedule	Actual
1.				
2.				
3.				
.				
.				
	Total			

III. Actual Drawl by Beneficiaries from the Grid (MkWh)

Sl.No.	Constituents	Drawl from Shared Projects + Bilateral + Power Traded	Net Drawl from CGSs including Dedicated Projects	Net Drawl (incl. Bilateral)
(1)	(2)	(3)	(4)	(5) = (3)+(4)
1.				
2.				
3.				
.				
.				
.				
	Total			

Intra-Regional & Inter - Regional Exchange of Power in ______________________ Region during the month ___

1. Intra-Regional Bilateral Transactions (Scheduled Drawl)

(All figures in MkWh)

To-------> From ¦ V	Constituent #1	Constituent #2	…..	Total
Name of The Constituents & Trader				
.				
.				
.				
Total				

Note : The ex-periphery metering point may please be indicated

2. Inter-Regional Bilateral Transactions (Scheduled Drawl) **(All figures in MkWh)**

To-------> From ¦ V	Constituent #1	Constituent #2	…..	Total
Name of The Constituents & Trader				
.				
.				
.				
Total				

FORMAT-30

[ ][26]

[26] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT-31
PERIODICITY- MONTHLY
SUBMISSION BY- 10TH DAY

Monthly Data regarding Loss of Generation on account of Shortage of Coal, Gas, Unreqisitioned Liquid Fired Capacity & Backing Down due to System Constraints in
______________ Region for the Month ____________

SL.NO.	Name of State/ Station	Installed Capacity (MW)	Fuel Type	Loss of Gen. for the Month (MkWh)
	STATE SECTOR			
1.				
2.				
3.				
4.				
	CENTRAL SECTOR			
1.				
2.				
3.				
4.				
	Total			

Summary

1. Loss of Generation due to Shortage of Coal ____________ MkWh
2. Loss of Generation due to Shortage of Gas ____________ MkWh
3. Loss of Generation due to Unrequisitioned Liquid Fired Capacity ____________ MkWh

(Sub-Total) ____________ **MkWh**

4. Loss of Generation due to System Constraints (Low System Demand, Transmission Constraints, etc.) ____________ MkWh

Total ____________ **MkWh**

FORMAT-__ RPCs

DATA FOR LOAD GENERATION BALANCE REPORT (LGBR) FOR THE YEAR 20…. TO 20……

1. Effective Capacity for the Year 20 -20

S. No	Generating Station		Unit No.	Date of BLR (for Thermal/ Gas Stations)	Effective Capacity as on 31/3/20….	Plant				Remarks
	Name	*Thermal/ Nuclear/ Gas/ Hydro/ Other				Aux. Consumption (%)	Forced outage rate (%)	Planned Outage (%)	Target PLF %	

2. Maintenance Schedule for the Year 20 -20

S. No	Station Name	*Thermal/ Nuclear/ Gas/ Hydro/ Other	Unit No.	Capacity (MW)	Proposed Schedule			Reason	Total No. of maintenance days during year to previous reported year	Remarks
					From	To	No. of days			

3. Addition in Installed Capacity (MW)

S. No	Station Name	*Thermal/ Nuclear/ Gas/ Hydro/ Other	Unit No.	Capacity (MW)	Month	Ex-bus MkWh day	Remarks
						April… March	

4. Monthly Generation Ex-bus Targets (MW) (max.) and Average Energy (MkWh/day) for the Year 20 -20

S. No	Name of Gen. Station	April….		May……..		…………….		February……		March………		Remarks
		MW	MkWh/Day	MW	MkWh/Day	………	………	MW	MkWh/Day	MW	MkWh/Day	

5. Monthly Estimated Peak Demand (MW) (max.) and Average Energy Requirement (MkWh/day) of Constituents for the Year 20 -20

April…………		May…………..		………..		February………..		March…………		Remarks
MW	MkWh/Day	MW	MkWh/Day	………	……..	MW	MkWh/Day	MW	MkWh/Day	

% Growth Rate considered for calculating Energy Requirement and Estimated Peak Demand ________%

6. Share of States/ UTs in the Central Sector Generating Stations (MW)

S. No.	**Name of Station**	Constituent 1	Constituent 2	-------------	Constituent 5	Unallocated
1	Station 1					
2	Station 2					

7. Firm power import/export bilateral agreement/arrangements with other constituents

S. No	Constituent		April…………		May………….		………..		February………..		March…………		Remarks
	From	To	MW	MkWh/Day	MW	MkWh/Day	………	………	MW	MkWh/Day	MW	MkWh/Day	

8. Monthly anticipated water levels and energy content for the Year 20 -20

S. No	Name of Hydro Station	Month	Levels as on 1st day of the month (meter)	Average inflows during the month (Cusecs)	Average discharge during month (Cusecs)	Energy content as on 1st day of the month (MkWh)

9. Energy Availability Calculation of the State/ System/ Region (MkWh)

S. No.	POWER STATION	April 20 _	May 20_	June 20_	----------	January 20_	February 20_	March 20_	Total
1	Energy available from hydro stations								
2	Energy available from thermal* stations								
3	Share from Dedicated Power Stations								
4	Share from Central Generating Stations								
5	Scheduled Energy imports (giving break up)								
6	Total availability (1+ 2 + 3 + 4)								
7	Energy Requirement (from Table (5))								
8	Surplus (+) / Deficit (-)								

10. Peak Availability of the State/ System/ Region (MW)

S. No.	Power Station	April 20_	May 20_	June 20_	--------------	January 20_	February 20_	March 20_	Maximum
1	Peak Power Available from Hydro Stations								
2	Peak Power Available from Thermal Stations								
3	Share from Dedicated Power Stations								
4	Share from Central Generating Stations								
5	Scheduled Peak Power Imports (giving break up)								
6	Total Peak Power Availability (1+ 2 + 3 + 4)								
7	Peak Power Requirement (from Table (5))								
8	Surplus (+) / Deficit (-)								

11. State wise Anticipated Energy Requirement Vs Energy Availability (MkWh) for the Year 20 -20

	April 20__	May 20_	June 20_	-------------	January 20_	February 20_	March 20_	Total
Region/ State/ System								
Requirement								
Availability								
Surplus/ Deficit (-)								
%								

12. State wise Anticipated Peak Demand Vs Peak Availability for the Year 20 -20

	April 20__	May 20__	June 20__	-----------------	January 20__	February 20	March 20__	Maximum
Region/ State/ System								
Peak Demand								
Peak Availability								
Surplus/ Deficit (-)								
%								

* Thermal Generating Stations include Coal, Liquid, Gas Open Cycle, Gas Combined Cycle & Nuclear

FORMAT-48 GENCO/ State Utilities/ RPCs

FORMAT-33
PERIODICITY- MONTHLY
SUBMISSION BY- 10TH DAY

Unscheduled Interchange (UI) Status of …………….Region for the Month of …………….

Sl.No.	Constituents/ Generators	Schedule Drawl (MkWh)	Actual Drawl (MkWh)	UI (Rs.) (-) Payable to the pool (+) Receivable from the pool
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

FORMAT-__ RPCs

FORMAT-34
PERIODICITY- MONTHLY
SUBMISSION BY- 10TH DAY

Details of Power Traded by the Trading Company for the Month of

Name of the Trader :
Licensee Details (No. and Date):

Sl. No.	Volume of Trading (MkWh)	Purchased from	Sold to	Point of purchase	Purchase price (Rs.)	Point of sale (Rs.)	Sale price (Rs.)	Transmission/ Wheeling Charges borne by Seller/ Trader/ Buyer (Rs.)	Transmissio n losses borne by Seller/ Trader/ Buyer (Rs.)	UI charges borne by seller/ Trader/ Buyer (Rs.)	Trading margin charged (Rs.)	Remarks
1												
2												
3												
4												
N												

FORMAT-__ Power Trading Companies

FORMAT-35
PERIODICITY- MONTHLY
SUBMISSION BY- 20TH DAY

Progress of Capacitor Installation Programme in ………………….. Region for the month of ……………

(All figures in (MVAr)

Name of the Constituents	Total installed as on …….. (previous year)	Requirement during ………. (current year)	Constituent's programme during ……….. (current year)	Actual addition during the current month ………	Faulty Capacitors removed during the current month ………	Total addition during the current year
1						
2						
3						
4						
5						
6						
.						
.						
.						
.						
.						
Total Region						

FORMAT-25 RPCs

FORMAT-36

Periodicity - Daily

Submission by - 1500 Hrs.

DAILY COAL REPORT: DATA FOR THE DATE (dd, mm, yy)………………………

Figures of coal quantity in metric tones (mt)

NAME & ADDRESS OF GENERATING COMPANY

(1) Coal Stock Position

Name of TPS	Date	Receipt	Cumulative receipt during the month	Consumption	Cumulative Consumption during the month	Stock Available

(2) Daily Source wise Receipt of Coal

Name of TPS	Date	Name of Coal Company			Total Receipt
		Source-I	Source-II	So on	

(3) Cumulative Source wise Receipt of Coal during the month.

Name of TPS	Date	Total pro rata linkage	Name of Coal Company			Total Receipt	Receipt as (%) of linkage
			Source-I	Source-II	So on		

(4) Wagons

Name of TPS	Date	Opening Balance	Wagons Received	Wagons Released	Closing Balance

Format -37 GENCO. COM

FORMAT-37
Periodicity- **Monthly**
Submission by **15th day**

COAL REPORT OF MONTH-------, 20---

1. Name of TPS :

2. Month & Year :

3. Capacity in MW :

4. Coal Data :

Source of supply as per linkage	Linkage in mt	Receipt in mt	Mode of Transport	Cost of Coal Rs/mt	Transportation Cost Rs./mt

A. Link Source

1.

2.

B. Diverted if any

1.

2.

C. Imported if any

Total Coal received during the month (A+B+C)

5. Total Coal Consumption in mt

   a) Indigenous Coal :
   b) Imported Coal :

6. Useable Coal Stock at the end of month in mt

   a) Indigenous Coal :
   b) Imported Coal :

7. Unit Generated in MkWh : During the month

8. Average UHV, GCV & % of ash content of Coal:
   (a) As received
   (b) As fired

9. No. of wagons received during the month

mt = metric tone

FORMAT-38
Periodicity - Monthly
Submission by 7th day

GENERATION LOSS DUE TO FUEL SHORTAGE

Name of thermal power station
Report of the Month & Year:

Date	Unit No.	Capacity in MW	Total Energy Loss in MkWh due to shortage of fuel	Remarks
1	2	3	4	5

FORMAT-39

[ ][27]

[27] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT-40

[ ][28]

[28] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT-41
Periodicity-Quarterly
Submission 40 days before the commencement of the quarter

PROPOSED COAL ALLOCATION FOR SHORT TERM LINKAGES FOR THERMAL POWER STATIONS

1. Name of the Power Station

2. No. of Units & Total installed capacity

3. Name of the Quarter (Period)

4. Planned Outage:

Sl. No.	Unit No.	Capacity in MW	Outage Period		Nature of maintenance
			From	To	

5. Generation Target for the Quarter in MkWh

First Month	Second Month	Third Month	Average Target Generation

6. Average Overall Specific Coal Consumption (Kg/kWh) for Station.

7. Coal Requirement to achieve Targeted Generation in metric tonnes:

First Month	Second Month	Third Month	Average Target Generation

8. Average Stock Building per month in metric tonnes subject to stocking capacity of the station's stock yard.

9. Average monthly coal requirement during the quarter in metric tonnes (details below)

Sl. No.	Source of supply/field/company	Mode of Transportation	Quantity
	Total		

FORMAT-42
Periodicity-monthly
Submission by 15th day

MONTHLY FUEL SUPPLY DATA OF GAS BASED THERMAL POWER STATIONS (UTILITY) FOR THE MONTH ……. YEAR 20--

Sl.No	Item	Particulars/ Data		
1	Name of the gas based Thermal power station			
2	Owner's name:			
3	Mailing address:			
	Telephone No.			
	Fax No.			
4	Installed capacity (Installed capacity & Unit rating in MW and No. of Units)			
5	Type of station (Whether CCGT/ OCGT)			
6	Energy generation of station during the month	Target	Actual	
	(MkWh)			
7	Alternate fuel being used (Naphtha/ HSD)			
8	Fuel supply position of the month			
	(1.) Allocation	Gas	HSD	Naphtha
		MMSCM	kl	mt
	(a.) As per original allocation for the month by Gas Linkage Committee			
	(b.) Present allocation for the month			
	(2.) Consumed during the month			
	(a.) For generation from existing Units			
	(b.) For commissioning, testing etc. of new Units			
9	Cumulative consumption during the year			
10	Average gross calorific value of the fuel for the month	kcal/SCM	kcal/ kl	kcal/ kg
11	Generation loss in MkWh, if any, due to shortage of gas/alternate fuel during the month			
12	Reasons for short supply of fuel compared to present allocation, if any			
13	Source of supply			
14	Mode of transport from source to power station (Rail/Road/Pipeline)			
15	Landed cost (Average for month) of fuel at power station in Rs./SCM	Rs./SCM	Rs./kl	Rs./mt
16	Remarks, if any.			

MMSCM-Million Metric Standard Cubic Metre
mt = metric tonne
kl = kilo litre

FORMAT- 43
Periodicity-monthly
Submission by 15th day

MONTHLY FUEL SUPPLY DATA OF LIQUID FUEL BASED THERMAL POWER STATIONS (UTILITY)
FOR THE MONTH ……. YEAR 20--

Sl.No	Item	Particulars/ Data		
1	Name of the liquid fuel based GT Station			
2	Owner's name:			
3	Mailing address:			
	Telephone No.			
	Fax No.			
4	Installed capacity (Installed capacity & Unit rating in MW and No. of Units)	GT	ST	
5	Type of station (Whether CCGT/ OCGT)			
6	Energy generation of station during the month	Target	Actual	
	(MkWh)			
7	Name of Primary fuel			
8	Fuel supply position of the month	Primary Fuel	Alternate Fuel	
		kl	Name-1	Name-2
			kl	kl
	(1.) Allocation			
	(2.) Consumed during the month			
	(a.) For generation from existing Units			
	(b.) For commissioning, testing etc. of new Units			
	(3.) Closing Stock at the end of the month			
9	Cumulative consumption during the year	kCal/l	kCal/l	kCal/l
10	Average gross calorific value of the fuel for the month			
11	Generation loss in MkWh, if any, due to shortage of fuel			
12	Reasons for short supply of fuel compared to present allocation, if any			
13	Source of supply			
14	Mode of Transport from source to power station (Rail/Road/Sea/Pipeline)			
15	Landed cost (average for month) of fuel at power station in Rs./kl			
16	Remarks, if any.			

FORMAT- 44
Periodicity-monthly
Submission by 15th day

MONTHLY FUEL SUPPLY DATA OF DG POWER STATIONS (UTILITY) FOR THE MONTH ……. YEAR 20--

Sl. No	Item	Particulars/ Data		
1	Name of the DG power station			
2	Owner's name:			
3	Mailing address:			
	Telephone No.			
	Fax No.			
4	Installed capacity (Installed capacity & Unit rating in MW and No. of Units)			
5	Energy generation of station during the month	Target	Actual	
	(MkWh)			
6	Name of primary fuel			
7	Fuel supply position of the month	Primary Fuel	Alternate Fuel	
		kl	Name-1	Name-2
			kl	kl
	(1.) Consumed during the month			
	(a.) For generation from existing Units			
	(b.) For commissioning, testing etc. of new Units			
	(2.) Closing Stock at the end of the month			
8	Cumulative consumption during the year	kCal/l	kCal/l	kCal/l
9	Average gross calorific value of the fuel for the month			
10	Generation loss in MkWh, if any, due to shortage of fuel for the month			
11	Reasons for short supply of fuel compared to requirement, if any			
12	Source of supply			
13	Mode of transport from source to power station (Rail/Road/Sea/Pipeline)			
14	Landed cost (average for month) of fuel at power station in Rs./kl			
15	Remarks, if any.			

FORMAT-45

[ ][29]

[29] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT - 46

[ ][30]

[30] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT- 47

[ ][31]

[31] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT-48
PERIODICITY- MONTHLY
SUBMISSION BY 3RD DAY

DISTRICT WISE MONTHLY PROGRESS OF INHABITED VILLAGE ELECTRIFICATION
DURING THE YEAR …………………………….
(AS PER....................... CENSUS)

Month ………………….

State/U.T …………………..

Sl No	Name of the District	Nos. of inhabited villages as per …............... Census	No. of inhabited villages electrified up to 31.03.20 ---------------------(end of previous year)	Achievement from 1.4.20… to ……… (during current year upto the end of month previous to the month under report)	No. of villages electrified during the …… (month under report)	Cumulative villages electrified as on …….. (end of month under report) (4+5+6)
1	2	3	4	5	6	7

[FORMAT- 49
Periodicity- Monthly
Submission by 3rd day

IRRIGATION PUMPSETS ENERGIZATION -PROGRESS

State/UT:………………………………………………………………………………
Name of Reporting Discom/utility: …………………………………………………………
Electrical Circle/Division :………………………………………………
For the Month of ……………………………………………Year………………………………….

Sl. No.	Name of the District	Total Pumpsets Existing /Effective at the end of the previous Month (Nos)	Pumpsets Energized during the Month (Nos)	Pumpsets De-energized during the Month (Nos)	Total Pumpsets Existing /Effective at the end of the Month (Nos) (=b+c-d)	Remarks
	a	b	c	d	e	f
A	Irrigation Pumpsets Energization (grid connected)					
	Total at the end of previous reporting year, as on 31March-20--					
1						
2						
3						
Total-A						
B	Irrigation Pumpsets Energization (Off grid supply)					
	Total at the end of previous reporting year, as on 31March-20--					
1						
2						
3						
Total-B						
Total - A+B						

][32]

[32] Substituted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT- 50

[ ][33]

[33] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[FORMAT- 51 (1/3)
Periodicity-Monthly
Submission by 3rd day

METERING STATUS OF FEEDERS (POWER SUB STATION - AREA WISE) IN DISTRIBUTION SYSTEM

State/UT:…………………………………
Name of Reporting Discom/utility: ………………………………………
Electrical Circle/Division ……………………………………………………
For the Month of …… Year………………………………….

Area-Urban										
Feeder Metering Power Sub Station **(**PSS) level (6.6 kV, 11 kV, 22 kV, 33 kV and higher, if any) (Please select the Voltage category applicable and provide details accordingly)										
Sl. No.	Name of Urban area/ Town, Census code	Name of 66, 33, 22/11 kV PSS feeding the feeders (with Code)	Capaci ty of 66, 33, 22/ 11 kV PSS, MVA	Name of Feeders originati ng from the PSS (with codes)	Type of feeders- Rural, Urban or Mixed @	Feeder Voltage (6.6 kV, 11 kV, 22 kV, 33 kV, etc.)	Feeder metering Status (Yes/ No)	If Metered, Type of Meter provided (AMR / Normal Electronic meter)	If Metered with AMR, Whether communica ting to National Power Portal (Yes/ No)	Remarks (Status of defective meters, communication status, etc.)
	1	2	3	4	5	6	7	8	9	10
1										
2										
3										
Total-Urban										

Area-Rural									
Feeder Metering PSS level (6.6 kV, 11 kV, 22 kV, 33 kV and higher, if any) (Please select the Voltage category applicable and provide details accordingly)									
Sl. No.	Name of 66, 33, 22/11 kV PSS feeding the feeders (with Code)	Capacity of 66, 33, 22/ 11 kV PSS , MVA	Name of Feeder s origin ating from the PSS (with codes)	Type of feeders- Rural, Urban or Mixed	Feeder Voltage (6.6 kV, 11kV, 22 kV, 33 kV, etc.)	Feeder metering Status (Yes/ No)	If Metered, Type of Meter provided (AMR/ Normal Electronic meter)	If Metered with AMR. Whether communica ting to NPP (Yes/ No)	Remarks (Status of defective meters, communication status, etc.)
	1	2	3	4	5	6	7	8	9
1									
2									
3									
Total-Rural									
Total - Rural + Urban									
@ Rural (domestic and commercial) Agriculture , or Mixed of Rural, Agriculture and Industrial, etc.									

Format-51(2/3)
Periodicity - Monthly
Submission By 3rd day

METERING STATUS OF DISTRIBUTION TRANSFORMERS (PSS AND FEEDERS, AREA WISE) IN DISTRIBUTION SYSTEM

State/UT: ………………………………

Name of Reporting Discom/utility: ……………………………………………………………

Electrical Circle/Division …………………………………………………………

For the Month of …………………………………………Year………………………………….

Area-Urban

Distribution Transformer (DT) (33, 22, 11, 6.6 kV/ 0.4 kV or 0.215 kV) Metering (Please select the Voltage category applicable and provide details voltage wise)

Sl. No.	Name of Urban area/ Town, Census code $	Name of Feeders originating from the PSS (with codes) $	Type of feeders -Rural, Urban or Mixed	Feeder Voltage (6.6 kV, 11 kV, 22 kV or 33 kV, etc.)	Number of DTs in Service	Aggregate Capacity of DTs (MVA)	Total Number of DTs metered	DTs Metered with AMR / Normal Electronic meter	If Metered with AMR, Whether communicating to DC (Yes/ No)	Remarks (Status of defective meters, communication status, etc.)
	1	2	3	4	5	6	7	8	9	10
1										
2										
3										
Total - Urban										

Area-Rural

Distribution Transformer (DT) (with 33kV, 22kV, 11 kV, 6.6 kV/ 0.4 kV or 0.215 kV) Metering (Please select the Voltage category applicable and provide details voltage wise)

Sl. No.	Name of Feeders originating from the PSS (with codes) $	Type of feeders- Rural, Urban or Mixed	Feeder Voltage (6.6 kV, 11kV, 22 kV, or 33 kV, etc.)	Number of DTs in Service	Aggregate Capacity of DTs (MVA)	Total Number of DTs metered	DTs Metered with AMR / Normal Electronic meter	If Metered with AMR, Whether communicating to DC (Yes/ No)	Remarks (Status of defective meters, communication status, etc.)
	1	2	3	4	5	6	7	8	9
1									
2									
3									
Total - Rural									
Total - Urban + Rural									

$ Name / Type of feeders and their code must match with Feeders from PSS of Format-51(1/3).

"Format-51(3/3)
Periodicity - Monthly
Submission By 3rd day

METERING STATUS OF CONSUMERS (POWER SUB STATION - AREA WISE) OF THE CIRCLE IN DISTRIBUTION SYSTEM

State/UT: ……………………………………………………………………………………………

Name of Reporting Discom/utility: ……………………………………………………………

Electrical Circle/Division ………………………………………………………

For the Month of ……………………………………………Year………………………………….

Area-Urban											
Sl. No.	Name of Urban Areas $	Name of Circle	Name of PSS with Codes, supplying to consumers $	Total Number of Consumers	Type of Meters (Electronic / Smart / Prepaid)				Total Number of Consumers metered (= sum of columns 5, 6, 7 & 8)	Percentage of Consumer metered (= column 9 x 100/ Column 4)	Remarks (Status of defective meters, communi-cation status, etc.)
					Number of Electro-Mechanical Meters	Number of Smart/ AMI meters	Number of Prepaid (Smart/AMI) meters	Number of Prepaid (Standalone meters)			
	1	2	3	4	5	6	7	8	9	10	11
1											
2											
3											
Total - Urban											

Area-Rural										
Sl. No.	Name of Circle	Name of PSS with Codes, supplying to consumers $	Total Number of Consumers	Type of Meters (Electronic / Smart / Prepaid)				Total Number of Consumers metered (= sum of columns 4, 5, 6 & 7)	Percentage of Consumer metered (= column 8 x 100 / Column 3)	Remarks (Status of defective meters, communication status, etc.)
				Number of Electro-Mechanical Meters	Number of Smart/ AMI meters	Number of Prepaid (Smart/AMI) meters	Number of Prepaid (Standalone meters)			
	1	2	3	4	5	6	7	8	9	10
1										
2										
3										
Total - Rural										
Total - Urban + Rural										
$ Name of PSS /feeder s and code must match with Format-51(1/3)										

][34]

[34] Substituted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT- 52

[ ][35]

[35] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[FORMAT - 53
Periodicity-Monthly
Submission By 30th day after end of quarter

RELIABILITY INDICES (SAFI, SAIDI, CAIDI & MAIFI) -CONSUMER AFFECTED/ LOAD INTERRUPTED BASIS ON THE FEEDER

State/UT: ……………………………………………………………………………………… Name of Reporting Discom/utility: …………………………………………………………… Electrical Circle/Division …………………………………………………………

For the Month of ………………………………………………Year…………………………………….

<table>
<tr><td colspan="2" rowspan="2">Targets as per Standard of Performance (Urban)</td><td>SAIFI</td><td>SAIDI</td><td>CAIDI</td><td>MAIFI</td><td rowspan="2"></td><td colspan="3" rowspan="2">Targets as per Standard of Performance (Rural)</td><td>SAIFI</td><td>SAIDI</td><td>CAIDI</td><td>MAIFI</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td colspan="7">Calculation for SAIFI, SAIDI, CAIDI#</td><td colspan="4">Calculation for MAIFI#</td></tr>
<tr><td>Name of Circle/Area</td><td>Type of Circle/Areas (Urban – U Rural-R)</td><td>Total No of feeders (U/R) in the circle/area $</td><td>Total Nos of consumers (U/R) in the feeders in the</td><td>Nos of Interruptions (>3min/ 5min /10min) @</td><td>Duration of Interruption considered (>3min /5min /10min)</td><td>Nos of consumers in the affected feeders</td><td>SAIFI</td><td>SAIDI</td><td>CAIDI</td><td>Nos of momentary Interruptions(<3min/5min/10min) @</td><td>Nos of consumers in the interrupted feeders</td><td colspan="2">MAIFI #</td></tr>
<tr><td colspan="14">Area - Urban</td></tr>
<tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Total-Urban</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="14">Area - Rural</td></tr>
<tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Total –Rural</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Overall Discom</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
</table>

SAIDI – System Average Interruption Duration Index

SAIFI – System Average Interruption Frequency Index

CAIDI – Consumer Average Interruption Duration Index

CAIFI – Consumer Average Interruption Frequency Index

MAIFI – Momentary Average Interruption Frequency Index

@Strikeout whichever is not applicable.

calculation Formula as specified in Standard of Performance of SERCs/ JERCs

$-Nos of Feeders must match with Format – 51 (1/3)

Notes: Targets as fixed by respective SERCs/JERCs may be indicated. If not fixed/available, it may be clearly mentioned.

][36]

[36] Substituted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

[FORMAT- 54
Periodicity- Quarterly
Submission by 30th day after end of quarter

RELIABILITY INDICES (SAIFI, SAIDI, CAIDI & MAIFI) FOR URBAN/RURAL AREAS -LOAD AFFECTED/ LOAD INTERRUPTED BASIS ON THE FEEDER

State/UT: …………………………………………………………………………………………

Name of Reporting Discom/utility: ……………………………………………………………

Electrical Circle/ Division …………………………………

For the Month of ………………………………………………Year………………………………….

Targets as per Standard of Performance (Urban)		SAIFI	SAIDI	CAIDI	MAIFI	Targets as per Standard of Performance (Rural)				SAIFI	SAIDI	CAIDI	MAIFI
			Calculation for SAIFI, SAIDI, CAIDI#								Calculation for MAIFI#		
Name of Circle/Area	Type of Circle/Areas (Urban – U Rural- R)	Total No of feeders (U/R) in the circle/ area $	Total Nos of consumers (U/R) in the feeders in the circle/ area	Total connected load (kW) in the feeders(U/R) in the circle/ area	Nos of Interruptions (>3min / 5min /10min)@	Duration of Interruption considered (>3min /5min / 10min)	Affected load (kW) in the feeders	SAIFI	SAIDI	CAIDI	Nos of momentary Interruptions (<3min/5 min/ 10min)	Affected load (kW) in the feeders	MAIFI
Urban Areas													
1													
2													
3													
Total-Urban													
Rural Areas													
1													
2													
3													
Total -Rural													
Overall Discom													

SAIFI – System Average Interruption Frequency Index

SAIDI – System Average Interruption Duration Index

CAIFI – Consumer Average Interruption Frequency Index

CAIDI – Consumer Average Interruption Duration Index

MAIFI – Momentary Average Interruption Frequency Index

@Strikeout whichever is not applicable.

calculation Formula as specified in Standard of Performance of SERCs/ JERCs

$-Nos of Feeders must match with Format-51 (1/3)

Notes: Discoms to select the applicable Format (Format-1: consumer interruption basis) or

(Format-2: Load interruption basis) while submitting the data as specified in respective SOP order.

][37]

[37] Substituted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT- 55

[ ][38]

[38] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT-56
Periodicity – Annual Submission
by 30th April

AGGREGATE TECHNICAL & COMMERCIAL (A T & C) LOSSES FOR THE FINANCIAL YEAR _______

Name of Utility____

Sl. No.	Item	Unit	
1	Self Generation	MkWh	
2	Purchased from Central Power Sector Utilities	MkWh	
3	Purchased from other Utilities	MkWh	
4	Total Units (UI_T) (1+2+3)	MkWh	
5	Units Traded with other Utilities (U_T)	MkWh	
6	Units Utilised within Licensed Area (U_1) = {(4)-(5)}	MkWh	
7	Units Billed within Licensed Area (U_B)	MkWh	
8	Amount Billed within Utility Area (A_B)	Rs. Crores	
9	Amount Realised within Utility Area (A_R)	Rs. Crores	
10	Collection Efficiency ($CE = A_R / A_B$)	--	
11	Units Realised (U_R) = (U_B * CE)	MkWh	
12	AT&C Losses ($U_1 – U_R$)	MkWh	
13	AT&C Losses $\{1 – (U_R/U_1)\} * 100$	%	

FORMAT - 57

[ ][39]

[39] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

FORMAT-58
Periodicity- `Monthly
Submission-by 20th day

HEAT RATE DATA OF COAL/LIGNITE BASED THERMAL POWER STATIONS FOR MONTH ………YEAR ………20…..20…...

1.0 General:

(i) Station Name:--------------------------------

(ii) Station Capacity: -(No. of units with size)

2.0 Design parameters for the Station:

Unit No.	Unit Capacity (MW)	Date of commissioning	Make		Boiler Efficiency (%)	Turbine Heat Rate (kcal/kWh)	Unit Heat Rate (Col.7x100)/ Col.6 (kcal/kWh)	Weighted Design Station Heat Rate w.r.t. Capacity (kcal/kWh)
			Boiler	Turbine				
1	2	3	4	5	6	7	8	9
U-1								
:								
:								
:								
:								
Un								
Station								

3.0 Operational Performance Data For The Station (month-wise) For The Year : ------------------------

Month	Coal / Lignite stocks at the beginning of the month	Coal / Lignite stocks at the end of the month (Tonnes)	Coal / Lignite received during the month (Tonnes)	Total Coal / Lignite consumptio n during the month Col.(2+4-3) (Tonnes)	Generation (MkWh) during the month	Average GCV of Coal / Lignite (kcal/kg)	Specific Coal / Lignite Consumption (kg/kWh) Col.(5)/{(6)*1000}	Oil Consumpti on (kl)	Specific Oil Consumption (ml/kWh) Col.(9)/(6)	Avg. GCV of Oil (kcal/l)	Actual Station Heat Rate Col.(7x8) + Col. (10x11)/1000 (kcal/kWh)
1	2	3	4	5	6	7	8	9		11	12
April											
May											
:											
:											
:											
:											
March											
Weighted/ Total For The Year (April - March)						Weighted average				Weighted average	

FORMAT - 59
Periodicity- Monthly Submission- by 20th day

HEAT RATE DATA OF COMBINED CYCLE GAS TURBINE POWER STATIONS FOR MONTH …………YEAR…………20… 20

1.0 General:

i) Station Name: ---

ii) Station Capacity: (No. of units with size)

1.1 Design parameters for the Station:

No. of Modules	Module Capacity (MW)	Date of commissioning	Make		Module Heat Rate (kcal/kWh)	Weighted Design Station. Heat Rate w.r.t.Capacity (kcal/kWh)
			Gas Turbine	Steam Turbine (if any)		
1	2	3	4	5	6	7
Module# 1						
:						
:						
:						
:						
Module# n						

2.0 Operational Performance Data For The Station For The Year : ---------------------------

Month	Liquid fuel stock in the beginning of the month (kl)	Liquid fuel stock at the end of the month (kl)	Liquid fuel received during the month (kl)	Total Liquid fuel consumption during the month Col. (2+4-3) (kl)	Generatio n (MkWh)	Average GCV of Liquid Fuel (kcal/l)	Specific Liquid fuel Consumption (l/Kwh)) (5)/(6)*1000)	Gas Consumption (at S.T.P.) (million Cu.m)	Specific Gas Consumption (Cu.m/kWh) (9)/(6)	Average GCV of Gas (at S.T.P.) (kcal/Cu. m)	Actual Station Heat Rate Col.(7x8+10x11) kcal/kWh)
1	2	3	4	5	6	7	8	9	10	11	12
April											
May											
:											
:											
:											
:											
March											
Weighted/AV. Total (March to March)											

FORMAT-60 Page-1 of 2
Periodicity- Monthly
Submission-by 20th day

MONTHLY ENVIRONMENTAL DATA OF THERMAL POWER PLANTS

NAME OF THERMAL POWER STATION :

I. STACK EMISSIONS (UNIT WISE AND MONTH WISE)

UNIT NO.	DATE	SPM (mg/Nm3)	SO_2 (mg/Nm3)	NO_X (mg/Nm3)

II. AMBIENT AIR QUALITY (MONTH WISE)
(AS PER CPCB NOTIFICATION No. S.O.384E dt. 11.4.94)

PARAMETERS	LOCATION-I (POWER STATION)	LOCATION-II (COLONY)	LOCATION-III (OUTSIDE THE PLANT WITHIN 20 KM.)	METHOD OF MEASUREMENT
SPM (µg/m3)*				
SO2 (µg /m3)*				
NOX (µg /m3)*				
RPM (µg /m3)*				
LEAD (µg/m3)*				
CO (mg/m3)**				

* 24 HOURS WEIGHTED AVERAGE

** 8 HOURS WEIGHTED AVERAGE

III. LIQUID EFFLUENT DISCHARGE DATA

A. CONDENSER COOLING WATER (MONTH WISE)

Rise in inlet to outlet temperature oC	
pH	
Free available chlorine (mg/litre)	

* Amended as per EPA Notification GSR 7 dt. 22nd Dec.1998

B. BOILER BLOW DOWN (MONTH WISE AND UNIT WISE)

Oil & Grease (mg/litre)	
Copper (mg/litre)	
Iron (mg/litre)	
Total Suspended Solids (mg/litre)	

C. COOLING TOWER BLOW DOWN (MONTH WISE AND UNIT WISE)

Free av. Chlorine (mg/litre)	
Zinc (mg/litre)	
Chromium (mg/litre)	
Phosphate (mg/litre)	

D. ASH POND EFFLUENTS (MONTH WISE)

pH	
Oil & grease (mg/litre)	
Total suspended solids (mg/litre)	

Source : EPA Notification S O 844(E) dt. 19th Nov. 1986

Format-61

[ ][40]

[40] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

Format 62

[ ][41]

[41] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

Format 63

[ ][42]

[42] Deleted vide Revision /deletion of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 17.03.2022.

Format 64 Page 1/4

Periodicity Annually

Submission by 30th June

DISTRIBUTION COMPANY DATA FOR FINANCIAL STUDY

For the financial Year………………..

Name of the Company

(a) Date of obtaining license and its validity period

(b) Ownership -State Owned / JV / IPP

(c). Address of the Company

(d) Area(s) of Distribution (Names), Area in sq.km., population and maps

(e) Phone No./ FAX /E-Mail address

(A)<u>TECHNICAL PARTICULARS</u>

1 Energy Purchased

Sl. No.	Sources	Units Purchased kWh	Cost Rs Cr.
a			
b			
c			
	Total		

2 Units (Energy) Billed kWh

3 Realised Units kWh

4 Distribution Losses

(a) Technical losses %

(b) Commercial losses (see foot note) %

(c) Collection Efficiency (from col.11of table 5) %

(d) AT&C Losses [4(b) /4(c)] %

5 Details of Energy Consumption

	Consumers	No. of consumers				Consumption kWh	Tariff	Billed Revenue	Realised Revenue	Collection Efficiency
		Metered	Unmetered	Flat Rate	Total		paisa/Unit Slab wise	Rs Cr.	Rs Cr.	(10/9)
1	2	3	4	5	6	7	8	9	10	11
a	Domestic (Slab wise)									
	Slab 1									
	Slab 2									
	Slab 3									
	Slab 4									
b	Non-domestic (Commercial)									
c	Industrial									
	EHT >33KV									
	HT>650Volts&<33KV									
	LT upto 650 Volts									
d	Agriculture									
	HT(Metered)									
	LT(Metered)									
	LT(Unmetered)									
e	Railways Traction									
f	Bulk Supply									
g	Water works/ irrigation public works									
h	Street lighting									
I	Licensees									
j	Others									
	TOTAL									

6 Average waiting period for obtaining new connection

- a Domestic days
- b Commercial days
- c Industrial days

7 Length of EHT lines…………….CktKm.

Length of HT lines…………...…Ckt Km.

Length of LT lines……………...Ckt Km.

8 Availability of distribution Net work (%) =(Nos. of hours for which network was available/Total no. of hours) x 100

Foot Note: 4(b) Commercial losses = (Energy purchased- Energy billed)/Energy purchased =[Total(1)-(2)]/Total(1)

(B) <u>FINANCIAL PARTICULARS (as per Annual Report</u>)

1 Revenue Income

a	Sale of Power	Rs. Cr.
b) i)	Misc. Income	Rs. Cr.
ii)	Subvention Received from State Govt.	Rs. Cr.
	Total (1)	Rs. Cr.

2 Revenue Expenditure

	Fixed Charges	
a)	Interest & financing Charges	
b)	Depreciation	Rs. Cr.
c)	O&M Expenses	
i)	Spares and Consumables	Rs. Cr.
ii)	Employee Cost	Rs. Cr.
iii)	Adm. & Gen Expenses	Rs. Cr.
iv)	Insurance Charges	Rs. Cr.
v)	Training	Rs. Cr.
vi)	R&D	Rs. Cr.
viii)	Others	Rs. Cr.
d)	Provisions	Rs. Cr.
	Total (a+b+c+d)	Rs. Cr.

3 Profit / (Loss) (before Tax)

Tax Provision for Tax	Rs. Cr.
Profit / (Loss) (after Tax)	Rs. Cr.

4 Sources of Fund

a)	Equity	
I)	Paid-up Capital	Rs. Cr.
ii)	Reserves	Rs. Cr.
b)	Loans	
I)	Secured	Rs. Cr.
ii)	Un Secured	Rs. Cr.
c)	Consumer Contribution	Rs. Cr.
	Total (a+b+c)	Rs. Cr.

5 Application of Funds

a)	Gross Block	Rs. Cr.
b)	Less Accumulated Depreciation	Rs. Cr.
c)	Net Block	Rs. Cr.
d)	Capital Work in Progress	Rs. Cr.
e)	Investments	
	in Power Sector	Rs. Cr.
	outside Power Sector	Rs. Cr.
f)	Current Assets, Loans and Advances	
	I) Inventory	Rs. Cr.
	ii) Receivables	Rs. Cr.
	iii) Advances	Rs. Cr.
	iv) Cash & Bank Balance	Rs. Cr.
	Total (f)	Rs. Cr.
g)	Less Current Liabilities and Provision	Rs. Cr.
	I) Current Liabilities	Rs. Cr.
	ii) Provisions	Rs. Cr.
	Total (i+ii)	Rs. Cr.
h)	Net Current Assets (f-g)	Rs. Cr.
i)	Misc. Expenditure	Rs. Cr.
Total	(c+d+e+h+i)	Rs. Cr.
6	**Investment during the year**	Rs. Cr.
7	**Details of assets created during the year**	
8	**Electricity Duty/ Taxes**	p/unit
9	**Fuel Cost Adjustment**	p/unit
10	**Total Number of Employees**	
	Technical	Nos.
	Non technical	Nos.
11	**Persons Trained during the year**	Nos.

FORMAT- 65
Periodicity - Monthly
Submission by 20th day

MONTHLY ABSTRACT OF ASH GENERATION AND UTILISATION

Name of the Entity………………………………….

NAME OF POWER PLANT…………………………………………

Installed capacity [Total …….……..MW] .... 15 year action plan… [MW]

9 year action plan…................ [MW]

YEAR…………………….. LTPM-- [LAKH TONNES PER MONTH] ASH UTILIZATION IN THE MAIN AREAS [LTPM]

S. No.	Month	Coal consumed LTPM	Ash content %age	Ash Generation LTPM	Ash Utilized LTPM	%age utilization	Bricks	Cement	Concrete	Roads & Embankment	Hydro Sector	Ash dyke raising	Agriculture/ Wasteland	Mine fill	Others/ High value added areas
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	APRIL														
2	MAY														
3	JUNE														
4	JULY														
5	AUGUST														
6	SEPTEMBER														
Half yearly Sub-total															
7	OCTOBER														
8	NOVEMBER														
9	DECEMBER														
10	JANUARY														
11	FEBRUARY														
12	MARCH														
TOTAL															
ANNUAL (MTPA)															

NOTE:

MTPA - Million Tonnes per Annum

[FORMAT No. – 66
Periodicity- Half Yearly (April-Sep & Oct-March) Submission
by- 31st October & 30th April

REPORT ON LONG-TERM & MEDIUM-TERM POWER PURCHASE AGREEMENT BY INDEPENDENT POWER PRODUCERS

NAME OF THE GENERATING COMPANY:

S. No.	Regis tration No. on E-Gen portal	Name of the Project	Installed Capacity (in MW)	Date of Commence ment of Supply (dd-mm- yyyy)	Project Location (State)	Sector (Central/ State/ Private)	Technology (Hydro /Thermaletc.)	Unit Number	Unit Capacity (in MW)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Contracted Capacity (in MW) (Please provide details if contract is not for RTC supply)	Untied Capacity (in MW) (Please provide details if contract is not for RTC supply)	Startdate of PPA (dd-mm-yyyy)	End date of PPA (dd-mm- yyyy)
(11)	(12)	(13)	(14)

Counterparties of PPA (along with MW capacity)	Basis of tariff (Section 62 or 63 of ElectricityAct 2003 or Anyother)	Tariff during reporting period(Rs/kWh)	
		Fixed Charge (Rs/kWh)	Variable Charge (Rs/kWh)
(15)	(16)	(17)	(18)

Notes: (i) If Registration No. on E-Gen portal is being filled in column (2), the details in column (3) to (8) need not be filled.

(ii) Column (8) and (9) to be filled only if PPA is based on specific unit.

RTC- Round The Clock.

FORMAT - 67
PERIODICITY- MONTHLY
SUBMISSION BY- 05-MM-YYYY
(in .xls / API file)

Name of Power Exchange:

Details of Area Clearing Prices (Rs/MWh) -Time block wise on daily basis for DAM/ RTM/ GDAM

Date	Hour	Time Block	*A1	*A2	*E1	*E2	*N1	*N2	*N3
DD-MM-YYYY	1	00:00 - 00:15							
DD-MM-YYYY	1	00:15 - 00:30							
DD-MM-YYYY	1	00:30 - 00:45							
DD-MM-YYYY	1	00:45 - 01:00							
DD-MM-YYYY	2	01:00 - 01:15							
DD-MM-YYYY	2	01:15 - 01:30							
DD-MM-YYYY	2	01:30 - 01:45							
DD-MM-YYYY	2	01:45 - 02:00							
DD-MM-YYYY									
DD-MM-YYYY									
DD-MM-YYYY									
DD-MM-YYYY									
DD-MM-YYYY									
DD-MM-YYYY									
DD-MM-YYYY									
DD-MM-YYYY	23	22:00 - 22:15							
DD-MM-YYYY	23	22:15 - 22:30							
DD-MM-YYYY	23	22:30 - 22:45							
DD-MM-YYYY	23	22:45 - 23:00							
DD-MM-YYYY	24	23:00 - 23:15							
DD-MM-YYYY	24	23:15 - 23:30							
DD-MM-YYYY	24	23:30 - 23:45							
DD-MM-YYYY	24	23:45 - 24:00							

*S1	*S2	*S3	*W1	*W2	*W3	Any other bid area in future	Wt. Avg. Market Clearing Price

FORMAT - 68
PERIODICITY- MONTHLY
SUBMISSION BY- 05-MM-YYYY
(in .xls / API file)

Name of Power Exchange:

Details of electricity transacted in Power Exchanges- time block wise for DAM/ RTM/ GDAM.

Date	Hour	Time Block	Purchase Bid (MWh)	Sell Bid (MWh)	MCV (MWh)
DD-MM-YYYY	1	00:00 - 00:15			
DD-MM-YYYY	1	00:15 - 00:30			
DD-MM-YYYY	1	00:30 - 00:45			
DD-MM-YYYY	1	00:45 - 01:00			
DD-MM-YYYY	2	01:00 - 01:15			
DD-MM-YYYY	2	01:15 - 01:30			
DD-MM-YYYY	2	01:30 - 01:45			
DD-MM-YYYY	2	01:45 - 02:00			
DD-MM-YYYY					
DD-MM-YYYY					
DD-MM-YYYY					
DD-MM-YYYY					
DD-MM-YYYY					
DD-MM-YYYY					
DD-MM-YYYY					
DD-MM-YYYY	23	22:00 - 22:15			
DD-MM-YYYY	23	22:15 - 22:30			
DD-MM-YYYY	23	22:30 - 22:45			
DD-MM-YYYY	23	22:45 - 23:00			
DD-MM-YYYY	24	23:00 - 23:15			
DD-MM-YYYY	24	23:15 - 23:30			
DD-MM-YYYY	24	23:30 - 23:45			
DD-MM-YYYY	24	23:45 - 24:00			

Cleared Volume (MWh)	Congestion (MWh)	Volume Loss - Real Time Curtailment (MWh)	Final Scheduled Volume (MWh)	Wt. Avg. MCP (Rs/MWh)

MCP: Market Clearing Price; MCV: Market Clearing Volume

FORMAT - 69

PERIODICITY- MONTHLY

SUBMISSION-BY-05-MM-YYYY

Name of Power Exchange: (in .xls / API file)

Details of electricity transacted in Power Exchanges for DAM/ RTM/ GDAM (or any other product/ contract as introduced in future).

Date	ırchase Bid (MWh)	Sell Bid (MWh)	MCV (MWh)	Cleared Volume (MWh)
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
Total				
Minimum				
Maximum				
Average				

Congestion (MWh)	Volume Loss - Real Time Curtailment (MWh)	Final Scheduled Volume (MWh)	Wt. Avg. MCP (Rs/MWh)

MCP: Market Clearing Price; MCV: Market Clearing Volume

FORMAT - 70
PERIODICITY- MONTHLY
SUBMISSION-BY-05-MM-YYYY
(in .xls / API file)

Name of Power Exchange:

Term Ahead Market (TsAM) / Green-TAM (GTAM))- Data for Intraday/ Daily/Any day/ Day Ahead Contingency/ Weekly contracts (any other Contract/ Product introduced in future). (On Trade Date Basis)

s	Market Clearing Volume for traded date (MWh)	Congestion for traded date (MWh)	Cleared Volume for traded date (MWh)	Wt. Avg. Market Clearing Price (for the traded volume of electricity) (Rs/MWh)
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
Total				
Minimum				
Maximum				
Average				

FORMAT - 71
PERIODICITY- MONTHLY
SUBMISSION-BY-05-MM-YYYY

Name of Power Exchange: (in .xls / API file)

Term Ahead Market (TAM) / Green-TAM (GTAM) - Data for Intraday/ Daily/Anyday/ Day Ahead Contingency (DAC)/ Weekly contracts (any other Contract/ Product introduced in future).

On Delivery Date Basis

Date	Cleared Volume for delivery date (MWh)	Real Time Curtailment (MWh)	Final Scheduled Volume for delivery date (MWh)	Wt. Avg. Market Clearing Price (for the delivered volume of electricity) (Rs/MWh)
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
DD-MM-YYYY				
Total				
Minimum				
Maximum				
Average				

FORMAT - 72

PERIODICITY- ANNUALLY

DATA OF YEAR: 20…- 20….

SUBMISSION-BY-15-MAY-YYYY

Name of Power Exchange: (in .xls / API file)

Details of electricity transacted in Power Exchanges in DAM/ RTM/ GDAM

Month	Purchase Bid (MWh)	Sell Bid (MWh)	Market Clearing Volume (MWh)	Cleared Volume (MWh)
APR-YYYY				
MAY- YYYY				
JUN- YYYY				
JUL- YYYY				
AUG- YYYY				
SEPT- YYYY				
OCT- YYYY				
NOV- YYYY				
DEC- YYYY				
JAN- YYYY				
FEB- YYYY				
MAR- YYYY				
Total				

Congestion (MWh)	Volume Loss - Real Time Curtailment (MWh)	Final Scheduled Volume (MWh)	Wt. Avg. Market Clearing Price (Rs/MWh)

FORMAT-73

PERIODICITY- ANNUALLY

DATA OF YEAR: 20…- 20….

SUBMISSION-BY-15-MAY-YYYY

Name of Power Exchange: (in .xls / API file)

Intraday/ Daily-Any day/ Day Ahead Contingency/ Weekly contract wise TAM and Green-TAM data (any other Contract/ Product introduced in future). (On Trade date basis)

Month	Market Clearing Volume for traded date (MU)	Congestion for traded date (MU)	Cleared Volume for traded date (MU)	Wt. Avg. Market Clearing Prices (for the traded volume of electricity) (Rs/kWh)
APR-YYYY				
MAY- YYYY				
JUN- YYYY				
JUL- YYYY				
AUG- YYYY				
SEPT- YYYY				
OCT- YYYY				
NOV- YYYY				
DEC- YYYY				
JAN- YYYY				
FEB- YYYY				
MAR- YYYY				
Total				

FORMAT - 74
PERIODICITY- ANNUALLY
DATA OF YEAR: 20…- 20….
SUBMISSION-BY-15-MAY-YYYY

Name of Power Exchange: (in .xls / API file)

Intraday/ Daily-Anyday/ Day Ahead Contingency/ Weekly contract wise TAM and Green-TAM data (any other Contract/ Product introduced in future). (On Delivery date basis)

Month	Cleared Volume for delivery date (MU)	Real Time Curtailment (MU)	Final Scheduled Volume for delivery date (MU)	Wt. Avg. Market Clearing Price (for the delivered volume of electricity) (Rs/kWh)
APR- YYYY				
MAY- YYYY				
JUN- YYYY				
JUL- YYYY				
AUG- YYYY				
SEPT- YYYY				
OCT- YYYY				
NOV- YYYY				
DEC- YYYY				
JAN- YYYY				
FEB- YYYY				
MAR- YYYY				
Total				

FORMAT - 75
PERIODICITY- MONTHLY
DATA OF YEAR: 20- 20
SUBMISSION-BY-05-MM-YYYY
(in .xls / API file)

Provider: National Load Despatch Centre (NLDC)

BILATERAL TRANSACTION DATA						
Entity Name	Region	Bilateral Transaction Buy		Bilateral Transaction Sell		Banking transactions (MU)*
		Direct (MU)	Through Trader (MU)	Direct (MU)	Through Trader (MU)	

* Banking energy quantum under bilateral transactions (MU) between the contracting parties to be shown here.

FORMAT - 76
PERIODICITY- MONTHLY
DATA OF YEAR: 20…- 20….
SUBMISSION-BY-05-MM-YYYY
(in .xls / API file)

Provider: National Load Despatch Centre (NLDC)

CROSS BORDER TRADE DETAILS					
Sl. No.	Name of the Country	Name of the Traders	Types of Contracts*	Total Export (MU)	Total Import (MU)

* MoU between Governments, any other instrumentalities, etc. through which the electricity transaction is taking place.

FORMAT - 77

PERIODICITY- DAILY
SUBMISSION BY- 10:00 hours of next day
(in .xls / API file)

Provider: National Load Despatch Centre (NLDC)

Details of entities purchasing and selling on Power Exchanges in DAM/ TAM/ GTAM/ RTM/ GDAM markets.

NTITY	IEX		PXIL		Any other PX approved by CERC	
	Purchase (MU)	Sell (MU)	Purchase (MU)	Sell (MU)	Purchase (MU)	Sell (MU)

FORMAT - 78

PERIODICITY- ANNUALLY

SUBMISSION-BY-15-MAY-YYYY

(in .xls / API file)

Name of the Electricity Regulatory Commission:

DETAILS OF TARIFF ORDER AND TRUING UP ORDER BY THE ________________ ELECTRICITY REGULATORY COMMISSION

Sl. No.	Name of the Distribution Licensees/ Transmission Licensees/ generating companies, etc.	Date of application of the Tariff petition & Tariff year	Date of issue of the Tariff Order & Tariff year

Control Period of the Tariff Order & Tariff year	Date of application of the Truing up petition & Tariff year	Date of issue of the Truing up Order & Tariff year	Truing ups period Truing up Order & Tariff year

FORMAT - 79
PERIODICITY- DAILY
SUBMISSION BY- 10:00 hours of next day
(in .xls / API file)

Provider: National Load Despatch Centre (NLDC)
Details of Deviation Settlement Mechanism (DSM) volume.

Region	Entity/ Beneficiary	DSM Volume (MU)	
		Import	Export

FORMAT - 80
PERIODICITY- DAILY
SUBMISSION BY- 10:00 hours of next day
(in .xls / API file)

Provider: National Load Despatch Centre (NLDC)
Details of despatch under Reserve Regulations Ancillary Services (RRAS)

Region	Entity	Ancillary Despatched Volume (MU)	Regulation UP Volume (MU)	Regulation Down Volume (MU)

FORMAT - 81

PERIODICITY- DAILY

SUBMISSION BY- 10:00 hours of next day

(in .xls / API file)

Provider: National Load Despatch Centre (NLDC)

Details of Un-Requisitioned Surplus (URS) from the generations being scheduled by the RLDCs

Region	Entity/ Beneficiary	Quantum of URS (MW)	Quantum of URS energy (MU)

FORMAT-82

PERIODICITY- MONTHLY

SUBMISSION BY (DATE):- 10TH OF THE FOLLOWING MONTH

Monthly Renewable Energy Generation

1. **Name: of RLDC/SLDC/Genco/SNA/ED/Discom :**
2. **Data: for the Month/Year-**

Sl. No.	Type of Renewable Energy Generation Source	Installed Capacity (MW) as on last date of the month				Generation (MUs) during the month			
		Central Sector	State Sector	Private Sector	Total	Central Sector	State Sector	Private Sector	Total
1	Wind								
(i)	Wind Onshore								
(ii)	Wind Offshore								
2	Solar- Ground Mounted								
(i)	Photovoltaic (PV)								
(ii)	Solar Thermal								
3	Solar - Rooftop								
4	Solar -Floating								
5	Hybrid								
6	Bio Mass								
7	Bagasse								
8	Small Hydro (upto 25 MW)								
9	Others (Waste to Energy etc) (Source may be specified)								
	Grand Total:								

<u>Note:-</u> The Generation/ Installed capacity is to be reported for the plant located within the physical boundary of the respective State/ UT.

<u>Abbreviations</u>:-

Hybrid: Generation Plant where more than one renewable primary source of energy, including, storage is used.

FORMAT NO: 83
PERIODICITY:-MONTHLY
SUBMISSION BY (DATE):- 10TH OF THE FOLLOWING MONTH

Details of Monthly Plant wise Renewable Energy Generation and Curtailment

1. **Name of RLDC/SLDC/Genco/SNA/ED/Discom:**
2. **Data for the Month/Year-**

S. No.	E-gen Registration No.	*Name of the Plant	*Name of the Gener-ating Comp-any	ocation/ District/ State	*Installed Capacit y (MW)
(1)	(2)	(3)	(4)	(5)	(6)
1		Plant 1			
2		Plant 2			
3					
4					

*Type [Wind(Onshore/Offshore)/Solar {(Ground Mounted- PV/Solar Thermal) /Rooftop/Floating}/ Hybrid/Small Hydro/ Biomass/Bagasse/ Others**(Waste to Energy)	*Sector (Central / State / Private)	ieneration (MUs)	RE Curtailment (MUs)	Reason of Curtailment/ Remarks
(7)	(8)	(9)	(10)	(11)

Note: 1. The data in Column Nos. (3) to (8) are static data and need to be provided one time only for Existing/New Projects, in case E-Gen Registration No. is not available.

2. In case of 'Other**', the source may be specified.

Abbreviations:-

Hybrid: Generation Plant where more than one renewable primary source of energy, including, storage is used.

FORMAT NO: 84
PERIODICITY:-MONTHLY
SUBMISSION BY (DATE):- 10TH OF THE FOLLOWING MONTH

Details of Renewable Energy Plants commissioned during the Month

Data for the Month:-

Name of RLDC/SLDC/SNA/Genco/ED/Discom:-

Sl. No.	E-Gen Registration No.	*Name of the Plant	*Plant Capacity (MW)	*Type[Wind(Onshore/Offshore)/Solar {(Ground Mounted-PV/Solar Thermal) /Rooftop/Floating}/ Hybrid/Small Hydro/ Biomass/Bagasse/ Others**(Waste to Energy)
1				
2				
3				
		Total:		

*Location (District/State)	Capacity Commissioned (MW)	Date of Commissioning (DD/MM/YYYY)

Note: **1.** The data in columns marked as (*) are static data and need to be provided one time only for Existing/ New Projects, in case E-Gen Registration No.is not available.

2. In case of 'Others**', the source may be specified.

Abbreviations:-

Hybrid: Generation Plant where more than one renewable primary source of energy, including, storage is used.][43]

[43] Inserted vide addition/ revision of the formats in the Central Electricity Authority (Furnishing of Statistics, Returns and Information) Regulations, 2007 w.e.f. 25.07.2023.

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the 26th June, 2010

No. 12/X/STD(GRID)/GM/CEA - Whereas the draft of the Central Electricity Authority· (Grid Standards) Regulations, 2006 was published, as required by Sub-section (3) of Section 177 of the Electricity Act, 2003 (36 of 2003), read with rule 3 of the Electricity (Procedure for Previous Publication) Rules, 2005;

Now, therefore, in exercise of the powers conferred by sub-section (2) of Section 177 read with Section 34 and clause (d) of Section 73 of the Electricity Act, 2003, the Central Electricity Authority hereby makes the following regulations, namely:-

1. Short Title, commencement and application.- (1) These regulations may be called the Central Electricity Authority (Grid Standards) Regulations, 2010.

(2) Save as otherwise provided in these regulations, they shall come into force on the date of their publication in the Official Gazette.

(3) These regulations shall apply to the Entities, Appropriate Load Despatch Centres, and, Regional Power Committees.

2. **Definitions.-** (1) In these regulations, unless the context otherwise requires,-

(a) "Act" means the Electricity Act, 2003;

(b) "Appropriate Load Despatch Centre" means the National Load' Despatch Centre, Regional Load Despatch Centre or State Load Despatch Centre or Area Load Despatch Centre as the case may be;

(c) "Area Load Despatch Centre" means the centre as established by the State Transmission Utility or licensee for load despatch and control in a particular area of the State;

(d) "Bulk consumer" means a consumer who avails supply at voltage of 33 kV or above;

(e) "condition based maintenance" means a set of maintenance actions based on continuous or frequent assessment of equipment condition, which is obtained from either of or a combination of embedded sensors, external tests and measurements;

(f) "disaster management" means the mitigation of the impact of a major breakdown on the system and bringing about restoration in the shortest possible time;

(g) "Emergency Restoration System" means a system comprising of transmission towers or structures of modular construction, complete with associated components such as insulators, hardware fittings, accessories, foundation plates, guys, anchors or installation tools and they like to facilitate quick restoration of damaged or failed transmission line towers or sections;

(h) ”Entity” means a Generating Company including captive generating plant or a transmission licensee including Central Transmission Utility and State Transmission Utility or a distribution licensee or a Bulk Consumer whose electrical plant is connected to the Grid at voltage level 33 kV and above;

(i) "grid disturbance" means tripping of one or more power system elements of the grid like a generator, transmission line, transformer, shunt reactor, series capacitor and Static VAR Compensator, resulting in total failure of supply at a sub-station or loss of integrity of the grid, at the level of transmission system at 220 kV and above (132 kV and above in the case of North-Eastern Region);

(j) "grid incident" means tripping of one or more power system elements of the grid like a generator, transmission line, transformer, shunt reactor, series capacitor and Static VAR Compensator, which requires re-scheduling of generation or load, without total loss of supply at a sub-station or loss of integrity of the grid at 220 kV and above (132 kV and above in the case of North-Eastern Region);

(k) 'Schedule' means schedule appended to these regulations;

(l) "time based maintenance" means inspection, cleaning and replacement of parts of the equipment based on a predetermined time schedule.

(m) "transient stability" means the ability of the power system to maintain synchronism when subjected to a severe disturbance such as a short circuit on a transmission line;

(n) "voltage unbalance" means the ratio of the maximum voltage deviation of the phase voltage from the average phase voltage to the average phase voltage of the three phases;

(2) Words and expressions used and not defined in these regulations but defined in the Act shall have the meaning assigned to them in the Act.

3. Standards for Operation and Maintenance of Transmission Lines.- (1) All Entities, Appropriate Load Despatch Centres and Regional Power Committees, for the purpose of maintaining the Grid Standards for operation and maintenance of transmission lines, shall,-

(a) make all efforts to operate at a frequency close to 50 Hz and shall not allow it to go beyond the range 49.2 to 50.3 Hz or a narrower frequency band specified in the Grid Code, except during the transient period following tripping.

(b) maintain the steady state voltage within the limits specified below in Table 1:

Table 1

S. No.	Nominal System Voltage (kV rms)	Maximum (kV rms)	Minimum (kV rms)
1	765	800	728
2	400	420	380
3	220	245	198
4	132	145	122
5	110	121	99
6	66	72	60
7	33	36	30

(c) ensure that the temporary over voltage due to sudden load rejection remains within the limits specified in Table 2,-

Table 2

S. No.	Nominal System Voltage (kV rms)	Phase to Neutral Voltage (kV peak)
1	765	914
2	400	514
3	220	283
4	132	170

Provided that for the voltage level below 132 kV, the temporary over voltage limits as given in Table 2 shall be decided by the State Commission in the respective State Grid Code.

(d) ensure that the maximum permissible values of voltage unbalance shall be as specified in Table 3 below:-

Table 3

S.No.	Nominal System Voltage (kV rms)	Voltage Unbalance (%)
1	765 and 400	1.5%

2	220	2%
3	33 to132	3%

Provided that Bulk consumers shall avoid unbalanced load during operation:

Provided further that the distribution licensees shall ensure that their loads are not unbalanced.

(e) provide standard protection systems having the reliability, selectivity, speed and sensitivity to isolate the faulty equipment and protect all components from any type of faults, within the specified fault clearance time and shall provide protection coordination as specified by the Regional Power Committee.

Explanation.- For the purpose of this regulation "fault clearance time" means the maximum fault clearance times are as specified in the Table 4 below,-

Table 4

S.No.	**Nominal System Voltage (kV rms)**	**Maximum Time (in milliseconds)**
1	765 and 400	100
2	220 and 132	160

Provided that in the event of non clearance of the fault by a circuit breaker within the time limit specified in Table 4, the breaker fail protection shall initiate tripping of all other breakers in the concerned bus-section to clear the fault in the next 200 milliseconds.

(f) operate the system in a such a way that the Grid System is capable of withstanding one of the following contingencies without experiencing loss of stability:-

(1) outage of one single largest generating unit of the system or

(2) outage of a 132 kV Double circuit line or

(3) outage of a 220 kV Double circuit line or

(4) outage of a 400 kV Single circuit line or

(5) outage of a 400 kV Single circuit line with series compensation or

(6) outage of 765 kV Single circuit line without series compensation or

(7) outage of one pole of HVDC Bipolar line or

(8) outage of an Interconnecting Transformer

(g) operate the system in a such a way that under any one of the following contingencies, the system remains stable and sustains integrity so that no generator loses synchronism and no part gets isolated from the rest of the system:

(1) tripping of a single largest generating unit; or

(2) transient ground fault in one phase of a 765 kV Single Circuit Line close to the bus; or

(3) a permanent single phase to ground fault in 400 kV single circuit line followed by 3 pole opening of the faulted line; or

(4) a permanent fault in one circuit of a 400 kV Double Circuit Line when both circuits were in service in the pre-contingency period; or

(5) a transient single phase to ground fault in one circuit of a 400 kV Double Circuit Line when the second circuit is already under outage; or

(6) a three-phase permanent fault in a 220 kV or 132 kV line; or

(7) a permanent fault in one pole of HVDC bipolar in a HVDC Converter Station.

(h) observe the following permissible limits of voltage fluctuation :-

(i) the permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5 percent:

(ii) for occasional fluctuations other than step changes the maximum permissible limit is 3 percent:

Provided that the standard on voltage fluctuations shall come into force concurrently with clause 4 of Part IV of the Schedule to the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007.

(2) The transmission licensee shall ensure that the voltage wave-form quality is maintained at all points in the Grid by observing the limits given in Table 5 below,-

Table 5

S.No.	System Voltage (kV rms)	Total Harmonic Distortion (%)	Individual Harmonic of any particular Frequency (%)
1	765	1.5	1.0
2	400	2.0	1.5
3	220	2.5	2.0

4	33 to 132	5.0	3.0

Provided that the standard on Harmonic Distortion shall come into force concurrently with clause 3 of Part IV of the Schedule to the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007.

Explanation : For the purpose of this regulation, Total Harmonic Distortion (V_{THD}) expressed as percentage, shall be calculated as under,-

$$V_{THD} = \sqrt{\sum_{n=2}^{n=40} \frac{V_n^{\ 2}}{V_1^{\ 2}}} X100$$

'1' refers to fundamental frequency (50 Hz)

'n' refers to the harmonic of n^{th} order (corresponding frequency is 50 x n Hz)

4. Operation Planning.- The Regional Power Committee shall periodically review the performance of the grid for the past period and plan stable operation of the grid for the future, considering various parameters and occurrences such as frequency profile, voltage profile, line loading, grid incident, grid disturbance, performance of system protection schemes and protection coordination.

5. **Maintenance Planning.-** (1) The Regional Power Committees shall, before the commencement of the financial year, prepare an annual maintenance plan for the generating stations and the inter-State transmission system in their respective regions keeping in view the demand pattern and maintenance schedule of the generating units and diversity in demand of the States.

(2) The Regional Power Committees shall co-ordinate the annual maintenance plan for Inter-Regional transmission system.

(3) The Regional Power Committees shall review and revise the coordinated generation and transmission system maintenance plan in their monthly operating Committee meetings.

(4) The State Load Despatch Centre shall in consultation with the concerned transmission licensee, coordinate the annual maintenance plan of Intra-State transmission system taking into account the annual maintenance plan of generating units and inter-state transmission system decided by the Regional Power Committee.

(5) The State Load Despatch Centre shall also review and coordinate the maintenance plan of intra-state transmission system for the next month, taking into account the monthly

maintenance plan of generating units and inter-state transmission system prepared by the Regional Power Committee for the next month.

(6) The generating company or transmission licensee shall, before actual shut down, obtain the approval of the Appropriate Load Despatch Centre.

6. **Coordination in Operations.-** (1) No Entity shall introduce or take out the element of the grid without the concurrence of the Appropriate Load Despatch Centre except in case of imminent risk of safety of plant and personnel in which case it must intimate Appropriate Load Despatch Centre giving reasons therefore.

(2) The Appropriate Load Despatch Centre shall inform all affected parties of the outage.

7. **Operating Instructions.-** (1) Every generating company and transmission licensee shall provide written operating instructions for each equipment and operating procedure for sequence of operations of power system equipment in their control room.

(2) The operating instructions followed shall not be inconsistent with the manufacturer's instructions.

(3) The operating instructions and procedures may be revised by the generating company or transmission licensee, as the case may be.

8. **Instructions by Regional Load Despatch Centres and State Load Despatch Centres to be recorded.-** (1) All operational instructions given by Regional Load Despatch Centres and State Load Despatch Centres through telephone, Fax, e-mail, etc shall be given a unique operating code number and every Regional Load Despatch Centre and State Load Despatch Centre shall maintain a voice recorder for recording and reproduction of conversation with time tag or stamp.

(2) The record of instructions referred to in sub-regulation (1) shall be kept for at least six months.

9. **Automatic under frequency Relay.-** (1) All Entities shall set their under- frequency (UF) Relays and rate of change of frequency with time Relays in their respective systems, in accordance with the plan made by the Regional Power Committee, to provide adequate load relief for grid security and ensure the operation of these relays at the set frequencies.

(2) All constituents shall submit a detailed report of operation of these Relays at different frequencies to Regional Load Despatch Centre and Regional Power Committee on daily basis and the Regional Power Committees shall carry out inspection of these Relays as and when required.

10. **Islanding Schemes.-** (1) The Regional Power Committees shall prepare Islanding schemes for separation of systems with a view to save healthy system from total collapse

in case of grid disturbance.

(2) The Entities shall ensure proper implementation of the Schemes referred to in sub-regulation (1).

Explanation.- For the purposes of this regulation 'Islanding Scheme' means a scheme for the separation of the Grid into two or more independent systems as a last resort, with a view to save healthy portion of the Grid at the time of grid disturbance.

11. Categorisation of grid incidents and grid disturbance based on severity of trippings.- The categorisation of grid incidents and grid disturbances shall be as follows:-

(1) Categorisation of grid incidents in increasing order of severity,-

Category GI-1 - Tripping of one or more power system elements of the grid like a generator, transmission line, transformer, shunt reactor, series capacitor and Static VAR Compensator, which requires re-scheduling of generation or load, without total loss of supply at a sub-station or loss of integrity of the grid at 220 kV (132 kV in the case of North-Eastern Region);

Category GI-2 - Tripping of one or more power system elements of the grid like a generator, transmission line, transformer, shunt reactor, series capacitor and Static VAR Compensator, which requires re-scheduling of generation or load, without total loss of supply at a sub-station or loss of integrity of the grid at 400 kV and above (220 kV and above in the case of North-Eastern Region).

(2) Categorisation of grid disturbance in increasing order of severity,-

Category GD-1 - When less than ten per cent. of the antecedent generation or load in a regional grid is lost;

Category GD-2 - When ten per cent. to less than twenty percent of the antecedent generation or load in a regional grid is lost.

Category GD-3 - When twenty per cent. to less than thirty per cent. of the antecedent generation or load in a regional grid is lost;

Category GD-4 - When thirty per cent. to less than forty per cent. of the antecedent generation or load in a regional grid is lost ;

Category GD-5 - When forty per cent. or more of the antecedent generation or load in a regional grid is lost.

Explanation: For the purpose of categorisation of grid disturbances, percentage loss of generation or load, which ever is higher shall be considered.

12. Reporting of events affecting grid operation.- (1) Any tripping of generating unit or transmission element, along with relay indications, shall be promptly reported by the respective Entity to the Appropriate Load Despatch Centre in the reporting formats as devised by the Appropriate Load Despatch Centre.

(2) The Appropriate Load Despatch Centre shall promptly intimate the event to the Regional Load Despatch Centres and State Load Despatch Centres of the affected regions and States respectively which shall, in turn, take steps to disseminate this information further to all concerned.

13. Reporting of grid disturbance.- (1) The Regional Load Despatch Centre shall inform occurrence of the grid disturbance to the constituents immediately and to the concerned Regional Power Committee at the earliest.

(2) The grid disturbance resulting in failure of power supply to large areas in a State shall also be reported by the Regional Load Despatch Centre to the Authority within twenty four hours of the occurrence of the grid disturbance.

(3) The Regional Load Despatch Centre shall also post on its website a brief preliminary grid disturbance report, indicating the affected area or system, extent of outage and the likely cause of initiation for the benefit of the constituents of the region.

14. Restoration of grid following grid incident and grid disturbance.- (1) The Regional Load Despatch Centre, in consultation with Regional Power Committee, shall develop procedures for enabling restoration and normalisation of the Grid for inter-State system at the earliest, following grid incident and grid disturbance of the categories specified in regulation 11.

(2) The State Load Despatch Centre shall also develop procedures accordingly for restoration of intra-State system.

(3) The restoration procedures shall be reviewed following any addition of generating station or transmission line or at least once in two years, and revised, if considered necessary by the Regional Load Despatch Centre and State Load Despatch Centre, as the case may be.

(4) The procedures specified in sub-regulations (1), (2) and (3) shall be made available to, and be followed by all concerned Entities, Regional Load Despatch Centres and State Load Despatch Centres.

15. Operational Data during normal operation and during grid incidents and grid disturbances.- (1) All real time operational data as required by the Appropriate Load Despatch Center shall be furnished by the Entities.

(2) All data required by Regional Power Committee, in discharge of the responsibilities assigned to it, shall be furnished by Regional Load Despatch Centre (RLDC).

(3) All operational data, including disturbance recorder and event logger reports, for analysing the grid incidents and grid disturbance and any other data which in its view can be of help for analysing grid incident or grid disturbance shall be furnished by all the Entities within twenty four hours to the Regional Load Despatch Centre and concerned Regional Power Committee.

(4) All equipment such as disturbance recorders and event loggers shall be kept in healthy condition, so that under no condition such important data is lost.

(5) A real time operation display of the grid position shall also be made available to the Regional Power Committee by Regional Load Dispatch Centre.

(6) Regional Load Dispatch Centre shall classify the grid incidents and grid disturbances according to regulation 11, analyse them and furnish periodic reports of grid incidents and grid disturbances to the Regional Power Committee which shall recommend remedial measures to be taken on the Report of Regional Load Despatch Centre to prevent recurrences of such grid incidents and grid disturbances.

16. Operational Data Records.- (1) Operational data including equipment and system parameters logged manually and electronically shall be preserved for at least three years.

(2) Logbooks shall be maintained by every manned switchyard and sub-station or at the control centre responsible for operation of the unmanned switchyard and sub- station.

(3) All operations conducted shall be recorded in chronological order and the time of each operation and occurrence of each event shall be recorded in such a manner that there shall be no over-writing and any mistake shall be neatly cut by a line and new words written thereafter.

(4) The observations made during inspection including important parameters and deviation of parameters outside permissible tolerances shall also be recorded in the logbook and all entries must be made in the logbooks immediately.

(5) A record shall be kept of the number of grid incidents and grid disturbances of various categories by the respective Regional Power Committees for each financial year.

(6) A compendium of grid disturbances, indicating details such as the date and time of the disturbance, the sequence of tripping, the cause, and the sequence of restoration, remedial measures taken to avert recurrence of such incidents and disturbances shall be maintained by the respective Regional Power Committee.

17. Communication facilities.- The communication facilities installed by the transmission licensees shall be in accordance with Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and shall be maintained in good operating condition.

18. Safety Procedure.- (1) The Entity shall prepare contingency procedures for use of operators at each sub-station and switchyard and these shall be regularly updated.

(2) All operating personnel shall be trained in contingency procedures at regular intervals and the entities shall require their personnel to follow the contingency procedures during operation and maintenance.

(3) The fire fighting equipment shall be made available at all sub-stations, switchyards and converter stations and shall be checked periodically for its upkeep and mock exercises in fire fighting shall be carried out at least once in a year and record maintained.

19. Maintenance of Tools and Equipment.- The maintenance staff shall be made aware of the list of tools, devices and equipment for various maintenance and rectification works on transmission lines, sub-stations, switchyards and converter stations and the tools shall be made readily available and certified for usage.

20. Maintenance Procedures.- The Entity shall prepare maintenance procedures for each equipment in line with the manufacturer's recommendations and prudent utility practices.

21. Hot Line Methods.- (1) The hot line techniques for maintenance of critical transmission lines and sub-stations shall be adopted wherever possible.

(2) Only trained staff shall be used for the hot line techniques and the tools employed in such techniques shall have necessary certification from a national or international accredited laboratory before usage.

22. Emergency Restoration System.- Each transmission licensee shall have an arrangement for restoration of transmission lines of 400 kV and above and strategic 220 kV lines through the use of Emergency Restoration System in order to minimise the outage time of the transmission lines in case of tower failures.

23. Inspection and Patrolling.- (1) All essential parameters, which indicate the healthiness of the equipment in a sub-station, shall be inspected by the shift engineer once in each shift and periodically by the officer-in-charge.

(2) Overhead lines shall be patrolled at periodicity decided by the transmission licensee and different patrolling schedules shall be implemented by the transmission licensees for normal terrain, vulnerable terrain and most vulnerable terrain.

(3) The patrolling schedules for ground inspection of live lines and tower top inspection of de-energised lines shall be separately issued by the licensees.

(4) The important lines shall be inspected by senior engineers after patrolling by junior staff and maintenance works such as tree cutting and replacement of damaged insulators shall be carried out immediately after patrolling, wherever required.

24. Maintenance schedules.- (1) Entities shall identify critical equipment and as far as possible, practice condition based maintenance for such equipment in place of traditional time based maintenance.

(2) In case of time based maintenance, the periodicity of maintenance of lines shall be fixed based on whether they are passing through normal area or polluted area or coastal area and the transmission lines and sub-stations in polluted or coastal areas shall be maintained more frequently.

(3) The maintenance of lines passing through and sub-stations located in such areas should be completed once before onset of winter so as to minimise tripping under conditions of fog or due to salt deposit on insulator discs in coastal areas and once before onset of summer.

(4) Maintenance and cleaning of various equipment fittings, accessories, primary instruments and sensors shall be carried out when they are de-energised during the shut-down of main equipment so as to minimise shutdown time.

(5) Where defects are observed through condition monitoring or during patrolling and inspection, the maintenance work on various items of equipment may be advanced depending on the condition of the equipment.

25. Use of diagnostic techniques for condition monitoring of equipment.- The diagnostic methods of maintenance shall be preferred over traditional time based maintenance. For purpose of this regulation, devices or methods specified in the Schedule shall be used.

26. Thermo – vision scanning.- The Thermo-vision scanning for hot spots on all overhead lines and sub-station equipment at voltage level of 220 kV and above shall be carried out at least once a year and necessary remedial measures shall be taken where hot spots are detected.

27. Failure analysis.- (1) All failures of equipment and tower collapse shall be analysed by the Entity to avoid recurrence and a copy of the report shall be submitted to the Regional Power Committee and the Authority.

(2) The Authority may appoint a group of experts for investigation and analysis and the representatives of manufacturers may be invited to participate in such analysis.

(3) All relevant data which may help the group of experts in analysing the failures shall be furnished by the respective Entities.

(4) The recommendations of the group of experts shall be submitted to the Authority and the

recommendations accepted by the Authority shall be implemented and circulated to all within the organisation and to other concerned organisations to prevent recurrence of similar failures.

28. Inventory control and spare part management.- (1) The required spare parts shall be kept in stock, to ensure speedy the maintenance of the equipment.

(2) Computerised materials management system shall be developed by the Entities to optimise inventory.

29. Maintenance Audit.- (1) An internal committee may be established by the Entities to verify whether actual maintenance works are carried out at site in compliance of the procedures and the policy of the transmission company.

(2) The observations of the Committee shall be put up to the management of the Entity for perusal and taking corrective action, if any.

30. Residual life assessment.- The residual life assessment shall be carried out for all major equipments including transformers, reactors, breakers, as envisaged by the relevant standards specified by the Bureau of Indian Standards, manufacturer's instruction or industry best practices and suitable remedial action for breach of the same shall be taken by the management of the Entity.

31. Disaster management.- (1) The maintenance staff shall be trained in disaster management and a detailed procedure for the same shall be developed by the Entity and displayed prominently.

(2) This detailed procedure shall be reviewed periodically and also based on mock exercises carried out by the Entity.

(3) The maintenance staff shall be trained in emergency restoration procedures for managing major failures and breakdowns.

(4) The equipment including vehicles, diesel generating sets and fire fighting equipment and Emergency Restoration System for transmission lines shall be kept available at sub-station or at appropriate location for disaster management.

32. Maintenance records.- The records of all maintenance carried out for each equipment shall be kept in the table and formats in electronic form and hard copy and the next due date for maintenance of each item of work shall be clearly marked in such tables and formats.

33. Training.- (1) Every person involved in operation and maintenance of transmission lines shall be trained at the induction level and at least once in a year.

(5) The shift staff shall be trained to make them thorough in carrying out operations at each sub-station and every person concerned with real time operation shall be trained.

(6) Every grid operator shall undergo training in real time digital simulator and a refresher course at least once in two years.

(7) The maintenance personnel of every entity shall also be trained in preventive and breakdown maintenance of various equipment and the personnel shall be trained in various detailed maintenance procedures.

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Secretary

Central Electricity Authority

SCHEDULE

(See regulation 25)

The Devises and Methods for Condition Based Monitoring of Equipment

(1) Hot line puncture detection of insulators

(2) Vibration measurement of the line

(3) Pollution measurement of the equipment

(4) Dissolved Gas Analysis of Transformer oil

(5) Frequency response analysis of transformers/reactors

(6) Tan δ and capacitance measurement

(7) Circuit breaker operational analyzer

(8) Dynamic contact resistance measurements of breakers

(9) Third harmonic resistive current measurements of surge arresters

(10) Recovery voltage measurements of transformers/reactors

(11) Vibration measurements of the reactors

(12) Steady state and Dynamic testing of protective relays

(13) Signature Analysis

(14) Partial Discharge measurement for transformers/Gas insulated Switchgear

(15) Static resistance meter for circuit breakers, isolators, bus bar joint, earth switches etc.

(16) Ground tester for measurement of resistivity of soil and ground resistance

(17) Battery impedance test equipment

(18) Insulator tester

(19) SF6 gas leakage detector and dew point

(20) Power quality Analyzer

(21) Fibre optic cable testing devices

Central Electricity Authority

NOTIFICATION

New Delhi, the 24th, January, 2010

F.No.CEA/TETD/MP/R/02/2011.- In exercise of the powers conferred by section 177 read with clause (c) of section 73 of the Electricity Act, 2003 (36 of 2003), the Central Electricity Authority hereby makes the following regulations, namely:-

1. Short title and commencement.- (1) These regulations may be called the Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations, 2011.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. Definitions.- (1) In these regulations, unless the context otherwise requires,-

(a) "Act" means the Electricity Act, 2003;

(b) "contractor" means a person or an agency who undertakes to produce a given result, not merely supply of goods or articles of manufacture but including civil works or erection of equipment or testing and commissioning of equipment or operation and maintenance of equipment and includes a sub-contractor;

(c) "Owner" means a company or body corporate or association or body of individuals, whether incorporated or not, or artificial juridical person, which owns or operates or maintains electrical plants or electric lines and includes,-

(i) "Occupier" as defined in the Factories Act, 1948 (63 of 1948);

(ii) "Employer" as defined in the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (27 of 1996).

(2) Words and expressions used herein and not defined but defined in the Act shall have the meanings respectively assigned to them in the Act.

3. **[Applicability.─** These Regulations shall be applicable to generating companies, transmission licensees, distribution licensees, Central Transmission Utility, State Transmission Utilities or any person.][1]

4. Safety provisions relating to Owner.- (1) The Owner shall make safety an integral part of work processes to ensure safety for employees including employees of contractor, sub-contractor as well as visitors.

(2) [The Owner shall obtain accreditation of electric plants with IS-18001 certification.][2]

(3) The Owner shall obtain above mentioned certification for all the existing electrical plants and electric lines and those under construction within two years from

[1] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.
[2] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.

the date of coming into force of these regulations and for new installations within two years from the date of commencement of construction.

(4) The Owner shall set up a sound and scientific safety management system which shall include,- •

(a) [Formulation of written statement of policy in respect of safety and health of employees, duly signed by owner, shall be displayed at conspicuous places at the premises;][3]

(b) defining and documenting responsibilities for all levels of functionaries to carry out safety related activities including responsibilities of the contractors;

(c) preparing detailed safety manual complying with the statutory requirements and manufacturers' recommendations;

(d) [(i) establishing procedures to identify hazards that could give rise to the potential of injury, health impairment or death and measures to control impact of such hazards;

(ii) setting up an Early Warning System to deal with hazardous events such as Glacial Lake and Landslide Outburst Floods, Earthquakes, Cloudburst, Flash Floods, Avalanches, Dam Break event, etc. in case of all large hydro projects under operation as well as under implementation; and

(iii) establishing Standard Operating Procedure to deal with these hazardous events;][4]

(e) providing adequate human, physical and financial resources to implement the safety management system;

(f) providing safe working environment and evolving framework for occupational safety and health;

(g) providing and maintaining medical facilities;

(h) providing adequate training to all employees to keep them aware of safety related issues;

(i) establishing system for accident reporting, analysis, investigation and implementation of recommendations;

(j) [establishing system for proper communication, documentation and record management either in certified soft copy or hard copy form in relation to occupational safety and health;][5]

(k) formulating emergency management plan for quickly and effectively dealing with

[3] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.
[4] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.
[5] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.

probable emergencies that may arise on site as well as off- site;

(l) [establishing methodology for internal and external audit of safety management system as per relevant Indian Standard;][6]

(m) establishing system for periodic monitoring and review of the safety system by the management;

(n) overseeing the safety performance of contractors.

5. Safety manual.- Safety manual referred to in clause (c) of sub-regulation (4) of regulation 4 shall be site specific but for similar installations, common safety manual may be prepared and made applicable to such installations and these safety manuals shall cover the matters identified in Schedule-I and Schedule-II annexed to these regulations.

6. Safety officer and safety committee.- (1) (a) The Owner shall appoint one qualified safety officer where the· number of employees, including contract workers, exceeds five hundred and where the number of employees is less than five hundred, a suitable officer shall be designated as safety officer:

Provided that where number of employees exceeds one thousand. one more safety officer shall be appointed for every additional one thousand employees.

(b) A person shall not be eligible for appointment as a safety officer unless he is qualified,-

(i) under section 40-B of the Factories Act, 1948 (63 of 1948) and rules made thereunder; or

(ii) under sub-section (2) of section 38 of the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (27 of 1996) and rules made thereunder.

(c) (i) Where number of safety officers appointed exceeds one, one of them shall be designated as chief safety officer who shall have higher ranking than the others and he shall be in-charge of the safety functions and the other safety officers shall work under his control.

(ii) The chief safety officer or the safety officer, as the case may be, shall be given the status of a senior executive and he shall work directly under the control of the Chief Executive.

(d) The safety officer shall be appointed before start of construction activities and the safety set-up chart shall be prepared and properly displayed at a conspicuous place.

(e) The safety officer shall advise and assist the Owner in fulfillment of his

[6] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.

responsibilities concerning prevention of personal injuries and maintaining a safe working environment.

(f) The safety officer shall be authorised to stop the execution of any work which in his judgment is unsafe and may result in injury to any person and he shall also have the power to remove the employees or contract workers from the site, if they are found not using personal protection equipment or in unsafe practice or procedure.

(g) The safety officer shall develop and organise safety training programmes at regular intervals in order to impart proper safety training and shall also create safety awareness among the employees.

(2)(a) where the number of employees, including contract workers exceeds two hundred and fifty, the Owner shall constitute a safety committee comprising of equal number of representatives of the management and the employees and during construction, the safety committee shall also include representatives of contractors and their employees with equal representation and the representatives of the management shall include the safety officer and medical officer:

Provided that where number of employees, including contract workers, is two hundred and fifty or less, the safety committee shall be constituted by the Owner for a group of electrical plants or electric lines, as the case may be.

(b) The safety committee shall promote co-operation between the workers and the management for maintaining proper safety and health at work place.

(c) The safety committee shall meet at least once in a month during construction stage and once in three months during operation and maintenance of electrical plants and electric lines and the decisions and recommendations of the safety committee shall be complied with by the Owner within the time limit as decided by the safety committee.

7. Safety provisions relating to contractor.- (1)The Owner shall incorporate the safety provisions in the contract document which are required to be complied by the contractor's employees during execution of the contract to facilitate safe working during execution of the work.

(2) The contractor shall observe the safety requirements as laid down in the contract and in case of sub-contract, it shall be the responsibility of main contractor that all safety requirements are followed by the employees and staff of the sub- contractor.

(3) The contractor employing two hundred employees or more, including contract workers, shall have a safety co-ordinator in order to ensure the implementation of safety requirements of the contract and a contractor with lesser number of employees,

including contract workers, shall nominate one of his employees to act as safety co-ordinator who shall liaise with the safety officer on matters relating to safety and his name shall be displayed on the notice board at a prominent place at the work site.

(4) The contractor shall be responsible for non-compliance of the safety measures, implications, injuries, fatalities and compensation arising out of such situations or incidents.

(5) [In case of any accident, the contractor shall immediately submit a state of the same to the Owner and the safety officer, containing the details of the accident, any injury or casualities, extent of property damage and remedial action taken to prevent recurrence.][7]

8. Reporting of accidents.- The cases of outage of an electrical plant or an electric line of following nominal rating due to any accident related to any equipment e.g. fire, explosion of pressure piping or pressure vessel, implosion, emission of hazardous chemicals, collapse of transmission tower, flooding of power house area, shall be reported to the Authority within twenty four hours, whether or not any death or disablement is caused to any person,-

(a)	Thermal generating units	:	200 MW and above;
(b)	Hydro-electric generating units	:	50 MW and above;
(c)	Electric lines/ sub-stations	:	132kV and above.

9. Emergency management plan.- (1) An on-site emergency management plan shall be formulated for thermal generating plant, hydro-electric generating plant, sub-station and group of electric lines for quickly and effectively dealing with probable emergencies like fire, explosion, gas leakages, landslides, floods, earthquakes, storms, cyclones, hurricanes, and crisis situations arising in the event of strikes, terrorist threats, attacks and sabotages, bomb threats and explosions and reducing response time.

(2) The provisions to be made for the on-site emergency management plan shall conform to the Schedule -III annexed to these regulations.

(3) The on-site emergency management plan shall be prepared by the Owner of electrical plants and electric lines before the commencement of trial operation except that for existing electrical plants and electric lines, the on-site emergency management plan shall be prepared within ninety days from the date of coming into force of these regulations:

Provided that in case of construction of electrical plants and electric lines, emergency action plan shall be prepared, before commencement of construction activity, to handle emergencies like fire, explosion, collapse of lifting appliances

[7] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.

and transport equipment, collapse of building or structures, gas leakages, land slides, floods, earthquakes, storms, cyclones, hurricanes and crisis situations arising in the event of strikes, terrorist threats, attacks and sabotages, bomb threats and explosions.

(4) The Owner shall ensure that a mock drill of the on-site emergency management plan is conducted at least once every six months.

(5) The Owner shall arrange to furnish to the District Collector the information pertaining to industrial activities under his control, including the nature, extent and likely effects of off-site possible major accidents as well as any additional information which the District Collector may require in this regard and the minimum information to be furnished by the Owner is given as under:-

(a) details of the key employees of the emergency team and their responsibilities;

(b) liaisoning arrangements with neighbourhood organisations;

(c) risk assessment information giving possible nature of incidents, events, mis-happenings which may give rise to emergency conditions in the vicinity of the premises, risk analysis and impact assessment;

(d) information regarding type of hazardous chemicals and fuels at plant site,-

(i) chemicals (quantities and toxicological data);

(ii) fuels (quantities and storage method);

(iii) material safety data sheets;

(e) internal and external communication plan in case of emergency;

(f) details of facilities available at site,-

(i) fire fighting equipment;

(ii) details of diesel generating sets and dewatering facilities available;

(iii) rescue equipment available;

(iv) medical resources available;

(v) type of vehicles, mobile cranes, dumpers etc.;

(vi) list of contractors and details of resources available with them;

(vii) list of private caterers providing canteen facility;

(viii) list of emergency material suppliers like tents, pumps, diesel generating sets, tarpaulins etc.;

(ix) water resources available.

10. Medical facilities.- (1)The Owner shall provide medical facilities,-

(a) to prevent and control occupational diseases;

(b) to prevent and reduce disability;

(c) to provide immediate relief to accident victims.

(2) An occupational health centre with the services and facilities as per scale laid down hereunder shall be provided for all electrical plants and electric lines and maintained in good order:-

where number of employees, including contract workers, working at one premises are fifty or less,-

(i) the services of a medical officer on retainer-ship basis, in his clinic shall be arranged and the said medical officer shall carry out the pre-employment as well as periodical medical examination and render medical assistance during any emergency;

(ii) there shall be a minimum of five persons trained in first-aid procedures amongst whom at least one shall always be available during the working hours;

(iii) a fully equipped first-aid box shall be maintained;

(b) where number of employees, including contract workers, working at one premises are between fifty-one and two hundred, then the Owner shall arrange for,-

(i) an occupational health centre having the facilities for health examination, diagnosis, treatment and maintenance of health records;

(ii) a part-time medical officer as overall in-charge of the said centre who shall visit the premises at least twice a week and whose services shall be readily available during medical emergencies;

(iii) one qualified and trained dresser-cum-compounder on duty throughout the working hours;

(iv) a fully equipped first aid box in all the departments;

(c) where number of employees, including contract workers, working at one premises are more than two hundred, then the Owner shall arrange for,-

(i) an occupational health centre having the facilities for health examination, diagnosis, treatment and maintenance of health records;

(ii) one full-time medical officer for premises employing upto five hundred workers and one more medical officer for every additional one thousand workers;

(iii) one nurse, one dresser-cum-compounder and one sweeper-cum- ward boy through out the working hours;

(iv) the occupational health centre shall be suitably equipped to manage medical emergencies.

(3) The medical officer of occupational health center shall be involved in planning

the emergency handling of large number of injured employees in the event such as fire, explosion, natural calamities and man-made disasters and all the equipment required for providing immediate relief to the injured during emergencies shall always be kept in readiness in occupational health center.

(4) [The Owner shall ensure that a fully equipped ambulance van is provided at the site for transportation of serious cases of accident or sickness to the hospital promptly and said ambulance van is maintained in good condition and equipped with necessary facilities.

Provided that where number of employees including contract workers is less than two hundred, the Owner may make arrangements for procuring such facility at short notice from a nearby hospital or other place, to meet any emergency.][8]

(5) The Owner shall put in place programme for periodic medical check- up of employees and at least the following periodic medical check-ups shall be carried out and records maintained, namely:-

(a) once before employment to ascertain physical fitness of the person to do the particular job;

(b) medical check-ups of all employees at intervals not exceeding twelve months;

(c) colour vision tests and eye sight examination for drivers, skilled workers, technicians, supervisors and crane operators annually for those who are less than forty- five years old and every six months for those who are more than forty- five years old;

(d) [Tests for respiratory disorder for employees exposed to dusty environment in power generating stations once every six months:

Provided that this provision shall not be applicable for the hydro power stations after commissioning of the project;][9]

[(e) Vertigo Test for all personnel involved in height work.][10]

11. Safety training and awareness.- (1) Regular safety training programmes to be conducted for employees shall include the following:-

(a) general safety awareness;

(b) first aid;

(c) emergency procedures including shock treatment;

(d) use of personal protective equipment;

(e) safety precautions while handling electro-mechanical equipment;

(f) use of different types of fire fighting equipment;

[8] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.
[9] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.
[10] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.

(g) response in the event of emergencies including fire, flood, landslide, earthquake etc.;

(h) site specific hazards and the precautions as· well as response in respect of the same;

(i) ten hours training per year to each employee.

(2) The Owner shall ensure that adequate safety training is provided by the contractor to his employees.

(3) Safety promotional activities shall be organised periodically to create awareness and enthusiasm among the employees which shall include organising safety day, safety week, fire safety day, fire safety week, safety competitions, posters, slogans, safety calendars and displays depicting possible consequences of unsafe acts and conditions in conspicuous locations in the plant.

[(4) Owner shall ensure availability of adequate infrastructure for imparting effective audio-visual safety training at the plant or premises.

(5) Safety precautions including imparting specialized training shall be ensured in critical activities like scaffolding, electrical works, hot works, working in confined spaces.][11]

[12. Safety Audit. – (1) Safety audit of generating stations shall be periodically carried out every two years by an accreditated third party and the audit report shall be sent to the Authority.

(2) Authority through a designated officer may verify such reports by physical site inspections as and when required.

(3) Safety checks shall be site specific and shall include the minimum safety checks as identified in Schedule IV annexed to these Regulations.

13. Relaxation of regulations. – The Authority may, by order and for reasons to be recorded in writing, relax any of provisions of these Regulations in respect of the matters referred to the Authority on case to case basis.][12]

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[11] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.

[12] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.

Schedule - I

[See regulation 5]

Minimum contents of safety manual for construction of electrical plants and electric lines

(A) Common to all electrical plants and electric lines:

1. Safely policy;
2. Safety organization;
3. Responsibilities of contractor;
4. Responsibilities of employees;
5. Reporting of accidents;
6. Enquiry of accident and dangerous occurrences;
7. Occupational health and medical facilities;·
8. Emergency management plan;
9. Location of safety equipment and emergency facilities in the plant;
10. Safety inspections and audits;
11. Safety training, awareness and promotion;
12. [Hazard identification and risk assessment including job safety analytical framework and safe working procedure;][13]
13. Personal protection equipment;
14. Communication facilities;
15. Fire prevention and protection;
16. Emergency escape routes;
17. Working at height:
    (a) Scaffolds;
    (b) Ladders;
    (c) Working platform;
    (d) Fall arresting equipment;
    (e) Temporary stairs;
    (f) Suspended jhoolas;
    (g) Floor openings;
    [(h) man lifter;][14]
18. Safe working environment:
    (a) Illumination and emergency lighting;
    (b) Noise pollution;

[13] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.
[14] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.

(c) Harmful gases and dust pollution;
(d) Thermal radiation;
(e) Ventilation;
(f) Confined spaces;
[(g) Radioactive Radiation;
(h) Drainage facility for excess water;][15]

19. Protection against hazardous chemicals and gases;
20. Safety in handling oils;
21. Safety in painting works;
22. Safety in transportation, earthmoving equipment and other construction equipment or machinery;
23. Safety in use of electricity;
24. Safety in handling electrical equipment such as:
    (a) Earthing of equipment;
    (b) Working on bus-bars, transformers, circuit breakers, insulators etc.;
    (c) Working on lines during installation of insulators, stringing of conductors, jumpering and fixing of spacers or vibration dampers;
    (d) Extra high voltage/ high voltage static capacitor banks;
    (e) Opening or splicing de-energised conductors or over-head ground wires;
    (f) Storage batteries;
    (g) Testing of medium voltage/ high voltage/ extra high voltage equipment;
    (h) SF_6 gas filled equipment;
25. House keeping;
26. Safety in material handling;
27. Safety in use of lifting machines and tackles;
28. Safety while lifting heavy equipment;
29. Frequency and type of tests for safety equipment;
30. Fencing of rotating machinery;
31. Safety during demolition;
32. Safety during excavations;
33. Safety while working in rainy and foggy environment;
34. Safety during blasting;
35. Safety in tunneling works;
36. Safety in trenches works;
37. Handling and use of explosives;

[15] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.

38. Handling of flammable gases;
39. Safety in pilling;
40. Safety in structural steel works;
41. Safety in concreting work;
42. Safety in welding and cutting operations;
43. Safety in grinding and machining;
44. Safety in the use of hand tools and power-operated tools;
45. Safety in waste disposal;
46. Safety in road cutting works;
47. Working adjacent to rail tracks;
48. Working adjacent to live roads;
49. Site perimeter fencing;
50. Traffic management;
51. Prevention of unauthorised entry;
[52. Working in night and foggy atmosphere;
53. Safety in surface cleaning or preparation work;
54. Permit to work system.][16]

(B) Additional requirements specific to hydro-electric generating stations:

1. Safety in construction of dams and coffer dams;
2. Safety in quarries, gravel pits and borrowed areas;
3. Rescue equipment for prevention from drowning;
4. Control of dust, silica and noxious gases in underground works (including ventilation of underground works);
5. Safety in grouting, guniting, shot creting;
6. Safety against flooding and flash floods;
7. Working in gassy tunnels;
8. Safety while simultaneous working in different elevations or locations in hilly areas;
9. Suitable preventive measures against landslides;
10. Suitable safety measures to minimise the effect of mishaps resulting on account of geological surprises.

Schedule- II

[See regulation 5]

Minimum contents of safety manual for operation and maintenance of electrical

[16] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.

plants and electric lines

The following safety features shall be additionally covered in 'Safety Manual for Operation and Maintenance' in addition to those covered in Schedule-I,-

(A) Common to all electrical plants and electric lines:

1. Procedure for obtaining permission to work for carrying out operations and maintenance of equipment;
2. Safety in operation and maintenance of various electro-mechanical equipment as per recommendations of manufacturers;
3. Safety of structures and buildings;
4. Safety in workshops and garages;
5. Safe handling, collection and disposal of hazarduous waste;
6. Safety in sub-station, switchyard and switchboards;
   - (a) Safe working clearance;
   - (b) Guarding of live apparatus;
   - (c) Operation on live apparatus;
   - (d) General provisions relating to maintenance;
   - (e) Working in areas containing exposed live high voltage and extra high voltage conductors;
   - (f) Demarcation of work areas;
   - (g) Working on remotely controlled and automatically controlled equipment;
   - (h) Working on equipment operated by or containing compressed air;
   - (i) Working on circuit breakers, transformers, isolators, surge arresters, instrument transformers, storage tanks etc.;
   - (j) Handling failed SF_6 circuit breaker;
   - (k) Working on or near to low, medium, high voltage and extra high voltage equipment;
   - (l) Procedure for adding or removing equipment to or from the extra high voltage and high voltage system.

[7. Safe storage, handling and Installation of various electro-mechanical equipment as per recommendations of manufacturers.][17]

(B) Additional requirements applicable for thermal generating stations:

1. Safety in conveyors, belts, cableways etc.;
2. Safety in storage and handling of materials.

(C) Additional requirements applicable for hydro-electric generating stations:

[17] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.

1. Guarding of hydraulic works and mechanical equipment;
2. Maintenance of scroll cases and draft tubes.

(D) Additional requirements applicable for electric lines:

1. Safety measures in over head lines;
2. Inspections and maintenance of steel towers and structures;
3. Norms for patrolling of lines;
4. Classification of terrain of electric lines i.e. normal terrain and vulnerable terrain;
5. Tower top patrolling;
6. Thermo vision scanning;
7. Punctured insulator detection;
8. Offline fault location, signature analysis;
9. Maintenance schedule of electric lines;
10. Safety in washing of live insulators and testing of insulators on live lines;
11. Hot line maintenance;
12. Safety in working in underground systems.

Schedule- III

[See regulation 9(2)]

Elements of on-site emergency management plan for electrical plants and electric lines

1. On-site emergency management plan shall be developed to deal with all probable emergencies which can occur at the premises such as:

   (A) Common to all electrical plants:

   (a) Major fire in cable gallery;

   (b) [Major fire in transformer yard or switchyard, as the case may be;][18]

   [(c) Major fire in battery room or switchgear room or control room, as the case may be.][19]

   (B) Specific to thermal generating stations:

   (a) Fire in coal handling and conveyor system;

   (b) [Toxic gas dispersion caused by uncontrolled chlorine toner leakage and ammonia leakage;][20]

   (c) Major leakage in natural gas pipelines (e.g. full bore rupture of gas pipe line) resulting in unconfined natural gas leakage leading to vapour cloud explosion

[18] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.
[19] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.
[20] Substituted vide Amendment, 2022 w.e.f. 15.11.2022.

and fire;

(d) Major hydrogen gas leakage from generator leading emergency situation that can lead to fire and explosion;

(e) Boiler drum burst;

(f) Implosion or explosion of boiler furnace;

(g) Large scale fire in fuel oil area, coal storage, naphtha or liquefied natural gas storage area.

(C) Specific to hydro-electric generating stations:

(a) Flooding of powerhouse;

(b) Landslides.

2. On-site emergency management plan shall include the following:-

(a) Name and address of the Chief Incident Controller;

(b) Alarm system and method of reporting and declaring emergency;

(c) Emergency response procedure including response to off-site emergency management plan and crisis and disaster management plan;

(d) Details of the key employees of the emergency team and their responsibilities;

(e) Addresses and contact numbers of local administration, police, hospitals, involved in assisting during emergency;

(f) Risk assessment information giving possible nature of incidents and events giving rise to emergency conditions, risk analysis and impact assessment;

(g) Details about the site:

(i) Locations where emergency may arise;

(ii) Emergency control room and alternate emergency control room;

(iii) Demarcation of safe assembly zone relevant to each type of emergency condition;

(h) Description of hazardous chemicals and fuels at plant site:

(i) Chemicals (quantities and toxicological data);

(ii) Fuels (quantities and storage type);

(iii) Material safety data sheets;

(i) Internal and external communication plan during emergency;

(j) Details of fire fighting and other facilities available to deal with emergency conditions;

(k) Details of first aid and hospital services available and their adequacy;

(l) Post emergency activities:

(i) Collection of records;

(ii) Conducting enquiries and concluding preventive measures

(iii) Making insurance claims;

(iv) Preparation of enquiry report and suggestion scheme;

(v) Implementation of enquiry report recommendations;

(vi) Rehabilitation of affected persons within plant;

(vii) To re-start the plant.

[**Schedule- IV**

[See Regulation 12]

Elements of safety checks for electrical plants

1. **Emergency Management Plan.─**

   (A) Fully tested Siren of approximately 110 dB to 120 dB level shall be available.

   (B) Adequate numbers of Wind Socks or Cones shall be available at strategic locations.

   (C) Emergency exit as per standard shall be available.

2. (A) **General Aspects of Safety.─**

   (i) factory inspectorate or directorate officials should visit at least once in a year;

   (ii) safety Policies should be reviewed once in a year;

   (iii) safety Committee shall be constituted under Plant Head or Deputy Plant Head; and

   (iv) at least one number of advanced life support ambulance shall be available;

   (B) **Safety training and awareness.─**

   Safety training and awareness programmes shall be conducted at least one in a year.

   (C) **Safety Promotional Activities.─**

   Safety promotional activities such as Signages and posters awards for safety shall be done once in a year.

   (D) **Safety Metrics and Incident Control Measures.─**

   Special safety measures shall be taken to check or avoid vulnerable accidents *viz.* fall from height, confined space entry, fall of materials, lack of supervision or knowledge, Bottom ash area.

   (E) **Hazard Identification and Control.─**

   Hazard Identification Study shall be done for identifying hazards in order to prevent and reduce any adverse impact that could cause injury to personnel, damage or loss of property, environment and production, or become a liability.

3. **Boilers Act, 1923.─**

The provisions of Boilers Act, 1923 (as amended from time to time) shall be complied with including the inspection and certification of the boiler by the Boiler Inspector.

4. **Compliance with respect to Environmental Provisions or regulations.─**

Adequate Environment Protection measures especially for waste water, chemicals and dust suppression system shall be provided in line with Air and water Act and provisions of appropriate Pollution Control Board.

5. **Maintenance Safety Management System.─**

Periodic health check up of workers shall be done as per hazardous industries.

6. **Internal Safety Audit.─**

Regular Internal Safety Audits shall be carried out by the owner of the plant.

7. **External Safety Audit.─**

Safety checks or audits of generating stations shall be periodically carried out as per the regulation 12 above.

8. **ISO 45001: Safety Audit.─**

Plant shall be audited and certified as per ISO 45001 at least once in a year.

9. **Fire Detection, Protection and Maintenance System.─**

(a) Minimum two numbers Electric with two numbers jockey pumps (one working plus one standby) shall be installed.

(b) Fire hydrant pumps shall be tested weekly and fire hydrant jockey pumps shall be tested daily in each shift.

(c) Fire tenders shall be inspected daily in each shift and adequate manpower for each shift shall be employed.

(d) All external fire detection shall be checked quarterly and all heat and smoke detectors annually tested.

10. **Safety Aspects of Boiler.─**

(A) **General or Statutory Requirements.─**

Boiler shall be externally inspected every time after annual maintenance or during hydro test.

(B) **Superheaters and Reheaters.─**

(a) Superheaters and Reheaters tubes shall be inspected once a year during annual overhaul.

(b) Safety valves shall be tested once a year during annual overhaul.

(C) **Economiser.─**

Economiser tubes shall be inspected once a year during annual overhaul.

(D) **Drum or Separator and Steam Headers.─**

(i) Drum instrumentations shall be calibrated once in year.

(ii) Drum internals shall be inspected once in a year.

(E) **Air Preheaters and Steam Coil Air Preheaters.─**

(i) Air Preheater water washing shall be done once in a week.

(ii) Air Preheater instrumentations shall be calibrated once in a year.

(F) **Steam Generator Integral Piping, Valves, Fittings and Mountings.─**

Calibration of instruments such as pressure gauges, Thermocouple, Resistance Temperature Detectors, Flow sensors etc. shall be done during annual overhaul.

(G) **Duct Work, Dampers and Insulation.─**

Metallic and Non-Metallic expansion joints shall be replaced once in three years and for Circulating Fluidized Bed Combustion boilers once in six months.

(H) **Soot Blowing System.─**

Soot blower operation shall be done daily.

(I) **Electrostatic Precipitator. ─**

(i) Ministry of Environment Forest and Climate Change Norms in respect of Suspended Particulate Matter level shall be maintained.

(ii) Dust collection efficiency shall be tested daily by opacity monitor.

(J) **Operation and Maintenance Aspects.─**

(i) Boiler Overhauling shall be done every year.

(ii) Safe shutdown of unit shall be done strictly as per Original Equipment Manufacturer's Operation and Maintenance Manual.

11. **Safety Aspects of Turbine Generator.─**

(A) **General Aspects.─**

Safety awareness programs shall be conducted on safety for Turbine manpower.

(B) **Steam Turbine Protection.─**

(i) Main turbine over speed protection checking shall be done atleast once in a month or as per Original Equipment Manufacturer's Manual.

(ii) Automatic Turbine Tester checking shall be done atleast once in a month or as per Original Equipment Manufacturer's Manual.

(C) **Turbine Vibrations.─**

Main Turbine Vibration readings shall be maintained as mentioned in the unit specific Original Equipment Manufacturer's Operation and Maintenance Manual.

(D) **TG Foundation and Civil works.─**

TG deck Non Destructive Test shall be carried out by competent agency.

(E) **Valves and Non Return Valves.─**

Valves required for smooth operation shall be checked after every major shutdown as mentioned in the unit specific Original Equipment Manufacturer's Operation and Maintenance Manual.

(F) **Turbine lubricating oil and jacking oil system.─**

(i) Hydro test of lube oil system shall be carried out as mentioned in the unit specific Original Equipment Manufacturer's Operation and Maintenance Manual.

(ii) Oil pipe line shall be inspected daily as mentioned in the unit specific Original Equipment Manufacturer's Operation and Maintenance Manual.

(G) **Turbine Bearings and Turning Gear.─**

Lubrication and maintenance of turbine bearings and turning gear shall be done continuously as mentioned in the unit specific Original Equipment Manufacturer's Operation and Maintenance Manual.

12. **Safety Aspects of Balance of Plant.─**

(1) **Coal Handling Plant and Associated Sub-System.─**

(A) **Railway Siding and Track Hopper.—**

(i) Signalling system of the track shall be kept in healthy condition and in auto mode.

(ii) While working at Wagon Tipplers, the following shall be ensured:—

a. ultrasonic sensors and signalling system in proper condition;

b. the speed of the locomotive less than 5 km per hour in tippler area;

c. brakes applied gently;

d. all wagon doors remain closed;

e. decoupling and coupling done from outside handle; and

f. all limit switches in healthy condition.

(iii) Maintenance of wagons shall be carried out weekly.

(iv) Maintenance of locos shall be carried out every hundred hours of running.

(B) **Coal Yard and Stacker and Reclaimer.—**

Water pressure shall be at least 3.5 kg/cm^2 in hydrant line at the farthest end.

(2) **Ash Handling Plant and Associated Sub-System.—**

(i) **Bottom Ash System.—**

Bottom Ash handling system, after burning grate, Slag bath, submerged conveyor, elevated conveyor, bin or silo shall be properly maintained.

(ii) **Ash Bund or Dyke.—**

Maintenance inspection of Ash Dyke shall be carried out every alternate day.

(3) **Fuel Oil Unloading System.—**

Electrostatic charges accumulated in the Bowser Lorry during movements or transportation has to be discharged by the drivers before unloading fuel oil, using a discharge rod, to prevent Explosions.

(4) **D M Plant.—**

External inspection of the acid and alkali storage tanks shall be done once in six months.

(5) **Cooling Tower.—**

Cooling Tower concrete structure shall be inspected during annual maintenance by a designated Civil Engineer.

(6) **Compressor House.—**

Receiver tanks shall be hydraulically tested periodically at least once in a year.

(7) **Transformers, Switchyard and Sub stations.—**

Environment friendly Clean Agent System shall be provided in Control Rooms viz. Main Control Room, Coal Handling Plant Control Room, Switchyard Control Room, Ash Handling Control Room.

(8) **Diesel Generator.—**

Diesel Generator system shall be checked daily.

(9) **Lift and Hoist.—**

Testing of Lift and hoist shall be done every year by competent agency.

13. **Electrical and control and instrumentation system and associated sub-system.─**

(a) Electrical panels or Relays or interlocks or Lights shall be maintained and inspected under regular maintenance programme in every shift.

(b) Electrical panel rooms shall be segregated. Also, the Air Handling Unit room shall be segregated from the remaining facilities. For Air Conditioners which involves circulation shall be provided with automatically closing damper to prevent the circulation of smoke in case of any fire.][21]

[21] Inserted vide Amendment, 2022 w.e.f. 15.11.2022.

MINISTRY OF POWER

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the 30th September, 2013

File No.12/X/STD(CONN)/GM/CEA.- Whereas draft of the Central Electricity Authority (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations, 2010 was published on 4th April 2012, as required by sub-section (3) of section 177 of the Electricity Act, 2003 (36 of 2003), read with rule 3 of the Electricity (Procedure for Previous Publication) Rules, 2005;

Now, therefore, in exercise of powers conferred by sub-section (1) of Section 177 of the Electricity Act, 2003, the Central Electricity Authority hereby makes the following regulations, namely:-

1. Short title and commencement - (1) These Regulations may be called the Central Electricity Authority (Technical Standards for [Connectivity below 33 kilovolts][1]) Regulations, 2013.

(2) They shall come into force on the date of their publication in the Official Gazette.

(3) For distributed generation resources already connected to the electricity system on the date of commencement of these regulations, the generating company and the licensee of the electricity system to which the generating station is connected shall mutually discuss and agree on the measures which can be taken to meet the technical standards specified in these regulations within one hundred and eighty days of the coming into force of these regulations.

2. Definitions - (1) In these regulations -

(a) "Act" means the Electricity Act, 2003 (No. 36 of 2003);

(b) [“applicant” means a generating company, charging station, prosumer or a person seeking connectivity to the electricity system at voltage level below 33 kV;][2]

(c) "appropriate licensee" means transmission licensee or the distribution licensee, as the case may be, to whose electricity system the electricity generated from the distributed generation resource shall be injected or is being injected;

(d) "British Standards" (BS) means those standards and specifications approved by the British Standards Institution;

[(da) charging point” means a facility for recharging of batteries of electric vehicle for private or public non-commercial use, connected at 415/220 Volts;

(db) “charging station” means a facility for recharging of batteries of electric vehicles for commercial use and shall also include multiple charging points for non-commercial public

[1] Substituted vide Amendment, 2019 w.e.f. 06.02.2019

[2] Substituted vide Amendment, 2019 w.e.f. 06.02.2019

use and capable of transferring power from electric vehicle to the grid;][3]

(e) "distributed generation resource" means a generating station feeding electricity into the electricity system at voltage level of below 33 kV;

(f) "frequency" means the number of alternating cycles per second expressed in Hertz;

(g) "IEC Standard" means a standard approved by the International Electrotechnical Commission;

(h) "Indian Standards" means standards specified by Bureau of Indian Standards;

(i) "interconnection point" means a point on the electricity system, including a sub-station or a switchyard, where the interconnection is established between the facility of the applicant and the electricity system and where electricity injected into or drawn from the electricity system can be measured unambiguously for the applicant;

(j) "inverter' means a device that changes direct current power into alternating current power;

[(ja) "prosumer" means a person, including energy storage system, which consumes electricity from the grid and can also inject electricity into the grid, using same point of connection;][4]

(k) "protection system" means the equipment by which abnormal conditions in the electricity system are detected and fault clearance, actuating signals or indications are initiated without the intervention by the operator;

(l) "Site Responsibility Schedule" (SRS) means a schedule for demarcating the ownership, responsibility for control, operation and maintenance of the equipment at the interconnection point;

(m) "unintended island" means a part of the electricity system which remains energised by one or more distributed generation resource, when such part of the system has been isolated from the remaining part of the electricity system; and

(n) ["user" means a charging station, prosumer or a person who is connected to the electricity system or a generating company whose distributed generation resource is connected to the electricity system;][5]

(2) The words and expressions used herein and not defined in these regulations but defined in the Act shall have the meanings assigned to them in the Act.

3. [Application of these regulations - These regulations shall apply to all generating companies or persons owning distributed generation resources, charging stations, prosumers or persons who are connected to or seeking connectivity with the electricity system below 33 kV voltage level:

[3] Inserted vide Amendment, 2019 w.e.f. 06.02.2019
[4] Inserted vide Amendment, 2019 w.e.f. 06.02.2019
[5] Substituted vide Amendment, 2019 w.e.f. 06.02.2019

Provided that in case, a licensee owning the electricity system to which connection is to be made, also owns the distributed generation resources, charging station or prosumers, these regulations shall apply mutatis mutandis.][6]

4. General Connectivity Conditions - (1) The applicant shall make a formal request to the appropriate licensee for connection to electricity system of the appropriate licensee or generating station as the case may be.

(2) The applicant shall be responsible for the planning, design, construction, reliability, protection and safe operation of its own equipment subject to the regulations for construction, operation, maintenance and connectivity and other statutory provisions.

(3) The applicant and the user shall furnish data as prescribed by the appropriate licensee in a non- discriminatory manner.

(4) The applicant and the user shall provide necessary facilities in the distributed generation resource for communication and storage of data and other parameters as may be stipulated by the appropriate licensee in a non-discriminatory manner.

(5) The applicant and the user shall coordinate with the appropriate licensee on the issues including but not limited to protection, safety, and metering.

(6) The appropriate licensee shall carry out the inter-connection study to determine:-

(a) the point of inter-connection, required interconnection facilities and modifications required on the existing electricity system, it any, to accommodate the interconnection,

(b) the maximum net capacity of the distributed generation resource at a particular location for single-phase and three phase generators connected to a shared single-phase system or three phase system respectively, based on the capacity and configuration of the electricity system, and imbalance in the power flows that distributed generation resource may cause,

(c) likely impact, if any, on the quality of service to consumers connected to the electricity system and measures to mitigate the same,

(d) additional measures to ensure safety of the equipment and personnel.

(7) Every connection of an applicant's system to the electricity system shall be covered by a connection agreement between the applicant and appropriate licensee, which shall contain general and specific technical conditions, applicable to that connection.

(8) The appropriate licensee shall inform the concerned State transmission utility within thirty days of acceptance of application for connectivity of a generating station to electricity system operating at voltage level below 33 kV. The concerned State transmission utility shall in turn inform the State Load Despatch Centre with details of installed capacity, generator

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[6] Substituted vide Amendment, 2019 w.e.f. 06.02.2019

capabilities, connectivity and likely date of commissioning or date of commercial operation.
[(9) The applicant and the user shall comply with the cyber security guidelines issued by the Central Government from time to time.][7]

5. Standards and Codes of Practice. - (1) The applicant shall follow the industry best practices and applicable industry standards in respect of the equipment installation and its operation and maintenance.

(2) The equipment including overhead lines and cables shall comply with the relevant Indian standards issued by Bureau of Indian Standards.

(3) In case the Bureau of Indian Standards has not issued relevant standard, IEC standard or British Standards or standard issued by American National Standards Institute (ANSI) or any other equivalent International Standard shall be followed in that order:

Provided that whenever a standard other than Indian Standard is followed, necessary corrections or modifications shall be made for nominal system frequency, nominal system voltage, ambient temperature, humidity and other conditions prevailing in India before actual adoption of the said standard.

(4) The effects of wind, storms, floods, lightning, elevation, temperature extremes, icing, contamination, pollution and earthquakes must be considered in the design and operation of the connected facilities.

(5) Installation, operation and maintenance of the equipment by the applicant shall conform to the relevant standards specified by the Central Electricity Authority as and when they come into force.

6. Safety. - The applicant shall comply with the Central Electricity Authority (Measures Relating to Safety and Electricity Supply) Regulations, 2010 for the proposes of safety under these regulations.

7. Sub-station Grounding. - Sub-station grounding shall be done in accordance with IS 3043, the code of practice for earthing issued by Bureau of Indian Standard.

8. Metering. - (1) Meters shall be provided as specified in the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 for the purpose of metering under these regulations.

(2) Measurement of harmonic current injection, Direct Current injection and flicker shall be done with calibrated meters before the commissioning of the project and once in a year in presence of the parties concerned and the indicative date for the same shall be mentioned in the connection agreement:

Provided that in addition to annual measurement, if appropriate licensee or the generating company, as the case may be, desires to measure harmonic current injection or

[7] Inserted vide Amendment, 2019 w.e.f. 06.02.2019

Direct Current injection or flicker, It shall inform the other party in writing and the measurement shall be carried out within five working days

9. Schematic Diagrams. - The applicant and user shall prepare single line schematic diagrams in respect of its system facility and make the same available to the appropriate licensee.

10. Inspection, Test, Calibration and Maintenance prior to connection. - (1) Before physical connection, the applicant shall complete all inspections and tests finalised in consultation with the appropriate licensee or generating station to which his equipment is getting connected.

(2) The applicant shall make available all drawings, specifications and test records of the project equipment to the appropriate licensee or generating station as the case may be.

11. [Standards for distribution generation resources and prosumers, when acting as a generator][8]. - Harmonic current injections from a generating station shall not exceed the limits specified in IEEE 519.

(2) The distributed generating resource shall not inject Direct Current greater than 0.5% of the full rated output at the interconnection point.

(3) The distributed generating resource shall not introduce flicker beyond the limits specified in IEC 61000:

Provided that the standards for flicker shall come into effect from 1st April 2014.

(4) Every distributed generating resource shall be equipped with automatic synchronisation device:

Provided that induction generators, except self-excited induction generators, shall not require a synchronising device:

Provided further that distributed generation resources using inverters shall not be required to have separate synchronising device, if the same is inherently built into the inverter.

(5) For three-phase generators, the circuit breakers shall be three-phase devices with electronic or electromechanical control.

(6) Distributed generation resource operating in parallel with electricity system shall be equipped with the following protective functions to sense abnormal conditions on electricity system and cause the distributed generation resource to be automatically disconnected from electricity system or to prevent the distributed generation resource from being connected to electricity system inappropriately-

(a) over and under voltage trip functions if voltage reaches above 110% or below 80% respectively with a clearing time upto two seconds; however, appropriate

[8] Substituted vide Amendment, 2019 w.e.f. 06.02.2019

licensee may prescribe a narrower range of voltage for the purpose.

(b) over and under frequency trip functions, if frequency reaches 50.5 Hz and below 47.5 Hz with a clearing time upto 0.2 seconds; however, appropriate licensee may prescribe a narrower range of frequency for the purpose.

(c) the distributed generation resource shall cease to energise the circuit to which it is connected in case of any fault in this circuit.

(d) a voltage and frequency sensing and time-delay function to prevent the distributed generation resource from energising a de-energised circuit and to prevent the distributed generation resource from reconnecting with electricity system unless voltage and frequency is within the prescribed limits and are stable for at least sixty seconds; and

(e) a function to prevent the distributed generation resource from contributing to the formation of an unintended island, and cease to energise the electricity system within two seconds of the formation of an unintended Island.

(7) The equipment of the generating station shall meet following requirements, namely:-

(a) circuit breakers or other interrupting equipment shall be suitable for their intended application with the capability of interrupting the maximum available fault current expected at their location.

(b) distributed generation resource and associated equipment shall be designed so that the failure of any single device or component shall not potentially compromise the safety and reliability of the electricity system.

(c) paralleling-device of distributed generation resource shall be capable of withstanding 220% of the nominal voltage at the interconnection point.

(8) Every time the generating station is synchronised to the electricity system, it shall not cause voltage fluctuation greater than ± 5% at the point of connection.

(9) After considering the maintenance and safety procedures, the distribution licensee may require the applicant with a distributed generation resource of capacity exceeding a particular level to provide a manually operated isolating switch between the distributed generation resource and the electricity system, which shall meet following requirements:

(a) allow visible verification that separation has been accomplished;

(b) include indicators to clearly show open and closed positions;

(c) be capable of being reached quickly and conveniently twenty four hours a day by licensee's personnel without requiring clearance from the applicant;

(d) be capable of being locked in the open position;

(e) may not be rated for load break nor may have feature of over-current protection; and

(f) be located at a height of at least 2.44 m above the ground level.

(10) Prior to synchronisation of the distributed generation resource for the first time with electricity system, the applicant and the appropriate licensee shall agree on the protection features and control diagrams.

(11) one copy each of the approved drawing and diagrams showing important equipment, protection and control features shall be signed by representative of the applicant and the licensee and shall be in possession of the applicant and licensee.

(12) These drawing and diagrams shall be amended as and when any changes are made in the distributed generation resource or interconnection facility.

[11A. **Standards for charging station, prosumer, or a person connected or seeking connectivity to the electricity system. -**

(1) The applicant shall provide a reliable protection system to detect various faults and abnormal conditions and provide an appropriate means to isolate the faulty equipment or system automatically.

(2) The applicant shall ensure that fault of his equipment or system does not affect the grid adversely.

(3) The appropriate licensee shall carry out adequacy and stability study of the network before permitting connection with its electricity system.

(4) The limits of injection of current harmonics at the point of common coupling by the user, method of harmonic measurement and other such matters, shall be in accordance with the IEEE 519-2014 standards, as amended, from time to time.

(5) The measuring and metering of harmonics shall be a continuous process with power quality meters complying with the provisions of IEC 61000-4-30 Class A.

(6) The data measured and metered as mentioned in sub-regulation (5), shall be available with the distribution licensee and be shared with the consumer periodically.

(7) The applicant seeking connectivity at 11 kV or above shall install power quality meters and share the recorded data thereof with the distribution licensee with such periodicity as may be specified by the appropriate Electricity Regulatory Commission:

Provided that the user connected at 11 kV and above shall comply with the provision of this sub-regulation within twelve months from the date of commencement of the Central Electricity Authority (Technical Standards for [Connectivity below 33 Kilo Volts) Amendment Regulations, 2019][9].

(8) In addition to harmonics, periodic measurement of other power quality parameters such as voltage sag, swell, flicker, disruptions shall be done by the

[9] Substituted vide Amendment, 2019 w.e.f. 06.02.2019.

distribution licensee as per relevant IEC standard and the reports thereof shall be shared with the consumer.][10]

12. Site Responsibility Schedule. - (1) A Site Responsibility Schedule for every interconnection point shall be prepared by the appropriate licensee.

(2) Following information shall be included in the Site Responsibility Schedule, namely:-

(a) schedule of electrical apparatus services and supplies;

(b) schedule of telecommunications and measurement apparatus; and

(c) safety rules applicable to each plant and apparatus.

(3) Following information shall also be furnished in the Site Responsibility Schedule for each item of equipment installed at the connection site, namely:-

(a) the ownership of equipment;

(b) the responsibility for control of equipment;

(c) the responsibility for maintenance of equipment;

(d) the responsibility for operation of equipment;

(e) the manager of the site;

(f) the responsibility for all matters relating to safety of persons at site; and

(g) the responsibility for all matters relating to safety of equipment at site.

13. Access at Connection Site - The applicant and user shall provide reasonable access and other required facilities to the appropriate licensee for inspection of the equipment belonging to the applicant or user, as the case may be, and for maintenance of the equipment, if any, installed by the appropriate licensee in the premises of the applicant or user, as the case may be.

[14. Registration in Registry maintained by the Authority. - The user or the applicant, as the case may be, shall get its generating unit and station of such capacity and with effect from such date as may be fixed by the Authority, registered and obtain an online generated Unique Registration Number from the Authority:

Provided that no generating unit or generating station shall be granted connectivity with the grid without the unique registration number with effect from such date as may be fixed by the Authority.

15. Compliance of regulations. - (1) It shall be the responsibility of concerned licensee to ensure that before connectivity to the grid, all the provisions with regard to the connectivity stipulated in these regulations are complied with by the applicant.

(2) The user may be disconnected from the grid by the licensee for non-compliance of any provision of these regulations, under report by the licensee to the appropriate Electricity Regulatory Commission.

[10] Inserted vide Amendment, 2019 w.e.f. 06.02.2019.

16. Relaxation of Regulations. - The Authority, by order in writing and the reason to be recorded, may relax any provision of these regulations in respect of any matter referred to the Authority on the case to case basis.][11]

[11] Inserted vide Amendment, 2019 w.e.f. 06.02.2019

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the 27th February, 2020

No. Comm._Std./PCD/CEA.– Whereas the draft of the Central Electricity Authority (Technical Standards for Communication System in Power System Operations) Regulations, 2020 was published in six newspaper dailies, as required by sub-section (3) of section 177 of the Electricity Act, 2003 (36 of 2003) read with sub-rule (2) of rule (3) of the Electricity (Procedure for Previous Publication) Rules, 2005, inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of forty-five days, from the date on which the copies of the newspaper containing the said draft regulations were made available to the public;

And whereas copies of the said newspapers containing the said draft regulations were made available to the public on the 26th March, 2019;

And whereas the objections and suggestions received from the public on the said draft regulations were considered by the Central Electricity Authority;

Now, therefore, in exercise of the powers conferred by sub-section (1) of section 177 of the Electricity Act, 2003 (36 of 2003) read with clause (b) of section 73 of the said Act, the Central Electricity Authority hereby makes the following regulations, namely: -

CHAPTER I

PRELIMINARY

1. **Short title and commeneement.** (1) These regulations may be called the Central Electricity Authority (Technical Standards for Communication System in Power System Operations) Regulations, 2020.

   (2) They shall come into force on the date of their publication in the Official Gazette.

2. **Definitions.–** (1) In these regulations, unless the context otherwise requires, -

   (a) "Act" means the Electricity Act,2003 (36 of 2003);

   (b) "Authority" means the Central Electricity Authority established under sub-section (2) of section 70 of the Act;

   (c) "automatic generations control" means capacity to regulate the power output of selectable units in response to total power plant output, tie-line power flow, and power system frequency;

   (d) "bulk consumer" means a consumer who avails supply at voltage of 33 kV or above;

   (e) "communication channel" means a dedicated virtual path configured from one node to another node, either directly or through intermediary node;

   (f) "communication network" means an interconnection of communication nodes through a combination of media, either directly or through intermediary node;

(g) "communication system" is a collection of individual communication networks, communication media, relaying stations, tributary stations, terminal equipment usually capable of inter- connection and inter-operation to form an integrated communication for power sector including existing communication system such as inter-State transmission system or intra-State transmission system, satellite, cellular, optical fiber and radio communication system and their auxiliary power supply system used for regulation of inter-State and intra-State transmission of electricity;

(h) "control centre" means National Load Despatch Centre or Regional Load Despatch Centres or State Load Despatch Centres or Renewable Energy Management Centres or Area Load Despatch Centres or Sub -Load Despatch Centres or Load Despatch Centres of distribution licensee including main and backup as applicable;

(i) "cyber security" means protecting information, equipment, devices, computer resource, communication device and information stored therein from unauthorised access, use, disclosure, disruption, modification or destruction as defined in clause (nb) of sub-section (1) of section 2 of the Information Technology Act, 2000 (21 of 2000);

(j) "data" means a set of values of analogue or digital signal including a text, voice, video, tele - protection, alarm, control signal, phasor, weather parameter, parameter of a machine or power system;

(k) "earthing" means connection between conducting parts and general mass of earth by an earthing device;

(l) "forecasting service provider" means a service provider who provides forecast related to weather or renewable energy resources and demand for use of users;

(m) "interface agreement" means an agreement signed between parties sharing the communication system;

(n) "node" means a connection point on a communication network, at which data is conveyed via communication channels to or from that point to other points on the network;

(o) "power exchange" means the exchange which has been granted registration in accordance with the provisions of the Central Electricity Regulatory Commission (Power Market) Regulations, 2010;

(p) "Renewable Energy Management Centre" means the centre being established to enable forecasting, scheduling and monitoring of renewable energy generation;

(q) "renewable energy power plant" means the power plants generating grid quality electricity from renewable energy sources namely small hydro, wind, solar including its integration with combined cycle, biomass, bio fuel cogeneration, urban or municipal waste and other such sources as approved by the Central Government in the Ministry of New and Renewable Energy;

(r) "Schedule" means a schedule annexed to these regulations;

(s) "supervisory control and data acquisition" means a system that acquires data from remote locations over communication system and processes it at centralised control location for monitoring, supervision, control as well as decision support;

(t) "user" means a person such as a generating company including captive generating plant, renewable energy power plant, transmission licensee, distribution licensee or a bulk consumer, whose electrical system is connected to the inter-State transmission system or the intra-State transmission system;

(u) "wideband node" means wide bandwidth data transmission with an ability to simultaneously transport multiple signals and traffic types.

(2) Words and expressions used and not defined in these regulations but defined in the Act shall have the respective meanings assigned to them in the Act.

3. Application. - These regulations shall apply to all the users, National Load Despatch Centre, Regional Load Despatch Centres, State Load Despatch Centres, Load Despatch Centres of distribution licensee, Central Transmission Utility, State Transmission Utilities, Regional Power Committees, Renewable Energy Management Centres, forecasting service provider and power exchanges.

CHAPTER II

REQUIREMENTS

4. Functional requirement.- (1) The communication system shall provide reliable data and voice communication and tele-protection for power system at national level, regional level, inter-State level and intra-State level.

(2) The communication system shall be capable to provide integration with supervisory control and data acquisition system, wide area measurement system, video conferencing system, automatic meter reading, electronic private automatic branch exchange, voice over internet protocol and tele-protection.

5. Performance requirement. - (1) User shall be capable of transmitting all operational data as required by appropriate control centre.

(2) Communication system shall relay the control command from the control centre to relevant equipment within two seconds for supervisory control and data acquisition and within one second for wide area measurement system, whether the command is transmitted directly or via data concentrator.

(3) Communication system shall be planned with required bandwidth to conform the

data interval time as specified in Schedule-I.

6. **Interface requirements. -** (1) The required communication interfaces shall be provided at both sending and receiving ends.

(2) All the interfaces shall be provided with audio-visual status indication to indicate its normal operation as per relevant standards.

(3) The standards for interfacing to communication system shall be as specified in Schedule II.

7. **Reliability. -** (1) Total outage period shall be less than sixteen hours on monthly basis each for interface node, wideband node and communication network.

(2) The total outages in a rolling twelve months assessment period shall be less than forty-eight hours.

(3) The communication system shall be designed to ensure adequate redundancy.

8. **Design and planning. –** (1) Communication system shall be planned up to the interface points of the user and the respective control centre including the interfacing communication equipment at the respective location.

(2) Cellular and radio frequency based communication technology shall not be considered for control and protection functions.

(3) Communication system shall be designed as per communication planning criteria for development of reliable communication system for the power system.

(4) Central Transmission Utility or State Transmission Utility while planning shall consider design of the intervening communication system for seamless integration to have wideband network.

(5) User shall ensure centralised monitoring or management of its communication network and shall provide necessary facilities for configuration, identification of fault and generation of various reports on availability of the communication system.

(6) User shall be responsible for planning, design, implementation, secured operation and maintenance of its own communication infrastructure to be interfaced with the communication system.

(7) User, whose system is proposed to be interfaced with the communication system, shall furnish the requisite interface information to the appropriate control centre as specified by them.

(8) Communication equipment installed shall be interoperable, so as to allow seamless integration between different vendors.

(9) Every interfacing with the intervening communication system shall be covered by interface agreement between the parties sharing the communication which shall contain general and specific technical conditions supported by interfacing details and layout drawings for the interfacing.

(10) Network equipment shall be synchronized through provision of global positioning system clock to achieve the desired functionality.

(11) Communication equipment for all the nodes shall be provided with at least ten hours battery backup and extended backup shall be provided depending upon the requirement.

(12) Supply voltage shall be 220/48V Direct Current +15%, -10%. (positive pole earthed).

(13) The minimum guaranteed life for all the wideband communication equipment shall be ten years.

9. Site responsibility schedule. - (1) A site responsibility schedule for every interface point shall be prepared by the owner of the communication interface equipment at the interfacing location.

(2) Site responsibility schedule shall include -

(a) schedule of telecommunication interface equipment, their responsibility for access, maintenance and operation;

(b) schedule of auxiliary power supply catering communication equipment;

(c) schedule of patching details (like Synchronous Transport Module (STM) level, E-1 level, Transmission Control Protocol/Internet Protocol (TCP/IP level) for channel routing, and numbers of fiber connectivity;

(d) type of connectors required for making the connection through;

(e) specific information provided by the original equipment manufacturer;

(f) site or node common drawings for each interface point; and

(g) responsible person for the site.

(3) If packet technology is used in backhaul network, following additional information shall be included, namely:-

(a) mode of connectivity;

(b) protocol used (Level 2 or Level 3); and

(c) bandwidth provisioning.

10. Outage planning. - Monthly outage shall be planned and got approved by the owner of communication equipment in the concerned regional power committee, as per detailed procedure finalised by the respective regional power committee.

11. Connection with earth. - Earth connection of communication equipment (indoor and outdoor) shall be done in accordance with the norms of the Institute of Electrical and Electronics Engineers (IEEE)-1100, the Institute of Electrical and Electronics Engineers (IEEE)-80 or the Bureau of Indian Standards (BIS):3043, as per the applicability.

12. Lightning and surge protection. – (1) Protection against lightning and electric surge shall be provided as per International Electro-Technical Commission (IEC) 61000-4-5 and compliant to relevant parts of IS/IEC 62305, as per the applicability.

(2) The resistibility of communication equipment installed against over voltage and over current shall be as per International Telecommunications Union Telecommunication (ITU-T)-K 20 recommendations.

13. **Safety and testing. -** (1) Owner of communication equipment shall be responsible for the safety of its equipment installed.

(2) Testing shall be carried out as and when the communication equipment is replaced or upgraded to conform the compliance to these standards.

14. **Cyber security. -** (1) All users and control centres connected to the communication system shall have robust programs in place to adequately and continuously manage cyber security risks that could have adversely impact power system communications infrastructure.

(2) The cyber security program shall address the following, namely: -

(a) compliance with provisions of the Information Technology Act, 2000 (21 of 2000) and National Cyber Security Policy, 2013 as amended from time to time;

(b) implementation of the National Critical Information Infrastructure Protection Centre (NCIIPC) Guidelines;

(c) implementation of guidelines and advisories issued by Computer Emergency Response Team (CERT India) and applicable Sectoral Computer Emergency Response Team (CERT); and

(d) compliance to the Central Electricity Authority (Cyber Security) Regulations, as and when they come into force.

15. **Access to connection site or node. -** Owner of the interface site or node shall provide reasonable access and space to the user or its authorised representative, whose equipment is installed or proposed to be installed, at the interface site for installation, configuration, testing and operation and maintenance of the equipment.

16. **Access to data.** (1) Confidentiality of data and information of the power system shall be maintained.

(2) Protecting data and information from unauthorised, incorrect or accidental access, use, modification, destruction or disclosure shall be the responsibility and obligation of the concerned user and control center.

(3) Communication system access shall be designed, developed, built, configured and maintained in such a way that only authorised person has access.

17. **Data retention. -** (1) User shall keep evidence of compliance on availability for the previous two calendar years plus the current year for all the interfaces which are in

operation.

(2) Historical data of ninety days shall be kept.

18. System upgradability and expandability. (1) All Communication interfaces shall be sized, though not necessarily equipped, to support system/subsystem expansion or upgradation to full capacity as provided by specified aggregate transmission rates.

(2) Equipment units provisioned for equipped sub-units shall be terminated with appropriate termination interfaces.

19. Centralised monitoring. (1) Control centre shall have centralised supervision and monitoring system by integrating its network management system with network management system of other users and standalone network elements, which are not being monitored on network management system within its jurisdiction on national and regional basis.

(2) Users shall provide necessary support to interface their network management system or network element with centralized network management system.

(3) Users shall take necessary action for operation and maintenance of their respective interfaces.

(4) Network management system shall have features to store necessary information and facility to generate report on communication system availability of major equipment as well as the data channels on daily or weekly or monthly or annually basis.

(5) Network management system shall have displays for audio-visual alarm generation and logging facility to facilitate the operator for quick fault detection.

(6) Network management system shall facilitate access to the equipment for configuration and fault restoration as well as to facilitate monitoring the performance of the communication system.

(7) Centralised monitoring shall be in main and back-up control centre architecture with centralised database and twenty-four hours maintenance on all days.

(8) For very small aperture terminal communication, network management system (NMS) shall have facility of maintaining link availability status along with signal strength of the nodes.

(9) For very small aperture terminal communication, redundant configuration shall be enabled in network management system.

20. Maintenance and testing. (1) User shall permit in-service diagnostic testing to be executed both locally and from remote network management system locations to facilitate performance trending, efficient diagnosis and corrective resolution of all the interfaces in operation.

(2) The testing equipment and tools shall be maintained to facilitate testing of the interfaces of the communication system at the time of fault and during the course of

maintenance.

21. Training. (1) Specialised training shall be provided to the persons manning the centralised monitoring center and to the field support staff to ensure quick fault detection and restoration of the communication system.

(2) Training shall be provided to the maintenance persons on all communication equipment for its operation and maintenance.

22. Adoption of new technologies. – Plan shall be made for introduction and adoption of new technologies, with the approval of the appropriate Commission or as per the regulations or pursuant to the reforms programme of the appropriate Government.

23. Standards and codes of practice. - (1) The industry best practices and applicable industry standards in respect of the equipment installation and operation and maintenance shall be followed.

(2) Save as otherwise provided in these regulations, the relevant Indian Standards shall be followed to carry out the purpose of these regulations and where relevant Indian Standards are not available, International Standard shall be followed and in the event of any inconsistency, the provisions of these regulations shall prevail:

Provided that whenever an International Standard is followed, necessary corrections or modifications shall be made for prevailing local ambient conditions before adoption of the said Standard.

(3) The effects of wind, storms, floods, lightning, elevation, temperature range, icing, contamination, pollution, earthquakes etc, shall be considered in the design and operation of the connected facilities.

CHAPTER III

WIDEBAND NETWORK

24. The communication system shall be formed by a wideband network to support the requirement of power system operation.

25. Requirement of wideband network. - (1) The wideband network shall be designed in a manner to ensure absolute channel delay less than 25 milliseconds and channel delay asymmetry less than 0.1 milliseconds required for protection applications.

(2) The wideband network shall be configured for automatic switchover to the alternate path or route in case of failure of one path and the switching time delay shall be less than 50 milliseconds.

(3) Terminal equipment shall support automatic switchover function between the redundant modules, and modules and hardware required for supporting the automatic switch over shall be provided.

(4) New node, when added to the existing network, the terminal equipment shall be compatible to the existing one and shall be possible to integrate with the existing

respective network management system either at State level or at Central level for complete monitoring, reconfiguration and control.

(5) Terminal equipment shall be designed with required number of directions considering the route redundancy and future expansion.

(6) The wideband network shall have the following communication interfaces, namely: -

(a) high speed bundled n x E1 support including ethernet, gigabit ethernet (GbE);

(b) high speed E1 channel support;

(c) 64 kilobits per second (kbps) and n x 64 kilobits per second (kbps) data and Protection channel support;

(d) low speed (300 -1200 bits per second) data channel support;

(e) voice (2 wires, 4 wires) channel support;

(f) data transport supporting network management channels; and

(g) Institute of Electrical and Electronics Engineers (IEEE)-C37.94 interface card for teleprotection of lines.

(7) The relevant standards and code of practice of wideband network as specified in the Bureau of Indian Standards (BIS), the International Telecommunications Union Telecommunication (ITU-T) and the International Electro-Technical Commission (IEC) shall be followed.

CHAPTER IV

FIBRE OPTIC COMMUNICATION

26. Requirements of fibre optic communication. (1) All wideband communications shall be established using fibre optic communication consisting of underground fibre optic cable, optical ground wire (OPGW) or underground fiber optic cable (UGFO) and all dielectric self supporting (ADSS).

(2) Unarmoured cable shall be laid within a polyvinyl chloride **(**PVC) pipe or hume pipe or permanently lubricated high-density polyethylene (PLB HDPE) pipe.

(3) The cable shall be rodent and termite proof.

(4) The cable shall contain 12 or 24 or 48 numbers dual window single mode (DWSM) or dual window multi mode (DWMM) fibre depending on the local network design and requirement envisaged and shall consider the overall design and requirement of the backbone network.

(5) Approach cable for optical ground wire termination to fibre optic distribution panel (FODP) shall be armoured or unarmoured cable with suitable protection and matching the fiber count equal to optical ground wire cable to maintain uniformity and ease of utilisation of fibers.

(6) Ingress protection class 66 or better complaint splice enclosures shall be provided to encase the optical cable splices in protective, moisture and dust free environment.

(7) Maximum twelve fibres shall be terminated in a single splice tray.

(8) Fibre optic distribution panel (FODP) shall be ingress protection class 55 compliant and shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays and shall be provided with ground lugs.

(9) The overall optical fibre path attenuation shall not be more than as calculated below: -

(a) maximum attenuation at 1550 nanometer: 0.21 decibel (dB)/kilometer x total kilometer + 0.05 decibel (dB)/splice x no. of splices + 0.5 decibel (dB)/connector x no. of connectors + maintenance margin, if any, as specified in relevant standards;

(b) maximum attenuation at 1310 nanometer: 0.35 decibel (dB)/ kilometer x total kilometer + 0.05 decibel (dB)/splice x no. of splices + 0.5 decibel (dB)/connector x no. of connectors + maintenance margin, if any, as specified in relevant standards.

(10) Attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 decibel (dB).

(11) Induced attenuation due to temperature shall be ≤ 0.05 decibel (dB) (-60 deg. C to +85 deg. C).

(12) Fibre optic cable shall be protected from damage due to factors like crushing, bending, twisting, tensile stress and moisture, wide temperature variation, Hydrogen evolution, etc.

(13) Short circuit current for optical ground wire shall be ≥6.32 kilo ampere for 1.0 second (for 220 kilo volt and above lines) and ≥ 5.60 kilo ampere for 1.0 second (for 132 kilo volt and 66 kilo volt lines).

(14) Direct current (D.C.) resistance at 20 deg. C shall be < 1.0 ohm/kilometer.

(15) Everyday tension (EDT) of optical ground wire shall be ≤ 20% of ultimate tensile strength (UTS).

(16) Maximum permissible dynamic strain shall be +/- 150 micro strains.

(17) Proof stress level shall be ≥ 0.69 gigapascal.

(18) Maximum chromatic dispersion shall be 18 picosecond (ps)/(nanometer (nm) x kilometer (km)) at 1550 nanometer (nm), 3.5 picosecond (ps)/(nanometer (nm) x kilometer (km)) at 1288-1339 nanometer, 5.3 picosecond (ps)/(nanometer (nm) x kilometer (km)) at 1271-1360 nanometer, as the case may be.

(19) Zero dispersion wavelength shall be 1300 to 1324 nanometer.

(20) Maximum zero dispersion slope shall be 0.092 picosecond (ps) / (nanometer^2 x kilometer(nm^{2}xkm).

(21) Cable cut-off wavelength (λcc) shall be ≤1260 nanometer (nm).

(22) Bend performance shall be-

(a) at 1310 nanometer (nm) (75±2 millimeter(mm) dia Mandrel), 100 turns: Attenuation Rise <0.05 decibel (dB);

(b) at 1550 nanometer (nm) (30±1 millimeter(mm) radius Mandrel), 100 turns; Attenuation Rise ≤0.05 decibel (dB);

(c) at 1550 nanometer (nm) (32±0.5 millimeter(mm) dia Mandrel), 1 turn; Attenuation Rise ≤0.50 decibel (dB).

(23) Polarisation mode dispersion coefficient shall be ≤0.2 picosecond/kilometer$^{1/2}$ (ps/km$^{1/2}$).

(24) The relevant standards and code of practice of fibre optic communication as specified in the Bureau of Indian Standards (BIS), the International Telecommunications Union Telecommunication (ITU-T), the International Electro-Technical Commission (IEC), the Institute of Electrical and Electronics Engineers (IEEE), the Electronic Industries Association/ Telecommunications Industry Association (EIA/TIA), the Bell Core, the Telecommunication Engineering Centre (TEC), the American Society for Testing and Materials (ASTM) and the Electro chemical Impedance Spectroscopy (EIS) shall be followed.

CHAPTER V

POWER LINE CARRIER COMMUNICATION

27. Requirements of power line carrier communication. - (1) Power line carrier communication (PLCC) shall be used in the grid network between two consecutive substations and power line carrier communication shall provide speech, data and tele-protection requirements of the power system.

(2) Power line carrier communication shall be duplex, independent transmission (Tx) and receiving (Rx) channels, operating in the carrier frequency spectrum 40 to 500 kHz.

(3) Power line carrier communication terminal shall be operated in either analogue power line carrier communication or digital power line carrier communication (DPLC) or mixed mode.

(4) Power line carrier communication shall be suitable for use with the outdoor equipment viz. line traps, capacitive voltage transformer (CVT), coupling device and high frequency (HF) cable.

(5) Input circuit of the power line carrier communication terminal shall be provided with protective device to eliminate any surge transfer.

(6) Companders and expanders shall be provided to improve voice transmission characteristics for the system.

(7) Fail safe devices shall be provided to avoid malfunction in one unit or damage of any sub- assembly.

(8) Power line carrier communication set shall be designed to give guaranteed

performance from 0 deg. C to 50 deg. C and the thermal capability of the equipment shall be so designed to be operational up to 55 deg. C for 24 hours continuously.

(9) Coupling device (line matching unit and protective devices) shall be interposed between the capacitive voltage transformer and the connection line (co-axial cable) to the power line carrier communication terminals and shall conform to the carrier frequency operating characteristics between phase to earth coupling units as specified in following Table, namely: -

TABLE

Serial number	**Characteristics**	**Units**	**Values**
(1)	**(2)**	**(3)**	**(4)**
1.	Nominal impedance (equipment side)	Ohm (Ω)	150 (for balanced secondary circuit) 75 (for unbalanced secondary circuit)
2.	Maximum composite loss	decibel (dB)	2
3.	Return Loss	decibel (dB)	Equal to or greater than 12 decibel (dB)
4.	Transmission band	Kilo Hertz (kHz)	40 to 500

(10)The coupling device shall be suitable for outdoor mounting and shall be fitted on the steel structure and the temperature of metallic equipment mounted outdoor is expected to rise up to 65 deg. C with ambient temperature of 50 deg. C.

(11)High frequency cable shall be provided to connect coupling unit installed in the sub-station to the power line carrier communication terminals installed indoors, and values of attenuation per km of the cable shall be as per the following Table, namely: -

TABLE

Frequency (kilohertz)	**Attenuation (decibel/Kilometer) (dB/km)**
10	0.8
60	1.4
300	3.3
500	4.7

(12)The nominal bandwidth for transmitting or receiving shall be programmable from 4 kilohertz (kHz) to 8 kilohertz (kHz) in steps of 4 kilohertz (kHz). Power Line Carrier Communication terminal at bandwidth of 4 kilohertz (kHz) shall be suitable for following configuration, namely:-

(a) speech + 4 x 1200 Baud Data (minimum);

(b) data rates shall be selectable in steps, compliant with commonly used standardised data rates such as 200, 300, 600 and 1200 Bauds; and for digital power line carrier communication 1200, 2400, 4800 and 9600 bauds;

(c) gross speed and transmission bandwidth shall be programmable for up to 28.800 kilo bit/s in 4 kilohertz (kHz) spectral bandwidth, up to 72 kilo bit/s in 8 kilohertz (kHz) bandwidth;

(d) return loss in the transmitter band shall be >10 decibel (dB);

(e) tapping loss shall be <1.5 decibel (dB) (as per International Electro-Technical Commission (IEC):60495);

(f) automatic gain control (AGC) range of the receiver shall be 40 decibel (dB) (minimum).

(13)Regarding data multiplexing-

(a) power line carrier communication terminal shall be provided with an internal multiplexer for the time division multiplexing of up to eight serial data channels which can be allocated individually to the internal modems.

(b) data ports shall be compliant with V.24/V.28, RS232 and/ or V.11/ X.21/ X.24 as per functional requirement.

(c) ethernet port shall be provided for equipment configuration via Local Area Network (LAN), or for general IP forwarding and shall have facility to operate at 9600 bits/s at good signal-to-noise ratio (SNR) of 35 decibel (dB) and above within the nominal band width of 4 kHz and this functionality shall be possible for signal-to-noise ratio (SNR) of 25 decibel (dB) for band width of 8 kilohertz (kHz).

(14)Power line carrier communication equipment comprising of not limited to the following shall be provided -

(a) coupling devices (Line matching unit and protective devices);

(b) coupling filters;

(c) high frequency cable;

(d) power line carrier terminals;

(e) tele protection equipment;

(f) private automatic exchange;

(g) 48V direct current (DC) power supply equipment; and

(h) wave trap.

(15)The relevant standards and code of practice of power line carrier communication as specified in the Bureau of Indian Standards (BIS), the International Electro-Technical Commission (IEC), the European Standards (EN) and the International Special Committee on Radio Interference (CISPER) shall be followed.

CHAPTER VI
CELLULAR COMMUNICATION

28. Requirements of cellular communication.-(1) Cellular communication may be used for data acquisition system, where feasibility of access to wideband network is not possible.

(2) Cellular communication shall be adopted after ensuring the available signal level up to the required strength and dual or more Subscriber Identification Module (SIM) with different service provider with automatic changeover to ensure 99.5 per cent. link availability for interruption free operation of the communication system.

(3) Design shall be for satisfactory and continuous operation in open environment with operating temperature range of -10 deg. C to 55 deg. C and humidity up to 95 per cent. noncondensing.

(4) Field interface shall be optical port / RS232 / RS485 / RJ45 IP or any other suitable port.

(5) Receiving device shall support International Electro-Technical Commission (IEC) - 60870 -5- 101 and International Electro-Technical Commission (IEC) – 60870 -5- 104 protocol and Device Language Message Specification (DLMS) (IS15959/IEC 62056), Modbus for interfacing.

(6) Receiving end shall have Multi Wide Area Network Virtual Private Network (WAN VPN) concentrator with built-in facility to manage at least 250 remote nodes for a fixed IP provided for control center.

(7) Receiving end shall have redundant Multi Wide Area Network Virtual Private Network (WAN VPN) Concentrator with a fail over – fall back feature for uninterrupted data communication.

(8) Router shall be capable of handling Virtual Private Network (VPN) based security by assuming a fixed IP issued by the Multi Wide Area Network Virtual Private Network (WAN VPN) concentrator at the supervisory control and data acquisition (SCADA) end.

(9) Device shall have the capability of data encryption with Triple Data Encryption Standard (3-DES) or Advanced Encryption Standard (AES) 128 or latest to ensure secured communication network over broadband, 2G or 2.5G or 3G or 4G or 5G or latest.

(10) Device shall have capability to decide and act according to the best available link in redundant mode configuration with automatic switch over.

(11) Quality of service (QoS) and bandwidth management shall be planned to get optimal bandwidth usage.

(12) Centralised monitoring at control centre shall be available.

(13) Receiving device shall have Internet Protocol Security (IPsec), Point-to-Point Tunneling Protocol (PPTP), and Layer 2 Tunneling Protocol Virtual Private Network (L2TP VPN) support up to eight concurrent tunnels with max 70 Mbps throughput.

(14) Communication equipment or modem shall comply with Ingress Protection (IP) rating suitable for the installation condition as agreed between the user and provider.

(15) The relevant standards and code of practice of cellular communication as specified in the Bureau of Indian Standards (BIS), the International Electro-Technical Commission (IEC), the European Standards (EN), the European Telecommunications Standards Institute (ETSI) and the International Special Committee on Radio Interference (CISPER) shall be followed.

CHAPTER VII

VERY SMALL APERTURE TERMINAL COMMUNICATION

29. Requirement for very small aperture terminal. - (1) Very small aperture terminal communication shall be used for supervisory control and data acquisition (SCADA) control functions of power system operation and shall not be used for primary protection function of power system as geo-stationery satellite hop delay is 240 milliseconds.

(2) Very small aperture terminal shall be able to work with all geostationary satellites to the extent possible, visible from India and work efficiently from all parts of India.

(3) Very small aperture terminal shall work either on Ku-band or C-band or extended C band or any other band for interruption free continuous operation in extremely rainy (more than 10 millimeter/hour intensity) and cloudy conditions.

(4) Very small aperture terminal communication shall be adopted after ensuring link availability of 99.5 per cent. and required level of signal strength.

(5) Very small aperture terminal communication shall not be part of national or State wideband backbone network.

(6) All regulatory clearance from regulatory bodies shall be taken to operate the very small aperture terminal communication.

(7) All regulatory guidelines including size of the antenna shall be followed.

(8) Pool band width feature shall be adopted for the very small aperture terminal network.

(9) Uplink and down link configuration of very small aperture terminal communication shall be redundant (1 + 1) at Hub.

(10) Very small aperture terminal communication network shall be designed based on Frequency Time Division Multiple Access (FTDMA) or Multi-frequency Time Division Multiple Access (MFTDMA) or Single Channel Per Carrier Demand Assigned Multiple Access (SCPC DAMA) technology or any other proven future technology with configurable data rate as per data communication requirement.

(11) Bit error rate shall be lesser than $1 X 10^{-7}$ (data) to $1 X 10^{-4}$ (Voice).

(12) Very small aperture terminal communication shall support broadcast, unicast, multicast, transmission control protocol (TCP) spoofing.

(13) Very small aperture terminal communication shall support IP RJ45 (IP or E&M).

(14) Receiving device shall support the International Electro-Technical Commission (IEC) - 60870 -5- 104 and the International Electro-Technical Commission (IEC) - 60870 -5-101 protocols for interfacing data as well as to IPv4, IPv6, RIP v1, v2, Address Resolution Protocol (ARP) / Virtual Local Area Network (VLAN), Internet Control Message Protocol (ICMP), Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Telnet, Internet Group Management Protocol (IGMP), v1, v2, Simple Network Management Protocol (SNMP) for networking utilities.

(15) Very small aperture terminal communication system shall be designed for 230 V +/- 30% alternating current (AC) power supply at 50 Hz.

(16) Very small aperture terminal communication system shall be designed for trouble free operation at temperature range -10 deg. C to 55 deg. C and humidity up to 95 per cent. non-condensing, and wind speed of minimum 80 kilometers per hour (kmph).

(17) Very small aperture terminal communication system shall be able to deliver bi-directional composite data traffic.

(18) Round trip delay shall be less than 800 milliseconds (ms).

(19) Very small aperture terminal in door unit (IDU) (for remote sites) shall support Transport Control Protocol/ Internet Protocol (TCP/IP) without the need of an external router.

(20) Very small aperture terminal in door unit (IDU) shall have separate storage banks for software and firmware, to enable configuration changes pertaining to either the terminal (firmware) or the overall system architecture (software), without affecting the other.

(21) Very small aperture terminal shall be able to take the software and firmware downloads from the hub over the air, without any disturbance to the online user traffic while in operation on per terminal (Unicast), per group (Multicast) or entire network

(Broadcast) basis.

(22) The relevant standards and code of practice of very small aperture terminal communication as specified in the Bureau of Indian Standards (BIS) and the International Telecommunications Union (ITU-R) shall be followed.

CHAPTER VIII

RADIO FREQUENCY COMMUNICATION

30. Requirement of radio frequency communication. - (1) Radio frequency (RF) communication shall be used below 132 kilovolt / 110 kilovolt system for low speed data acquisition system and shall not be used for protection of power system equipment.

(2) Radio frequency (RF) communication shall be adopted after ensuring required level of signal level with clear line of sight and link availability (99.5 per cent.) for interruption free operation of the communication system.

(3) Radio frequency (RF) communication shall be designed for satisfactory and continuous operation in open environment with operating temperature range of -10 deg. C to 55 deg. C and humidity up to 95 per cent. non-condensing.

(4) Radio frequency (RF) communication shall not be part of national or State wideband backbone network.

(5) Utilisation of radio spectrum in radio frequency (RF) communication shall be subject to regulatory clearance and all regulatory guidelines shall be followed.

(6) Radio frequency (RF) communication shall be capable of delivering data, voice and video conferencing, and latency shall be less than 5 milliseconds (ms).

(7) Radio frequency (RF) communication equipment shall comply with Ingress Protection (IP) rating suitable for the installation condition as agreed between the user and provider.

(8) Radio frequency (RF) communication system shall support concurrent use of Internet Protocol (IP), voice over internet protocol (VoIP) and video.

(9) Radio frequency (RF) communication shall be capable of channel bandwidth selection with 5 MHz steps.

(10) Radio frequency (RF) communication shall be capable to capture both side (local and remote) spectrum view and the equipment shall have site and link management facility for configuration.

(11) Radio frequency (RF) communication shall support Simple Network Management Protocol (SNMP), Management Information Base (MIB) II and Bridge Management Information Base (MIB).

(12) After terminating the radio frequency (RF) network at the gateway, the upstream communication till the receiving end control centre shall comply to IPv4 and IPv6

network protocols with backward compatibility feature.

(13) Radio frequency (RF) communication shall have facility to upgrade software over the air from remote.

(14) Gateway device shall have 10 BASE-T/100 BASE-TX ethernet port to connect to any network.

(15) Network Management System (NMS) shall be provided to monitor the performance from the control centre and the Network Management System shall be capable to provide bandwidth utilisation, latency, link health and signal strength of the network.

(16) Radio frequency (RF) communication network shall support multiple communication protocols to provide flexibility.

(17) Radio frequency (RF) communication shall provide scalability, interoperability and future proofing.

CHAPTER IX

RELAXATION AND INTERPRETATION OF REGULATIONS

31. Relaxation and Interpretation of Regulations. – The Authority may, by order and for reasons to be recorded in writing, relax any of provisions of these regulations in respect of the matters referred to the Authority on case to case basis.

SCHEDULE I

[See regulation 5(3)]

Data interval time

Category	Data Type	Time Interval (Sec)			Time Interval (Sec) via Data Concentrator		
		765 or 400 kV	220* or 132** kV	Below 132** kV	765 or 400 kV	220* or 132** kV	Below 132** kV
Automatic Generation Control (AGC)	Analog Value	2		3	2		3
Dispatch	Status	2	3	4	2	3	5
	Analog Value	4	5	6	4	5	7
Phasor	Analog/Status	0.04 to 0.01			0.04 to 0.01		
Forecast/	Value	60			60		

Weather			

* 220kV may be read as 220 kV or 230 kV depending on voltage level defined.

** 132kV may be read as 132 kV or 110 kV depending on voltage level defined.

SCHEDULE II

[See regulation 6(3)]

Standards for interfacing to communication system

Interfaces	Type	Standards
Electrical Interface	Ethernet	IEEE 802.3 / IEEE 802.3u
	Ethernet VLAN	IEEE 802.1 P/Q
	Serial	RS232 / RS422 / RS485 / X.21 / X.25 / G.703 / V.35 / RJ45
Optical Interface		ITU-T G.957, G.958
Tele-protection /Control	Relay	IEEE C37.94, ITU-T G.703
Voice		2-wire FXO/2-wire FXS/ 4- wire E&M, VoIP
SDH		ITU-T G.821/G.826
IP - Packet Switched Networks	Layer 2.5 OSI	RFC 2702, RFC 4379, RFC 4090 & RFC 4553 – Circuit Emulation
RF		IEEE 802.11s, IEEE 802.15.4, ETSI EN 300 220-1, ETSI EN 300 440.
Cyber Security		MD5 Authentication, 3.SNMPv3, Radius/TACS+
Video		H.323
Cellular	GPRS/3G/4G/ NBIoT/MPLS	ETSI, 3GPP Compliant
MPLS-TP:		G.8110,8112,8113.1,8113.2,8121,8121.1,8121.2,8131,8151,8152.
MPLS-IP:		As per standard Industry practice.

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the 23rd December, 2022

CEA-TH-17/1/2021-TETD Division. - Whereas the draft of the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022 was published in six newspaper dailies, as required by sub-section (3) of section 177 of the Electricity Act, 2003 (36 of 2003) read with sub-rule (2) of rule 3 of the Electricity (Procedure for Previous Publication) Rules, 2005, inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of forty-seven days, from the date on which the copies of the newspaper containing the said draft regulations were made available to the public;

And whereas copies of the said newspapers containing the public notices and the said draft regulations on the website of the Central Electricity Authority were made available to the public on the 30th December, 2021;

And whereas the objections and suggestions received from the public on the said draft regulations were considered by the Central Electricity Authority;

Now, therefore, in exercise of the powers conferred by clause (e) of sub-section (2) of section 177 of the Electricity Act, 2003 (36 of 2003) read with clause (b) of section 73 of the said Act, the Central Electricity Authority hereby makes the following regulations, namely: -

CHAPTER I

1. **Short title, commencement and applicability. -** (1) These regulations may be called the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022.

   (2) Applicability. - These regulations shall apply to generating companies, transmission licensees, distribution licensees, Central Transmission Utility, State Transmission Utilities.

   (3) They shall come into force on the date of their publication in the Official Gazette.

2. **Definitions-** (1) In these regulations, unless the context otherwise requires,

   (a) "Act" means the Electricity Act, 2003;

   (b) "Authority" means the Central Electricity Authority established under sub-section (2) of Section 70 of the Act;

   (c) "Automatic voltage regulator" means a continuously acting automatic excitation control system to
   regulate a generating unit terminal Voltage;

   (d) "Autotransformer" means a power transformer in which at least two windings have common section;

(e) "Base load operation" means operation at maximum continuous rating or its high fraction;

(f) "Basic insulation level" means reference voltage level expressed in peak voltage with standard 1.2/50 μs lightning impulse wave. Apparatus shall be capable of withstanding test wave of basic insulation level or higher;

(g) "Black start" means the startup of a generating unit or gas turbine or internal combustion engine based generating set without use of external power following grid failure;

(h) "Boiler maximum continuous rating" means the maximum steam output, the steam generator can deliver continuously at rated parameters;

(i) "Break time" means interval of time between the beginning of the opening of a switching device and the end of the arcing;

(j) "Cold start", in relation to steam turbine, means start up after a shutdown period exceeding seventy two hours (turbine metal temperatures below approximately forty percent of their full load values);

(k) "Combined cycle gas turbine module" means gas turbine generators, associated heat recovery steam generators and steam turbine generator;

(l) "Control load", in relation to coal or lignite based thermal generating units, means the lowest load at which the rated steam temperature can be maintained under auto control system;

(m) "Design head" means the net head at which peak efficiency of hydraulic turbine is attained while operating at rated output;

(n) "Generator transformer" means power transformer required to step up generator voltage to connected bus voltage;

(o) "Gross head" means the difference in elevation between the water levels of upstream reservoir and the center line of the turbine runner in case of Pelton turbine and tail race water level at the exit end of the draft tube in case of Francis and Kaplan turbine;

(p) "Gross Station Heat Rate" or "Station Heat Rate" means the heat energy input in kCal required to generate one kWh of electrical energy at generator terminals of a thermal generating station.

(q) "Gross turbine cycle heat rate", in relation to coal or lignite based thermal generating station, means the external heat energy input to the turbine cycle required to generate one kWh of electrical energy at generator terminals;

(r) "High heat value" means the heat produced by complete combustion of one kilogram of solid fuel or liquid fuel or one standard cubic metre of gaseous fuel as determined as per relevant Indian Standard;

(s) “Highest system voltage” means the highest root mean square line to line value of voltage which can be sustained under normal operating conditions at any time and at any point in the system. It excludes temporary voltage variation due to fault conditions and the sudden disconnection of the large load;

(t) “Hot start”, in relation to steam turbine, means start up after a shut down period of less than ten hours (turbine metal temperatures approximately eighty percent of their full load values);

(u) “House load” means the unit is operating in isolation to the grid and generating electric power to cater to its own auxiliaries;

(v) “Impedance earthed neutral system” means a system whose neutral point is earthed through impedances to limit earth fault currents;

(w) “Impulse” means a unidirectional wave of voltage or current which, without appreciable oscillations, rises rapidly to a maximum value and falls, usually less rapidly, to zero with small, if any, loops of opposite polarity. The parameters which define a voltage or current impulse are polarity, peak value, front time, and time to half value on the tail;

(x) “Impulse withstand voltage” means peak value of the standard impulse voltage wave which the insulation of an equipment is designed to withstand under specified test conditions;

(y) “Insulation co-ordination” means the selection of the dielectric strength of equipment in relation to the voltages which can appear on the system for which the equipment is intended and taking into account the characteristics of the available protective devices;

(z) “Isolated neutral system” means a system where the neutral point is not intentionally connected to earth, except for high impedance connections for protection or measurement purposes;

(za) “Maximum continuous rating”,-

(i) in relation to coal or lignite based thermal generating units, means maximum continuous output at the generator terminals (net of any external excitation power) as guaranteed by the manufacturer at the rated parameters;

(ii) in relation to combined cycle gas turbine module, means the sum of maximum continuous output of the Gas Turbine Generator and Steam Turbine Generator measured at the generator terminals (net of any external excitation power) as guaranteed by the manufacturer for design fuel and corresponding to site conditions;

(iii) in relation to Internal Combustion engine based generating sets, means maximum continuous output at the generator terminals (net of any external excitation power) as guaranteed by the manufacturer for design fuel and corresponding to site conditions;

(zb) "Maximum net head" means the net head resulting from the difference in elevations between the maximum head water level and the center line of turbine runner for vertical Pelton turbine and tailrace water level for vertical Francis turbine with one unit operating at no load speed corresponding to turbine discharge of approximately five percent of the rated flow. Under this condition, the hydraulic losses are negligible and may be disregarded;

(zc) "Mesh voltage" means the maximum touch voltage within a mesh of a ground grid;

(zd) "Minimum net head" means the net head resulting from the difference in elevation between the minimum head water level or the minimum draw down level and the center line of turbine runner for vertical Pelton turbine and the maximum tail water level for vertical reaction turbine;

(ze) "Minimum tail water level" for a hydro station means the water level in the discharge chamber in case of Pelton turbine and tail race at the exit end of the draft tube in case of Francis and Kaplan turbines corresponding to a discharge required to run one machine at no load;

(zf) "Motor control centre" means the switchgear which contains modules for electric supply to motor and associated load like heaters, actuators, control transformers etc. and their control;

(zg) "Net head" means the gross head less all hydraulic losses, including draft tube exit losses, wherever applicable and excluding those pertaining to the turbine;

(zh) "Overhead line" means any electric line which is placed above the ground and in the open air, but does not include live rails of traction system;

(zi) "Owner" means the company or body corporate or association or body of individuals, whether incorporated or not or artificial juridical person who owns or operates or maintains Electrical Plants or Electric Lines or both;

(zj) "Power system stabilizer" means controlling equipment which receives input signals of speed, frequency and power to control the excitation via the voltage regulator for damping power oscillations of a synchronous machine;

(zk) "Performance coal" means the coal of quality for which steam-generator erformance is guaranteed by the manufacturer;

(zl) "Power transformer" means a transformer that transfers electric energy in any part of the circuit between the generator and the distribution primary circuits;

(zm) "Pump turbine" means a hydraulic turbine having a runner capable of running in one direction in generating mode and reverse direction in pumping mode;

(zn) "Pumped storage plant" means a system of generating electricity in which the electricity is generated during the peak hours by using water that has been pumped into upper reservoir during off-peak hours from the lower reservoir;

(zo) "Runaway speed" means the speed attained by the hydraulic turbine at full gate opening while operating at maximum head conditions when the generator is disconnected from the system and the governor is in-operative;

(zp) "Solidly earthed neutral system" means a system whose neutral point is earthed directly;

(zq) "Specific speed" defined in metric kW, in relation to hydraulic turbine, means the speed in rotations per minute at which a given hydraulic turbine would rotate, if reduced homologically in size, so that it would develop one metric horse power under one meter of net head;

(zr) "Station" means either the Thermal Generating Station or Hydro-electric Generating Station depending upon the context;

(zs) "Station transformer" means power transformer required to step down the grid voltage to cater to the starting and shut down of generating unit load and station load during running;

(zt) "Step potential" means the maximum value of potential difference possible of being shunted by a human body between accessible points on the ground separated by distance of one pace which may be assumed to be one metre;

(zu) "Sub-critical unit", in relation to coal or lignite based thermal generating unit, means a unit designed for main steam pressure less than the critical pressure (225.56 kg/ cm^2);

(zv) "Super-critical unit", in relation to coal or lignite based thermal generating unit, means a unit designed for main steam pressure more than the critical pressure (225.56 kg/cm^2);

(zw) "Surge arrester" means a protective device for limiting surge voltages on equipment by diverting surge current and returning the device to its original status and is able to repeat these functions as specified;

(zx) "Switchyard" means a sub-station associated with a generating station for transforming electricity for further transmission;

(zy) "Synchronous condenser mode" refers to that condition of the synchronous machine coupled to the turbine when it is running only with mechanical load and supplying leading or lagging reactive power;

(zz) "Thermal generating station" means the 'generating station' as defined in clause (30) of section 2 of the Act for generating electricity using fossil fuels such as coal, lignite, gas, liquid fuel or combination of these as its primary source of energy;

(zza) "Touch potential" means the potential difference between the object touched and the ground point just below the person touching the object when ground currents are flowing;

(zzb) "Transformer" means a static electric device consisting of a winding, or two or more coupled windings, with or without a magnetic core, for introducing mutual coupling between electric circuits to transfer power by electromagnetic induction between circuits at the same frequency, usually with changed values of voltage and current;

(zzc) "Transients" means over voltage or over current phenomena prevailing in an electrical system for a short period of the order of a fraction of a second or a few seconds not exceeding five seconds;

(zzd) "Turbine setting", in relation to hydro-electric generating station, means the elevation of runner center line with respect to maximum tail water level for vertical Pelton turbine installation and the elevation with respect to minimum tail water level for Francis or Kaplan turbine installation;

(zze) "Unit auxiliary transformer" means the transformer meant for catering the loads connected to unit buses corresponding to auxiliaries required for respective Boiler, Turbine and Generator;

(zzf) "Unit",-

(i) in relation to a coal or lignite based thermal generating station, means steam generator with interconnected steam turbine-generator and auxiliaries, operated as one single set or system to generate electric power;

(ii) in relation to a hydro- electric generating station, means generator with interconnected turbine and auxiliaries, operated as one single set or system to generate electric power.

(zzg) "Ultra super-critical unit" in relation to coal or lignite based thermal generating unit means a supercritical unit with steam temperature of 600/600^{0}C or higher at turbine inlet;

(zzh) "Warm start", in relation to steam turbine, means start up after a shutdown period between ten hours and seventy two hours (turbine metal temperatures between approximately forty percent and eighty percent of their full load values).

(2) words and expressions used herein and not defined but defined in the Act shall have the meanings respectively assigned to them in the Act.

3. **General requirements.─** (1) The Electrical Plants and Electric Lines shall be suitable for full range of ambient and other environmental conditions as prevailing at site.

(2) The various parts or components or assemblies of equipment and systems shall be of proven materials with well established physical and chemical properties appropriate to the service as intended.

(3) All equipment and systems installed shall comply with the provisions of statutes, regulations and safety codes, as applicable.

(4) The Electrical Plants and Electric Lines shall be designed to comply with requirements stipulated in other Central Electricity Authority Regulations as well, framed under the Electricity Act 2003.

(5) (a) The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with latest version of relevant standards and codes issued by Bureau of Indian Standards or reputed international standards *viz.* International Electrotechnical Commission Standards/ American Society of Mechanical Engineers Standards/ Deutsches Institut für Normung Standards or equivalent and codes. However, in the event of any conflict between the requirements of the international standards or codes and the requirements of the Bureau of Indian standards or codes, the later shall prevail.

(b) For standardization of Test Protocols in Power Sector, Central Electricity Authority "Guidelines for the

Type Tests for major equipment of Power Sector" shall be followed.

(6) All materials, components and equipment shall be tested at all stages of procurement, manufacturing, erection, commissioning as per comprehensive Quality Assurance Programme to be agreed mutually between the Owner and the equipment supplier and which shall comply to the Central Electricity Authority "Guidelines for Model Quality Assurance Plan (MQAP) for major equipment of Power Sector".

(7) The International System or Metre-Kilogram-Second system of units shall be used for design, drawings, diagrams, instruments etc.

(8) The owner shall retain in good condition and make available for lifetime at the site following documents (the owner shall also keep the records updated as per modifications done in the system from time to time):

(a) as-built drawings including, but not limited to the civil, mechanical, electrical, instrumentation and architectural works;

(b) copies of the project design memorandum, technical description, data sheets, operating manuals and
manufacturer's warranties for all major items or equipment or both;

(c) copies of the results of all tests performed as per contract and;

(d) technical documents relating to the design, engineering and construction of the electrical plant or electric line or both.

(9) (a) The Owner shall implement information technology based system for effective project monitoring so as to facilitate timely execution of the projects of capacity equal to or higher than capacity indicated below.—

(i)	Thermal generating station	:	250 MW;
(ii)	Hydro generating station	:	100 MW;
(iii)	Transmission lines and sub-stations	:	220 kV and above.

(b) The system shall be web based and shall have connectivity with major suppliers/contractors and shall also have provision for connection to centralized project monitoring system of the Authority and in compliance with all applicable codes, standards, guidelines, cyber security codes and guidelines and safety requirements in force.

CHAPTER II

TECHNICAL STANDARDS FOR CONSTRUCTION OF THERMAL GENERATING STATIONS

4. Technical Standards for construction of Thermal Generating Stations are covered in following four parts namely:-

(a) Part- A: Common to all types of Thermal Generating Stations;

(b) Part- B: Coal or lignite based Thermal Generating Stations;

(c) Part- C: Gas Turbine based Thermal Generating Stations; and

(d) Part- D: Internal Combustion Engine based Thermal Generating Stations.

PART- A

COMMON TO ALL TYPES OF THERMAL GENERATING STATIONS

5. **General Technical Requirements-** (1) The coal, lignite and gas based thermal generating stations shall be designed to give life of not less than twenty five years.

Internal Combustion engine based Stations shall be designed for life not less than fifteen years.

(2) The Station shall comply with all applicable environmental stipulations of Ministry of Environment, Forests and Climate Change in regard to ambient air quality, gaseous emissions, liquid effluent discharges, solid waste disposal, Noise level and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

(3) **Noise level.─**

(a) Noise level at the Station boundary shall not exceed the ambient air quality standard in respect of noise as notified by Ministry of Environment, Forest and Climate Change and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

(b) noise level for the continuously operating equipment shall not be more than 85 dBA at a distance of one metre and at a height of 1.5 metre from any equipment except for the following:─

(i) turbine- Generator and Pulverizers – 90 dBA

(ii) safety valves and associated vent pipes, High Pressure/Low Pressure Bypass Valve, Soot blowers or Wall blowers, Regulating drain valves – 115 dBA

(iii) Internal Combustion engine based generating sets of capacity upto one MVA. They shall meet the stipulations of Ministry of Environment, Forest and Climate Change on "Noise limit for generator sets run with diesel". For other than one mega volt ampere capacity, it shall be provided with acoustic enclosure or by treating the room acoustically in line with Ministry of Environment, Forest and Climate Change stipulations:

Provided that for short term exposure, noise levels shall not exceed the limits as stipulated in the Occupational Safety and Health Administration Standard.

(c) equipment or machines shall be provided with acoustic enclosure or acoustic treated building, wherever required so as not to exceed the permissible noise limits.

(4) Areas where a potential flammable atmosphere exist shall be classified in accordance with the provisions of latest version of relevant Indian Standard.

Provided that to the extent practicable, equipment requiring operator's attention and electrical equipment shall not be installed in hazardous areas.

(5) All the equipment and surfaces (excluding coal or lignite mills, pulverized

fuel pipes, lube oil piping and electrical equipment) having skin temperature more than $60^{0}C$ shall be provided with required insulation along with cladding.

Provided that the insulating materials, accessories and protective covering shall be non-sulphurous, incombustible, low chloride content, chemically rot proof, non-hygroscopic and shall withstand continuously and without deterioration the maximum temperature to which they can be subjected as per duty conditions.

Provided further that the insulation or finishing materials containing asbestos in any form shall not be used.

(6) Auxiliaries involving large power consumption such as motor driven boiler feed pumps, induced draft fans (radial type) shall be provided with variable frequency drive or hydraulic coupling to optimize power consumption.

6. Site Selection and Layout Considerations.─

(1) **Site selection.─** The following criteria shall be considered for selection of site for thermal generating stations**;**

(a) availability of adequate land for the Station;

(b) avoidance of proximity to geological faults, high flood zone of rivers or the high tide zones of sea or backwaters;

(c) siting criteria prescribed by Ministry of Environment, Forest and Climate Change;

(d) availability of required water;

(e) feasibility of rail, road or other linkages for transportation of fuel and equipment to the site;

(f) feasibility of power evacuation.

(2) **Layout considerations.─** The following minimum layout requirements shall be complied with as may be applicable for coal or lignite or gas turbine based Stations:

(a) the layout of the Station shall be compact so as to optimise use of land, materials and minimize system losses.

(b) adequate provision shall be made in regard to space and access in order to carry out the maintenance of various equipment.

(c) adequate maintenance facilities shall be provided, as required, for assembly, disassembly and handling during maintenance of various equipment.

(d) due consideration shall be given for the wind direction while deciding on the relative location of the following: ─

(i) cooling tower and switchyard to minimize the moisture drift towards the switchyard;

(ii) chimney and ash disposal area with respect to township and adjoining habitation areas (applicable for coal or lignite based generating stations).

(e) (i) adequate space shall be provided for unloading and maintenance purposes in Turbine- Generator area;

(ii) requisite lay down area shall be provided for each unit on Turbine-Generator floor and same shall be approachable with electric overhead travelling crane;

(iii) in case of coal or lignite based generating stations, two transverse bays shall be provided in Turbine- Generator area at ground level for unloading and maintenance purposes and for Stations with multiple units, adequate space shall be provided to meet the requirement for simultaneous maintenance of two units.

(f) coal or lignite mill-bunker bay shall preferably be located either on sides or rear of the steam generator to avoid the dust nuisance and in case bunker bay is located adjacent to Turbine- Generator area, suitable isolation arrangement (pressurization or air curtains) shall be provided to avoid entry of coal or lignite dust in Turbine- Generator area.

(g) adequate fire escape staircases shall be provided in Turbine- Generator building with fire doors at each landing.

(h) for coal or lignite based generating stations, interconnecting walkways between Turbine- Generator building and steam generator shall be provided at Turbine- Generator operating floor level and at deaerator floor level:

Provided that walkways at various levels shall also be provided for interconnection between steam generator and mill-bunker bay.

(i) minimum one staircase, for each unit or module, and minimum one elevator shall be provided in the Turbine- Generator building and in addition, at least the following elevators shall also be provided for coal or lignite based generating stations .─

(i) one passenger-cum goods elevator for each steam-generator;

(ii) one elevator for chimney with suitable landings.

(j) adequate number of permanent stores and open paved yard shall be provided as per requirement of the Station for storage of spares and materials etc.

PART- B

COAL OR LIGNITE BASED THERMAL GENERATING STATIONS

7. Operating Capabilities of a Unit in the Station.─ (1) The unit shall give Maximum Continuous Rating output under the following conditions namely:-

(a) maximum cooling water temperature at site;

(b) worst fuel quality stipulated for the unit;

(c) the generating unit and its auxiliaries shall be suitable for continuous operation without any restriction within a frequency range, voltage range and combined variation of voltage – frequency as specified in the latest Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations and its Amendments.

(2) The unit shall be capable of base load operation:

Provided that the unit shall also be capable of regular load cycling and two-shift operation.

(3) The steam turbine shall be designed for a minimum of four thousand hot starts, one thousand warm starts and one hundred fifty cold starts during its life.

(4) (a) The sub-critical unit shall be designed for constant pressure and sliding pressure operation.

(b) The supercritical unit shall be designed for sliding pressure operation or modified sliding pressure condition.

(c) At any operating load, the throttle reserve shall be sufficient so as to achieve an instantaneous increase in turbine output by five percent of the corresponding load with maximum output limited to one hundred five percent.

(5) The design shall cover adequate provision for quick start up and loading of the unit to full load at a fast rate.

Provided that the coal based thermal generating units shall have minimum rate of loading or unloading of 3% per minute between 70% to 100% of maximum continuous rating, 2% per minute between 55% to 70% of maximum continuous rating and 1% per minute between 40% to 55% of maximum continuous rating.

(6) The unit shall be capable of automatically coming down to house load and operation at this load in the event of sudden external load throw off.

8. **Steam Generator (Boiler) and Auxiliaries ─** (1) The steam generator shall normally be based on pulverized fuel combustion and shall be of sub-critical or super- critical type with single pass or two pass or any other proven flue gas path configuration:

Provided that wherever very low grade fuel or coal or lignite with high sulphur content is stipulated, fluidized bed combustion based steam generator may also be considered based on Owner’s assessment of techno- economics and availability of proposed unit size.

(2) The efficiency of the steam-generator (on high heat value basis) in percent, as

guaranteed by the manufacturer, shall not be less than the value as arrived with the following formula for the quality of performance coal or lignite:

$$\text{Minimum steam generator efficiency (\%)} = 92.5 - \frac{[\,50xA + 630(M+9xH)\,]}{HHV}$$

where,

A = % ash in fuel;

M = % moisture in fuel;

H = % hydrogen in fuel and;

HHV = high heat value of fuel in kcal/kg.

(3) The steam generator and its auxiliaries shall be suitable for outdoor installation.

(4) Boiler maximum continuous rating shall correspond to at least one hundred two percent of the steam flow at turbine inlet under valves wide open condition [including overload valves (High Pressure stage by pass), if provided] plus continuous steam requirement for auxiliary systems of the unit (e.g. fuel oil heating, etc.) when unit is operating above control load and the steam generator shall be capable to give boiler maximum continuous rating output for the worst fuel quality stipulated.

(5) All parts of the steam generator including pressure parts, vessels, piping, valves including safety valves and fittings shall meet the requirements of Indian Boiler Regulations.

(6) All start up vents shall be provided with two valves in series - one motorized isolating and other motorized regulating type.

(7) If indigenous coal is proposed as main fuel, its typical characteristics (high abrasive ash, slow burning, high ash resistivity, etc.) shall be given due consideration while designing the steam generator and auxiliaries.

(8) Pressure withstand capability of the furnace shall correspond to minimum ±660 mmwc at sixty seven percent yield strength or maximum expected pressure/draft of fans, whichever is higher.

(9) Maximum average gas velocity, when using indigenous coal, in any zone of furnace, superheater, reheater, economizer shall be ten m/sec to prevent erosion of pressure parts and maximum local velocity can be upto twelve m/s.

(10) For pulverized coal or lignite based steam-generators, fuel oil firing system shall be provided for start- up and low load flame stabilization and light diesel oil or heavy fuel oil or both shall be used for fuel oil firing system.

(11) Pulverised fuel combustion based steam generator shall not require oil support

above forty percent boiler maximum continuous rating load:

Provided that fluidized bed combustion based steam-generator shall be designed such that oil support is not needed beyond twenty five percent boiler maximum continuous rating load.

(12) The pulverized fuel system shall meet the following requirements namely:—

(a) design of pulverized fuel system shall comply with requirements of National Fire Protection Association ;

(b) coal or lignite preparation system for pulverized fuel system shall have sufficient spare milling capacity (e.g. at least one spare mill when using worst coal corresponding to maximum continuous rating in case of medium speed mills);

(c) coal supply to the mills shall be from the individual coal bunkers having storage capacity of about ten hours for the unit operation at maximum continuous rating;

(d) the coal fineness achieved from the pulverisers shall be at least 70% thru 200 mesh (75 microns) and 98% thru 50 mesh (300 microns) at rated capacity of the pulveriser, with an input coal size up to 50 mm.

(13) To maintain balance draft conditions in the furnace over the entire load range while burning the stipulated range of fuel, 2x60% forced draft fans and 2x60% induced draft fans shall be provided.

(14) Suitable air pre-heating system shall be provided for recovery of useful heat from the exhaust flue gases:

Provided that steam coil air pre-heater may also be provided for maintaining air temperature within safe limits to prevent acid corrosion during start up or very low ambient air temperature conditions.

(15) The soot blowing system shall be provided for the waterwall, superheater, reheater, economizer and air preheater.

(16) The dust collecting system (electro-static precipitator, bag filter etc.) shall be provided for removing suspended particulate matter from the flue gases to meet the statutory stipulation as per environmental clearances and electro-static precipitator shall comply with following requirements namely:—

(a) electro-static precipitator shall be able to meet the stipulated suspended particulate matter emission requirement even when one electric field in each pass of the electro-static precipitator is out of service while firing stipulated worst fuel with unit operation at maximum continuous rating;

(b) electro-static precipitator shall be provided with effective ash evacuation system having controls for ash temperature and monitoring of ash level in the hopper.

(c) each hopper shall have a storage capacity of minimum of eight hours with unit operation at maximum continuous rating and the hopper valley angle to the horizontal shall be minimum sixty degrees;

(d) specific weight of ash may be considered not more than 650 kg/m³ for determining hopper storage capacity and not less than 1350 kg/m³ for electro-static precipitator structural design;

(e) pressure withstand capability of the electro-static precipitator casing shall correspond to minimum ±660 mmwc at 67% yield strength and flue gas temperature of 200^{0}C.

9. **Steam Turbine and Auxiliaries.─** (1) The steam turbine shall comply with latest versions of relevant International Electrotechnical Commission standards or equivalent.

(2) The gross turbine cycle heat rate as guaranteed by the equipment manufacturer shall not exceed the following values:

Table 1

Unit rating (MW)	**Heat rate* (kcal/ kWh) at 100% maximum continuous rating with motor driven boiler feed pump**	**Heat rate* (kcal/ kWh) at 100% maximum continuous rating with turbine driven boiler feed pump**
50 MW to less than 100 MW**	2280	-
100 MW to less than 200 MW**	2000	-
200 MW to less than 250 MW**	1970	-
250 MW to less than 500 MW**	1955	-
500 MW and above**	1895	1935
Supercritical units	1770	1830
Ultra Supercritical units	1725	1790

Note: ─*corresponding to reference conditions of 33°C cooling water temperature and 0% de-mineralised water make up.

** sub-critical units.

(3) The steam turbine shall be of tandem or cross compound construction, reheat, condensing type with number of uncontrolled extractions as optimized for regenerative feed heating.

(4) The steam flow through steam turbine under valves wide open condition shall correspond to one hundred five percent of steam flow corresponding to maximum continuous rating output and the turbine output under valves wide open condition shall be minimum one hundred five percent of maximum continuous rating output.

(5) A self-contained lubricating oil system shall be provided for each steam turbine-generator:

Provided that one main oil pump shall be provided which may be either directly driven by turbine shaft or by an alternating current motor with a minimum of one alternating current motor driven auxiliary oil pump as standby for the main oil pump:

Provided further that provision shall also be made for one direct current motor driven emergency oil pump for meeting lubricating oil requirement during non-availability of alternating current motor driven pump.

(6) Suitable mechanism shall be provided to ensure lubrication and prevent damage to bearings of steam turbine-generator during starting or turning gear operation:

Provided that in case jacking oil system is provided to supply high pressure oil to bearings of steam turbine-generator to lift the rotor during starting or turning gear operation, the same shall be with 2x100% jacking oil pumps (one alternating current driven and one direct current driven).

Provided further that hand barring gear shall be provided for manually rotating the turbine in an emergency.

(7) The oil used for turbine governing (control) shall be supplied either from the lubricating oil system or from a separate control oil system and in case of separate control oil system, the pumps provided shall be of 2x100% capacity:

Provided that fire resistant fluid shall be used in control fluid system for all hydraulically operated valves or servo motor of turbine stop and control valves.

(8) Each steam turbine shall be provided with one main oil tank of capacity five to eight oil changes per hour (at normal operating level) and oil purification system of adequate capacity and in addition, the station shall be provided with central turbine oil storage and purification system consisting of one pure oil tank, one dirty oil tank and oil purification unit.

(9) The steam turbine shall be provided with electronically controlled electro-hydraulic governing system:

Provided that the steam turbines of rating higher than two hundred mega watt shall be provided with back up governing system of mechanical hydraulic or electro- hydraulic type.

(10) The turbine shall be provided with protective devices as per relevant International Electrotechnical Commission or equivalent, including the following namely: —

(a) separately actuated over-speed trip device;

(b) emergency hand trip devices to facilitate manual tripping of the turbine locally and from control room.

(11) Turbine vibrations shall be minimized and shall be within limits as per latest version of relevant standards of International Organisation for Standardisation.

(12) Non-return valves shall be provided in the steam extraction lines as required for protection from overspeed that may result from sudden load throw off or turbine trip.

(13) Hydraulic or pneumatic or diesel generator operated device shall be provided for rapid reduction of vacuum in condenser to bring turbine rotor to rest as quickly as possible under emergency conditions.

(14) The start-up and drainage system shall comply with relevant American National Standards Institute or American Society of Mechanical Engineers Standard or equivalent regarding prevention of water damage to steam turbines.

(15) For steam turbines of rating higher than hundred mega watt, turbine by-pass system of capacity not less than sixty percent of boiler maximum continuous rating steam flow shall be provided for fast hot and warm start ups of unit, dumping steam in condenser during sudden turbine trip (without tripping the steam generator), unit house load operation etc.

(16) Condensate polishing system shall be provided in the steam turbine cycle for the following namely:-

(a) units with rated pressure of about 170 kg/cm^2 and above at turbine inlet;

(b) units with once- through steam generators;

(c) units using sea water for condenser cooling.

(17) Suitable feed water regenerative system consisting of low pressure heaters, deaerator and high pressure heaters shall be provided for optimized cycle efficiency:

Provided that feed water heaters and deaerator shall be designed in accordance with the American Society of Mechanical Engineers boiler and pressure vessels codes and Heat Exchanger Institute Standards or equivalent.

(18) Steam condenser shall meet the following requirements namely:—

(a) the design, manufacturing and testing of condenser shall be as per Heat Exchanger Institute Standards or equivalent;

(b) condenser tubes shall be of stainless steel except in case of units using sea water for cooling in which case condenser tubes shall be of titanium;

(c) on load condenser tube cleaning system shall be provided for regular cleaning of condenser tubes: Provided that debris filter shall also be provided at condenser inlet for sea water application;

(d) vacuum pumps or steam ejectors shall be provided as per Heat Exchanger Institute Standards or equivalent for evacuating air steam mixture and non-condensable gases from the condenser.

(19) 3x50% or 2x100% condensate extraction pumps as per Hydraulic Institute Standards design shall be provided for each unit.

(20) The unit shall be provided with boiler feed pumps of adequate capacity to give rated output and the design shall meet the requirements of Hydraulic Institute Standards or equivalent:

Provided that the following configurations may be adopted subject to compliance of Indian Boiler Regulations:

(a) Large Size Units (500 MW & above)

2x50% or 1x100% turbine driven boiler feed pump plus one number motor driven boiler feed pump of adequate capacity for start-up of the unit.

or

2X50% motor driven boiler feed pumps.

(b) Small Size Units (<500MW)

3x50% or 2x100% motor driven boiler feed pumps.

10. Electrical System.─

(1) **General requirements─**

(a) for the purpose of design of electrical equipment and systems, an ambient temperature of 50^0C and relative humidity of 95% shall be considered and the equipment shall be suitable for operation in a highly polluted environment:

Provided that for equipment installed in air conditioned areas, design ambient temperature shall be 35^0 C;

(b) the telecommunication system shall be based on optical fibre or power line carrier communication or both:

Provided that Owner's telecommunication equipment provided to transmit the required data of the Station to the procurer of electricity, Regional or State Load Despatch Centre and Transmission Company shall have matching equipment and compatible communication protocol with the receiving end.

(2) **Generator─**

(a) the generator shall comply with relevant Indian Standard or International Electrotechnical Commission standard;

(b) the efficiency of generator shall be more than 98% at rated load;

(c) insulation shall be thermal class F for stator and rotor winding as per relevant International Electrotechnical Commission with temperature rise limited corresponding to thermal class B insulation;

(d) generator shall be either hydrogen cooled or hydrogen and water cooled or air cooled type**:**

Provided that the hydrogen cooled generator shall be capable of delivering at least two third of its rated output with one hydrogen gas cooler out of service;

(e) resistance temperature detectors or thermocouples shall be provided at suitable locations for monitoring the temperatures of stator core, stator windings and bearings:

Provided that suitable arrangements shall also be made for monitoring the temperature of the rotor winding in case static excitation system is provided;

(f) for hydrogen cooled generators, hydrogen gas system shall be provided with driers (if applicable) of 2x100% duty to maintain dryness of hydrogen inside the machine:

Provided that suitable system shall be provided to prevent condensation during long shut down:

Provided further that the system shall have the provision of on-line dew point measurement as well as gas analyser;

(g) for water cooled stator winding, stator water cooling system shall be closed loop type with 2x100% AC motor driven circulating water pumps, 2x100% de-mineralised water heat exchangers, 2x100% filters, one mixed bed de-mineraliser and one alkalizer unit (as applicable);

(h) in case of hydrogen cooled machines, the seal oil system provided shall be equipped with 2x100% AC motor driven pumps and 1x100% DC motor driven pump and the system shall be provided with coolers and filters having 2x100% duty:

Provided that any other proven system as per Original Equipment Manufacturer's practice or recommendations shall also be acceptable subject to acceptance of the owner;

(i) Excitation System—

(i) suitable generator excitation system as well as automatic voltage regulator shall be provided with the generator as per Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007, as amended from time to time:

Provided that power system stabilizer shall be provided in automatic voltage regulator as per Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007, as amended from time to time;

(ii) the rated current of the excitation system shall be at least 110% of the machine excitation current at the rated output of the machine and the rated voltage shall be at least 110% of the machine excitation voltage;

(iii) (a) automatic voltage regulator shall have 2x100% auto channels and automatic changeover:

Provided that in the event of failure of auto channels, manual control shall be possible;

(b) in case of static excitation system, power thyristor converter shall be fully controlled three phase, full wave bridge type with fast and high ceiling performance. The converter shall have 'N+2' redundancy where N is the number of bridges required to deliver rated excitation current and 'N+1' number of bridges shall deliver the ceiling voltage or current;

(c) in case of brushless excitation system, rectifier assembly shall be provided with either complete bridge as redundant or at least one redundant parallel branch in each of the six arms of the bridge.

(j) Instrument Transformers. —

(i) Current transformers—

The type and accuracy of current transformers for protection purposes shall comply with relevant Indian Standard or International Electrotechnical Commission Standards:

Provided that current transformers for metering shall also comply with Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 as amended from time to time;

(ii) Voltage transformers—

The type and accuracy of Voltage transformers for protection purposes shall comply with relevant Indian Standard or International Electrotechnical Commission Standards:

Provided that voltage transformers for metering shall also comply with Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 as amended from time to time.

(3) **Power transformers.—**

(a) the power transformers (generator transformer, unit auxiliary transformers, station transformers) shall comply with latest versions of relevant Indian Standard or International Electrotechnical Commission Standards;

(b) the generator transformer shall be.—

(i) provided to step up generating voltage for connection to the grid:

Provided that it shall also be used to provide start-up power from the grid in case circuit breaker is provided between the generator and generator-transformer in generator circuit breaker scheme;

(ii) filled with oil and cooling shall be of oil forced air forced or oil directed air forced type:

Provided that alternate cooling arrangement *viz.* oil natural air forced, or oil natural air natural may also be adopted depending upon unit size;

(iii) provided with two or more cooling radiator banks with suitable number of standby fans and oil pumps:

Provided that the total capacity of coolers for each transformer shall be minimum one hundred twenty percent of actual requirements.

(c) the unit auxiliary transformer shall be. —

(i) used to meet the unit load requirement during normal running of the unit:

Provided that in case of generator circuit breaker scheme, it shall provide power requirement of the unit auxiliaries and station auxiliaries during start-up and normal running of the unit;

(ii) filled with oil and cooling shall be of oil natural air forced or oil natural air natural type:

Provided that oil forced air forced or oil directed air forced cooling are also acceptable depending upon transformer size;

(iii) provided with two or more cooling radiator banks with suitable number of standby fans and oil pumps:

Provided that the total capacity of coolers for each transformer shall be minimum one hundred twenty percent of actual requirements.

(d) the station transformer(s) shall be.—

(i) used to cater the start-up power requirement, station auxiliary load requirement during normal operation of the unit(s) and unit load in case of outage of Unit Auxiliary Transformer:

Provided that in case of generator circuit breaker scheme, station transformer may not be required;

(ii) filled with oil and cooling shall be of oil natural air forced or oil natural air natural type:

Provided that alternate cooling arrangement *viz.* oil natural air forced, or oil natural air natural are also acceptable depending upon unit size;

(iii) provided with two or more cooling radiator banks with suitable number of standby fans and oil pumps:

Provided that the total capacity of coolers for each transformer shall be minimum 120% of actual requirements.

(e) the insulation levels for the transformer windings and bushings shall be as per Table 10 under Regulation 45;

(f) dynamic short circuit withstand test shall be conducted on one unit of each type and rating of transformers, to validate the design and quality, unless such test has been successfully conducted as per Indian Standard 2026 part 5 within last ten years on transformer of similar design. Criteria for similar design shall be as per Annexure J of Central Electricity Authority's "Standard Specifications and Technical Parameters for Transformers and Reactors (66kV and above)";

(g) mobile centrifuging plant of adequate capacity shall be provided for purifying the transformer oil with provision of on-line testing instruments and annunciating panel.

(4) **High tension switchgear.─**

(a) High tension switchgear- vacuum type of circuit breakers shall be provided for high tension switchgear (11/6.6/3.3 kV) which shall be of draw out type, re-strike free:

Provided that the same shall be applicable for 33kV voltage level also in case used;

(b) the protective relays shall be of numerical type with self monitoring, diagnostic features and communication facility;

(c) the switchgear shall be designed for suitable fault withstanding capability.

(5) **Low tension switchgear.─**

(a) air break type of circuit breakers shall be provided for Low Tension switchgear (415 V) which shall be of draw out type, trip free, stored energy operated and with electrical anti-pumping features;

(b) the protective relays shall be of numerical type with self monitoring, diagnostic features and communication facility;

(c) the switchgear shall be designed for suitable fault withstanding capability.

(6) **Busducts.─**

(a) the busducts shall be of standard size as per relevant Indian Standard and designed to carry maximum continuous current under normal site conditions without exceeding temperature rise limits;

(b) (i) the generator busducts shall be phase segregated or isolated phase type.

Provided that the busduct rated more than 3150 Amp and upto 6000 Amp shall be isolated phase type:

Provided further that the busduct rated more than 6000 Amp shall be continuous isolated phase type;

(ii) a hot air blowing system or air pressurization system shall be provided to prevent moisture deposition in case of isolated phase busducts while space heaters may be provided in case of other busducts.

(c) (i) surge arresters and voltage transformers connected to generator busducts shall be located in separate cubicles for each of the three phases:

Provided that voltage transformers shall be accommodated in draw-out type compartments in phase-isolated manner in a cubicle;

(ii) The surge arresters and voltage transformers cubicles shall comply with relevant Indian Standard or International Electrotechnical Commission Standards;

(d) the High Tension busduct (11/6.6/3.3 kV) shall be segregated phase type and Low Tension busduct (415V) shall be non-segregated phase or sandwich type;

(e) The bus assembly shall be designed mechanically to withstand rated continuous current as well as the specified short-circuit current without damage or permanent deformation of any part of the bus structure.

(7) **Power supply system.─**

(a) all auxiliaries dedicated to the unit shall be fed from the unit bus connected to Unit Auxiliary Transformer:

Provided that during start -up and shut - down of the unit, the unit auxiliaries shall be supplied power from the station bus connected to station transformer:

Provided further that in case of generator circuit breaker scheme, the same shall be provided by the unit bus;

(b) all the loads pertaining to balance of plant facilities shall be fed from station bus connected to Station transformer.

Provided that station bus shall also be capable of supplying power to largest unit in the Station during start-up and shut-down:

Provided further that in case of generator circuit breaker scheme, the loads pertaining to balance of plant facilities shall be fed from the unit bus or any other common system bus;

(c) (i) power supplies, buses, switchgears, interlocks and standby supply systems for station and unit auxiliaries shall be designed in such a way that the equipment connected are not endangered under all operating conditions:

Provided that transformer voltage ratios, type of tap changers and tap ranges, impedances and tolerances thereon shall be so optimized that the auxiliary system voltages under various grid and loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of motors.

(ii) the vector groups of the generator transformers, unit auxiliary transformers and station transformers shall be so selected that the paralleling at 11/ 6.6/ 3.3kV buses shall be possible:

Provided that the vector group of auxiliary transformers shall have identical vector groups;

(d) in thermal power stations with unit sizes greater than one hundred mega watt, automatic bus transfer system (consisting of fast, slow, etc. transfer in auto mode) shall be provided to minimise time for transfer from unit to station buses at 11/ 6.6 kV levels:

Provided that bus transfer scheme shall also have manual mode to initiate transfer including live changeover through synchronization:

Provided further that the 11/6.6/3.3 kV switchgear buses for balance of plant facilities shall be provided with auto-closure facility to changeover supply from one source to another:

Provided also that critical 415 V switchgear buses shall also have auto-closure facility to changeover supply from one source to another;

(e) auxiliary transformers, as required, shall be provided to meet the demand at various voltage levels of auxiliary power systems, with the criteria that each switchgear, motor control centre, distribution board shall be fed by 2x100% transformers or feeders.

Provided that the auxiliary transformers shall be designed to carry the maximum expected load:

Provided further that the Low Voltage auxiliary transformers shall be energy efficient as per relevant Indian Standard:1180.

(8) **Neutral earthing.─** The earthing of neutral of various systems shall be as follows:─

(a)	Generator star point	:	Through dry type distribution transformer with secondary loaded with a resistor.
(b)	Generator transformer, Station transformer – high voltage winding star point	:	Solidly earthed.
(c)	33kV,11kV, 6.6kV or 3.3 kV system	:	Through a resistance in case of star connected windings; or Through artificial transformer with its secondary loaded with resistor in case of delta connected windings.
(d)	415 V system	:	Solidly earthed.
(e)	DC system	:	Unearthed.

(9) **Earthing system.─**

(a) the earthing system shall be designed for a life expectancy of at least forty years and for maximum system fault current or 40 kA for 1.0 sec, whichever is higher;

(b) the minimum rate of corrosion of steel used for earthing conductor shall be considered as 0.12 mm per year while determining the conductor size;

(c) grounding and lightning protection for the entire Station shall be provided in accordance with relevant Indian Standard or Institute of Electrical and Electronics Engineers Standards.

(10) **Protection system.─**

(a) fully graded protection system with requisite speed, sensitivity and selectivity shall be provided for the entire station and shall be designed to avoid mal-operation due to stray voltages:

Provided that the generator, generator transformer, unit auxiliary transformer shall be provided with protection systems connected to two independent channels or groups, such that one channel or group shall always be available for any type of fault in the generator and these transformers;

(b) the electrical protection functions for generator, generator transformer, unit auxiliary transformer and station transformer shall be provided in accordance with but not limited to the list given in **SCHEDULE-I**.

(11) **Synchronization.─** Automatic as well as manual facility along with check synchronizing and guard relay features shall be provided for closing of generator transformer or generator circuit breaker for synchronization of generator with the grid:

Provided that High Tension auxiliary buses shall also be provided with manual synchronizing facility.

(12) **Power and control *c*ables, and cabling.─**

(a) (i) power and control cables shall be flame retardant low smoke type with fire survival cables to be provided for certain essential auxiliaries;

(ii) cables to be directly buried shall be essentially armoured type;

(iii) flame retardant low smoke cables and fire survival cables shall meet test requirements as per relevant American Society of Testing and Materials, International Electrotechnical Commission, Institute of Electrical and Electronics Engineers and Swedish Standards;

(iv) derating factors for site ambient and ground temperatures, grouping and soil resistivity shall be considered while determining the size of cables.

(b) (i) cable installation shall be carried out as per relevant IS and other applicable standards;

(ii) power cables and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables with higher voltage grade cables in topmost tier and control cables in bottommost tier;

(iii) all cables associated with one unit shall preferably be segregated from cables of other units;

(iv) cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

(13) **Standby power supply system .─**

(a) automatic mains failure reliable standby power supply system shall be installed for feeding emergency loads in the event of failure of Station supply;

(b) one such supply system shall be provided for each unit of two hundred mega watt and above:

Provided that, in addition, there shall be one common standby such supply system of same rating to serve a block of two unit;

(c)station with a single unit of two hundred mega watt or higher rating shall be provided with two no. such supply system of full design capacity.

(14) **Direct current system.─**

(i) standard voltage levels of the Direct Current system shall be two hundred twenty volts, forty eight volts and twenty four volts for control and protection of various equipment:

Provided that 110V DC or 125V DC may be provided for off-site areas and for Gas Turbine as applicable;

(ii) two sets of batteries, each catering to 100% load, shall be provided for each Direct Current system with one float -cum- boost charger for each set of battery.

(15) **Illumination system.─**

(i) adequate illumination shall be provided in accordance with relevant Indian Standard:

Provided that emergency AC and DC illumination shall also be provided at important places;

(ii) energy conservation measures shall be adopted while designing the lighting system.

(16) **Motors.─**

(a)AC motors shall be squirrel cage induction type suitable for direct on-line starting and shall comply with relevant Indian Standard:

Provided that the crane duty motors may be slip ring or squirrel cage induction type.

(b) Direct current motors shall be shunt wound type.

(c) all motors shall be either totally enclosed fan cooled or totally enclosed tube ventilated or closed air circuit air cooled or closed air water cooled type.

(d) temperature rise shall be limited to 70^0 C by resistance method for both class B and class F insulation.

(e) the degree of protection of all the motors shall be IP (ingress protection) 55:

Provided that outdoor motors shall be provided with suitable canopies;

Provided further that enclosures of the motors located in hazardous areas shall be flame proof type conforming to relevant Indian Standard.

(f) all Low Tension motors shall be of minimum high efficiency (IE2) class as per relevant Indian Standard.

11. Control and Instrumentation System.─

(1) **General.─**

(a) Control and Instrumentation system provided for the Station shall be consistent with modern power station practices and in compliance with all applicable codes, standards, guidelines, cyber security codes and guidelines and safety requirements in force.

(b) The complete thermal, mechanical and electrical functions of the unit shall be remotely controlled from the central control room and those of balance of plant facilities shall be controlled from respective local control room during normal as well as emergency conditions:

Provided that the number of control areas shall be kept to the minimum with a view to optimizing manpower requirement.

(c) All standby auxiliaries shall be designed to start automatically as quickly as possible on failure of running auxiliaries as per process requirement.

(2) **Control system for steam generator and turbine generator.─**

(a) The state of art microprocessor based distributed digital control, monitoring and information system shall be provided for monitoring and control of steam generator, turbine- generator and auxiliaries and shall include monitoring and information, sequential control for drives, closed loop control for regulating drives, interlocking and protection, historical data storage, alarm annunciation system, sequence of events recording system etc.:

Provided that the distributed digital control, monitoring and information system shall be independent for each unit.

(b) (i) Control systems integral to steam generator and turbine-generator shall be implemented as part of distributed digital control, monitoring and information system:

Provided that the turbine protection system and electro- hydraulic governing system may be implemented as per standard practice of turbine manufacturer.

(ii) Control systems integral to steam generator shall include furnace safeguard supervisory system (comprising burner management system, master fuel trip, mills automation etc.) which shall comply with latest version of National Fire Protection Association code:

Provided that the master fuel trip system shall comply with requirements of relevant National Fire Protection Association or Verband der Elektrotechnik, Elektronik und Informationstechnik

(Germany) codes.

(iii) Control systems integral to turbine- generator shall include turbine protection system, electro- hydraulic governing system, turbine stress control system, turbine supervisory system, automatic turbine run up system and automatic on load turbine testing system.

(c) Man machine interface system configured around latest state-of- art redundant workstations with open architecture shall be provided to operate the unit under all operating conditions:

Provided that the minimum number of hardwired devices shall also be provided for safe shutdown of unit as a back-up:

Provided further that a large video screens shall also be provided in the control room.

(d) Distributed Digital Control, Monitoring and Information System shall be provided with 100% redundancy for processors, control and input or output bus as well as network components.

(e) (i) All input modules for control, interlocking and protection shall be provided with redundancy;

(ii) Output modules for all High Tension drives and critical Low Tension drives shall also be provided with redundancy;

(iii) Redundant inputs and outputs shall be connected to different respective input and output cards of Distributed Digital Control, Monitoring and Information System i.e. triple redundant inputs shall be connected to three separate input cards;

(iv) The logics for redundant drives shall not be in the same processor.

(f) The design of the control systems and related equipment shall adhere to the principle of 'fail safe operation' wherever the safety of personnel and plant equipment is involved, where 'Fail safe operation' signifies that the loss of signal, loss of power or failure of any component shall not cause a hazardous condition:

Provided that it shall also be ensured that occurrence of false trips is minimized:

Provided further that no single failure either of component or power source of Distributed

Digital Control, Monitoring and Information System shall cause loss of generation.

(g) The control system shall include on-line self-surveillance, monitoring and diagnostic facility providing the details of each fault at the Man Machine

Interface system.

(h) It shall be possible to remove and replace various modules (like any input module, output module, interface module, etc.) on-line from its slot for maintenance purpose without switching off power supply to the corresponding rack and without jeopardizing safety of the Station equipment and personnel.

(i) (i) The historical data storage and retrieval system shall store and process system data for future analysis:

Provided that the data shall be transferable to removable storage media for long-term storage (at least two years) and retrieval.

(ii) The binary data to be stored shall include status of Sequence of Events (1milli-second resolution), alarm and other binary inputs:

Provided that all the important analog data shall be stored at one second interval.

(iii) Selected logs *viz*. start-up log, trip analysis log shall also be stored.

(j) Master and slave clock system shall be provided to ensure uniform timing in all the control systems across the entire plant.

(k) All coal or lignite fired units of size two hundred fifty mega watt and above shall be provided with on-line efficiency monitoring and optimization system to maximize the operational efficiency.

(3) **Control system for balance of plant.—** Programmable Logic Controller based or Distributed Digital Control, Monitoring and Information System based control system with independent Man Machine Interface system shall be provided for all the balance of plant facilities like coal or lignite handling plant, ash handling plant, cooling water system, water treatment plant etc.:

Provided that the Programmable Logic Controllers shall be latest state of the art system with redundant processors:

Provided further that for minor balance of plant systems, the control systems can also be relay based.

(4) **Local Area Network .—** A redundant industrial grade station-wide Local Area Network shall be provided for information exchange between Distributed Digital Control, Monitoring and Information System of each generating unit, Programmable Logic Controllers for balance of plant as well as gateway for connecting to the other off-line services of the Station (computerized inventory management, maintenance management systems etc.).

(5) **Communication system.—** An effective communication system shall be provided to facilitate quick communication among the operating personnel at

various locations of the power station.

(6) **Measuring instruments and systems.─**

(a) Instruments such as transmitters, thermocouples, resistance temperature detectors, local gauges, flow elements, transducers shall be provided as required for comprehensive monitoring of various parameters of the Station locally as well as in control room(s) through Distributed Digital Control, Monitoring and Information System.

(b) Microprocessor based vibration monitoring and analysis system shall be provided for monitoring and analysis of vibration of critical rotating equipment (i.e. turbine- generator, boiler feed pumps, induced draft or forced draft or primary air fans etc.).

(c) On line flue gas analysis instruments including sulphur-di-oxide (SO_2), nitrogen oxides (NOx), oxygen, carbon mono-oxide (CO) and dust emission monitoring systems shall be provided.

(d) The triple sensors shall be provided for critical binary and analog inputs required for protection of steam generator and steam turbine as well as for critical control loops (e.g. furnace draft, drum level, condenser vacuum):

Provided that redundant sensors shall be provided for other important applications.

(e) All electrical instruments and devices like switches, transmitters, controllers, analyzers, solenoid valves which are located in the hazardous locations like hydrogen generation plant shall be provided with explosion proof enclosure suitable for hazardous areas as per National Fire Protection Association or National Electrical Code.

(7) **Power supply system.─** Independent, redundant and reliable 230 V or 110 V AC through uninterrupted power supply system (UPS) and/or DC power supply at standard voltage levels (e.g. 220V/ 48V/ 24V) shall be used for control and instrumentation systems.

(8) **Control valves.─** The control valves and accessories shall be designed, constructed and tested as per Indian Boiler Regulations, American Society of Mechanical Engineers code for power cycle piping and American Society of Mechanical Engineers boiler and pressure vessel code or equivalent.

(9) **Steam and water analysis system.─** An on-line sampling and analysis system shall be provided, as per the recommendation of manufacturers of steam-generator and steam turbine, for continuously monitoring the quality of condensate, feed water, steam etc.

12. Balance of Plant.─

(1) **Coal or lignite handling system.─** The arrangement for transportation of coal or lignite from supply source to the Station may be by rail or other captive systems such as merry go round, belt conveyor system, ropeway system etc. and the system shall comply with the following requirements:

(a) The coal or lignite handling plant capacity shall be such as to meet the day's fuel requirement by its operation in fourteen hours:

Provided that a day's fuel requirement shall be worked out at 100% Boiler Maximum Continuous Rating using worst coal or lignite plus a margin of ten percent.

(b) The coal or lignite handling plant shall be provided with 100% standby streams with each stream to be provided with 2x75% or 3x50% paddle feeders (in case of track hoppers) or apron feeders (in case of wagon tippler) and 2x50% crushers with belt feeders:

Provided that single set of coal or lignite conveyers from the stockyard to the bunkers shall not cater to more than three units.

(c) In case of rail based transportation, marshalling yard for handling of wagons and unloading system shall be designed to facilitate return of empty wagons within the time prescribed by the Indian Railways under the worst seasonal conditions.

(d) Provision of proper dust suppression facility shall be made for coal at various locations i.e. receiving point, stockyard and discharge points of conveyors to avoid dust nuisance and spontaneous fire.

(e) The provision for measurement of weight of coal or lignite shall be made through weighbridges at the receiving point:

Provided that the weight of coal or lignite fed to individual units shall also be measured through belt-weighers.

(f) Magnetic separator system for removal of ferrous materials and detectors for non-ferrous materials shall be provided on the conveyor system.

(g) Arrangement shall be made for sampling of coal or lignite, and associated instruments/ equipment shall be provided to monitor quality of coal or lignite on as- received basis as well as on as- fired basis before the bunkers.

(2) **Fuel oil system .─**

(a) The capacity of fuel oil storage facilities shall be adequate for the requirement of fuel oil for at least thirty days' operation of the Station.

(b) Suitable heating arrangement shall be made for heating the heavy fuel oil by steam to maintain its flowability.

(c) The aspects regarding proper storage and handling of fuel oil shall be as per statutory requirements of Chief Controller of Explosives.

(d) Suitable measuring and recording facilities shall be provided for quantum of fuel oil received and used.

(3) **Ash handling system.─**

(a) (i) Ash management plan for utilization and disposal of fly ash as well as bottom ash shall be formulated in accordance with Ministry of Environment, Forest and Climate Change requirements and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

(ii) Ash pond management shall be judiciously planned to optimize the land use and facilitate utilisation of pond ash:

Provided that it shall also conform to Ministry of Environment, Forest and Climate Change requirements and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

(b) For Pulverised Fuel Based Steam Generator.─

(i) Arrangement shall be provided for extraction of 100% of fly ash produced and its transportation to silos in dry form.

(ii) Dry fly ash storage silos of adequate capacity (about 16 hours of ash generation with unit operation at maximum continuous rating) to collect dry fly ash shall be provided in a separate area near the Station boundary with provision for independent access.

(iii) In addition to fly ash disposal in dry form, the provision may also be made for disposal through wet slurry system or high concentration slurry system:

Provided that in case of wet slurry system, suitable ash water recirculation system shall be provided to recycle and reuse water.

(iv) Furnace bottom ash alongwith economizer ash shall be extracted and disposed in wet, semi- wet or dry form.

(v) The design requirements of ash handling system for pulverised fuel based steam generators shall be as indicated in the **SCHEDULE-II**.

(c) For Fluidized Bed Steam Generator.─

(i) Dry fly ash extraction, transportation and storage system shall meet the requirements as stipulated above for pulverized fuel based system.

(ii) In addition to fly ash disposal in dry form, the provision may also be made for disposal through wet slurry system or high concentration slurry system:

Provided that in case of wet slurry system, suitable ash water recirculation system shall be provided to recycle and reuse water.

(iii) Furnace bottom ash shall be extracted in dry form by means of drag link chain conveyor and further disposed in wet, semi-wet or dry form.

(iv) The design requirements of ash handling system for fluidized bed steam generators shall be as indicated in **SCHEDULE-II**.

(4) **Station water system.─**

(a) Station Water Scheme.─

(i) The station water scheme shall be designed to meet the total clarified water requirement of the Station consisting of cooling tower make up (for non-coastal stations), de-mineralised water, service water, potable water and miscellaneous requirements.

(ii) For coastal Stations, sea water shall be used for cooling of condenser and secondary cooling of plate heat exchangers, and clarified (non-saline) water shall be used for de-mineralisation system, service water, potable water and miscellaneous requirements:

Provided that in case non-saline water is not available, sea water shall be used for production of non-saline water through desalination plant:

Provided further that de-silting arrangement and travelling water screens shall be provided at the sea water intake.

(iii) Raw water for production of clarified water shall be drawn from identified source of water and supplied to the Station site by raw water pumps with adequate standby provision and 2x50% or 1x100% capacity pipeline:

Provided that provision for de-silting (if required) and travelling water screens shall be made at the raw water intake point:

Provided further that adequate storage of raw water shall be provided at the Station site considering the period of non-availability of input water from the source.

(b) Pre-treatment System.─

The raw water shall be treated in pre-treatment plant to produce clarified water for meeting the requirement of clarified water of the Station:

Provided that adequate provisions for raw water chlorination, chemical dosing and sludge handling shall also be made.

(c) Cooling Water System.─

(i) The cooling water system for condenser and secondary cooling system for Station equipment shall be clarified water based and shall be of closed cycle type using cooling towers:

Provided that Air Cooled Condensers can also be used based on site specific conditions:

Provided further that for coastal Stations using sea water, once through cooling system shall be used which shall conform to Ministry of Environment, Forest and Climate Change requirements of temperature rise requirements of temperature rise and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

(ii)(a) The cooling tower shall be of mechanical induced draft type or natural draft type depending upon site specific techno-economics.

(b) The design wet bulb temperature of the cooling tower shall correspond to the ambient wet bulb temperature which is not exceeded for more than five percent of the time during four summer months in an average year.

(c) Adequate recirculation allowance shall be considered for arriving at design wet bulb temperature for induced draft cooling tower.

(iii) The design of Circulating Water pump house shall be based on sump model studies and hydraulic transient analysis shall be carried out for Circulating Water piping system.

(iv) (a) Circulating Water pumps shall be provided on unit basis for supply of cooling water. Provided that the standby pump(s) may be on unit basis or common to the Station.

(b) The Circulating Water pumps shall normally be of vertical wet pit type or Concrete volute type or Metallic volute type.

(v) Chemicals such as chlorine, acid, anti-scalant, biocide shall be dosed in the Circulating Water system for improving quality of circulating water and reducing its scaling and corrosive tendency.

(d) De-mineralisation System.─

(i) (a) The capacity of de-mineralised plant shall be based on the requirement of de-mineralised water for heat cycle make-up, equipment cooling system make-up, regeneration of de- mineralised plant and condensate polishing plant, if envisaged.

(b) The de-mineralised plant shall be designed to produce the daily requirement of de- mineralised water of the Station in twenty hours of operation of the de-mineralised plant.

(c) Adequate redundancy shall be provided in the number of de-mineralising streams.

(ii) The demineralized water shall be stored in minimum two nos. de-mineralised water storage tanks of total storage capacity equal to twenty four hour Station requirement.

(e) Waste Water Treatment System.─

The waste water generated at various locations shall be segregated at the source of generation according to its type:

Provided that similar type of waste water shall be collected at one point and suitably treated for reuse in the plant:

Provided further that the treatment of plant waste water shall be in accordance with the statutory requirements.

(5) **Fire detection, alarm and protection system.─**

(i) A comprehensive fire detection, alarm as well as fire protection system shall be installed for the Station in conformity with relevant Indian Standard.

(ii) Automatic fire detection and alarm system shall be intelligent and addressable type and shall be provided to facilitate detection of fire at the incipient stage and give warning to the firefighting staff.

(iii) Major equipment to be used for fire detection and protection system shall be in accordance with relevant Indian Standard or Underwriters Laboratories, USA or Factory Mutuals, USA or Loss Prevention Certification Board, United Kingdom or VDS (Germany).

(iv) Dedicated fire water storage and pumping facilities of adequate capacities shall be provided for the fire fighting system as per Tariff Advisory Committee guidelines:

Provided that the main fire water pumps shall be electrically driven and standby pumps shall be diesel engine driven.

(v) Necessary hydrant system, complying with Tariff Advisory Committee guidelines, shall be provided at various locations to cover the entire Station.

(vi) All major and minor fire risks in the Station shall be protected against fire by suitable automatic fire protection systems:

Provided that the following systems shall be generally adopted for various fire risks:

(a) Each transformer and reactor shall be provided as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

(b) Automatic high velocity water spray system as per IS 15325, shall be provided for the following areas namely: -

(ba) Lubricating oil systems including storage tanks, purifier units, coolers, turbine oil canal pipelines;

(bb) Generator seal oil system tanks, coolers;

(bc) Steam generator burner fronts.

(c) Steam turbine bearing housing and air pre-heater shall be provided with manually actuated high velocity water spray system.

(d) Automatic medium velocity water spray system, complying with Tariff Advisory Committee guidelines, shall be provided for the areas relating to:

(da) Cable galleries, cable vaults, cable spreader rooms, cable risers, cable shafts etc.;

(db) Coal conveyors, transfer points, crusher houses etc.;

(dc) Fuel oil pumping stations;

(dd) Light Diesel Oil and day oil tanks;

(de) Reliable standby power supply system building.

(e) Automatic foam system shall be provided for fuel oil storage tanks as per National Fire Protection Association guidelines.

(f) Automatic inert gas flooding system, comprising of 2x100% inert gas cylinder batteries conforming to National Fire Protection Association, shall be provided for Unit control rooms, control equipment rooms and area above false ceiling of these rooms.

(vii) Portable fire extinguisher as per Tariff Advisory Committee guidelines shall be provided for each room/area of power station in addition to fixed fire protection system to extinguish fire in its early phase to prevent its spread.

(viii) Fire station and fire tenders along with trained staff shall be provided for the Station.

(ix) Passive fire protection measures such as fire barriers for cable galleries and shafts etc., fire retardant coatings, fire resistant penetration sealing for all openings in floors, ceilings, walls etc., fire proof doors etc. shall be provided to prevent spreading and for containment of fire.

(6) **Compressed air system.─**

(a) Compressed air system comprising of instrument air and service air shall be provided to cater to the requirement for operation of various pneumatically operated drives and general purpose cleaning and maintenance services:

Provided that air dryers shall be provided for instrument air to achieve desired dryness.

(b) At least one number air compressor shall be provided as standby.

(7) **Ventilation and air-conditioning system.─**

(a) Suitable ventilation and air-conditioning system shall be provided to achieve proper working environment in the Station.

(b) (i) Central control room, local control rooms and service building for Operation and Maintenance personnel shall be air conditioned:

Provided that the air- conditioned areas shall be maintained at about 25°C and 50 % relative humidity for comfort conditions.

(ii) Water chilling unit shall be of 2x100% or 3x50% capacity and condensing units shall be of 2x100% capacity:

Provided that the package type air-conditioners shall have 2x100% capacity or 3x50% capacity equipment:

Provided further that for window air conditioners and split air conditioners, if used for small control rooms, at least one unit shall be kept as standby.

(c) The type of ventilation systems to be provided, excluding for air conditioned areas shall be as under:─

(i) All floors of TG building, switchgear rooms and cable gallery: Evaporating cooling system

(ii) Other buildings: Mechanical ventilation system

(8) **Mill rejects system.─**The mill rejects system shall be provided to collect reject from coal mills in case of vertical mills:

Provided that the system shall be of mechanized type i.e. drag chain conveyor or pneumatically pressurized conveying system:

Provided further that the system shall consist of collection of rejects from each coal mill and transport to silos for final disposal.

(9) **Electric overhead travelling crane .─**

(a) The Electric Overhead Travelling cranes shall be provided for maintenance of Turbine Generator cycle equipment and Circulating Water pumps:

Provided that these shall comply with the requirements of latest versions of relevant Indian Standard:

Provided further that the crane capacity shall be taken as five percent more than the single heaviest equipment to be lifted by the crane.

(b) Two Electric Overhead Travelling cranes may be provided for maintenance of Turbine Generator cycle equipment in case more than two steam turbine generators are housed in the Turbine Generator hall.

(10) **Laboratories.─** The Station shall be provided with following laboratories namely:-

(a) Electrical laboratory with necessary equipment and instruments for testing and maintenance of electrical equipment;

(b) Control and Instrumentation laboratory with necessary equipment and instruments for testing, calibration and maintenance of control and instrumentation systems;

(c) Chemical laboratories with necessary equipment, instruments and reagents for chemical analysis in water treatment plant, steam and water analysis and analysis of coal, ash and flue gas.

13. **Civil Works.─** The design philosophy of civil works shall be based on techno-economics of various options for the construction techniques.

(1) **Geo-technical investigations.─** Geo-technical investigations required for elastic assessment of foundation geology shall be carried out during investigation stage prior to taking up construction activity:

Provided that the geo-technical investigations shall include determination of the sub soil type, ground water table etc., based on which, the type of foundation system, the bearing capacity, the pile parameters, requirement of soil stabilization or compaction etc., shall be established.

(2) **Site levelling.─** (a)The formation level of the Station shall be kept minimum 1.0 m above the high flood level of the site.

(b) It is preferable to keep the entire Station at the same level:

Provided that to keep the leveling cost to minimum, different levels may be adopted for various blocks:

Provided further that the optimization of excavation and filling quantities may be done while fixing the levels of different blocks.

(3) **Foundations.─**

(a) Open foundations or pile foundations or a combination of the two keeping in view the lightly or heavily loaded foundations may be suitably adopted:

Provided that in certain cases, ground improvement and stabilization methods may also be considered.

(b) The foundations for turbines, boiler feed pumps and other rotating equipment shall be suitably designed and the amplitude of vibrations shall be within the limits recommended by the equipment supplier:

Provided that to optimize the foundation system of rotating equipment, 3-D finite element analysis may also be carried out:

Provided further that the following loads shall be considered for the design of foundations, as applicable:

(i) load of equipment;

(ii) load of other accessories;

(iii) dead load of foundation structure;

(iv) vacuum load;

(v) unbalance forces;

(vi) loss of blade force;

(vii) short circuit force;

(viii) temperature forces;

(ix) torque loads;

(x) frictional and other longitudinal forces;

(xi) live loads; and

(xii) wind and seismic loads.

(4) **Turbine Generator and other buildings.─**

(a) All buildings shall be designed as Reinforced Cement Concrete or steel framed super structures with masonry or steel cladding:

Provided that the Turbine Generator building shall have structural steel framework for super structure with metal cladding on exterior face:

Provided further that other buildings may have Reinforced Cement Concrete or steel framework with masonry cladding of minimum one masonry unit thickness on exterior face.

(b) The design of steel structures shall be as per provisions of latest version of relevant Indian Standard:.

Provided that composite construction with steel supporting structures and Reinforced Cement Concrete floors may be adopted for the Turbine Generator and other buildings considering the size, loadings and requirements of construction schedule.

(5) **Structure system.─**

(a) Turbine Generator building shall preferably be moment resisting structure in transverse direction and braced in longitudinal direction:

Provided that mill and bunker building shall be provided with moment resisting frame in the transverse direction and braced in longitudinal direction.

(b) The structures shall be designed considering worst load combination of dead loads, superimposed dead loads, imposed loads, design earthquake loads, wind loads etc.:

Provided that the superimposed dead loads shall include the loads due to equipment and associated auxiliaries and accessories, duct loads as well as crane loads with impact etc.:

Provided further that seismic forces shall be considered as per site specific seismic parameters.

(6) **Architectural requirements.─**

(a) Overall architectural character of Station building should be in harmony with natural character of environment, climatic conditions and local landscape:

Provided that the interior design should be given due consideration.

(b) The finishing works shall meet the requirements of aesthetics, durability and functional aspects:

Provided that adequate glazing shall be provided for natural light:

Provided further that adequate ventilation shall be provided in all the buildings.

(7) **Chimney. ─**

(a) Chimney may be single flue unitized or multi-flue for two or more units.

(b) The height of chimney shall be decided based on Ministry of Environment, Forest and Climate Change guidelines and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

(c) Provision of chimney shall also be got cleared by Airport Authority of India.

(d) The size of flue liner shall be decided based on the exit velocity and temperature of flue gases:

Provided that the flues or flue liners shall be of material appropriate as per flue gas condition and provided with suitable thermal insulation:

Provided further that the portion of flue liner above chimney shall be of acid resisting bricks protected by Reinforced Cement Concrete minishell.

(e) Chimney windshield shall be of Reinforced Cement Concrete construction:

Provided that chimney shall have internal platforms and internal ladder:

Provided further that the top external portion of windshield shall be provided with alternate bands of red and white colour to meet aviation safety requirements.

(f) Chimney shall be provided with liner test port for continuous emission monitoring, lightning protection and grounding system, aviation obstruction lighting and an elevator.

(g) Wind tunnel testing for chimney shall be carried out to optimize the design.

(h) The windshield shall be designed for vertical loading, wind loading, cross wind loading, seismic loading, circumferential wind loading and thermal gradients across the shell.

(8) **Corrosion protection.─** Steel structures may be provided with epoxy or polyurethane based painting systems:

Provided that suitable measures shall be provided against corrosion for Stations located in coastal areas:

Provided further that use of special cements, corrosion resistant steel, protective coatings for both concrete and steel are some of the options which can be considered in such conditions.

(9) **Roads and drainage.─** The entire area within the Station boundary shall be well connected with a network of roads and drainage system:

Provided that the drains in the Station area shall be designed for maximum rainfall intensity of fifty years frequency.

(10) **Safety provisions.─** The safety provisions shall be in conformity with the provisions laid down by National Building Code and other international codes.

PART- C

GAS TURBINE BASED THERMAL GENERATING STATIONS

14. Operating Capabilities.─(1) The gas turbine shall be installed along with heat recovery steam generator and steam turbine except where intended to be used for emergency, black start or only for peaking duty.

(2) Combined cycle gas turbine module, comprising of gas turbine generator and steam turbine generator, shall give its maximum continuous rating output at the specified site conditions and the design fuel.

(3) The combined cycle gas turbine module shall be capable of base load operation. However, these shall also be capable of load cycling and two-shift operation.

(4) The generating unit and its auxiliaries shall be suitable for continuous operation without any restriction within a frequency range, voltage range and combined variation of voltage – frequency as specified in the latest Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations and its Amendments."

(5) The design of the equipment and control system shall be suitable for operation of the Combined cycle gas turbine module in automatic load frequency control.

(6) Grid connected Gas turbine rating (International Organization for Standardization) upto one hundred mega watt shall be provided with black start

facility.

(7) The gross heat rate of combined cycle gas turbine module as guaranteed by the equipment manufacturer shall not exceed the following values:

Table 2

Gas Turbine rating (ISO)	Gross Heat Rate of CCGT module (on HHV basis) in kcal/kWh at ISO conditions with natural gas as fuel at 100% load
20 MW to 30 MW	2250
> 30 MW to 200 MW	1825
> 200 MW	1700

15. **Gas Turbine and Auxiliaries.─** (1)The gas turbine and auxiliaries shall comply with latest versions of applicable codes of International Organization for Standardization or American Society of Mechanical Engineers.

(2) The gas turbine compressor shall have a stable aerodynamic characteristic throughout its operating regime:

Provided that the operating point in the entire frequency range of 47.5 to 51.5 Hz shall be sufficiently away from surge line so that it is stable at all conditions of load, ambient temperature and blade fouling.

(3) The compressor shall be provided with variable type inlet guide vanes to meet start up and shutdown requirements, improved part load performance in combined cycle mode of operation and exhaust gas temperature control over a wide range.

(4) Combustion chamber arrangement shall be such as to allow maintenance without dismantling of compressor or turbine section and with minimum dismantling of piping and electrical connections.

(5) NOx control shall be either through dry low NOx combustor or through steam or water injection and shall be able to achieve the NOx level limits stipulated by pollution control authorities.

(6) Combustion system shall be provided with flame detection system for monitoring and protection.

(7) Gas turbine shall be provided with self contained lubrication oil system and control oil system with adequate redundancy for pumps and coolers.

(8) Gas turbine shall be provided with an air intake filtration system along with on-line cleaning system to deliver filtered air of acceptable quality to the gas turbine.

(9) Gas turbine generating unit shall be controlled by an electro-hydraulic governing system with 100% back up:

Provided that all necessary protective devices required for safe operation shall be provided:

Provided further that control system of the gas turbine shall include necessary features to check healthiness of protective devices.

(10) The gas turbine shall be capable of withstanding momentary speed rises upto the over-speed trip limit under transient conditions.

(11) Gas turbines envisaged for dual fuel operation (natural gas as primary fuel and liquid fuel as back-up fuel) shall be capable of on-load fuel changeover from natural gas to liquid fuel and vice- versa automatically or with manual initiation.

(12) All piping, valves and fittings downstream of liquid fuel delivery system and NOx water injection system shall be made of stainless steel of suitable grade to avoid corrosion so as to prevent entry of rust into the combustion chamber and mal-operation of stop/ control valves.

(13) Each gas turbine shall be provided with on-line fuel flow metering device to monitor fuel consumption.

(14) **Gaseous fuel conditioning system.─**

(a) Fuel gas conditioning system of the plant shall be designed to provide required quantity of clean, dry gas at required pressure, temperature and quality suitable for the gas turbine.

(b) The temperature of the gas delivered to the gas turbine shall be at least 200C higher than hydrate forming temperature or gas dew point whichever is higher.

(c) A chromatograph and analyzer shall be provided for determining the composition and heating value of the fuel gas.

(d) Design of fuel gas system shall be as per the provisions of the latest version of relevant American National Standards Institute Standards or equivalent.

(e) The gas leak detection and protection system shall necessarily be provided for enclosed areas.

(15) **Liquid fuel storage and conditioning system.─**

(a) Liquid fuel storage capacity shall be provided corresponding to fifteen days requirement, if liquid fuel is used as the primary fuel.

(b) Liquid fuel storage area shall be at least 90 meters away from the gas turbine.

(c) Liquid fuel unloading, storage and forwarding system shall be designed to comply with all applicable statutory requirements.

16. Heat Recovery Steam Generator and Auxiliaries.─

(1) Heat Recovery Steam Generator shall be suitable for outdoor installation and shall

be constructed to form a gas tight envelope to prevent gas leakage.

(2) Heat Recovery Steam Generator shall comply with Indian Boiler Regulation requirements.

(3) Gas turbine exhaust plenum shall be designed for proper gas velocity and temperature distribution and effective pressure recovery:

Provided that the exhaust system design shall take into account very rapid start-up and shutdown rate of the gas turbine.

(4) Arrangement for mandatory purging of gas turbine exhaust system and Heat Recovery Steam Generator shall be provided in order to eliminate chances of explosion (puffing) for combined cycle plants envisaged for operation on liquid fuel firing.

(5) The design of Heat Recovery Steam Generator shall be based on finned tube heat transfer banks of superheaters, evaporators, economisers etc.

Provided that the fin density shall not be higher than 200 fins/m.

(6) The design of Heat Recovery Steam Generator shall be suitable for direct on line starting along with the gas turbine.

(7) The Heat Recovery Steam Generator shall be designed for single pressure/two pressure/three pressure steam generation based on gas turbine rating and techno-economics.

(8) In the event of loss of feed water, it shall be possible to continue Heat Recovery Steam Generator operation for a short duration till the mode of operation of gas turbine is changed to open cycle or gas turbine is tripped and coasted down.

(9) The gas temperature at Heat Recovery Steam Generator exit, the temperature of condensate entering condensate pre-heater and temperature of feed water entering economiser shall be such as to avoid acid dew point corrosion.

17. **Steam Turbine and Auxiliaries.─** Steam turbine shall be single or multi pressure, condensing type complying with relevant IEC Standards or equivalent:

Provided that other requirements stipulated for coal or lignite based thermal generating stations in Part-B of this Chapter in respect of steam turbine and auxiliaries shall be complied with, as applicable.

18. **Electrical System.─** Electrical Systems shall meet the requirements stipulated for coal or lignite based thermal generating stations in Part-B of this Chapter in respect of Electrical System, as applicable:

Provided that in case of smaller size of generators, the neutral may be earthed through resistance or voltage transformer.

19. **Control and Instrumentation System.─** Control and Instrumentation Systems shall meet the requirements stipulated for coal or lignite based thermal generating stations in Part-B of this Chapter in respect of Control and Instrumentation System, as applicable.

20. **Station Water System.─** Station water system which includes clarified water system, cooling water system, de-mineralisation system, service water system, potable water system, waste water treatment system shall meet the requirements as stipulated in Part B of this Chapter in respect of Station Water System, as applicable.

21. **Fire Detection, Alarm and Protection System.─**Fire detection, alarm and protection system shall meet the requirements as stipulated for coal or lignite based thermal generating stations in Part B of this Chapter in respect of fire detection, alarm and protection system, as applicable.

22. **Civil Works.─** Civil works shall meet the requirements as stipulated for coal or lignite based thermal generating stations in Part B of this Chapter in respect of civil works, as applicable:

Provided that the stack shall be of steel construction and its height shall meet the requirements of Ministry of Environment, Forest and Climate Change and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

PART D

INTERNAL COMBUSTION (IC) ENGINE BASED THERMAL GENERATING STATIONS

23. **General.─** (1) The IC engine based thermal generating stations shall comprise of generating sets (Gen- sets) and associated facilities and these shall use liquid fuel *viz.* heavy fuel oil, diesel, bio oil or natural gas or a combination of gas and liquid fuel.

(2) The IC engine based thermal generating stations shall be suitable for indoor installations either on pads or on reinforced concrete foundations and smaller IC engine based generating sets (Gen- sets) may be skid mounted.

(3) All the facilities required for receiving and feeding the inputs such as fuel, lubricants, water, air etc. and the control panel and synchronizing panel shall be provided.

24. **Operating Capabilities of IC Engine based Generating Sets (Gen- sets).─** (1) The Gen- sets shall be capable of base load operation:

Provided that these shall also be capable of load cycling and single shift or two-shift operation.

(2) The IC engine and all rotating auxiliaries shall be suitable for continuous operation within the frequency range of 47.5 Hz to 51.5 Hz.

(3) For grid connected generating stations, design of the equipment and control

system shall be suitable for operation of the Gen- set in automatic load frequency control.

(4) The Gen- set shall have auto start, auto loading, auto stop features and capable of parallel operation in the power distribution system with synchronizing facilities.

(5) The gross heat rate of Gen- set as guaranteed by the manufacturer shall not exceed the following values namely:-

(a) **Diesel engine based Gen- sets (four stroke)**

Table 3

Gen- Set Rating	Gross Heat Rate (on HHV basis) in kcal/ kWh at 100% load
100 kW to 1 MW	2350
>1 MW to 3 MW	2250
> 3 MW to 10 MW	2200
>10 MW	2150

(b) **Diesel engine based Gen- sets (two stroke)**

Table 4

Gen- Set Rating	Gross Heat Rate (on HHV basis) in kcal/ kWh at 100% load
3 MW to 10 MW	2000
> 10 MW	1950

(c) **Gas engine based Gen- sets**

Table 5

Gen- Set Rating	Gross Heat Rate (on HHV basis) in kcal/ kWh at 100% load
>1 MW to 3 MW	2400
> 3 MW to 5 MW	2300
>5 MW	2150

25. **IC Engine and Auxiliaries .—** (1) The IC engine and auxiliaries shall comply with latest versions of applicable IS/ ISO/ BS (British Standard) or equivalent codes.

(2) Turbo charger, if applicable, shall be of robust construction, suitable of being driven by engine exhaust:

Provided that it shall draw air through air filter and have adequate capacity to suit engine requirements.

(3) The IC engine shall be capable of satisfactorily driving the generator at 10% over load at rated speed for one hour in any period of twelve hours of continuous running for applications other than base load operation.

(4) The IC engine shall be provided with suitable self-starting device.

(5) The IC engine shall be provided with an air intake filtration system to deliver filtered air of quality suitable for the engine.

(6) An engine driven or a separate AC motor driven booster pump shall be provided to deliver the fuel oil from the supply tank through the filters:

Provided that, if required, an AC motor driven fuel oil priming pump shall also be provided to keep the high-pressure system primed for remote and quick starting at any instant.

(7) The IC engine shall be cooled by radiators (engine mounted or remote type) or by heat exchangers using cooling tower:

Provided that in case of remote radiators, low speed axial fans shall be provided to keep the noise level well within acceptable limits.

(8) (a) The IC engine shall be provided with micro-processor based control system.

(b) The governor shall be electronic type complying with latest version of relevant IS:

Provided that an over speed trip mechanism shall be provided to automatically shut off fuel in case the set reaches above 10% of rated speed.

(c) An engine mounted emergency stop push button shall be provided to stop the engine during emergencies.

(9) Lubricating oil system for IC engine shall be of self contained type or a common lubricating oil system may be provided for two or more IC engines.

(10) Crankcase gases shall be piped outside the engine room so that oil fumes do not accumulate on the engine and radiator.

(11) The IC engine shall be furnished with exhaust system comprising of efficient silencers, chimney etc.

(12) NOx level, stack height and noise level shall comply with the guidelines laid down by Ministry of Environment, Forest and Climate Change and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

26. Liquid Fuel Storage and Conditioning System.— (1) Liquid fuel storage capacity shall be provided corresponding to fifteen days requirement.

(2) Liquid fuel unloading, storage and forwarding system shall be designed to comply with all applicable statutory requirements.

(3) Each IC engine or a group of IC engines installed at one location shall be

provided with on-line fuel flow metering device to monitor fuel consumption.

27. **Electrical System.―** Electrical requirements stipulated in Part B of this Chapter shall be complied with for switchgear, transformers, cables, protections etc. as applicable:

Provided that in case of smaller size of generators, the neutral may be earthed through resistance or voltage transformer.

28. **Control and Instrumentation System.―** Control and Instrumentation Systems shall meet the requirements stipulated for coal or lignite based thermal generating stations in Part B of this Chapter in respect of Control and Instrumentation System, as applicable.

29. **Station Water System.―** Station water system shall meet the requirements as stipulated for coal or lignite based thermal generating stations in Part B of this Chapter in respect of Station Water System, as applicable.

30. **Fire Detection, Alarm and Protection System.―** Fire detection, alarm and protection system shall meet the requirements as stipulated for coal or lignite based thermal generating stations in Part B of this Chapter in respect of fire detection, alarm and protection system, as applicable.

31. **Civil Works.―** Civil works shall meet the requirements as stipulated for coal or lignite based thermal generating stations in Part B of this Chapter in respect of civil works, as applicable:

Provided that the stack shall be of steel construction and its height shall meet the requirements of Ministry of Environment, Forest and Climate Change and any other stipulation of the Central Pollution Control Board and State Pollution Control Board in this regard.

CHAPTER-III

TECHNICAL STANDARDS FOR CONSTRUCTION OF HYDRO-ELECTRIC GENERATING STATIONS

32. **Preliminary**.―

(a) This Chapter stipulates the minimum technical requirements for construction of Hydro-Electric Generating Stations for various types of schemes i.e. Run- of-river scheme, Storage scheme, Pumped Storage scheme, Canal head scheme etc. with installed capacity of twenty five mega watt and above. The regulations herein shall also be applicable for construction for life extension purpose in the existing generating stations, wherever feasible.

(b) For Hydro-electric generating stations having installed capacity less than twenty five mega watt, the stipulations as appropriate, shall apply.

33. **General Requirements.―**

(1) While designing hydro-electric projects, the life of the civil works shall not be

less than one hundred years, while that of main electro-mechanical generating equipment i.e. turbine, generator, transformers, auxiliaries, etc. installed shall not be less than forty years with regular inspection and required maintenance.

(2) The station shall be designed for unconstrained operation within the range of maximum net head and minimum net head, specified silt conditions wherever applicable and full range of ambient and other environmental conditions.

(3) The dimensions of the power house, turbine setting, speed rise, pressure rise, run-away speed, etc. shall be governed by the limits specified in relevant Indian Standards.

(4) (a) The chemical analysis of water and silt data including the petrographic and petrofabric analysis shall be taken into consideration while designing the turbine, main inlet valve and other auxiliary equipment susceptible to abrasive effects of silt.

(b) Suitable materials, protective coatings and painting shall be provided to resist silt abrasion wherever required as per the site conditions.

(5) The generating units of rated capacity fifty mega watt and higher shall be capable of operation in synchronous condenser mode, wherever feasible.

(6) (a) The operation of the unit shall be smooth and quiet.

(b) The noise level shall not be more than 90 dBA at a distance of 1 metre from any equipment when operating near rated output.

34. Layout Considerations.─

(1) General layout of the station shall be developed considering the proper utilization of space, functional requirements, future extensions and considering requirements of space during construction stage.

(2) Maintenance facilities shall be provided as required for assembly, disassembly and handling during maintenance of all important equipment and auxiliaries.

(3) (a) Fire escape staircases and galleries shall be provided in main station building and Cavern.

(b) Each equipment room shall be provided with alternate exits to be used in case of fire or accidents, as per requirements of the Factory Act and other statutory requirements.

(4) (a) Adequate provisions in layout shall be made for protection of power house against flooding.

(b) The required provisions for protection against flooding are given in Regulation 42.

35. Operating Capability of the Generating Unit.─

(1) The unit shall be capable of giving the rated output continuously as specified by

the manufacturer at the rated design head and rated discharge and shall be capable of operating between the minimum and maximum head specified by the purchaser and ambient temperature at site as specified.

(2) The maximum continuous overload capacity up to 110% of rated capacity of the unit at the generator terminals during the high head conditions or high discharge conditions or both as guaranteed by the manufacturer shall be based on hydraulic parameters of the stations.

(3) The generating unit and its auxiliaries shall be suitable for continuous operation without any restriction within a frequency range, voltage range and combined variation of voltage – frequency as specified in latest Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations and its Amendments.

(4) (a) Provision shall be made for starting the machine in auto mode up to synchronization by a single command and loading of the unit to full load quickly.

(b) The design of the equipment and control system shall permit participation of the unit in automatic frequency control mode.

(5) The unit and all its associated auxiliaries shall be designed for trouble free operation up to maximum rating of the unit for the complete range of operation for active power and reactive power output.

(6) The unit and its auxiliaries shall be designed to operate for the silt levels and its characteristics specified for the project, based on the historical water inflow data of the river.

(7) The redundancy in the unit auxiliaries and station equipment shall be provided so that the generating unit continues to operate even in the event of outage of a part of the auxiliary system.

(8) The station shall be equipped with facilities for black start of one generating unit at a time in the event of grid black out conditions. However, for stations with variable speed machines, the facility of black start shall be provided wherever feasible.

36. Hydraulic Turbines and Auxiliaries.─

(1) The hydraulic turbine shall comply with latest versions of relevant Indian Standards or International Electrotechnical Commission standards.

(2) (a) Turbine shall have smooth and quiet operation.

(b) The vibrations, pressure pulsations and power fluctuations shall be within the limits specified in relevant standards.

(c) The amplitude of the vibrations at the shaft shall not exceed the limits specified in relevant National Electrical Manufacturers Association or International

Organization for Standardization standards.

(3) (a) The type and rotational speed of the turbine shall be selected considering the range of head, specific speed, head variation etc.

(b) In case two different types of turbines are found suitable for the range of head envisaged (overlapping zone of net head) at a particular site, the selection of turbine shall be based on the techno economic considerations taking into account the aspects such as head variation, civil costs, part load operation, operation and maintenance, efficiency etc.

(4) (a) The rated speed resulting in even number of pair of poles shall be preferred.

(b) In case of high silt content, at least one step lower synchronous speed shall be selected.

(5) (a) Before the manufacturing of the prototype turbine is taken up, homologous scale model of the prototype turbine shall be made, if not already available, and tested by manufacturer's Laboratory or NABL or APLAC or ILAC accredited independent third party to demonstrate that the prototype turbine will meet the guaranteed performance in respect of efficiency, output, smooth operation, pressure pulsations and other guarantees as stipulated in the technical specifications.

(b) For power station size up to one hundred mega watt and Unit size up to fifty mega watt, Computational Fluid Dynamics can be used to demonstrate that the prototype turbine will meet the guaranteed performance in respect of efficiency, output, smooth operation, pressure pulsations and other guarantees.

(6) (a) The weighted average efficiency shall be computed based on the efficiencies at various outputs.

(b) The weightage factors shall be selected corresponding to the average duration or period (in percentage) in a year, for which the units are expected to be operated at different outputs.

(c) The weighted average efficiency obtainable shall not be less than 93% for Francis, 92% for Kaplan and Bulb turbines and 91% for Pelton and Deriaz and Propeller turbines.

(d) The peak efficiency at rated conditions shall be higher than 94% for Francis, 93% for Kaplan and Bulb and 91.5% for Pelton, Deriaz and Propeller turbines.

(e) The weighted average efficiency of the turbine shall be determined after the installation and commissioning of the generating units on the basis of field acceptance tests on one of the units as per relevant Indian Standards or International Electrotechnical Commission standards. All the necessary arrangements for Field Acceptance Tests shall be provided during Power House Construction.

(7) The minimum load for continuous operation for various types of turbines shall be as per **SCHEDULE-III**.

(8) The pressure rise and speed rise of turbine shall be within the range specified by relevant Indian standards.

(9) (a) The turbine shall be designed to withstand runaway speed for fifteen minutes with cooling water on and intact without causing any residual detrimental effect on future operation of the machine.

(b) However, critical speed of the machine shall be around 25% higher than maximum runaway speed.

(10) Provision of runner removal from bottom for maintenance shall be made, wherever feasible. However, for pumped storage plants, either side removal at turbine pit or top removal from stator bore of runner shall also be acceptable.

(11) (a) The setting of reaction turbine, i.e. centre line of runner, with reference to minimum tail water level shall be governed by cavitation consideration.

(b) Based on the calculations, the centre line of the runner may work out to be either above or below the minimum tail water level.

(c) Pelton turbine shall be installed with its centre line at a height of minimum one runner pitch diameter above the maximum tail water level or as per the recommendations of the manufacturer.

(12) (a) Special care shall be taken to select the material of the underwater parts.

(b) The materials selected for runner, guide vanes, stay ring, runner chamber, upper draft tube cone, etc. shall have high wear resistance, corrosion and cavitation resistance.

(c) Besides, the use of the material having good weldability shall be considered so that parts can be fabricated and the eroded parts can be repaired easily at site.

(13) As most of the rivers in the Himalayan region carry high silt which erodes the runner and under water parts of a turbine at a comparatively faster rate, appropriate protective coatings shall be provided for these parts of a turbine in order to minimize silt erosion, wherever necessary and feasible.

(14) The guide vanes, runner, discharge ring and other hydraulic passages shall be designed for a life of 8000 operating hours against excessive pitting caused by cavitation.

(15) (a) The pump turbine shall be capable of giving output higher than the rated output while operating in the turbine mode.

(b) The pump turbine shall be hydraulically designed giving preference to its operation in "Pumping Mode" so that optimum efficiencies are obtained in both turbine and pump mode.

(16) The centre line of a pump turbine shall be fixed corresponding to pumping operation.

(17) Each penstock or hydro turbine shall have online water flow measurement system for unit size higher than one hundred mega watt. Penstock or Hydro Turbine meant for E-flow irrespective of size (mega watt) shall have online water flow measurement system.

37. Governing System.─

(1) (a) Microprocessor based digital governing system shall be used for regulating the flow of water to the turbines for the control of active power (mega watt) thus providing the requisite speed or frequency control and load control.

(b) The speed sensing device shall be provided with the requisite redundancy.

(c) The performance requirements of the governing system shall be governed by relevant Indian Standards or International Electrotechnical Commission standards.

(2) (a) High pressure oil system shall be provided for each turbine for the operation of wicket gates or nozzle and deflector servomotors through governors and for the control of main inlet valve.

(b) Piston type accumulator integrated with nitrogen bottles shall be used for pressures higher than 60 kg/cm^2.

(3) (a) Separate oil pressure systems shall be used for the control of turbine and the control of main inlet valve.

(b) Online oil filtration unit shall be used with servo valve based governing system.

(4) (a) The sizes of various components of oil sump tank and pressure receiver shall be calculated as per the relevant Indian Standards or American Society of Mechanical Engineers standards.

(b) The oil volume below its machine shutdown level shall be sufficient to perform three full operations of the servomotor *viz.* Close-Open-Close with oil pumps being out of operation for control of Turbine and one open operation of main inlet valve.

(c) The size of the accumulator shall be such that it shall be possible to operate the Penstock protection valve two times *viz.* Close-Open from minimum normal oil pressure without the operation of governor oil pumps and without dry nitrogen admission/Compressed air admission.

38. Main Inlet and Penstock Protection Valve.─

(1) The main inlet valve of either butterfly or spherical type shall be provided depending on head conditions.

(2) The spherical and butterfly valves shall comply with the requirements of latest versions of relevant Indian Standards or International Electrotechnical Commission standards.

(3) The valves shall have service seal on downstream side and maintenance seal on upstream side.

(4) (a) The opening and closing of spherical or butterfly valves shall normally be done under balanced water condition.

(b) Suitable number of air release valves and anti-vacuum valves shall be provided at the appropriate location on the downstream side to allow the air trapped in the Penstock to escape when it is filled with water through the bypass valves and for supplying or admitting the air when the valve is suddenly closed.

(5) The main inlet valve (butterfly or spherical valve) shall be provided for emergency closure in case of any eventuality including turbine speed increasing to runaway speed with counter weight only.

(6) (a) The Penstock Protection Valve shall be provided after the surge shaft as a second line of defence in the projects having the length of Head Race Tunnel 5000 m or more.

(b) The valve shall be designed for penstock rupture condition.

(7) The Penstock Protection Valve shall be provided with counter-weight for closing. Additional feature of oil assistance closing as back up shall also be provided for emergency closure.

(8) As far as possible, Main Inlet and Protection valve shall be provided and wherever it is not possible to provide such valves, ring gates or quick closing type intake gates shall be provided.

39. Mechanical Auxiliaries.─

(1) Electric overhead travelling cranes.─

(a) (i) The Electric overhead travelling cranes shall comply with the requirements and standards of latest versions of relevant Indian Standards or International Electrotechnical Commission standards.

(ii) The span of the crane shall be fixed in such a way that the travel and lift of the main and auxiliary hooks of the crane as well as the hook limits shall be adequate for the assembly and disassembly of the main equipment in the power house.

(iii) The lift above the service bay (upper limit) shall be adequate to hoist and carry the rotor of the generator and to assemble and disassemble the transformer.

(iv) The lift below the service bay (lower limit) shall be fixed in such a way as necessary for assembly and disassembly of the turbine.

(b) (i) The crane capacity shall be kept as 5% more than the maximum weight to be lifted inclusive of the weight of the lifting arrangements.

(ii) If the maximum weight to be lifted is more than 300 Tonnes, two cranes each of equal capacity shall be deployed to lift the heaviest package in tandem operation.

(c) The provision of variable voltage variable frequency drive for various crane motions for the purpose of precise speed control shall normally be made for crane. Additionally, provision of radio remote control shall be made for cranes having capacity 100 Tonnes and above.

(d) (i) The radio remote control equipment, wherever provided shall conform to all applicable Government rules and regulations.

(ii) The frequency of operation shall be in the requisite frequency band as per relevant standards.

(e) A monorail of adequate capacity can be provided for handling smaller packages, equipment and sub- assemblies and shall have larger reach than main crane.

(2) Cooling water system.─

(a) (i) The cooling water requirements of generator air coolers, shaft seal, turbine and generator bearings of each unit and generator transformer shall be met either by pumping the water drawn from the tail pool or draft tube or providing a penstock tapping for the same.

(ii) The penstock tapping shall not be considered in case of high head installations i.e. where the penstock pressure is more than 10 kg/cm^2.

(iii) If the penstock pressure is up to 10 kg/cm^2, a suitable pressure reducer depending on the requirement of net cooling water pressure (usually 3 to 5 kg/cm2) shall be provided.

(iv) However, as far as possible the penstock tapping for cooling water requirement shall be avoided.

(b) In the projects where rivers have silt laden water, closed circuit cooling water system shall be provided.

(3) Dewatering and drainage system.─

(a) (i) Submersible type of dewatering pumps shall be provided to pump out the water trapped between the penstock gate or main inlet valve and draft tube gate in case of Francis and Kaplan turbines to the dewatering sump when maintenance on the turbine of any unit is required to be carried out.

(ii) The capacity of the pump shall be chosen in such a way that a single unit can be dewatered up to draft tube gate within six hours of operation without raising the level in the sump with the main pump in operation. In addition, standby pump of capacity 50% of the main pump shall also be provided.

(b) (i) All the drainage water within the power house shall be collected inside the drainage sump constructed near the dewatering sump.

(ii) The drainage water shall be allowed to flow out to the tail race above the maximum flood water level using pumps, if required.

(c) (i) The drainage and dewatering sumps shall be inter-connected by means of gate valve and non-return valve, which allows the flow of water from the drainage sump to the dewatering sump only.

(ii) The spindle of the gate valve shall be extended up to the turbine floor so that it is possible to operate it from the turbine floor.

(d) (i) A suitable pressure hatch shall be provided to prevent any flow of water from dewatering sump into the power house.

(ii) Drainage sump shall not have any pressure hatch.

(4) Ventilation and Air-conditioning system.─

(a) A ventilation and air-conditioning system shall be provided to achieve proper working conditions inside the power house complex, to serve the purposes such as prevention of temperature stratification, removal of contaminated air, removal of waste heat from equipment as well as to provide fresh air necessary for human comfort with regard to temperature, humidity, and oxygen content, and to extract or force out smoke and other toxic gases during fire.

(b) (i) Ventilation system for circulation of natural air and exhaust shall be provided as a minimum requirement.

(ii) Cooling of air, wherever required, may be provided by evaporating, water cooled cooling tubes or chiller units.

(c) (i) The control room, offices, reception, conference room etc. shall be air-conditioned.

(ii) The conditioned air shall be about 25^0C at around 50% relative humidity for comfort conditions.

(iii) A choice of installation out of three different types of installations i.e. window or split type, package type or centralized air conditioning plants shall be made on the basis of the required tonnage and suitability of the installation at that particular location.

(5) High pressure and low pressure compressed air system.─

(a) The Nitrogen (N2) system having Piston type accumulator shall be provided for pressure more than 60 kg/cm^2.The high pressure compressed air can also be opted for lesser pressure requirement of turbine governing system and main inlet valve, where the pressure of HP air compressor shall be 1.1 times the working pressure.

(b) Low-pressure compressed air system shall be provided to meet requirements such as inflatable rubber seal of shaft glands, operation of pneumatic tools, cleaning, generator braking and jacking, boosting pressure in the fire protection hydro-pneumatic tank, pneumatic detection line for the operation of deluge valve provided for the generator transformer, etc.

(c) A separate compressed air system, wherever required, shall be provided to supply the compressed air for depressing the water level in the draft tube below the runner to run the machine in synchronous condenser operation mode and pump mode.

(6) Power House lift.─

(a) The lift and its associated equipment shall comply with the requirements of latest versions of relevant Indian Standard.

(b) A minimum of one lift shall be provided in the power house besides two sets of staircases for the movement of persons or goods.

(7) Oil handling and purification system.─

(a) (i) The insulating oil required in the generator transformers for the hydro station shall conform to relevant IS.

(ii) The type of turbine oil used as a working fluid in speed regulation system and as a lubricant and a coolant for thrust and guide bearings shall be as per the recommendations of the equipment manufacturer. The oil type shall be same for bearing and governor.

(b) The oil handling system for each grade of oil shall incorporate two tanks (one for pure oil and another for used oil), associated piping and control equipment.

(c) (i) The oil handling facilities shall be located within the power house or in an isolated building outdoors.

(ii) To convey the oil to the turbines, generators and transformers, suitable oil pipes shall be laid within the power house.

(iii) Portable type pumps and purifiers and standard oil drums may also be used for hydro-electric stations of installed capacity up to one hundred mega watt.

(8) Fire fighting system.─

(a) General.─

(i) The state of the art fire detection, alarm and protection system shall be provided for the station. The fire protection system as well as hydrant system shall be designed complying with the guidelines of National Fire Protection Association.

(ii) All major and minor fire risks in the Station such as transformers, cable galleries or shafts, control rooms etc. shall be protected against the fire by suitable automatic fire protection systems. The state of the art automatic fire detection and alarm system shall be provided to facilitate detection of fire at the incipient stage and warning to firefighting staff.

(iii) Portable and mobile fire extinguishers shall be provided to extinguish fire in the initial stage to prevent its spread.

(b) Each Transformer and Reactor shall be provided as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor/subsequent Regulations in this regard.

(c) The provision shall be made for water sprinkler system for oil plant rooms, especially in an underground power house. In addition, provision shall also be made for fire hose cabinets and hydrants inside the power house as well as for the transformer area. The water supply for the permanent fire protection installation should be based on the largest fixed fire suppression system demand plus the maximum hose stream demand of not less than 1890 L/min for a two hour duration. Two nos. of fire pumps, each capable of pumping water to fill the overhead water tank in six to eight hours time shall be provided.

(9) Equipment for Mechanical Workshop.─ Mechanical Workshop equipment shall be provided for essential maintenance work and onsite repairs in line with specific project requirements.

40. Electrical System.─

(1) General requirements.─

(a) For the purpose of design of equipment or systems, an ambient temperature up to 40^0C as applicable to station site and relative humidity of 95% shall be considered.

(b) The overall system shall be designed considering maximum voltage and combined variation of voltage and frequency as specified in latest Central

Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations and its Amendments.

(c) (i) The telecommunication system shall be based on optical fibre or power line carrier communication or both.

(ii) Owner's telecommunication equipment provided to transmit the required data of the station to the procurer of electricity, Regional and State Load Despatch Centre and Transmission Company, shall have matching equipment and compatible communication protocol with the receiving end.

(2) Generator or Motor-Generator.─

(a) General ─

(i) The generator shall comply with the requirements of the latest versions of Indian Standards or International Electrotechnical Commission standards.

(ii) Insulation shall be of thermal class F for the stator and the rotor windings with temperature rises at maximum guaranteed continuous output limited to that of thermal class B as per relevant Indian Standards or International Electrotechnical Commission standards.

(iii) The generator shall be capable of safely withstanding the maximum stresses during normal operation, run-away speed conditions, two phase and three phase short circuit conditions, single phase earth fault, 180 degree and 120 degree out of phase synchronization, magnetic unbalance with 50% of the poles short circuited within the speed of range of 1.3 times the rated speed, brake application etc.

(iv) (a) The construction of the generator shall be such that the rotor poles and stator coils can be handled out or in without removal of the rotor and without disturbing the upper bearing bracket wherever feasible. However, this may not be applicable to variable speed machines.

(b) The rotor poles shall be interchangeable.

(v) The output of motor generator shall match with the input required for pumping operation in the operating head range.

(vi) (i) The generator rated speed shall match the rated speed of the turbine or the pump-turbine.

(ii) A rated speed resulting in even number of pair of poles shall be preferred.

(vii) The current flowing in stator slot shall be limited to 3250 - 6500 Amperes with current through individual coil being limited to approximately 3250 Amperes.

(viii) The power factor and the requirements of reactive power capability shall be specified as per requirement of latest Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations and its Amendments.

(ix) Metal oxide surge arresters of suitable rating shall be provided for surge protection of generators.

(x) (i) Resistance temperature detectors or any other type of temperature sensors at suitable locations, for temperature monitoring of stator core, stator winding and bearings, shall be provided.

(ii) Suitable arrangement for rotor winding temperature monitoring shall also be provided.

(xi) The inertia of the machine shall be as per the transient stability studies required for the interconnected electrical power system to limit speed rise, pressure rise in waterway and negative pressure in Draft Tube and shall not have such a value which will cause the machine natural frequency to be in resonance with the expected frequency of draft-tube hydraulic surges. A margin of approximately 25% shall be provided for this.

(xii) Weighted average efficiency based on the computed efficiencies at various outputs for which the generator is expected to operate shall be more than 98% for machine greater than 30 MVA.

(xiii) Wherever required, dynamic braking shall be provided for generators in addition to mechanical brakes.

(xiv) Synchronous or asynchronous type generators shall be considered for Pumped Storage Plants with fixed or variable speed drives as per relevant Indian Standards or International Electrotechnical Commission.

(b) Bearing Arrangements—

(i) The prudent practice and recommendation of manufacturers shall be considered while deciding the bearing arrangement.

(ii) (a) Combined thrust and upper guide bearing mounted on a top bearing bracket above the rotor and lower guide bearing below the rotor shall be used for small diameter, long core, high speed machines. For medium to high capacity machines having low speed, combined thrust and guide bearing mounted on a separate bearing bracket located below the rotor and an upper guide bearing installed above the rotor on a separate, light weight bracket mounted on the top of the stator frame shall be provided.

(b) The arrangement of combined thrust and guide bearing mounted on a separate bearing bracket located below the rotor shall be used for low to medium capacity machines having low speed.

(iii) The horizontal mounted hydro-electric machines shall be provided with the journal type bearings. The number of journal bearings shall vary depending upon the machine output, speed, diameter, core length, etc.

(iv) The limiting temperature of the thrust bearing metal of hydro-electric machines shall be 80^0C. The guide bearing temperature limit shall be 70^0C.

(c) Fire Protection System for Generator ─

(a) Either water based or CO_2 type of fire suppression system shall be provided.

(b) A water based system shall be adopted in underground power stations because release of CO_2 gas in an underground installation shall be hazardous.

(d) Generator Bus duct ─

(i) (a) The generator bus duct shall comply with the requirements of the latest versions of relevant Indian Standards or International Electrotechnical Commission standards.

(b) Generator bus duct shall be segregated or isolated phase type.

(c) Bus duct rated more than 3150 Amperes shall be isolated phase type. The isolated phase ducts shall be preferred over the segregated phase bus ducts.

(d) Generator Bus duct rated more than 6000 Amperes shall be continuous isolated phase type.

(e) A hot air blowing system or air pressurization system can be provided to prevent moisture deposition in case of isolated phase ducts while space heaters may be provided in case of other bus ducts.

(ii) The bus duct shall be designed to carry maximum continuous current under normal site conditions without exceeding temperature rise limits. Based on these requirements standard size of bus duct as per relevant Indian Standards or International Electrotechnical Commission standards shall be used.

(iii) The bus assembly shall be designed to mechanically withstand a rated continuous current as well as the specified short-circuit current without damage or permanent deformation of any part of the bus structure.

(iv)The surge arrester and voltage transformer cubicle shall meet the requirements of relevant Indian Standards or International Electrotechnical Commission standards.

(v) The generator circuit breaker, as per relevant Indian Standards or International Electrotechnical Commission, shall be provided for Pumped

Storage schemes.

(e) Generator Neutral Grounding Terminal Equipment ─

(i) (a) Generator neutral grounding equipment shall be designed taking into account the maximum permissible operating voltage of the generator, voltage rise on load throw off (subsequent to detection of earth fault) field suppression time, ferro-resonance, etc.

(b) System earthing shall be such that it shall be possible to provide earth fault protection with proper discrimination i.e. in order to identify that the protection provided is able to identify it as an earth fault.

(ii) All large hydro-electric machines having a wye-connected stator winding with the neutral brought out of the machine housing shall be grounded via a high-resistance circuit consisting of a single- phase grounding transformer connected between the generator neutral and ground having a standard high voltage rating equal to the maximum machine phase to phase terminal voltage.

(f) Instrument Transformers ─

(i) The current transformers shall be window type fitted around the bus conductors for meeting the protection and measuring requirements.

(ii) The voltage transformers shall be located in separate cubicle for each of the three phases and mounted in withdrawable cabinets.

(iii) The surge diverters or the surge capacitors shall be provided in the same cubicle as that of the voltage transformers with suitable barriers.

(g) Machine Condition Monitoring Systems ─

The following monitoring equipment or systems for prediction of abnormality and preventive action shall be provided namely:-

(i) Air Gap Monitoring- In order to provide high degree of dimensional stability, online air gap monitoring system shall be provided. A uniform air gap under all the conditions of operation below a tolerance of $\pm$ 10% shall be maintained.

(ii) Vibration monitoring- The vibration of bearing and rotor shaft while the units are running shall be monitored by using on-line vibration monitoring equipment for replicating the forces acting on the rotor and bearings.

(iii) Partial discharge monitoring system- Online partial discharge monitoring system shall be provided for the generating units rated for one hundred mega watt and above.

(3) Excitation system.─

(i) Fixed Speed Machine.─

(a) (i) Static high initial response rectifier excitation system shall be used. Static rectifier excitation system shall obtain the necessary electrical power directly from the terminals of the generator.

(ii) The system shall consist of a power transformer, thyristor control element, electronic regulator and de-excitation unit.

(b) The capacity of the excitation system shall be adequate to supply continuously 1.1 times the excitation current and voltage required by the generator at its maximum continuous output and 100% rated voltage and also for supplying twice the excitation current required by the machine at its maximum continuous output and 110% rated voltage for a duration of one minute.

(c) The excitation system while operating at its maximum output, terminal voltage, power factor and speed shall be capable of changing from rated field voltage to ninety percent of ceiling voltage within 25 milliseconds for a sustained drop in generator terminal voltage of five percent.

(d) (i) The number of bridges shall be such that one bridge is always available as redundant. With the failure of two bridges it shall be possible to continue operation at reduced load.

(ii) The rectifier peak inverse voltage rating shall not be less than four times the maximum Root Mean Square voltage of the input.

(e) All the performance requirements of the automatic voltage regulation, power system stabilizer shall be in accordance with relevant IEEE standards or latest Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations and Central Electricity Authority (Grid Standards) Regulations and their Amendments.

(ii) Variable Speed Machine (with Synchronous and Asynchronous Operation) .─

(a) For Pump Storage Plants, AC excitation system shall be provided for asynchronous machines and Static Frequency Converter system for synchronous machines.

(b) The sizing of Excitation Transformers shall be decided based on excitation requirement of Generator. Sufficient redundancy of converters shall also be ensured.

(c) The variable speed electronic equipment will be adequate for starting purposes. There will be no need for additional starting equipment.

(d) The synchronous machines shall comply with clauses (b), (c) and (e) of sub-clause (3)(i) of regulation 40.

(e) The asynchronous machines shall comply with the latest Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations and their amendments on various aspects including rated output delivery in frequency range of 49.5 Hz to 50.5 Hz, voltage range of + 5 % and power factor of 0.95 (lag) to 0.95 (lead), remain connected to grid as per the specified voltage- time curve or table during fault or low voltage conditions and high voltage conditions, and active- reactive power control. It shall also comply to the latest clause 40 (3) (i) (e) of these regulations.

(4) Generator step-up transformers.─

(a) The generator transformers shall comply with the requirements of the latest versions of the relevant Indian Standards or International Electrotechnical Commission standards.

(b)(i) Water cooled transformers wherever feasible, shall be preferred and the type of cooling shall be generally oil forced water forced or oil directed water forced.

(ii) In case, provision of water cooling is not feasible, oil forced air forced or oil directed air forced type generator transformers shall be provided.

(c) (i) Selection of single phase or three phase transformers for hydro power stations shall be governed by the transportation limitations and shall be finalised considering the status of load carrying capacities of bridges, culverts etc. en-route.

(ii) In case of single phase transformers, one no. transformer shall be kept as spare for power plants having three and more generating units.

(d) Generator Transformers shall be suitable for continuous operation at rated MVA on any tap with voltage variation in accordance with relevant Indian Standards or International Electrotechnical Commission standards.

(e) Generator Transformer rating for pump turbine shall be sized according to higher of motor input power or continuous maximum rating of generator.

(f) The generator transformers with oil forced water forced or oil directed water forced type cooling shall be provided with two complete independent sets of cooling equipment each with 100% capacity and the generator transformers with oil forced air forced or oil directed air forced type shall be provided with adequate number of coolers with one cooler as standby.

(g) (i) On load tap changer may be considered for pumped storage schemes having reversible units.

(ii) The range of operation for the tap changer shall be governed by the power system requirements. (h)(i) Surge arrester shall be provided on the high voltage side of each transformer in case of transformers located in open area.

(ii) For transformers located in cavern, the requirement of the surge arrester characteristics, their number and exact locations shall be decided based on the insulation co-ordination studies.

(i) Insulation levels for the transformers windings and bushings shall comply with the requirements indicated in Table 10 under Regulation 45.

(j) Firewalls shall be provided as per the guidelines of BIS.

(k) The generator transformers having three phase rating of 120 MVA and above shall be provided with on line dissolved gas analyzer system.

(l) Dynamic short circuit withstand test shall be conducted on one unit of each type and rating of transformers, to validate the design and quality, unless such test has been successfully conducted as per IS 2026 part-5 within last 10 (ten) years on transformer of similar design. Criteria for similar design shall be as per Annexure-J of CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66kV and above)".

(5) Unit auxiliary and station auxiliary AC supply systems.—

(a) Unit Auxiliary AC Supply System —

The auxiliary supply system of each generating unit shall be provided with unit auxiliary transformer to feed the loads of the unit. The unit auxiliary transformers, dedicated for each unit, shall be provided for supplying power to various unit auxiliaries from the unit to which these are connected. The essential load consists of mainly cooling water pump motors, excitation system and AVR cooling fans, space heaters and oil pressure unit etc. The capacity of unit auxiliary transformer shall be selected based on the consideration that it is able to continuously cater to the requirement of all auxiliaries of the respective unit. During the starting and stopping of the units, these unit auxiliaries shall be supplied power from the station auxiliary AC supply system.

(b) Station Auxiliary AC Supply System —

(i) The station auxiliary AC supply system shall be designed to provide a high degree of reliability, continuity of service and primarily to supply uninterrupted AC supply to station auxiliaries during normal operation and unit auxiliaries during starting and stopping of the unit and during abnormal events.

(ii) The station supply loads for various equipment shall be determined and normal maximum demand shall be calculated at a diversity factor of 1.35. The availability of input supply shall be ensured from the sources independent of station generation. In addition, adequate provision for meeting load of auxiliaries for one unit during starting and/ or during the stopping of the unit shall also be kept and for this purpose the unit auxiliary boards shall be connected to station auxiliary boards through tie breakers.

(iii) Two nos. of Station Service Transformers of equal capacity one main and other as standby shall be provided for supplying power to the station service board feeding power to the station auxiliaries. In the event of AC supply failure, the station load shall be supplied by Reliable Power Supply System of suitable capacity connected to the station service board. The station service transformers, Reliable Power Supply System and station service boards shall be located at higher level.

(iv) The various auxiliary systems shall incorporate appropriate auto transfer scheme or manual change over to bring in the reserve supply source as required to prevent the loss of unit(s) and to ensure the equipment safety.

(c) The main or critical switchgear, motor control centres, Main Line Distribution Boards shall be fed by 2x100 % transformers or feeders and these shall be rated to carry the maximum load expected to be imposed.

(d) The electrical protective relays for unit auxiliary and station auxiliary supply system shall be of numerical type with self-monitoring and diagnostic features.

(6) DC supply system.─

(a) The DC supply systems for hydro power stations shall comprise of batteries, battery chargers and DC distribution boards. The standard voltage rating for the DC system shall be 220 V. Suitable converters may be used for other desired voltage levels.

(b) The battery shall have sufficient capacity to meet unit and station loads in addition to 3 hours of uninterrupted emergency illumination requirement. Further, DC requirement for Control and Instrumentation purpose shall be as per clause 41(2) (k).

(c) DC system shall comprise of two DC battery sets (both battery sets of full capacity) each with one float cum boost charger.

(d) The float cum boost battery charger as well as its automatic regulator shall be of static type. It shall have a facility of both auto as well as manual control in both the float and boost modes.

(e) DC distribution boards shall be designed to supply the various station loads like normal continuous load, emergency lighting load, excitation current for field flashing of generators and indicating lamp loads.

(f) The DC batteries, battery chargers, and DC distribution board shall be placed at a floor higher than that of machine hall in underground power house and not below the machine hall floor in surface power house.

(7) Neutral earthing.─ The earthing of neutral of various systems shall be as follows:

(a)	General transformer, Station transformer – HV Winding star point	:	Solidly earthed.
(b)	11 KV, 6.6kV or 3.3 kV	:	Through a suitable resistance in case of star or zig-zag connected windings; or Through artificial transformer with its secondary loaded with suitable resistor in case of delta-delta connected windings.
(c)	415 V system	:	Solidly earthed.
(d)	DC system	:	Unearthed

(8) Grounding System.─

(a) The grounding system shall be designed for a life expectancy of at least fifty years, for maximum fault current of the system. MS flats or rods shall generally be used as main ground mat. The touch and step potentials shall be maintained within acceptable limits as per relevant Institute of Electrical and Electronics Engineers or Indian Standards or International Electrotechnical Commission standards.

(b) Grounding and lightning protection for the entire power station and other areas or buildings shall be provided in accordance with relevant Indian Standards or Institute of Electrical and Electronics Engineers standards.

(c) Separate distinct grounding systems, if feasible, shall be provided for power house, switchyard and remote structures such as control buildings, communication buildings, spillway gate structures, storage buildings, etc. and other civil or hydraulic structures and inter-connected, if required.

(d) Special attention shall be made for grounding of high voltage Gas Insulated Switchgear equipment,
computer networks and communication equipment as per the manufacturer's recommendations.

(e) All equipment shall be grounded at two points for reliability.

(f) Provision at appropriate locations shall be kept for measurement of grounding resistance at regular intervals.

(9) Illumination.─

(a) (i) The illumination shall be provided as per relevant Indian Standards. Apart from normal AC illumination system, emergency AC and DC illumination at strategic locations shall also be provided.

(ii) DC illumination shall be provided to enable safe movement of personnel and access to important control points during an emergency.

(b)(i) Energy conservation measures shall be adopted, while designing the lighting system. Light Emitting Diode based luminaires, Sodium vapour (high pressure) or other more efficient latest technology lighting fixtures shall be provided for outdoor lighting of areas such as switchyards, spillways and dams, parking areas etc.

(ii) Automatic switching via photo electric cells can be adopted for outdoor lighting to optimize power consumption.

(c) Metal halide fixtures shall be used for certain indoor areas such as erection bay, generator hall, machine hall, turbine pit and other high bay areas where proper colour rendition is needed and long-life is essential.

(d) Light Emitting Diode lamps shall be used for battery powered emergency lights.

(10) (i) **EHV or HV or LV power cables, busducts and control cables.―** Cables shall be fire retardant low smoke low halogen type. Directly buried cables shall be essentially armoured type.

(ii) Cables shall be derated for the site ambient and ground temperatures, grouping and soil resistivity as per relevant Indian Standards. Wherever feasible or practical, HV or LV bus duct shall be used for interconnection.

(11) Cable trenches and cable racks.―

(i) A comprehensive procedure for segregation or separation of cables of different types and voltages shall be adopted for cable installation.

(ii) For laying of cables in a power house, a broad based system involving cable gallery, tunnels, trenches, cable racks, shafts etc. shall be provided.

(iii) In outdoor switchyards, a cable trench system shall be provided.

(iv) The main considerations shall be:

(a) Segregation and proper spacing shall be maintained;

(b) Control, auxiliary low voltage (up to 1.1 kV) power and medium voltage (above 1.1 kV and up to 66 kV) power cables shall be laid in separate trays/tiers preferably;

(c) Proper attention shall be given to ventilation and heat dissipation aspects particularly in case of HV cables.

(12) Electrical protection system.―

(a)(i) Fully graded protection system with requisite speed, sensitivity and selectivity shall be provided for the entire station.

(ii) Protection relays shall be configured in such a way that digital input points shall not pick up due to stray voltages.

(b) Protective relays shall be used to detect electrical faults, to activate the alarms and disconnect or shut down the faulted apparatus to provide for safety of personnel, equipment and system.

(c) Electrical faults shall be detected by the protective relays arranged in overlapping zones of protection.

(d) (i) All generating units shall have standard protection system to protect the units not only from faults within the units and within the Station but also from faults in sub-stations and transmission lines.

(ii) For the generating units with a rating of more than one hundred mega watt, protection system shall be configured into two independent sets of protection (Group A and B) acting on two independent sets of trip coil fed from independent DC supplies, using separate sets of instrument transformers, and segregated cables of current transformers and voltage transformers.

(iii) The main protection relays for the generators, motors, transformers and the transmission lines shall generally be of numerical type.

(e) All relays used shall be suitable for operation with CTs secondary rated for one ampere or five amperes as per relevant Indian Standards or International Electrotechnical Commission or Institute of Electrical and Electronics Engineers standards.

(f) The protections to be provided for the generating units as a minimum shall be as per **SCHEDULE-IV**, except for variable speed units which will have specialized protection functions.

(g) Relevant Indian Standards or International Electrotechnical Commission or Institute of Electrical and Electronics Engineers standards shall be applied for protection of generators, transformers and motors.

(13) Motors.─

(a) The AC Motors shall be squirrel cage or slip ring induction motors suitable for direct on line starting while crane duty motors shall be squirrel cage type induction motors with variable voltage and variable frequency drive as applicable.

(b) DC Motors shall be shunt wound. Temperature rise for air cooled motors shall be limited to 70^0 C by resistance method for both class B and F insulation.

(c) All motors shall be either totally enclosed fan cooled or totally enclosed tube ventilated.

(14) Reliable Power Supply System.─

(a) The provision of Reliable Power Supply System shall be made to meet the requirement of emergency power supply for essential station services and black starting of the unit considering the starting up of one generating unit at a time during black start condition.

(b) In the event of station service power disruption and for standby supply during grid black out condition, it shall be ensured that the essential auxiliaries of all the units are fed from Reliable Power Supply System and non-essential loads are automatically tripped.

41. Control, Protection and Instrumentation.─

(1) General.─The control and instrumentation system provided for the Station shall be consistent with modern power station practices and in compliance with all applicable codes, standards, Cyber security regulations or codes or guidelines and safety requirements.

(2) Control and protection system.─

(a) (i) Unit and station control system shall be microprocessor or computer based distributed digital control system interconnected through fibre optic cables or copper cables (for distances less than hundred meters) having hundred percent redundancy.

(ii) Each generating unit shall have independent programmable logic controller with requisite redundancies. The control of each unit from the unit control board shall be independent of each other.

(b) The following control, operation and monitoring points shall be provided for the generating units namely:-

(i) Manual control of individual equipment from control cubicle/control boxes located near the equipment;

(ii) Manual and automatic control from unit control board located near the unit at machine hall;

(iii) Automatic operation from station control centre located in the power house control room;

(iv) Provision shall be made for automatic operation of plant from remote Centre. It shall be compatible with the station control Centre and shall ensure transfer of data or communication signals.

(c) The control system shall be divided in the following groups with independent controls namely:-

(i) Generating unit controls;

(ii) Common controls (for control of common auxiliaries);

(iii) Switchyard controls;

(iv) Dam gate controls (wherever applicable);

(v) Auxiliary Power Supply control

Provided that controls in (i) to (v) can be suitably merged on case-to-case basis depending upon the extent of control required and the space availability.

Provided further that the above groups shall be interconnected and also controlled from the control room through computerised control system and the type of interconnection with remote equipment shall be through a reliable communication mode.

(d) The following modes of unit start and stop controls shall be provided namely:-

(i) Automatic start and stop;

(ii) Auto-inactive;

(iii) Step by step starting

(e) As a backup to the microprocessor based controls, a relay based back up shutdown may also be provided for parallel shutdown in case of emergency or protection master trip relay operation.

(f) A centralised control centre for the control of complete power station shall be installed in power house control room. Computer based human machine interface shall be installed with operator control stations having video display units, key board, printers, etc. for the operation of power station. For complete overview of complete station, a passive mimic board of interconnected large video screen shall be provided in the control room.

(g) The emergency stop push button for each unit for unit shut down shall be provided in the control room. The emergency push button shall be hard wired from unit control board.

(h) An automatic synchronizer with double channel design having frequency and voltage matching including one set of synchronizing equipment for manual synchronizing shall be provided in each UCB. A common manual synchronizing set shall be provided for smaller sets.

(i) Provisions for the historical storage/long term storage and retrieval of data shall be made.

(j) The computerized control system shall be compatible as per relevant IS or IEC standards for communication with protection panel, Load Despatch Centre and other PLCs.

(k) Independent and reliable 230 V AC UPS with 30 minutes backup with requisite redundancy shall be provided for the computerized control system equipment location in control room and DC power supply system shall be provided with minimum of 2 hours battery backup for controllers, input and output cards, control network for equipment local control, Unit Control Boards, Station Control Centre, Switchyard Controls, Dam Gate Controls as applicable and controls for common auxiliaries.

(3) **Instrumentation.─**

(a) Instruments such as transmitters, RTDs or other types of sensors, gauges, flow elements, transducers etc., shall be provided for comprehensive monitoring of various parameters.

(b) Microprocessor based vibration monitoring and analysis system shall be provided for crucial rotating equipment.

42. Provisions Required for Protection of Power House against Flooding.─

(a) Following provisions shall be made for protection of Power House against flooding namely:-

Suitable number of submersible pumps with provision for automatic starting by means of level switches shall be provided at main inlet valve floor, in addition to drainage and dewatering pumps as per Regulation 39(3);

(b) The control panels for dewatering and drainage pumps shall be located at a floor higher than that of turbine floor;

(c) Suitable float switches shall be provided in power house building to give closing signal to the MIV in the event of inundation of power house due to any reason including penstock rupture or leakage in penstock or for some other reasons;

(d) The station service transformers and station service boards shall be located at higher level;

(e) The excitation cubicles, unit control panels, unit protection panels etc. shall be located in the machine hall to the extent possible;

(f) The DC batteries, battery chargers and DC distribution boards shall be placed at a floor higher than that of machine hall;

(g) Provision of individual hoisting mechanism for draft tube gates of each unit may be considered for quick closing. The draft tube gates shall be capable of closing under unbalanced condition of water pressure;

(h) Elevation of pipe for central air admission shall always be above maximum flood level. Central admission system shall be provided for air in runner area of Francis turbines;

(i) During Construction, the storage of Electro-mechanical equipment shall be made at elevation higher than Flood level;

(j) During construction, appropriate measures shall be taken to avoid flooding of

Power house from Penstock, Tail race or other construction adits;

(k) As far as possible, the switchyard shall be constructed above the maximum flood level and wherever required, flood protection walls shall also be provided. The switchyard shall be designed to withstand earthquake as per relevant Indian Standards;

(l) There should be regular maintenance (including mock drill of opening and closing) of Penstock Protection Valve and the intake gates at regular intervals to ensure they are in proper working conditions so as to prevent flooding;

(m) Sufficient measures should be taken to prevent ingress of water inside power plant in case of flood like conditions. This may include provision of alternate channels for guiding flood water into river bypassing the power plant.

Chapter IV

PART-A

SUBSTATIONS AND SWITCHYARDS (66 kV AND ABOVE)

43. General.—

(1) The transmission system shall be planned and designed in accordance with Central Electricity Authority's "Manual on Transmission Planning Criteria".

Provided that the minimum rated short time withstand current of the equipment in substation or switchyard of following voltage level shall be as per Table 6 below.

Table 6

Voltage level	**Rated short time withstand current**
66 kV	31.5 kA (for 1 sec.)
110 kV or 132 kV	40 kA (for 1 sec.)
220 kV or 230 kV	50 kA (for 1 sec.)
400 kV	63 kA (for 1 sec.)
765 kV	50 kA (for 1 sec.)

(2) If the fault level at a sub-station exceeds or is likely to exceed the permissible fault level with the addition of more generators and termination of new transmission lines, adequate measures to limit the fault level like sectionalization/ splitting of the sub-station bus or installation of series reactors on the line/ bus or installation of Fault Current Limiter on line/bus/transformer/ reactor at the respective sub-stations shall be resorted to. Appropriate measures shall be taken to address the impact of the addition of the series reactors or Fault Current Limiter on existing system based on power system

studies/dynamic simulations.

(3) The sub-station or switchyard shall be designed and constructed to give a life of not less than thirty-five years.

(4) The sub-station or switchyard shall have IS-61850 based Substation Automation System or Supervisory Control and Data Acquisition system and Energy Management System and Substation Automation System or Supervisory Control and Data Acquisition Gateway shall be capable of communicating with Load Dispatch Centre, backup Load Dispatch Centre and Central Control Centre.

44. Design Considerations for Sub-stations and Switchyards. ─

(1) The sub-station or switchyard shall be Air-Insulated Sub-station or Gas Insulated Sub-station or hybrid substation or combination thereof. The factors to be taken into account for designing sub-stations shall be as under namely:─

(a) The substation shall be designed for seismic requirement of the site as per relevant IS;

(b) Land area required shall be considered based on the present requirement and the planned future expansion;

(c) The shunt capacitors, shunt reactors (bus reactors or switched or non-switched type line reactors), Controlled Shunt Reactors, Static Volt Ampere Reactive Compensators, Static Compensators, Static Synchronous Series Compensator, Static condenser, Fixed Series Capacitor, Thyristor Controlled Series Capacitor, Phase Shift Transformer, or other Flexible Alternating Current Transmission System devices are the power compensating devices, which shall be based on power system studies;

(d) The selection of switching schemes shall be based upon requirements for operational flexibility, system security, reliability, availability, criticality of load, maintainability and cost;

(e) For new substation, in any particular diameter of one and half breaker switching scheme, two transformers of same voltage ratio or two reactors or a double circuit line shall not be connected and as far as possible, incoming and outgoing feeders shall be in the same diameter, so as to make direct connection in case of outage of intermediate substation.

(2) Air Insulated Sub-stations ─

(a) The switching schemes as per Table 7 shall be adopted at different voltage levels in Air Insulated Sub- stations.

Table 7

Voltage level	Switching Scheme
66 kV or 110 kV or 132kV	Main and transfer bus scheme or Double bus scheme
220 kV or 230 kV	Double main and transfer bus scheme or Double bus scheme or Main & transfer bus scheme
400 kV or 765 kV or 1150 kV	One and half breaker scheme

(b) In case of Air Insulated Sub-stations, for bus-bars tubular aluminium pipe or flexible stranded conductor shall be considered taking into account the power flow requirements, corona effect and ambient conditions.

(c) Outdoor air insulated sub-station or switchyard shall be shielded against direct lightning stroke by provision of overhead shield wire or earthwire or spikes (masts) or a combination thereof.

(3) Gas Insulated Sub- stations ─

(a) Gas Insulated Sub- station shall be constructed in seismic prone areas, coastal areas, high altitude areas, very heavily polluted areas and for locations where space is major constraint.

(b) The switching schemes as per Table 8 shall be adopted at different voltage levels for outdoor, indoor or underground Gas Insulated Sub- station :

Table 8

Voltage level	Switching Scheme
66 kV	Single bus scheme or Main and transfer bus scheme or Double bus scheme
110 kV or 132 kV or 220kV or 230kV	Main and transfer bus scheme or Double bus scheme
400 kV or 765kV	Double bus scheme or One and half breaker scheme

(c) Gas Insulated Sub- station enclosure shall be non-magnetic type and for 400kV and higher voltage levels, it shall be isolated phase type.

(d) The arrangement of gas sections or compartments shall be such as to facilitate future extension on either end without any drilling, cutting or welding on existing equipment from any manufacturer and without the necessity of moving or dislocating the existing switchgear bays.

(e) The layout of Gas Insulated Bus Ducts shall be for easy accessibility & maintenance and the length of bus bars, bus ducts, isolator sections shall be optimized considering effects of fast transient voltage due to isolator operations.

(f) A crane of suitable capacity shall be installed in Gas Insulated Sub- station building for movement of
single largest module during installation and subsequent maintenance.

(4) Hybrid sub-station.—

(a) The bus-bars shall be air insulated type and switchgear shall have some or all functional units enclosed in SF_6 gas insulated housing.

(b) The switching schemes as per Table 7 shall be adopted at different voltage levels.

(5) The Air Insulated Substation or Gas Insulated Substation with complete digitalization shall have (a) digitalization at process level by introducing process bus architecture and merging unit for conventional/non-conventional Instrument Transformers, (b) digitalization at station level with Ethernet based communication on IEC-61850 protocol, (c) fibre optic cable links, (d) interface between process level and station level through Intelligent Electronic Devices at bay level and (e) security against cyber attack.

(6) Mobile Substations .—

(a) Wherever required, the vehicle mounted mobile substation comprising of trailer, incoming and outgoing high voltage and low voltage gas insulated or hybrid switchgears, power transformer, and associated connectors etc. shall be considered for putting into immediate service to resume power supply in short time in case of emergency or disaster.

(b) The mobile substation shall comply with provisions of Central Electricity Authority Regulations and
Bureau of Indian Standards' Codes.

(7) Grounding .—

(a) The grounding system shall be designed as per IEEE 80 for expected life of the substation maintaining the touch and step potential within acceptable limits throughout the life.

(b) Special consideration shall be given for Gas Insulated Sub- station earthing design to handle high frequency transients.

(c) If earth enhancement compound or material is considered for effective grounding in high soil resistivity area, the same shall be environmental friendly.

(d) Condition assessment of earthing mat, earthing pits, earth rod, surface layer material, and associated connections shall be carried out periodically to ensure effectiveness of grounding system and necessary steps shall be taken to mitigate the deficiency, if any.

45. System design parameters. ─

(1) The system design parameters of sub-station and switchyard equipment, except transformer and reactor, for installations at altitude upto 1000 m above Mean Sea Level shall be as given below in Table 9.

Table 9

	66 kV	**110 kV**	**132 kV**	**220 skV/230 kV**	**400 kV**	**765 kV**	**1150 kV**
Highest system voltage (kV)	72.5	123	145	245	420	800	1200
Rated frequency	50Hz						
No. of phases	3						
Rated insulation level							
(i) Minimum Lightning impulse withstand voltage (1.2/50 micro sec.) (kVpeak)	325	55 0	650	1050	1425	2100	2400
(ii)Minimum Switching impulse withstand voltage (250/ 2500 micro sec.) dry and wet (kVpeak)(phase to earth)	NA	NA	NA	NA	1050	1550 (1425 for GIS)	1800
(iii)Minimum One minute power frequency	140	230	275	460	630 (650 for GIS)	830 (960 for GIS)	1200

withstand voltage dry (kVrms)							
Minimum corona extinction voltage (kVrms phase to earth)	NA	NA	NA	NA	320	508	762
Maximum Radio Interference Voltage for any frequency between 0.5 MHZ to 2.0 MHZ in all positions (micro volts)	NA	NA	500 (at 92 kV rms)	1000 (at 156 kV rms)	1000 (at 266 kV rms)	2500 (at 508 kV rms)	2500 (at 762 kV rms)
System neutral earthing	Effectively earthed						

(2) The insulation level for windings and bushings of the transformer and reactor and GIS bushings, for installations at an altitude upto 1000 m above Mean Sea Level, shall be as per Table 10 below.

Table 10

	Windings			**Bushings**		
Highest voltage for equipment	Rated power frequency withstand voltage (kVrms)	Rated switching impulse withstand voltage (kVpeak) (phase to earth)	Rated lightning impulse withstand voltage (kVpeak)	Rated power frequency withstand voltage (kVms)	Rated switching impulse withstand voltage (kVpeak) (phase to earth)	Rated lightning impulse withstand voltage (kVpeak)
1200 kV	NA	1800	2250	1320	1950	2550

800 kV	NA	1550	1950	970 960 (GIS)	1550	2100
420 kV	570	1050	1300	695 650 (GIS)	1050	1425
245 kV	395	750	950	505 460 (GIS)	850	1050
145 kV	275	540	650	305	NA	650
123 kV	230	460	550	255	NA	550
72.5 kV	140	NA	325	155	NA	325
52 kV	95	NA	250	105	NA	250
36 kV	70	NA	170	77	NA	170
24 kV	50	NA	125	55	NA	125
17.5 kV	38	NA	95	42	NA	95
12 kV	28	NA	75	30	NA	75

(3) For installations at altitudes higher than 1000 m above Mean Sea Level, altitude correction factor on the applicable parameters such as rated insulation level, temperature rise limit, clearances and arcing distance for external insulation at the service location shall be applied as per methodology specified in relevant standards.

46. Salient Technical particulars of major equipments. ─

(1) Power Transformers. ─

(a) Power transformer shall be designed, manufactured, tested and commissioned as per Central Electricity Authority's "Standard Specifications and Technical Parameters for Transformers and reactors (66kV and above)".

(b) At existing sub-stations, the impedance, vector groups, OLTC connection and range etc. of a new transformer shall be matched with that of the existing transformer, if parallel operation is desired.

(c) In case single phase transformers are provided, minimum one single phase transformer of each rating shall be provided as spare for the entire substation or switchyard

(d) Dynamic short circuit withstand test shall be conducted on one unit of each type and rating of transformers, to validate the design and quality, unless such test has been successfully conducted as per IS 2026 part-5 within last ten years on transformer of similar design. Criteria for similar design shall be as per Annexure-J of Central Electricity Authority's "Standard Specifications and Technical Parameters for Transformers and Reactors (66kV and above)".

(e) Soak Pit and Oil collecting pit:

(i) An oil soak pit shall be designed & provided below each oil filled transformer or reactor to accommodate at least 150% of total quantity of oil contained in the transformer or reactor with minimum 300 mm thick layer of gravels or pebbles of approximately 40 mm size (spread over a steel iron grating or trans rack) providing free space below the grating.

(ii) Alternatively, an oil soak pit shall be provided below each transformer or reactor, to accommodate one-third of total quantity of oil contained in the transformer or reactor with minimum 300 mm thick layer of gravels or pebbles of approximately 40 mm size (spread over a steel iron grating or trans rack) providing free space below the grating provided a common remote oil collecting pit of capacity at least equal to oil quantity in the largest size transformer or reactor is provided for a group of transformers or reactors and bottom of the soak pit below the transformer or reactor shall be connected to the common remote oil collecting pit with drain pipe of minimum 150 mm diameter with suitable slope for fast draining of oil or water through gravity from soak pit to the common remote oil collecting pit.

(iii) Every soak pit below a transformer or reactor shall be designed to contain oil dropping from any part of the transformer or reactor.

(iv) The common remote oil collecting pit and soak pit (when remote oil collecting pit is not provided) shall be provided with automatic pumping facility, to always keep the pit empty and available for an emergency.

(f) The disposal of transformer oil shall be carried out in an environmental friendly manner.

(2) Shunt Reactor and Neutral Grounding Reactor .—

(a) Shunt Reactor and Neutral Grounding Reactor shall be designed, manufactured, tested and commissioned as per Central Electricity Authority's "Standard Specifications and Technical Parameters for Transformers and Reactors (66kV and above).

(b) Wherever required, the neutral of the line shunt reactors shall be grounded through adequately rated Neutral Grounding Reactors to facilitate single phase auto-reclosure.

(c) Wherever line reactor is proposed to be used as Bus reactor also, suitable arrangement shall be provided to bypass the Neutral Grounding Reactor.

(d) The Neutral Grounding Reactor used for 765 kV and 400 kV line shunt reactors, shall be protected by means of 145 kV surge arresters of suitable rating.

(e) The Neutral Grounding Reactor used with 220 kV and 132 kV line shunt reactors, shall be protected by means of 36 kV surge arresters of suitable rating.

(f) The neutral of bus reactor shall be solidly grounded.

(g) In case single phase shunt reactors are provided, then minimum one single phase unit of each rating shall be provided as spare for entire substation or switchyard.

(h) Soak pit and oil collecting pit as per clause (e) of sub-regulation (1) of regulation 46 for oil filled reactor and NGR shall be provided.

(3) Shunt Capacitors.—

(a) Capacitor banks shall not be provided at voltages higher than 132 kV.

(b) The redundancy in the number of Capacitor units shall be provided to avoid reduction in reactive compensation due to failure of the Capacitor units

(4) Circuit Breaker.—

(a) The circuit breaker shall be of class M2 with regard to mechanical endurance.

(b) The circuit breakers of 220kV and above voltage class shall be suitable for single phase and three phase auto-reclosing and circuit breakers of 132kV and below voltage class shall be suitable for three-phase auto-reclosing. Provided that, wherever frequent line to ground faults are encountered on 132 kV lines, Circuit breakers of 132kV class shall be suitable for single phase auto- reclosing.

(c) Each circuit breaker shall be provided with two numbers of trip coils fed through two separate DC supply feeders for greater reliability.

(d) The circuit breaker shall have the provision for local manual trip, which shall be at a position easily accessible to the operating person.

(e) The circuit breakers of 220 kV and above voltage class shall have a trip circuit supervision relay for both trip coils, DC supervision relays and lockout relay.

(f) Maximum Rated break time for circuit breakers of different voltage classes shall be as given in Table 11 below:

Table 11

Voltage Class	**Rated break time**
1150 kV	40 ms
765 kV	40 ms
400 kV	40 ms
220 kV/ 230 kV	60 ms
132 kV/ 110 kV	60 ms
66 kV	100 ms

(g) The circuit breakers of 400 kV voltage class for lines of length more than 200 km and of 765 kV voltage class shall be provided with Pre Insertion Resistors or

Controlled Switching Devices for controlling switching over voltage.

(h) Controlled Switching Devices shall be used for minimizing switching transients and inrush currents in transformers and reactors of 400kV and above voltage class.

Provided that, this requirement is not applicable for generator transformer.

(i) Due attention shall be given to the operating time and mechanical scatter of Circuit Breakers and grid condition at the point of interconnection while going for use of Controlled Switching Devices.

(j) The Controlled Switching Device shall be used only during intentional energization or de-energization of associated Circuit Breaker and shall remain bypassed otherwise including during fault tripping.

(5) Disconnector and Earthing Switch.—

(a) Earthing switches shall be provided at appropriate locations to facilitate earthing of outgoing transmission lines to enable maintenance.

(b) The main blades and earth blades shall be interlocked with both electrical and mechanical means, which shall be fail-safe.

(c) The disconnectors shall be of M2 class and suitable for Bus Transfer Current Switching duty.

(d) The disconnectors shall be suitable for local electrical and manual and remote electrical (from control room) operation.

(e) Earthing switches used in lines for 110 kV and higher voltages shall be suitable for induced current switching duty of Class B.

(f) Earthing switches shall be suitable for local electrical and manual operation and only local operation is recommended for earth switches.

(g) In case of GIS installations, high speed earthing switches shall be provided for grounding purpose at overhead line terminations and cable terminations and shall have rated fault making capability.

(6) Current Transformer.—

(a) The rated currents and ratio, the number of secondary cores, accuracy class, burden, secondary winding resistance, knee point voltage, and excitation current shall be in accordance with the requirements of the protection and metering system.

(b) The rated burden of cores shall be closer to the maximum burden requirement of metering and protection system for better sensitivity and accuracy and shall not exceed 20 VA.

(c) Instrument Security Factor shall be less than five for Current Transformers upto 400 kV voltage class and less than ten for Current Transformers of 765 kV and

1150 kV voltage class.

(d) The accuracy class for metering core shall be equal to or better than the accuracy class of the meter specified in the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

(e) In case of digital substations, Non-Conventional Current Transformers or conventional Current Trans- formers with merging units that are interfaced with the process bus and station bus architecture shall be used.

(7) Voltage Transformer.—

(a) The number of secondary cores, accuracy class and burden shall be in accordance with the requirements of the protection and metering system.

(b) The rated burden of Voltage Transformer cores shall be closer to the maximum burden requirement of metering and protection system for better sensitivity and accuracy and it shall not exceed 50VA.

(c) The accuracy class for metering core shall be equal to or better than the accuracy class of the meter specified in the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

(d) Wherever Power Line Carrier Communication is provided, Capacitor Voltage Transformer complying with relevant standards shall be used as the same are suitable for carrier coupling and the capacitance of Capacitor Voltage Transformer shall be decided depending on Power Line Carrier Communication requirements.

(e) In case of digital substations, Non-Conventional Voltage Transformers or conventional Voltage Trans- formers with merging units that are interfaced with the process bus and station bus architecture shall be used.

(f) Gas insulated voltage transformers, if used, shall be electromagnetic type.

(8) Surge Arrester.—

(a) Station class (i.e. Station Low duty, Station Medium duty and Station High Duty), gapless metal oxide (ZnO) type surge arresters shall comply to relevant standards.

(b) The rated voltage, continuous operating voltage, energy handling capability, nominal discharge current and other characteristics of a surge arrester shall be chosen in accordance with power system requirements.

(c) Surge arresters shall be provided at locations decided in accordance with insulation coordination studies.

(d) Air Insulated Substation Surge Arresters shall be fitted with pressure relief devices and diverting ports or fitted with prefabricated week spots (in case of polymer housing) suitable for preventing damage of housing.

(e) A leakage current monitor with surge counter shall be provided with each surge arrester.

(9) Line Trap. ─

(a) Line trap complying with the relevant Indian Standards shall be used in lines with Power Line Carrier Communication system.

(b) Line trap shall consist of a main coil in the form of an inductor, a tuning device and a protective device and in conjunction with a coupling capacitor/ Capacitor Voltage Transformer, it shall form a parallel resonant circuit.

(c) The tuning device shall be so arranged as to permit replacement without removing the line trap.

(d) The tuning as well as protective device shall be so designed that neither significant alteration in the line trap blocking requirements or protective function nor physical damage shall result from either temperature rise or the magnetic field of the main coil at rated continuous current or rated short time current.

(10) Insulators. ─

(a) The minimum specific creepage distances of insulators shall be as per Table 12 below:

Table 12

Pollution level	**Specific Creepage distance**
Very light	20 mm/kV (corresponding to the line to line highest system voltage)
Light and medium	25 mm/kV (corresponding to the line to line highest system voltage)
Heavy and very heavy pollution areas and areas upto 50 km from sea shore	31 mm/kV (corresponding to the line to line highest system voltage)

47. Sub- station and switchyard support facilities. ─

(1) Alternating Current and Direct Current Supply. ─

(a) Alternating Current and Direct Current supplies shall be provided as per requirements given in Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and for computation of capacity of battery for Direct Current supply in attended sub- station or switchyard, in general, the minimum durations assumed shall be as per Table 13 below:

Table 13

Steady and continuous load	3 hours
Emergency lighting loads	1 hour

Provided that communication equipment at substations shall be provided with battery backup as per requirement of Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations 2020.

(b) Alternating Current and Direct Current supply system shall be so designed as to meet the requirement of present as well as planned future bays of the sub-station.

(c) For 132 kV and above substations Direct Current system shall comprise of two sets of Direct Current battery each with separate float cum boost charger with auto changeover. Substations below 132 kV shall be provided with one set of battery and charger.

(d) The voltage rating for the Direct Current system for control and protection for 66 kV and 132 kV substations shall be 110 V or 220 V DC and for 220 kV and above substations it shall be 220 V DC.

(2) Lighting.—

(a) Adequate indoor and outdoor lighting including street lighting shall be provided for the sub- station and switchyard.

(b) Adequate normal and emergency AC and DC lighting shall also be provided in the control room and other identified locations of the sub- station or switchyard.

(c) Energy conservation measures and energy efficient lighting devices shall be adopted, while designing the lighting system.

(d) Average illumination levels shall be maintained as per relevant standard.

(3) Control Room and Kiosk.—

(a) Sub-station or switchyard control room and/or bay kiosks shall be provided to house the control and relay panels, bay control units, Intelligent Electronic Devices, protection relays, Substation Automation System, Supervisory Control & Data Acquisition System, Power Line Carrier Communication equipment, Optical Line Terminal Equipment, telemetry equipment and recording equipment, AC and DC distribution boards, DC batteries etc.

(b) Air conditioning with humidity control feature shall be provided in the control room as a functional requirement depending upon site environmental condition.

(4) Power and Control Cables.—

(a) Cables shall be Flame Retardant Low Smoke and Halogen type as per relevant

Indian Standards.

(b) For laying of cables a broad based system involving cable galleries, trenches, cable racks, shafts, cable sealing system etc. shall be provided.

(c) In outdoor switchyards, a cable trench system shall be provided and a comprehensive philosophy of segregation and proper spacing between cables shall be maintained.

(d) Power cables and control cables shall be laid on separate tiers.

(e) The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables with higher voltage grade cables in topmost tier and control cables in bottommost tier.

(f) The cable trench shall be properly sloped so as to drain freely any water which may enter the trench and suitable arrangement shall be provided to drain out excess water.

(5) Oil Evacuating, Filtering, Storing, Testing and Filling Apparatus.—

To monitor the quality of the oil for satisfactory performance of transformers and shunt reactors, and for periodical maintenance, necessary arrangement shall be made for oil evacuating, filtering, storing, testing and filling.

(6) Gas Filling, Evacuation, Filtering, Drying & Recycling Plant.—

Gas filling, evacuation, filtering, drying and recycling plant with adequate storage capacity shall be provided at a sub- station or switchyard or for a cluster of sub-stations and switchyards along with trolley for filling in or evacuation of gas from circuit breaker or gas insulated switchgear and to monitor the purity, moisture content, decomposition product etc. of the gas.

48. Protection and control.—

(1) Protective Relaying System.—

(a) Selective, sensitive, fast, graded and reliable protection system shall be provided for transmission lines, transformers, reactors, and bus bars so as to automatically isolate the faulty element minimizing the damage in the event of fault or abnormal condition.

(b) All major protection relays shall be of numerical type and communication protocol shall be as per IS- 61850.

(2) Grouping of Protection.—

(a) The protection circuits and relays shall be electrically and physically segregated into two groups each being independent and capable of providing uninterrupted protection even in the event of one of the protection group fails or taken out for maintenance.

(b) Interconnection between these two groups shall not generally be attempted.

However, such interconnection shall be kept to the bare minimum, if found absolutely necessary.

(3) The protections required in respect of transmission lines, transformers, reactors and bus bars is indicated in **SCHEDULE-V**.

(4) Disturbance Recorders, Event Loggers and Time Synchronization Equipment.—

(a) Each line or transformer or reactor or any other bay shall be provided with facility for disturbance recording, event logging and Time Synchronizing Equipment.

(b) Each line shall be provided with facility for distance to fault locator.

(c) All Disturbance Recording system shall have minimum recording time of 3 seconds (0.5 seconds for pre- fault and 2.5 seconds for post fault).

(d) Time Synchronizing Equipment complete with antenna, all cables and processing equipment shall be provided to receive synchronizing pulse through Global Positioning System or Indian Regional Navigation Satellite System Navic compatible for synchronization of event logger, disturbance recorder, Phasor Measurement Units, and Supervisory Control and Data Acquisition System or Substation Automation System.

(5) Optical Ground Wire and Power Line Carrier Communication.—

(a) Optical Ground Wire along with necessary terminal equipment shall be provided on transmission lines of voltage rating of 110 kV and above for speech transmission, line protection, and data channels.

(b) The primary path for tele-protection shall be on point-to-point Optical Ground Wire and alternative path shall be either on Power Line Carrier Communication or predefined physically diversified Optical Ground Wire paths.

(c) For reliable communication below 110 kV level the Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations, 2020 shall be used.

(d) The protection system for 400kV and higher voltage transmission line and the line compensating equipment shall have one hundred percent back up communication channels i.e. two channels for tele- protection in addition to one channel for speech plus data for each direction:

Provided that, for 220 kV, 132 kV, 110 kV and 66 kV lines, the channel for speech plus data can also be used for tele-protection.

(e) The generating company and the transmission licensee or transmission licensees at both end of substation or switchyard shall coordinate with each other and ensure the compatibility of Optical Ground Wire and Power Line Carrier Communication equipment at their respective ends.

(6) Phasor Measurement Units .—

(a) Synchrophasor measurement using Phasor Measurement Units along with fibre optic connectivity, Global Positioning System Receiver and communication equipment shall be provided for monitoring the entire interconnected grid on real time basis at substations of 400 kV and above voltage level, switchyard of generating stations at 220 kV and above voltage level, Alternating Current side of converter bays of High Voltage Direct Current stations and pooling point of renewable energy generating stations of fifty mega watt and more and Battery Energy Storage System of fifty mega watt and more.

(b) Phasor Measurement Units shall comply with IS 60255-118-1-2018.

(c) The dispersedly located Phasor Measurement Units shall communicate with Phasor Data Concentrators installed at certain strategic locations at State, Regional and National level.

49. Salient Technical Particulars/ Requirements of High Voltage Direct Current Terminals Stations.—

(1) The provisions given at Regulations 43, 44, 45, 46, 47, and 48 shall also be applicable for the Alternating Current equipment installed in the High Voltage Direct Current terminal station to be developed for bulk power transfer over long distances or asynchronous connections (back to back) between areas operating with different frequency regimes.

(2) The High Voltage Direct Current station shall be designed and constructed to give a life of not less than thirty- five years.

(3) The interfacing with the Direct Current line (overhead or cable), existing Alternating Current network, Telecommunication network, and Load dispatch center shall be properly planned and designed.

(4) The ratio of fault level in MVA at any of the convertor station (for conventional current source type), to the power flow on the High Voltage Direct Current bipole shall not be less than three under any of the load- generation scenarios.

(5) Technical details of High Voltage Direct Current terminals or stations for Line Commuted Converter based technology and Voltage Source Converter based technology are given in **SCHEDULE-VI**.

PART – B

SUB- STATIONS (33/11 kV, 33/22kV AND 22/11kV)

50. System Parameters. -

(1) The system shall conform to the design parameters indicated in Table 14 below:

Table 14

Parameter	33 kV	22 kV	11kV
Nominal system voltage (kV)	33	22	11
Highest system voltage (kV)	36	24	12
Frequency (Hz)	50	50	50
Lightning impulse withstand voltage (kV_{peak})	170	125	75
Power frequency withstand voltage (dry) (kV_{rms})	70	50	28

(2) System earthing shall be as per Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

51. General Consideration for 33/11 kV, 33/22 kV and 22/11 kV Sub-stations and Switching Stations. -

(1) The sub-station shall be indoor or outdoor or underground type depending upon the site requirement.

(2) The sub-station shall be either air insulated or gas insulated or hybrid, as the case may be: Provided that in coastal areas substation shall be GIS.

(3) The 33/ 11 kV or 33/ 22 kV or 22/ 11 kV sub-stations shall have adequate capacity to cater to load growth for at least five years.

(4) The maximum capacity of 33/11 kV or 33/22 kV or 22/11 kV sub-station shall be 100MVA, 75 MVA and 75MVA respectively.

(5) To meet N-1 contingency, each 33/ 11 kV or 33/ 22 kV or 22/ 11 kV sub-station shall normally have :

(a) two or more transformers and

(b) two incoming feeders from two different sources.

(6) In case both (the 33 kV or 22 kV) incoming feeders to the sub-station are from the same source (sub- station), each feeder shall supply independent sections of the 33/ 11 kV or 33/ 22 kV or 22/ 11 kV sub- station, the two sections being isolated from each other by bus sectionalizer or isolators.

(7) All sub-stations shall have independent circuit breaker control of 33 kV or 22 kV incoming feeders, transformers and 22 kV or 11 kV outgoing feeders.

(8) All the incoming feeders feeding the sub-stations shall have independent circuit breaker at source end.

(9) The incoming and outgoing feeders shall be on multi circuit towers to minimize the Right of Way requirement.

(10) The layout of the sub- station itself shall be such that the fire shall not

spread from one to other equipment and areas as far as possible.

(11) While selecting equipment for the sub-station de-rating due to increase in altitude and for cables due to death of burial in the ground shall be given due consideration as per the altitude/depth of burial at the site.

52. **Selection of Site.** - The selection of the site of the sub-station shall be done on the basis of the following namely:-

(a) The site shall take into consideration the capacity and location of the feeding grid sub-station, load in the area, spatial load forecast, demographic factors, the existing network configuration, etc. and the economic, and environmental considerations;

(b) The site shall be near the load center;

(c) The site shall be such that it is convenient for terminating extra high voltage or high voltage lines or cables;

(d) The site shall not be in a low-lying area to avoid flooding during the rains;

(e) The site shall be easily approachable in all the seasons;

(f) The site for air-insulated sub-station shall be away from garbage dumping ground to avoid vulture faults;

(g) The land shall be reasonably levelled and shall not have any open drainor nallah or road crossing it.

53. **Switching Arrangements. -** (1) Switching arrangements shall ensure operational flexibility, system safety and reliability.

(2) Single bus, single bus with bus sectionalizer, main and transfer bus, double bus or mesh arrangement shall be adopted as per requirement.

54. **System Configuration.** - The system configuration shall be radial, ring or combination of both as per requirements namely:-

(1) The radial configuration shall be minimized to improve reliability;

(2) In densely loaded city centers, and for essential services and installations, the system shall be of ring configuration.

55. **Power Transformers.** - (1) The transformers shall comply with the relevant IS.

(2) The 33/ 11 kV or 33/ 22 kV or 22/ 11 kV transformers shall have delta star or delta-zigzag winding connection.

(3) At existing sub-stations, the percentage impedance, vector groups, on load tap changer connection and range of the new transformer shall match with that of the existing transformer.

(4) The type and place of installation of transformer shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

(5) Transformers shall withstand, without injurious heating, combined voltage and frequency fluctuations which produce the over fluxing conditions as: 125% for 1 minute, 140% for five seconds and 150% for one second.

(6) Each transformer shall be provided with gas and oil actuated Buccholz relay fitted with alarm (local and remote) and trip contacts, if applicable.

(7) (a) A transformer with off-circuit tap changer shall have taps ranging from (+) 5% to (-) 10% in steps of 2.5% each on the higher voltage winding for variation in the voltage.

(b) The tap changing switch shall be located in such a way that it can be operated from ground level.

(c) The switch handle will be provided with a locking arrangement along-with tap position indication, for locking the switch.

(8) (a) On load tap changing device shall be provided with transformers of 3.15 MVA and higher rating for better voltage control by manual and automatic means.

(b) A transformer with on-load tap changer shall have taps ranging from (+) 5% to (-) 15% in steps of 1.25% each on 33 kV or 22 kV winding for voltage variation.

(9) All electrical safety requirements, clearances and ventilation shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

(10) (a) For indoor installation, the room shall be well ventilated for escape of heated air.

(b) air inlets shall be provided near the floor and outlets near the ceiling.

(11) A transformer shall be physically checked and tested for its electrical and mechanical performance characteristics as per relevant IS before commissioning.

(12) Transformer Health Monitoring system shall also be provided for monitoring the health of power transformers.

(13) A transformer shall be provided with two separate body earthing terminals which in turn shall be connected to two separate earth points, besides neutral earthing terminal.

56. Bus-bars. – (1) Bus-bars shall be of Rigid type or Strain type.

(2) Bus-bar shall be able to carry the expected maximum load current continuously without exceeding the temperature rise limit as per relevant IS.

(3) The capacity of a bus-bar shall also be checked for maximum temperature rise of the conductor under short circuit conditions.

(4) The bus-bar connections and insulator supports shall be mechanically strong

and bus-bars shall be supported so as to withstand the stresses generated by vibrations and short circuits.

(5) Aluminium or Copper used for bus-bars shall conform to relevant IS.

57. **Structures.** - (1) Structures shall be provided for. -

(a) Incoming and outgoing gantries and/or cable supports and terminations;

(b) Circuit breakers, isolators, fuses, insulators, CTs and PTs (potential transformers);

(c) Bus-bars and insulators.

(2) Switchyard structures shall be made of fabricated steel, reinforced cement concrete or pre-stressed concrete, rail or rolled steel joist depending on technical and economic considerations.

(3) The structures shall be able to withstand tension of conductors and load of the equipment and accessories without guys or stays.

(4) The steel structures shall be hot dip galvanised or painted:

(5) In highly polluted and corrosive atmospheric conditions galvanised structures with paint shall be used.

(6) Adequate muffing above the ground level shall be provided to avoid water accumulation near the structures.

58. **Insulators.** - (1) The insulators shall comply with relevant IS.

(2) The station design shall be such that number of insulators is minimum but at the same time reliability of supply is ensured.

(3) Suitable means shall be provided to accommodate conductor expansion and contraction and there shall not be any undue stress on any part or equipment due to temperature change.

(4) The minimum creepage distances for different pollution levels shall be as per Regulation 43.

(5) The post insulators shall be of pedestal type or Solid Core Station type.

(6) In the areas where problem of insulator pollution is expected (such as near sea or thermal power station, railway station, industrial area, etc.) special insulators *viz.* semi conducting glazed porcelain or polymer insulators with higher leakage resistance and creepage distance shall be used to minimize the flashover.

(7) The special coating like Room Temperature Vulcanized coating may also be used on the insulators in polluted areas as per requirement.

59. **Circuit Breakers.** - (1) Circuit breakers shall comply with the relevant IS and shall be SF_6 or vacuum type.

(2) The rated voltage of the circuit breakers shall be as per highest system voltage.

(3) Rated short time current rating of 33 kV circuit breakers shall not be less than 25 kA for one second and for 22 kV or 11 kV CBs shall not be less than 16 kA for one second.

(4) The operating mechanism of circuit breakers shall be motor operated spring charged type or magnetic actuator type.

(5) The circuit breaker shall be provided with anti-pumping and trip free features.

(6) The indoor circuit breakers shall be metal clad, either fixed type or draw out type.

(7) The rated rupturing capacity of the circuit breaker to be installed at any new sub-station shall be at least 25% higher than the calculated maximum fault level at the bus to take care of the increase in short circuit levels as the system grows.

60. **Isolators and Earthing Switches.** - (1) The isolators shall be as per capacity of substation and shall comply with relevant IS.

(2) The operating mechanism for the isolators and the controlling circuit breaker shall be interlocked so that the isolators cannot be opened unless the corresponding breakers are in open position.

(3) Earthing switches shall be provided at various locations to facilitate maintenance.

(4) Main blades and earth blades of earthing switches shall be interlocked, both electrically and mechanically.

(5) Earthing switches shall be motor operated as well as suitable for manual operation and only local operation is recommended for earth switches.

61. **Control and Relay Panels.** - (1) The control and relay panels shall conform to relevant IS.

(2) The panel shall be provided with:

(a) Numericalover current and earth fault relays conforming to relevant IS.

(b) Measuring instruments such as ammeter, voltmeter and energy meter for 33 kV, 22 kV and 11 kV systems.

(c) Mimic diagrams or Bay control unit (BCU).

(d) Annunciation, alarms and trip facilities.

62. **Surge Arrestor.** – (1) Distribution class, gapless metal oxide (ZnO) type surge arresters conforming to relevant IS shall be provided on the buses, high voltage and low voltage sides of all transformers and on the incoming terminations of 33/ 22 kV lines.

(2) The surge arrester which responds to over-voltages without any time delay shall be installed for protection of 33 kV, 22 kV and 11 kV switchgear, transformers, associated equipment and 33 kV, 22 kV and 11kV lines.

(3) Surge arresters shall be single-phase units suitable for outdoor duty.

(4) The rated voltage of surge arresters shall be 30 kV, 20kV, 9 kV and nominal

discharge current rating shall be 10 kA, 7.5kA and 5 kA for use on 33 kV, 22 kV and 11 kV systems respectively.

(5) Surge arresters for transformers shall be mounted as near the transformers as possible and the star point shall be connected to the independent earthing point.

63. Instrument Transformers (Current and Voltage Transformers) -

(1) **Current transformers (CTs) -**

(a) Current transformers shall comply with relevant IS.

(b) The rated current and ratio, the number of secondary cores (protection and/or metering), accuracy class, burden, secondary winding resistance, knee point voltage, instrument security factor and excitation current shall be as per the requirements of the protection and metering system.

(c) The selection of CT secondary current (5A or 1A) shall be based on the CT burden and knee point voltage.

(d) The CT may be oil filled or resin type for outdoor use and shall normally be cast resin type for indoor use.

(e) The accuracy class for metering core shall be as per the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

(2) **Voltage transformers (VTs) -**

(a) Voltage transformers shall conform to relevant IS.

(b) The number of secondary cores (protection or metering), accuracy class and burden shall be as per the requirements of the protection system.

(c) Voltage transformers shall be of inductive type or capacitor type.

(d) The voltage transformers shall be oil filled or cast resin type for outdoor use:

Provided that the indoor voltage transformers shall be cast resin type.

(e) Multiple earthing of voltage transformers shall be avoided under any circumstances.

(f) The accuracy class for metering core shall be as per the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

64. Control Room. - (1) Control room shall be provided to house the control and relay panels and all other indoor equipment, and measuring, monitoring and recording system required for control and operation of the sub-station.

(2) Adequate space shall be provided for the operation and maintenance staff.

(3) Provision of space for future expansion shall also be kept.

65. Earthing Arrangement. - Earthing shall be carried out in accordance with relevant IS and Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

66. Reactive Power Compensation. – (1) Capacitors, residual voltage transformers and neutral current transformers shall be as per relevant IS.

(2) Shunt capacitors shall be connected on secondary side of 33/11 kV, 33/22 kV or 22/11kV transformers if found necessary based on network studies conducted

(3) Where un-switched (fixed) capacitors are provided, the rating shall be chosen so as to prevent over compensation during off peak periods.

(4) Each capacitor unit shall be provided with a built-in discharge resistor of adequate rating to discharge the residual voltage as per relevant IS.

(5) The capacitors shall be fixed firmly to the supporting structure to make them immovable.

(6) Where the sub-station is feeding loads which have high harmonic levels, suitable harmonic filters shall be installed.

(7) In cases of sub-stations loaded with highly fluctuating loads like arc furnaces etc., flickers and voltage regulation problems may be overcome by installation of static var compensators (SVCs) or STATCOM.

67. **Power and Control Cables**. - (1) Cables shall be as per relevant IS.

(2) Cable laying shall be done complying with requirements of relevant IS including manufacturer's recommendation.

(3) The cables shall be segregated by running in separate trenches or on separate racks, with the highest voltage class cables laid at the highest racks or tiers.

(4) Cables shall not be laid directly on the trench floor.

(5) The cable trenches shall be properly sloped so as to drain freely any water which may enter.

(6) Care shall be taken in sub-station design to permit easy entry of cables into switchgear and convenience of handling afterwards.

(7) Segregation of AC and DC control cables and power cables shall be done.

(8) Sufficient extra length of cable shall be provided for repair of faults in terminations inside the switchgear.

(9) The relevant drawings of cable sizes, routes and termination details of control cables in the panels shall be available at work site and shall be preserved for future use and reference in the sub-station.

(10) All cable ends shall be suitably labelled to facilitate easy identification.

(11) Power Cables:

(a) Power cables shall be cross linked poly ethylene (XLPE) insulated, poly vinyl chloride sheathed type;

(b) Cables shall be flame retardant low smoke and low halogen type or flame retardant low smoke zero halogen type;

(c) Cables shall be de-rated for the site's ambient and ground temperature, grouping and soil resistivity as per IS;

(d) Proper attention shall be given to ventilation or heat dissipation aspects particularly in case of HV cables.

(12) Control Cables. -

(a) The control cables shall be of copper;

(b) Separate control cables shall be used for each CT and VT;

(c) Ferrules used on ends of control cables shall match with the details shown in the relevant termination drawings;

(d) Adequate number of spare cores shall be included in all control cables.

68. **Telecommunication System.-** A dedicated and reliable telecommunication system as per Central Electricity Authority (Technical Standards for Communication System in Power System Operations) Regulations, 2020 as amended from time to time. The Communication System will comply to Central Electricity Authority (Cyber Security in Power Sector) Guidelines, 2021.

69. **Automation System. -** Supervisory control and data acquisition system and Data acquisition system shall be provided in the sub-stations, associated feeders and distribution transformers for improving the operational flexibility, minimizing restoration time of power supply and preventing overloading of lines and transformers in real time mode.

70. **Sub-station Support Facilities. –** (1) **DC supply arrangement-** The battery charger, battery and load shall be connected in parallel and work as a system.

(a) **Battery**. -

(i) The 24V, 30V, 48V, 110V, 220V DC batteries shall be stationary lead acid or nickel cadmium or lithium-ion type;

(ii) The capacity and discharge rate of the batteries shall be as per the requirement;

(iii) The batteries shall conform to relevant IS;

(iv) A separate room for Substation Batteries shall be provided with ventilation and exhaust fan for taking out fume gases and provision of remote monitoring of sub-station batteries and exhaust fan shall also be made.

(b) **Battery charger. -**

(a) The battery chargers shall be automatic float cum booster type;

(b) The battery charger shall be capable of continuous operation at the rated load in float charging mode;

(c) The charger in boost charging mode shall be capable of boost charging the associated DC battery at the desired rate;

(2) **Auxiliary power supply transformer. -** An auxiliary power supply transformer

capable of meeting the auxiliary and lighting loads of the sub-station shall be provided..

(3) **Oil and SF_6 evacuating, filtering, testing and filling apparatus.** - Oil and SF_6 filling, evacuation, filtering and testing plants with adequate storage facilities along with requisite operation and maintenance tools and plants shall be provided for a cluster of sub- stations as per requirement.

71. **Fencing and Approach Arrangement.** – (1) Fencing or boundary wall shall be provided around the sub- station as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

(2) A metalled approach road to transport the equipment shall be provided leading from the main road.

72. **Lighting System -** In addition to the energy efficient lighting system provided for catering to the normal AC lighting load, emergency lighting operated on the DC system shall be provided in strategic locations *viz.* control room, battery room, passages etc.:

Provided that it shall be ensured to provide separate DC battery bank for emergency lighting in the substation and Sub Station's main battery bank used for protection system is not used for emergency lighting to avoid the draining of the main battery bank.

73. **Fire Fighting System. –** (1) The fire fighting system at Sub stations shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard .

(2) Fire extinguisher used in the fire fighting system shall conform to relevant Indian Standards.

PART–C

DISTRIBUTION SUB-STATIONS (DSS)

74. **General-** (1) The system shall conform to the design parameters indicated in Table 15 below. -

Table 15

Parameter	**33 kV**	**22 kV**	**11kV**	**0.415 kV**
Nominal system voltage (kV)	33	22	11	0.4 15
Highest system voltage (kV)	36	24	12	0.450
Frequency (Hz)	50	50	50	50

Lightning impulse withstand voltage (kVpeak)	170	125	75	-
Power frequency withstand voltage (dry) (kVrms)	70	50	28	3

(2) System earthing shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

(3) For consumers supplied at voltage not exceeding 650 V (except mines and oil fields), the nominal r.m.s. value of Voltage at the point of commencement of supply of electricity, shall be as follows namely:-

(i) Single Phase 230 Volts between phase and neutral;

(ii) Three Phase 400 Volts between phases.

Explanation. - For the purpose of sub-regulation 74(3), the expression "point of commencement of supply of electricity" shall mean the point at the outgoing terminal of meter installed at the consumer premises.

(4) The Distribution sub- stations shall normally be located near load center.

(5) The DSS can be installed indoor or outdoor or underground as per site requirement.

(6) The DSS with dry type transformer can be used for rooftop installation provided that the building is suitable for bearing the load and adequate fencing or isolation arrangement is ensured.

(7) The DSS can be conventional, package type, completely self protected (CSP) type.

(8) DSS may be installed vertical type (DT on ground with RMU and LT switches above DT on another platform or vice versa).

(9) The capacity of DSS shall be as per the load requirement keeping in view the future load growth for at least five years.

(10) In the selection of the equipment for the distribution substation de-rating due to increase in altitude and for cables due to depth of burial shall be given due consideration as per the altitude or depth of burial at the site.

75. Distribution Transformers. – (1) The transformer shall conform to relevant IS and shall be ISI marked.

(2) The transformer can be oil filled, or dry type depending on requirements and shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

(3) The maximum losses for dry transformers shall not be more than the values specified in latest Energy Conservation Building Code of Bureau of Energy Efficiency till Indian Standards for dry type transformer are published.

(4) In coastal areas, Distribution Transformer shall be indoor or package type or plinth-mounted.

76. **Transformer Mounting Structure. –** (1) The mounting of transformers shall be as per relevant Indian Standards.

(2) The structures shall be provided with. -

(a) anti-climbing devices and

(b) danger board.

(3) (a) The plinth shall be. –

(i) higher than the surroundings.

(ii) made of Concrete or Metal (properly earthed) or fire resistant fibre glass of adequate strength to withstand the load:

(b) the plinth can be pre-fabricated also.

(c) the plinth foundation shall be of concrete.

(4) Plinth mounted distribution sub-stations shall be adequately protected by fencing so as to prevent access to the equipment by unauthorized persons, animals and shall be provided with standard danger boards.

77. **Surge Arresters. – (**1) Surge arrester conforming to relevant IS shall normally be installed on the high voltage side of the transformer connected to overhead lines:

Provided that surge arrester shall also be provided on the low voltage side in areas of high isoceraunic activity.

(2) Surge arresters of rating 9 kV on 11 kV, 20 kV on 22 kV and 30 kV on 33 kV outdoor type shall be used for diverting the lightning surges to earth.

78. **LT Distribution Box-** (1) LT distribution box consisting of breaker and fuse cutouts and fittings conforming to relevant IS shall be provided from where distribution feeders shall be taken out.

(2) The size of the box shall be suitable for accommodating moulded case circuit breaker, fuse cutouts, cable connectors, bus-bars etc.

(3) The distribution box shall be mounted at a height of minimum 1.5 metres for pole mounted distribution transformers while the feeder pillar box can be installed at ground level, with adequate clearance:

Provided that for single phase transformer, the distribution box can also be directly mounted on the body of transformer.

79. **Protection System. - The protection system of transformers shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply)**

Regulations, 2010 or any successor or subsequent Regulations in this regard.

(1) **33/ 0.4 kV DSS and 22/ 0.4 kV DSS -**

(a) Suitable high rupturing capacity cartridge fuse or moulded case circuit breakers or miniature circuit breakers or air circuit break switch shall be provided on low voltage side.

(b) The high voltage side of these transformers shall be protected by circuit breakers or drop out fuses.

(2) **11/ 0.4 kV DSS -**

(a) Suitable high rupturing capacity cartridge fuses or moulded case circuit breakers or miniature circuit breakers or air break switch shall be provided on low voltage side for transformers of 100 kVA and above: Provided that the high voltage side of these transformers shall be protected by drop out expulsion type fuses or circuit breakers.

(b) Horn gap fuse with air break switch shall be provided on high voltage side and switch fuse unit or wire fuse on low voltage side shall be provided for transformers below 100 kVA.

80. **Earthing-** Earthing shall be provided for the DSS complying with relevant Indian Standards and Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

81. **LT Cables. -** (1) IS compliant XLPE cables shall be used for connecting LT supply from transformer bushings to the LT circuit breaker in the distribution box and for taking out outgoing feeders from the fuse units to the overhead lines.

(2) The LT cables may be armoured or unarmoured for transformers rated less than 100 kVA and shall be armoured for transformers of 100 kVA and higher ratings.

(3) The cables shall be properly clamped to the support without damaging the insulation.

(4) A loop arrangement shall be made at the connecting end and laying of cables shall be in such a way that rain water does not enter.

82. **Meters. -** The installation of meters shall be in conformance to the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

83. **Reactive Compensation. -** (1) Where the power factor is low, reactive compensation shall be provided on the distribution transformers by fixed or automatic switched type capacitors of adequate rating.

(2) In case of fixed capacitors it shall be ensured that the rating of the capacitors is such as to prevent over compensation during off peak period.

(3) In cases where loads fluctuate very fast or there is large intraday reactive variation, a suitable dynamic compensation like thyristor switched capacitors shall be considered.

(4) In loads which are rich in harmonics, suitable harmonics filters or de-tuned filter banks shall be considered.

Chapter V

PART-A

ELECTRIC LINES (66 kV AND ABOVE)

84. **General.─**

(1) The transmission system planning shall be in accordance with Central Electricity Authority's "Manual on Transmission Planning Criteria".

(2) The transmission line shall be designed and constructed to give a life of not less than thirty five years.

(3) Overhead transmission lines shall be planned, designed and constructed at

least in double circuit configuration.

Provided that for 765 kV lines single circuit configuration can be used with the approval of the National Committee on Transmission.

(4) Right-of-way for transmission lines of different voltage levels (with specific conductor type and configuration, design span and string arrangement) traversing through normal terrain or route without constraint, forest area, urban area, populated area and approach section near substation shall be as per **SCHEDULE-VII**.

(5) For transmission lines in areas where Right-of-way constraint is encountered, appropriate technology options such as use of steel pole structure, narrow based lattice towers, multi-circuit and multi-voltage towers, lattice or steel pole structure with one side stringing, XLPE cable or Gas Insulated Line, compact towers with insulated cross arm, and Voltage Source Converter based HVDC transmission on overhead line or underground cable shall be adopted.

(6) Steel pole structure, Multi-circuit (more than two circuits) or multi-circuit and multi-voltage towers for overhead lines upto and including 400 kV voltage level shall be considered in the urban areas, approach section of substation or switchyard and as an alternative to number of parallel lines passing through forest, eco-sensitive zone, wildlife sanctuary for effective use of available corridor.

(7) Routing of a transmission line shall avoid large habitations, densely populated areas, protected or reserved forest or National Parks or Wild Life Sanctuaries, the habitant zones of Great Indian Bustard and other protected species, civil or military airfields and aircraft landing approaches.

(8) The names of owners of the land falling under RoW of the transmission line shall be recorded after carrying out the check survey at the time of execution.

(9) The Transmission Service Provider or Transmission licensee shall arrange consents and approvals from Power and Telecommunication Co-ordination Committee and the concerned authorities for environmental and forest, mining, civil aviation, road, river, rail, canal and power line crossings.

85. Design and Construction of Transmission Lines.─

(1) Electrical Design Parameters of the Transmission Lines

(a) The design parameters of the transmission lines for altitude upto 1000 m above mean sea level shall be as indicated in Table 16 below:

Table 16

Parameter	**66 kV**	**110 kV**	**132 kV**	**220 kV/**	**+320 kV HVDC**	**400 kV**	**765 kV**	**+500 kV**	**+800 kV**	**1150 kV**

	AC	AC	AC	230 kV AC		AC	AC	HVDC	HVDC	AC
Nominal voltage (kV)	66	110	132	220/ 230	320	400	765	500	800	1150
Highest system voltage (kV)	72.5	123	145	245	336	420	800	525	840	1200
Rated Insulation Level (minimum)										
(i)Lightning impulse withstand voltage (1.2/50 micro sec)(kVpeak)	325	550	650	1050	1425	1550	2400	1800	2250	2400
(ii)Power frequency withstand voltage under dry condition (kVrms)	140	230	275	460	NA	680	830	NA	NA	1200
(iii)Switching surge withstand voltage under wet condition (kVpeak)	NA	NA	NA	NA	1050	1050	1550	1000	1850	1800
Minimum corona extinction voltage under dry condition (kV_{rms} phase to earth)	NA	NA	NA	156	350	320	508	550	880	762

Maximum radio interference voltage under dry condition (micro volts)	NA	NA	NA	1000 (at 156 kV rms)	22 kV/cm conductor surface gradient	1000 (at 320 kV rms)	1000 (at 508 kV rms)	22 kV/cm conductor or surface gradient	22 kV/cm conductor or surface gradient	00 762 kV rms)

(b) For installations at altitudes higher than 1000 m above Mean Sea Level, altitude correction factor on the applicable parameters such as rated insulation level, clearances and arcing distance for external insulation at the service location shall be applied as per methodology specified in relevant standards.

(c) The phase conductors of AC transmission lines shall be transposed in approximately three equal parts, wherever the length of the line is more than 100 km.

(2) Conductor.—

(a) Minimum two conductors per phase for 400 kV AC; four conductors per phase for ± 500 kV HVDC and 765 kV single circuit AC; six conductors per phase for 765 kV Double Circuit AC and ± 800kV HVDC; and eight conductors per phase for 1200 kV AC shall be used to meet the corona and Radio Interference requirement.

(b) The conductors shall be Aluminum Conductor Steel Reinforced or All Aluminum Alloy Conductor or Aluminium Alloy Conductor Steel Reinforced or High Conductivity Aluminium Alloy stranded conductors or High Performance conductors or High Temperature and Low Sag conforming to relevant Indian or international standards.

(3) Earthwire.—

(a) The earthwire of appropriate size to cater to predicted and design fault currents and lightning shall be used.

(b) Single earthwire shall be used for transmission lines up to 220 kV and two earthwires shall be used for transmission lines of 400 kV and higher voltage classes.

(c) The earthwire used in 66 kV voltage class lines shall be Optical Ground Wire or galvanized stranded steel or Aluminium Alloy Conductor Steel Reinforced type.

(d) The earthwire used in 110 kV and above voltage class lines shall be Optical Ground Wire.

Provided that in case of 400kV and above voltage class lines, at least one out of two earthwires shall be Optical Ground Wire and second earthwire shall be either of galvanized stranded steel or Aluminium Alloy Conductor Steel Reinforced conductor type.

(4) Towers.—

(a) The towers shall be self-supporting lattice steel structure or steel pole structure or structure with insulated cross arms or guyed tower and shall be fully galvanized.

(b) All electrical clearances shall be as per relevant standard and Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

(c) The pole, towers, and towers with insulated cross-arms shall be designed considering design loading criteria and conditions as per relevant IS.

(d) Wind Zone considered for wind loading shall be as per wind map given in National Building Code till the relevant Indian Standard is revised.

(e) For design of transmission line structures in eastern coast and Gujarat coast upto 60 km from sea coast, importance factor for cyclonic region i.e. K4 factor of 1.3 shall be considered to take care of cyclonic wind condition.

(f) For the transmission lines to be laid within 50 km of the border of the two wind zones specified in the Wind Map, towers shall be designed for the higher of the two wind zones.

(g) Reliability level as per Table-17 shall be considered for design of towers and steel pole structures of following transmission lines:

Table-17

66 kV to 400 kV Transmission lines with one or two circuits and one or two conductors per phase	Reliability level 1 corresponding to 50 years return period
66 kV to 400 kV Transmission lines with more than 2 circuits; 400 kV Transmission lines with more than two conductors per phase; Above 400 kV transmission lines	Reliability level 2 corresponding to 150 years return period
Special towers or Pole ; Tall River crossing towers or Pole; Multicircuit towers or Pole whose full scale prototype can not be tested due to limitation of testing facility	Reliability level 3 corresponding to 500 years return period

(h) The prototype of towers or poles shall be tested as per relevant Indian Standards. However, it shall not be mandatory to test prototype of tall river crossing towers or poles and other special towers or poles designed for reliability level 3 (500 year return period).

(i) Drag coefficient for calculation of wind load on tower as per Table 18 shall be considered for design of tower:

Table 18

Solidity Ratio	Drag coefficient
Upto 0.05	3.6
0.1	3.4
0.2	2.9
0.3	2.5
0.4	2.2
0.5 and above	2.0

(j) Delta configuration towers shall not be used for 765 kV single circuit line.

(k) For towers in snow bound areas, steel sections shall conform to Grade C of IS 2062.

(l) The fabricated tower or pole parts and stubs of transmission lines passing upto 20 km from through coastal / creek regions shall have following minimum mass and thickness of zinc coating (Table 19):

Table-19

	Minimum mass of zinc coating (gram/sq m)	**Average coating thickness of zinc coating (micron)**
For plates and sections below 5 mm	610	87
For plates and sections of 5 mm and above	900	127

(m) The danger plates, number plates, phase plates, circuit plates, anti-climbing devices, bird guards, day or night visual aids and markers for denoting transmission line or structures as per requirements of Directorate of Flight Safety or International Civil Aviation Organization and the bird diverters, wherever required, shall be provided.

(n) Spike type Bird guards on the Upper (tie members) and Lower main members and also on Plan bracings in the barrel of the tower at all the cross arm levels to prevent birds from making nests.

(o) Each tower shall be earthed such that tower footing impedance does not exceed 10 ohms.

(p) Pipe type or Counterpoise type earthing or multiple earthing or use of environmental friendly earth enhancement material shall be used for earthing of towers to achieve specified tower footing impedance. If still, specified tower footing impedance is not achieved, line surge arresters shall be used on phase conductors connected to that tower to reduce back flashover.

(q) Additional earthing shall be provided on towers after every seven to eight km distance for direct earthing of shield wires.

(5) Foundations.—

(a) The type of foundation for towers shall be decided based on geotechnical investigation of the soil properties and shall be designed and laid as per relevant Indian Standards.

(b) Pile type foundation shall be used for towers located in river or creek bed or on bank of river having scourable strata or in areas where river flow or change in river course is anticipated, based on detailed soil investigation, maximum flood discharge of the river during past twenty years, maximum velocity of water, highest flood level, scour depth and anticipated change in course of river based on river morphology data of at least past twenty years to ensure availability and reliability of the transmission line.

(6) Insulators, Insulator Strings and Hardware Fittings.—

(a) In a transmission line, for a particular Site Pollution Severity class, minimum specific creepage distance (corresponding to the line to line highest system voltage) shall be as specified in Table 20.

Table 20

Site Pollution Severity (SPS) class (As per IS 16683:Part-I:2018)	**Specific Creepage Distance (in mm/kV)**
Very Light or Light or Medium	20
Heavy	25
Very Heavy	31

(b) The silicone content in composite silicone rubber insulator shall be minimum 30% by weight and RTV silicone coating, if used on any insulator, shall be in accordance with IS 11310.

(c) Number of insulators, insulator profile, profile parameters and dimensions shall be selected based on electrical system parameters and site specific factors like altitude above mean sea level, expected environmental and pollution conditions complying with relevant IS or IEC standards.

(d) For river crossings or power line crossings (66kV or above), railways or road crossings (express way, national highway and state highway) minimum two sets of long rod insulators or two sets of disc insulator strings per phase per circuit shall be used.

(e) Electro-mechanical strength of insulator shall be selected such that:

(i). under 100% design wind loading conditions, the load on insulator string shall not exceed 70 % of its electro-mechanical strength;

(ii). under everyday temperature and nil wind conditions, the load on insulator string shall not exceed 25% of its electro-mechanical strength.

(f) Grading or Corona ring shall be provided with Composite silicone rubber insulators for 132 kV and above voltage class lines and with porcelain or glass insulators for 400 kV and above voltage class lines to control high concentration of electric field.

(7) Accessories for Conductor and Earthwire.—

The accessories required for the conductor and earthwire *viz.* mid-span compression joints, repair sleeve, T-connector, flexible copper or aluminium bond, vibration dampers, spacer or spacer-dampers, earthwire clamps etc. shall be used as suitable for type and size of conductor and earthwire used for the transmission line.

(8) Crossing by a transmission line.—

(a) For crossing of power line of 400 kV or above voltage class, large angle towers of deviation angle of 30-60 degree and designed for dead end condition, with required body extension, shall be used on either sides of the power line.

(b) For crossing of power line of 110 kV, 132 kV, 220 kV and 230 kV voltage class, the tension towers with required body extension shall be used on either sides of the power line and the crossing of power lines of 66 kV class shall be done with any type of towers (suspension or tension) with required body extension.

(9) The Route of transmission line (66 kV and above voltage level) shall be clearly identified as normal sections without constraint, sections through forest area, and sections through urban areas or populated area or approach section near substations and normal design span for various voltage level transmission lines be as indicated in the Table 21 below shall be adopted.

Table 21

Voltage (kV)	Normal design span (m)		
	Normal route without constraint	Forest area	Urban area / Populated area / approach section near substation
± 800 kV HVDC ±500 kV HVDC 1200 kV AC	400		
765 kV / 400 kV AC	400	300	250
230 kV/ 220 kV AC	325 to 350	250	200
132 kV	320	200	150
110 kV AC	305	200	150
66 kV AC	250	150	100

Provided that reduced design span for pole or narrow base structure may be considered based on techno-economic analysis.

(10) Cables and Gas Insulated Lines.― In the stretches where the construction of an overhead transmission line is not possible due to space constraints or right of way problems, XLPE cable or Gas Insulated Lines conforming to relevant IS or IEC standard, and rated for power flow requirement shall be considered for transmission of power based on techno-economic analysis.

86. Condition Assessment of Towers and earthing system.― (1) Utilities shall assess the condition of structure of towers, conductors, earthwire, all associated accessories, foundation and earthing system periodically using modern techniques and diagnostic tools and shall take appropriate action, wherever abnormality is noticed.

(2) For condition assessment of conductors, clamps, connectors, insulators etc., provision for on- line or off- line diagnostic tools and equipment shall be made.

(3) On- line tools shall include thermo-vision camera for detection of hot spots, corona camera and live line punctured insulator detector.

(4) Off- line tools shall include insulation resistance measuring instrument, contact resistance measuring instrument and tower footing impedance measuring tool.

(5) The on line (as in built feature of Numerical relay) and off-line fault locator shall be used for locating the transmission line faults.

(6) Patrolling of the lines shall be carried out on half yearly basis for smooth and trouble free operation of line and activities like replacement of missing members or

bolts, coping of chimney to avoid rusting of stubs, identifying rusted members, missing earthing connections etc.

(7) During patrolling, if any unauthorised construction/use/storage under and around the towers is observed, local administrative authority shall be immediately informed for assistance and necessary action.

(8) Frequency of patrolling of transmission lines shall be increased for the vulnerable tower locations (thunder prone, cyclonic prone area) and in theft prone areas. Members or nuts or bolts, if found missing during patrolling, shall be replaced to avoid failure of towers.

(9) The nuts and bolts of section above bottom cross arm level shall be rechecked and re-tightened after five years of commissioning of the transmission line and every ten years of service thereafter.

(10) Condition of earthing shall be checked after ten years of commissioning of transmission line and every five years of service thereafter and corrective action, if required may be taken.

87. Use of Helicopter and UAV.─

For survey, erection of towers, stringing of conductors/earthwire and patrolling of transmission line in difficult and inaccessible terrains and in other areas if techno-economically viable, use of helicopter or Unmanned Aerial Vehicle shall be considered:

Provided required clearance from Director General Civil Aviation or any other competent authority shall be obtained before taking up such activity.

88. Use of GIS platform.─

Transmission system asset mapping, route alignment and optimization of route of new transmission line for transmission projects shall be carried out on Bhuvan Indian Geo platform of National Remote Sensing Centre.

PART- B

ELECTRIC LINES (33 KV AND BELOW)

89. General.─ (1) The lines shall be constructed keeping in view the prime factors of safety as well as electrical and mechanical design considerations.

(2) The Owner who is connecting his new installation has to abide by the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and Central Electricity Authority (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations, 2013.

(3) The Owner shall arrange all required consents/approvals including civil aviation, road, river, rail, canal, power line crossings and environmental and forest clearances etc. from the concerned authorities.

(4) The Owner in accordance with the requirements of construction shall arrange right of way and way leave clearance:

Provided that compensation for right of way and way leaves shall be given as per applicable law, rules and regulations, guidelines/directives of local administrative/revenue authorities.

(5) The RoW width for urban areas:

(a) 33kV overhead lines for different types of structures, commonly used ACSR conductor (with maximum operating temperature of 85 degree) and normal design span

(b) 33kV lines with covered conductor mounted on pole type structure shall be as indicated below:

Conductor	**Structure Type**	**Design Span (in m)**	**String Type**	**RoW (in m)**
Commonly used ACSR Bare conductor	Lattice type/ Steel pole	250	"I" String/Suspension	15 meter
			Tension	
		150	"I" String/Suspension	12 meter
			Tension	
	Concrete Pole/Rail Pole/H Pole/ Single Steel Pole	100	Pin Insulator	9 meter
		60	Pin Insulator	8 meter
Covered	Pole	100		6 meter

90. Electrical Design Parameters of the Electric Lines.— (1) The electrical design parameters of the electric lines for altitude upto 1000 m above MSL shall be as indicated in Table 22 below:

Table 22

Parameter	**33 kV**	**22 kV**	**11 kV**	**0. 415 kV**
Nominal system voltage (kV)	33	22	11	0.415

Highest system voltage (kV)	36	24	12	0.450
Frequency (Hz)	50	50	50	50
Lightning impulse withstand volta	170	125	75	-
Power frequency withstand voltage (kV_{rms}) in dry condition	75	50	28	3

(2) For the electric lines at altitudes higher than 1000 m above MSL, basic insulation level (BIL), impulse withstand voltage requirements shall be kept higher than those indicated in Table 22 as per relevant standards and practices.

(3) System Earthing shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

91. Design and Construction of Electric Lines and Associated Equipment.─ (1) The design and construction of the electric lines shall comply with the relevant IS.

(2) The system shall be constructed so as to ensure:

(a) voltage conditions are within permissible levels;

(b) improvement of reliability and security of power supply;

(c) improvement in quality of supply;

(d) adequate capacity for load growth at least for next five years.

(3) Independent feeders shall be provided for essential loads such as water works, hospitals, defence, railways, airports and other sensitive installations and for selected consumers on request.

(4) Separate rural feeders for feeding irrigation load and domestic load shall be provided.

(5) Multi-circuit multi-voltage lines shall be adopted by the owner as per requirement.

(6) Extension of existing lines shall be carried out after ensuring that the limits of voltage variations on the lines are not exceeded.

(7) The reliability and security of supply shall be improved by use of sectionalizers, auto re-closers, ring main units and fault passage indicators as per techno economic considerations.

92. Routing of Overhead Electric Lines.─ (1)The route of the electric line shall be as short as possible.

(2) The routing of an electric line shall normally be avoided through following areas:

(a) Protected and reserved forest:

Provided that in case it is not possible to completely avoid the forests or areas having large trees, keeping in view the overall economy, the route shall be aligned in such a way that cutting of trees is minimized.

(b) National Parks and Wild Life Sanctuaries.

(c) Restricted areas such as civil and military airfields and care shall be taken to avoid aircraft landing approaches.

(d) Educational institutions, large habitations and densely populated areas.

(e) Rough and difficult country side, and natural obstructions, fruit gardens, lakes, rivers etc.

(f) The electric line shall normally not cross over cremation grounds and shall be far off from slaughterhouses and garbage dumping grounds to prevent interruptions by bird hits.

(3) The electric line shall be close to a road for approach during construction and ease of maintenance.

(4) Angle points in the route shall be minimized.

(5) Railway and road crossings shall be minimum on the line route and in case it is not possible to avoid the same, the crossings at right angles shall be preferred but the crossing shall not be less than 60 degrees in any case.

93. Supports (Poles and Towers) .─ (1) Supports shall conform to relevant IS.

(2) The supports shall be poles or narrow based lattice towers with fully galvanised structure as per site requirement.

(3) (a) The poles shall be pre-cast concrete pole, pre-stressed cement concrete pole, rolled steel joist, rail pole, spun pole, H-beam or steel tubular pole as required;

(b) PCC and PSCC poles shall not be used at cut-points and as end poles;

(c) In coastal areas, higher strength poles like rail poles or spun poles shall be used.

(4) Erection of poles shall be carried out in accordance with the provisions of relevant IS.

(5) In hilly areas appropriate snow or ice loading shall be considered for design of poles and towers.

(6) For locations involving long spans or higher clearances on account of crossing of power or communication lines or a railway line, specially designed poles/lattice towers or underground cable shall be used as per requirement.

(7) Double pole structure shall be used as per site conditions ensuring safe operation of lines

(8) The height of the pole above the ground level, length of pole below ground and working load shall be decided taking into consideration wind zone, terrain, topography, and the statutory clearances required.

94. Line Span.─ (1) The span shall be within the range specified by relevant IS.

(2) Line span shall be decided taking into consideration topography, wind pressure, type

of support, conductor configuration and ultimate tensile strength of conductor.

(3) Uniform span shall be maintained as far as possible between consecutive pole structures.

(4) While constructing a line, if a road crossing occurs at mid span, then a pole shall be placed on one side of the road so as to avoid mid span at the road crossing.

(5) While crossing another power line, the lower voltage line shall be underneath:

Provided that the lower line shall normally not cross at mid span of the upper line.

(6) While placing poles on high ground, shorter poles can be used while maintaining proper ground clearance at the middle of the span.

(7) Poles shall normally not be placed along the edges or cuts or embankments of creeks and streams.

(8) At all the places where the new line crosses over roads or another existing line, adequately earthed guard wire mesh below the line shall be provided to avoid the conductor of the new line falling over the areas below, in case of any break:

Provided that in cases where the line passes below an existing line, the guard wire mesh shall be provided above the new line under construction.

95. Maximum stresses and factors of safety.─ The permissible stresses and minimum factor of safety shall be as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

96. Stay Arrangements.─ (1) Galvanized iron stay wires and stay rods of adequate size and minimum tensile strength complying with relevant IS shall be used.

(2) The stays shall be provided at:

(a) angle locations;

(b) dead end locations;

(c) tee off points;

(d) steep gradient locations;

(e) cut-points;

(f) along the straight run at minimum two locations in one km.

(3) For double pole structure, four stays along the line, two in each direction and two stays along the bisection of the angle of deviation or as required depending on the angle of deviation shall be provided.

(4) When two or more stays are provided on the same pole, each stay shall be grouted entirely separate from the other.

(5) The angle between the pole and stay wire shall be about forty five degrees and in no case it shall be less than thirty degrees.

(6) Stays shall be anchored either by providing base plates, angle iron or rail.

(7) Stay wires shall be connected to the pole with IS complaint Porcelain Guy Strain Insulator

(8) The insulator shall be inserted in the stay wire at a height of minimum 3 m vertically above the ground level.

97. Protective Guard, Anti Climbing Devices and Danger Plates.─ Protective Guard, anti-climbing devices and danger plates shall be provided in accordance with Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

98. Insulators, Insulator Strings and Hardware Fittings.─ (1) Insulators and its fittings shall confirm to relevant IS.─

(a) pin insulators shall be used on lines up to 33 kV voltage level as per requirement;

(b) shackle insulators, using strap type fittings or U-clamp fittings, shall be used in lines below 650 volts;

(c) suspension and Tension insulator strings with disc insulators or long rod insulators offering equivalent performance shall be used on 33 kV or 22 kV or 11 kV lines:

Provided that the number of insulators and creepage distance shall be selected based on electrical system parameters taking into account altitude of site, expected environmental and pollution conditions etc;

(d) for critical locations with high pollution level, anti-fog type insulators or polymer insulators may be used for better performance;

(2) Insulator and insulator string rating shall be selected such that.─

(a) under 100% design wind loading conditions, the load on insulator string shall not exceed 70% of its mechanical strength;

(b) under everyday temperature and no wind/snow conditions, the load on the insulator string shall not exceed 25% of its mechanical strength;

(3) The insulation shall be designed to avoid excessive concentration of electrical stresses in any section or across leakage surfaces.

99. Cross-Arms.─ (1) cross-arms and the clamps shall be hot dipped galvanised conforming to relevant IS.

(2) Welding at site should be avoided as far as possible, in case welding becomes necessary, the joint shall be covered with cold galvanising paint.

100. Conductor.─ (1) The size of the conductor shall depend upon the voltage regulation, factor of safety, power to be transmitted, length of line, line voltage and mechanical strength desired.

(2) Aluminium Conductor Steel Reinforced (ACSR) or equivalent All Aluminium

Alloy Conductors (AAAC), All Aluminium Conductor (AAC), Aluminium Alloy Conductor Steel Reinforced (AACSR) or HTLS conductors along with requisite accessories shall comply with relevant IS.

(3) The configuration of conductors on the line can be triangular, horizontal or vertical depending upon the voltage level of the lines, terrain, right of way and clearances to be maintained:

Provided that in case clearance from a building is difficult to secure, vertical arrangements of the conductor shall be adopted.

(4) Suitable insulating paint shall preferably be provided on bare conductors in coastal areas to prevent corrosion as well as in power theft prone areas.

101. LT Spacers.─To avoid clashing and accidental mutual touching of bare overhead conductors on LT lines, spacers of adequate dielectric strength, which can be either spiral or composite shall be provided in between conductors at appropriate locations in different spans (particularly for lines having longer spans or lines having large sags encountering high winds).

102. Cables.─ (1) Underground cables or aerial bunched cables or covered conductor of adequate rating conforming to relevant Standards can also be used for supplying power.

(2) In coastal areas underground cables shall be used.

(3) PVC cables shall not be used in systems other than LT system.

(4) Aerial bunched cables or insulated cables or covered conductor shall be used in the congested, theft and accident-prone areas.

(5) Underground Cables shall normally be laid in trenches as per the relevant standards and utility practices:

Provided that direct burying of underground cables shall not be adopted except where cables enter and take off from a trench:

Provided further that cables may be laid in pipes or cables with co-extruded pipes may also be laid, though trenchless method as per the site requirement.

(6) The underground cables shall be segregated by running in separate trenches or on separate racks or in separate pipes.

(7) Cable trenches or pipes shall not be run through oil rooms and these shall be properly sloped so as to drain freely any water, which may enter.

(8) Cables shall not be laid directly on trench floor.

103. Service Line.─ (1) The service line shall be provided with insulated conductor, armoured cable or underground cable.

(2) The service line shall have adequate margin to take care of load growth for at least five years.

(3) Over-head service connection shall be provided either through independent service connection or through LV box.

(4) No tapping of service line shall be permitted for supplying power to any other consumer.

(5) Feeder pillar-box shall be used for providing underground service connection through cable to more than three or four consumers.

(6) The meters for the consumer connections shall be provided in accordance with the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

104. Surge Arrester.─ (1) Surge Arrester shall be as per relevant IS.

(2) The surge arresters shall be placed at the terminal points of the lines and also at the junction points of cables and bare overhead conductor lines.

(3) For 33 kV, 22 kV and 11 kV lines, surge arresters having rated voltage of 30 kV_{rms}, 20 kV_{rms} and 9 kV_{rms} and discharge current rating of 10 kA, 7.5 kA and 5 kA, complying with relevant IS, shall be used respectively.

105. Earthing.─ Earthing shall be as per relevant IS and Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

106. Protection of 33 kV, 22 kV, 11 kV and LT System.─ (1) The protection scheme shall be finalized by the Owner based on prudent utility practice.

(2) An earth leakage protective device shall be provided at consumer premises as per requirement of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations in this regard.

107. Repeal and Saving.─

(1) The Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 is hereby repealed.

(2) Notwithstanding such repeal, anything done or purported to have been done under the repealed regulations shall be deemed to have been done or purported to have been done under the relevant provisions of these regulations.

108. Relaxation of Regulations- The Authority may, by order and for reasons to be recorded in writing, relax any of provisions of these regulations in respect of the matters referred to the Authority on case to case basis.

SCHEDULE- I

[See sub-regulation (10) of regulation 10]

List of Electrical Protection Functions for Thermal Generating Units

1. **Generator**

Sl. No.	Protection Function	Remarks
(a)	Generator differential protection (87G)	
(b)	100% stator earth fault protection (64G)	For units of 100 MW and above.
(c)	95% stator earth fault protection (64G1)	For units less than 100 MW.
(d)	Standby stator earth fault protection (64G2)	
(e)	Inter-turn fault protection (87TG)	Applicable where split winding in Stator is provided and if six terminals are available.
(f)	Loss of field protection (40G)	To be duplicated for units of 500 MW and above.
(g)	Negative phase sequence current protection (46G)	
(h)	Low-forward power and Reverse power interlock for steam turbine generator (37/ 32G)	Preferably 3-phase power relays shall be provided. Both the relays shall be duplicated for units of 500 MW and above.
(i)	Rotor earth fault protection - two stages (64F1/F2)	
(j)	Definite time over-voltage protection (59G)	
(k)	Generator under frequency protection (81G)	
(l)	Over-fluxing protection for generator (99G)	To be provided for units of 500 MW and above in duplicate.
(m)	Overload protection for generator (51G)	
(n)	Back- up impedance protection, 3 pole (21G)	
(o)	Overheating (winding and/ or bearing) (49G)	Alarm only.
(p)	Instantaneous and time delayed over current protection on high voltage side	

	of excitation transformer (51)	
(q)	Generator pole slipping protection (98G)	
(r)	Accidental back energisation protection (50GDM)	
(s)	Generator circuit breaker failure protection (50ZGCB)	To be provided for GCB scheme only.

Note: In case digital multifunctional generator protection system is provided, the protection systems for generator shall be duplicated for units of one hundred mega watt and above. Each MGPS shall preferably be provided with individual inputs from CTs and VTs and connected to the independent set of hand-reset trip relays, such that one set is always available in case of testing and mal-operation of the other set. If the MGPS does not include any protection mentioned in the table above, separate discrete protection shall be provided for the same. The MGPS shall preferably have continuous self-monitoring and testing facilities.

2. Generator Transformer

Sl. No.	Protection Function	Remarks
(a)	Overall differential protection (87OA)	
(b)	Generator transformer differential protection (87GT) for single phase bank	
(c)	Restricted earth fault protection for generator transformer (87NGT)	
(d)	Over head line connection differential protection (87L)	For 3 single phase banks, if 87L Includes HV winding, separate 87NGT is not mandatory.
(e)	Back- up earth fault protection on generator transformer HV neutral (51NGT)	
(f)	Over-fluxing protection for generator transformer (99GT)	To be duplicated for units of 500 MW and above.
(g)	Back- up non-directional over-current protection in all phases on HV side of generator transformer (51GT)	
(h)	Generator transformer oil temperature indicator (OTI) trip (49Q) and winding temperature indicator (WTI) trip (49T)	

(i)	Generator transformer Buchholz (63), Pressure relief valve (PRV)/ other mechanical protections	
(j)	Pole discrepancy protection of generator transformer breaker (162)	To be provided, if single pole breakers are used.
(k)	Breaker failure protection of generator transformer breaker (50Z)	
(l)	Start-up earth fault protection for LV and HV winding of generator transformer and UATs (64T)	To be provided for GCB scheme only.

3. Unit Auxiliary Transformer(s)

Sl. No.	Protection Function
(a)	Differential protection (87UAT)
(b)	LV back-up earth fault protection (51NUAT)
(c)	LV restricted earth fault (87NUAT)
(d)	Back-up over-current protection (51UAT)
(e)	OTI(49Q) and WTI (49T) trip
(f)	Buchholz (63), PRV/ other mechanical protections

4. Station- Transformer(s)

Sl. No.	Protection Function
(a)	Differential current protection (87)
(b)	Restricted earth fault protection for LV winding (87NLV)
(c)	Restricted earth fault protection for HV winding (87NHV)
(d)	Back-up over-current protection on HV side (51)
(e)	Back-up earth-fault protection (51N)
(f)	Over-fluxing protection (99)
(g)	Buchholz protection (63)
(h)	Winding temperature high (49T)
(i)	Oil temperature high (49Q)
(j)	Pressure relief valve trip (PRV)
(k)	Breaker failure protection (50Z)

SCHEDULE-II

[See sub-regulation (3) of regulation 12]

Design Requirements for Ash Handling System

A. Design Requirements for Ash Handling System of Pulverised Fuel Steam Generators

1. The capacity of ash handling systems, as a percentage of maximum ash generated corresponding to firing of worst coal or lignite at boiler maximum continuous rating, shall not be less than the following:

1. (a) Fly ash system
   - (i) ESP fly ash and chimney ash : 90%
   - (ii) Air preheater ash : 5%

   (b) Bottom ash system
   - (i) Furnace bottom ash : 25%
   - (ii) Economiser ash : 5%

2. Ash removal rate shall meet the following criteria:
   - (a) Fly ash system : 8 hour collection in 6 hours
   - (b) Bottom ash system : intermittently once or twice in a shift for jet pump system;
     : Continuous for submerged scrapper conveyer system and dry system.

3. Ash handling system shall have the provision for following standby arrangement:

(a)	Bottom ash system	-	100% standby for jet pumps or 100% standby for submerged scrapper conveyor (SSC) or Dry Bottom Ash Handling System with metallic chain conveyor.
(b)	Fly ash system	-	100% standby for vacuum pumps, collector tanks, wetting heads;

		-	100% standby blowers for intermediate and storage silos;
		-	50% standby for air compressors to be used for transporting ash.
(c)	Ash slurry disposal	-	One pump stream as operating standby and one pump stream as maintenance standby for wet slurry system;
		-	One standby stream for high concentration slurry system.

B. Design Requirements for Ash Handling System of Fluidised Bed Steam Generators

1. The capacity of ash handling systems, as a percentage of maximum ash generated corresponding to firing of worst coal or lignite at boiler maximum continuous rating, shall not be less than the following:

   (a) Fly ash system

(i) ESP fly ash and chimney ash	:	80%
(ii) Air preheater ash	:	5%

   (b) Bottom ash system

(i) Furnace bottom ash	:	30- 40%
(ii) Economiser ash	:	5%

2. Ash removal rate shall meet the following criteria:

(a)	Fly ash system	:	8 hour collection in 6 hours
(b)	Bottom ash system	:	Continuous

3. Ash handling system shall have the provision for following standby arrangement:

(a)	Bottom ash system	-	100% standby for drag link chain conveyor
(b)	Fly ash system	-	100% standby for vacuum pumps, collector tanks, wetting heads;
		-	100% standby blowers for intermediate and storage silos;
		-	50% standby for air compressors to be used for transporting ash.
(c)	Ash slurry disposal		One pump stream as operating standby and one pump stream as maintenance standby for wet slurry system; One standby stream for high concentration slurry system.

SCHEDULE-III

[See sub-regulation (7) of regulation 36]

The minimum Load for Continuous Operation for Various Types of Hydraulic Turbines

Sl. No.	**Type of turbine**	**Minimum load for continuous operation (percent)**
(a)	Pelton or Kaplan or Bulb	30
(b)	Deriaz	40
(c)	Francis	50
(d)	Propeller	85

SCHEDULE-IV

[See clause(f) of sub-regulation (12) of regulation 40]

Minimum Protections to be provided for Hydro- electric Generating Units

1. Generator

Sl. No.	**Protection functions**	**Size of generating unit**		
		Small (<10 MVA)	Medium (10-100 MVA)	Large (> 100 MVA)
(a)	Differential (87G)	Y	Y	Y
(b)	95 % stator earth fault (64G1)	Y	Y	Y
(c)	100 % stator earth fault (64G2)	N	Y	Y
(d)	Backup impedance (21G)	N	Y	Y
(e)	Voltage controlled over current (51)	Y	N	N
(f)	Negative phase sequence (46G)	Y	Y	Y
(g)	Loss of excitation (40G)	Y	Y	Y
(h)	Reverse power (37/32G)	Y	Y	Y
(i)	Pole slipping (98G)	N	N	Y
(j)	Stator overload (49S)	Y	Y	Y
(k)	Over voltage (59G)	Y	Y	Y
(l)	Under frequency (81G)	Y	Y	Y
(m)	Dead machine (27/50G)	N	N	Y
(n)	Rotor earth fault (64R)	Y	Y	Y
Note: Y- Required; N- Not required.				

2. Excitation Transformer

Sl. No.	Protection functions	Size of generating unit		
		Small (< 10 MVA)	Medium (10-100 MVA)	Large (> 100 MVA)
(a)	Restricted earth fault (64)	Y	Y	Y
(b)	Instantaneous and IDMT over current (50/ 51)	Y	Y	Y
(c)	Winding temperature (49)	Y	Y	Y
Note: Y- Required.				

3. Generator Transformer

(a) Generator transformer differential protection (87T)

(b) Restricted earth fault protection (64GT)

(c) IDMT over current protection (51)

(d) Neutral grounding back-up earth fault protection (51NGT)

(e) Over head line connection differential protection (87L)

(f) Overfluxing protection (99GT)

(g) Monitoring of Insulation of low voltage bushing (59T)

(h) Buchholtz relay (63)

(i) Winding temperature protection (49T)

(j) Oil temperature protection (49)

(k) Pressure relief valve (PRV)

4. Generator and Generator Transformer

(a) Overall differential protection (87OA)

(b) Breaker Failure Protection (50Z)

5. Unit Auxiliary Transformer

(a) Restricted earth fault protection (64)

(b) Instantaneous and IDMT over current protection on high voltage winding (50/51)

(c) Neutral grounding back-up E/F protection (51NGT)

(d) Winding temperature protection (49T)

6. Station Auxiliary Transformer

(a) Restricted earth fault protection (64)

(b) Instantaneous and IDMT over current protection on high voltage winding (50/51)

(c) Neutral grounding back-up earth fault protection (51NGT)

(d) Winding temperature protection (49T)

SCHEDULE-V

[See sub-regulation (3) of regulation 48]

Protection Details of Transmission Lines, Transformers, Reactors and Bus Bars

1. **Transmission Line Protection**

No.	Protection	765 kV	400 kV	220 kV/230 kV	132 kV/110 kV/ 66 kV
(a)	Main l- Distance protection*	Y	Y	Y	Y (for 132 kV/110 kV) Y/N (for 66 kV)
(b)	Main Il- Distance protection* or directional comparison protection or phase segregated line differential protection	Y	Y	Y/N 'N' if Directional IDMT over current and earth fault back up protection is provided otherwise 'Y'	N
(c)	Directional inverse definite minimum time (IDMT) type earth fault relay	Y	Y	'Y' if both Main-I & Main- Il are distance protections otherwise 'N'	N
(d)	Directional IDMT over current and earth fault back up protection	N	N	'Y' if Main-II is not provided otherwise 'N'	Y
(e)	Two stage over voltage protection	Y	Y	Y/N	Y/N

(f)	Auto reclosing#	Y (Single phase and three phase)	Y (Single phase and three phase)	Y (Singlephase and three phase)	Y/N (three phase)

***For short line (less than 10 km) or cable or combination of overhead line and cable, line differential protection shall be used with built-in backup distance protection.**
 # For cable or combination of overhead line and cable, autoreclosing shall not be provided.

Note: (1) Y- Required; N- Not required; Y/N- Optional.

(2) Transmission lines with distance protection shall, in general, have carrier aided or fibre optic based inter- tripping or blocking feature.

(3) Separate cores of current transformer and voltage transformer shall be used for Main-I and Main-ll.

2. Transformer Protection

Sl. No.	**Protection**	**765 kV**	**400 kV**	**230 kV/220kV/ 132 kV/1 10 kV**	**66 kV**
(a)	Differential protection	Y	Y	Y	Y
(b)	Over fluxing protection	Y	Y	Y	N
(c)	Restricted earth fault (REF) protection	Y	Y	Y	Y
(d)	Backup directional over current and earth fault protection (HV and LV side) or impedance protection	Y	Y	Y	Y
(e)	Buchholz, WTI and OTI (for 1 MVA and above), MOG with low oil level alarm, OSR for OLTC, PRD, SA on both primary and	Y	Y	Y	Y

	secondary sides of transformers located outdoors and connected to over head lines				
(f)	Tertiary winding protection	Y	Y	Y	N

Note: (1) Y- Required; N- Not required.

(2) WTI- winding temperature indicator; OTI- oil temperature indicator; OLTC- on load tap changer; PRD- pressure relieve device; OSR- oil surge relay; MOG- magnetic oil gauge; SA- surge arrester.

3. **Reactor Protection**

Sl. No.	Protection	765 kV	220kV /400 kV
(a)	Differential protection	Y	Y
(b)	REF protection	Y	Y
(c)	Reactor backup protection (impedance type or definite time over current (O/C) and earth fault (E/F) protection)	Y	Y
(d)	Buchholz, WTI, OTI, MOG with low oil level alarm, SA (if required)	Y	Y

Note: (1) Y- Required.

(2) WTI- winding temperature indicator; OTI- oil temperature indicator; MOG- magnetic oil gauge; SA- surge arrester.

4. **Bus Bar Protection and Local Breaker Backup Protection (breaker failure protection)**

Bus bar protection and local breaker backup protection shall be provided in 220 kV and higher voltage interconnecting sub- stations as well as in all generating station switchyards. Duplication of bus bar protection shall be done for all main buses of 400kV and above voltage class. The bus bar protection scheme shall be centralized or distributed type and have provision for planned future expansion.

SCHEDULE-VI

(See regulation 49)

PART-A

Technical Details of Classical HVDC Terminals/ Stations

1. **General:** The conventional Thyristor (Gate Turn On device) based HVDC converter

technology or Line Commuted Converter technology or Current Source Converter technology shall be used for back to back and long distance bulk power HVDC transmission system. Gate Turn Off devices / other better devices capable of handling similar or higher quantum of power may also be considered.

2. **Design Consideration:** (a) The converter configuration and rating for HVDC installation shall be based on following considerations:
   - (i) The amount of power to be transmitted
   - (ii) The transmission distance
   - (iii) Staging consideration of the project
   - (iv) Location of converter station
   - (v) The amount of power to be transmitted at the different stages of the project
   - (vi) Reliability and availability requirements
   - (vii) Loss evaluation
   - (viii) Size and weight of the Converter transformers for transport
   - (ix) Electrical characteristics of sending and receiving end power system to which HVDC transmission system is connected

Note: The DC power rating shall include nominal, reverse, forward and overload power levels, specific loading cycle and weightage factor to calculate load losses.

(b) Electric design of HVDC transmission lines shall take into account the following considerations:
   - (i) Corona performance (Corona loss, Radio Interference, Audible Noise, Electric field and ion current in the vicinity of the line)
   - (ii) Air Characteristic
   - (iii) Insulator performance

(c) The minimum conductor height above Ground level shall be selected mainly on the basis of ensuring human safety, Ground level electric field and ion current density level. The corona loss with I^2R losses
in the conductors shall be considered for economic choice of the optimum conductor bundle in transmission line.

3. **System Data:** The following environmental, AC & DC system information, shall be considered:

(a) Environmental information:
   - (i) Ambient temperature
   - (ii) Humidity, rain fall intensity
   - (iii) Geographical co-ordinates
   - (iv) Isokeraunic level
   - (v) Wind velocity

(vi) Seismic Level

(vii) Altitude above sea level

(viii) Pollution level

(ix) Soil Properties

(x) Solar radiation

(xi) Snow/ice data

(b) AC System information:

(i) Short Circuit Ratio and Minimum & Maximum Short Circuit Current:

(ii) System voltage and frequency

(iii) Harmonic impedance characteristics

(iv) System Voltage distortion

(v) System Grounding

(vi) Torsional mode frequencies (Sub-synchronous Resonance)

(vii) AC system topology

(viii) AC system equivalent

(ix) MVAR exchange with AC system

(x) Data pertaining to generators in the vicinity

(c) HVDC line or Cable:

I. In case of overhead lines, the detail information shall include

(i) Line length

(ii) Conductor type

(iii) Conductor configuration

(iv) Rated DC Voltage

(v) Impulse withstand levels

(vi) Tower configuration for the Pole conductors & Dedicated Metallic Return conductor or earth electrode

(vii) Tower footing impedance

(viii) Earth electrode station (if applicable)

II. In case of Cable, the detail information shall include

(i) Cable length

(ii) Cable size and insulation

(iii) Rated and maximum DC voltage

(iv) Current rating

(v) Capacitance and resistance at rated load

(vi) Impulse withstand levels

4. System Performance:

The HVDC system shall be designed to meet all performance requirements and shall be compatible to existing system. The HVDC system shall not cause instability to the AC existing Network and shall not adversely affect other nearby HVDC Systems as well as Generating Units. This shall be verified by stability, multi infeed and Sub Synchronous Resonance studies.

5. **System Studies-** HVDC control parameters and equipment shall be selected by carrying out the following studies at different stages of the project and after project completion on major changes in the network or operating condition around the HVDC:
   (a) Main circuit parameters;
   (b) Short circuit studies;
   (c) Insulation co-ordination;
   (d) AC, DC and Power Line Carrier filter design, rating and performance;
   (e) Reactive power studies, switching arrangement & logic;
   (f) Temporary overvoltage;
   (g) Transient overvoltage, surge arrester stress;
   (h) Runback and run up studies;
   (i) Sub- synchronous resonance studies
   (j) AC breaker Transient Recovery Voltage and rate of rise of recovery voltage studies;
   (k) Overload study;
   (l) AC equivalent study;
   (m) DC Commutation switch requirements;
   (n) Load flow, stability, modulation and frequency controller design study;
   (o) Dynamic over voltage study;
   (p) Electrical interference study;
   (q) Reliability and availability study;
   (r) Audible noise study;
   (s) Loss calculation;
   (t) Dynamic performance study;
   (u) Studies for deciding operational logics or sequences;
   (v) Design of electrode line and its impact on dc equipment;
   (w) Commutation failure and recovery study;
   (x) Real Time Simulator based studies;
   (y) HVDC control and protection coordination study;
   (z) AC/ DC system interaction.
   (aa) Muti-infeed studies, if applicable

6. **Insulation co-ordination**

(a) HVDC System shall be suitably protected against Impulses and disturbances external and internal to the system such as switching impulses, lighting impulses, dynamic over voltages and load rejection. The insulation of all equipment shall be properly protected and coordinated with surge arresters and/or surge capacitors. Insulation coordination shall be done keeping in mind the minimum electrical clearances, safety clearances and maintenance clearances as per Switching Impulse Withstand Level. Insulation coordination shall be done as per relevant IS/IEC Standards. Insulation levels of oil filled equipment shall be less than other equipment considering its cost.

(b) The insulation of the equipment and protection levels of Surge Arresters connected to the converter ac bus bars of the converter stations at both rectifiers and inverter shall be coordinated with the insulation and surge arrester characteristics of the connected ac systems to which the converter stations are to be connected without exceeding the discharge duty of these arresters.

(c) Overvoltages caused by Bipole link HVDC transmission shall be controlled to 1.4 p.u or below. Events caused by other equipment in the A.C. network shall be controlled within the limits of the capability of the deblocked converter. In case the converter is tripped, and not possible to restart within seconds, filter tripping shall be allowed to limit overvoltages.

(d) The tripping action for lines shall be initiated if the over voltage exceeds 1.1 p.u. for 5 seconds and if 1.5
p.u. voltage persists for more than 100 milliseconds. The HVDC over voltage strategy shall be co- ordinated with such setting.

(e) The ratio of impulse withstand voltage to impulse protective level shall be in line with IEC-60071-5.

(f) The minimum insulation levels for 800 kV shall be as follows:

HV Transformer LIWL/SIWL (kV)	Smoothing reactor LIWL/SIWL (kV)	Thyristor Valve Structure LIWL/SIWL (kV)	DC Busbar LIWL/SIWL (kV)
1800/1600	1800/1600	1800/1600	1900/1600

LIWL- Lightning Impulse Withstand Level; SIWL- Switching Impulse Withstand Level

7. Radio Interference (RI), Acoustic Noise (AN) and DC field

(a) All the necessary precautions shall be made during HVDC design to ensure that there shall be no mal- operation, damage or danger to any equipment, system or personnel due to electromagnetic or electrostatic interference effects. The converter terminal(s) shall neither damage nor cause mal-operation of the DC control and protection system or the DC tele-control system.

(b) All the necessary precautions shall be taken in the form of noise suppression techniques, shielding and filtering devices to prevent harmful interference, which may be generated by the converter terminals, with the Power line carrier systems, Radio communication systems, Television systems, VHF, UHF & microwave radio systems.

(c) The noise generated by HVDC System shall also be limited by noise reducing measures, if necessary. Noise shall be less than 45 dBA in control room and office areas, 70 dBA at the station boundary and 70 – 90 dBA at various HVDC equipment areas.

8. Dynamic Performance:

(a) The purpose of dynamic performance design is to determine the control parameters for HVDC system and to ensure that the HVDC system shall have smooth, stable and fast operation for both steady state and transient conditions without adversely affecting the connected AC grid.

(b) The HVDC system shall recover to 90% of the pre-fault dc power transfer level consistently within 120 ms from the instant of fault clearing, without subsequent commutation failure or sustained oscillation for all inverter ac system fault conditions. For all rectifiers ac system fault conditions, the recovery time, to 90% pre- fault power level, shall be within 100 ms from the instant of fault clearing.

(c) HVDC shall continue operation at reduced power if conditions get outside the voltage, frequency and short circuit capacity ranges specified in system data as much as possible with its inherent capability.

9. Main Circuit Design-The purpose of Main Circuit design is mainly to determine the operating characteristics and rating of thyristor valves and converter transformers (MVA, tap changer range etc.) It also forms the input for AC Filter and Reactive compensation design. The main circuit arrangement and circuit shall depend on type of HVDC system, Power Transmission requirements, DC Voltage Levels, connected AC voltage levels, Reactive Power requirements and AC & DC Harmonic requirements. The system shall meet various harmonic performance parameters on both AC Side and DC side.

10. HVDC Station Equipment- The function blocks of converter station are Converter area (converter valves, converter transformer, Smoothing Reactor), DC yard (DC filters, DCCT, DCVD, PLC filters of DC side, DC pole arresters, Disconnectors and ground switches), AC filter yard, AC yard and auxiliaries. A typical LCC based HVDC station shall consist of the following main equipment:

(a) Thyristor valves and its accessories e.g. damping and grading circuits, converter cooling system, etc.;
(b) Converter transformers;
(c) Smoothing reactors (If required);
(d) DC filters*;
(e) AC filters (Harmonic filters and PLC filters) and shunt compensation;
(f) Control and protection of AC and DC side;
(g) Electrical and mechanical auxiliaries;
(h) Earth electrode station* / Dedicated Metallic Return (DMR) *;
(i) AC switchyard equipment;
(j) DC switchyard equipment*;
(k) AC & DC Surge arresters;
(l) AC & DC Measuring instruments;
(m) Communication system between converter stations (OPGW/ PLCC).
(n) DC wall bushings
(o) AC wall bushings (if applicable)
(p) Auxiliary Power System

* Not applicable for back to back schemes.

11. Converter Station AC Yard, Transformer yard and valve hall

(a) **AC commutating bus equipment-** The AC circuit breakers, disconnectors, instrument transformers and other switchyard equipment shall be similar to that of the equipment specified under Regulation
46. The bus rating shall be adopted according to the calculation considering single bus outage. The switching duties of the AC circuit breakers will be decided based on transient over voltage study, insulation co-ordination, AC filters and protection studies.

(b) **Dynamic over voltage limiter devices-** Converters connected to relatively weak AC systems may cause Dynamic Over Voltages during load rejection / disturbance. The Dynamic Over Voltage limiter shall consist of parallel arrester elements connected phase to phase or phase to ground and designed to absorb the desired amount of energy during a system disturbance. The Dynamic Over Voltage limiter shall be coordinated with recovery of DC system following a disturbance. The requirements of surge arresters shall be based on the insulation co-ordination study in line with relevant standards. The arresters used shall be metal oxide type conforming to relevant standard. For control of Dynamic Over Voltage, use of STATCOM, SVC and high power gapless arresters shall be evaluated.

(c) **AC harmonic filters and shunt compensation**

(i) The HVDC converter generates harmonics during the Conversion process and AC harmonic filters shall be used to limit ac voltage distortion due to harmonics to acceptable levels and also to meet the reactive power exchange requirements based on the studies carried out.

(ii) The AC harmonic filters shall be switched in and out by circuit breakers. Based on the studies, the reactive power requirement for the terminal and bank or sub-bank size shall be determined such that reactive power exchange with the AC bus shall remain within specified limits. Suitable redundancy shall be provided in the sub-bank filters to avoid reduction of transmission capacity of the station due to outage of any particular sub-bank for maintenance.

(iii) The main filter equipment namely capacitors, reactors and resistors shall comply with the requirements of following IEC

(A) Capacitors IEC 60871;

(B) Reactors IEC 60076-6;

(C) Resistors : IEC 62001/As per owner's specification

(D) Dynamic compensation: If required, dynamic compensation in the form of static compensator (STATCOM), static var compensator (SVC), thyristor controlled series capacitor (TCSC) etc. shall be used to improve stability during AC system transient faults. The requirement of dynamic compensation and the rating shall be derived from the studies.

(iv) Shunt Reactor Banks: Shunt reactors of suitable size shall be provided to meet reactive power exchange requirements derived from the studies. The shunt reactor shall be oil filled and must be switched in or out by a circuit breaker. The shunt reactor shall conform to relevant standard. The shunt reactor shall be covered under automatic switching under the reactive power control strategy.

(v) AC **filter Design:** The Total Harmonic Distortion (V_{thd}) of AC filter, as

$$V_{THD} = \sqrt{\sum_{n=2}^{n=40} \frac{V_n^{\,2}}{V_1^{\,2}}} X 100$$

'1' refers to fundamental frequency (50 Hz)

'n' refers to the harmonic of n^{th} order (corresponding frequency is 50 x n Hz) defined below, shall not exceed 2%.

Additional requirements as per relevant IEC shall also be fulfilled. In all Modes of operation, except the reduced dc line voltage modes, the performance requirement shall be met up to rated power with one larger size filter sub-bank and one characteristic harmonic sub-bank(largest) being out of service. All filter banks, sub-banks and branches shall be rated such that the remaining filter components are not overloaded and there is no restriction on the operating power level for any operating conditions with one filter bank outage for power level up to 1.0pu.

(d) **Power line carrier (PLC) filtering**- PLC filters shall be installed close to converter transformers to mitigate high frequency harmonic currents generated during thyristor switching.

(e) **Converter transformers:**

(i) The converter transformers shall be single phase/ three phase two winding or three winding units which shall be decided by size and transportation limitations. The transformers shall comply with the requirements of relevant standards. The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall be such that under 10% continuous over voltage condition it does not exceed 1.9 Tesla. The Converter transformer shall be capable of withstanding minimum DC current of 10A per single phase transformer entering through the neutral.

(ii) The insulation level for the transformer AC (line side) windings and bushings shall be as given at Regulation 45 and insulation levels of the valve side windings shall be determined in accordance with studies. The impedance of the transformer shall be determined as in accordance with studies and variations in impedance shall be as per the requirement of relevant standards.

(iii) Converter transformers shall be equipped with on load tap changer (OLTC) and metal oxide varistor (MOV) devices shall be provided between tap leads of the OLTC. The OLTC tap steps shall be determined in accordance with the operating strategy of both the converters. The OLTC shall be designed for a minimum 2,50,000 operations without repair or change of any part including oil. The OLTC shall be designed for a contact life of minimum 6,00,000 operations.

(iv) The requirements of soak pits and firewalls shall be in line with Regulation 46.

(v) Minimum one No. (single phase or three phase, as applicable) spare

Converter transformers of each type and rating per station shall be provided.

(f) **Thyristor valves**

(i) The thyristor valve assembly shall be designed and tested as per relevant IEC/IS.

(ii) The thyristor valve modules, used for converting AC to DC or vice versa, shall be complete with associated electronic firing system; protection, monitoring & damping system, auxiliaries and cooling system. Twelve pulse scheme shall be used.

(iii) One / Two twelve pulse valve group in series or parallel combination shall be used depending on the power rating and other requirement of specific project.

(iv) In case of two series converter configuration, a bypass switch shall be provided to bypass any faulty converter and use the remaining series converter at lower DC voltage.

(v) The thyristor valves shall be water cooled, air insulated and indoor type. The valves shall be either suspended type or floor mounted type depending upon the operating DC voltage and seismic requirements. The Double or Quadruple valve design shall be used depending on voltage level. Requisite redundancy shall be kept through a provision of suitable number of spare thyristor in valve modules.

(vi) The thyristor valve cooling system shall use de-ionized water circulated in a closed cycle. The cooling unit shall comprise of a de-ionizer, expansion vessel, conductivity, flow and temperature sensors, mechanical filters, etc. Adequate redundancies shall be provided. Necessary control and monitoring including tripping of the HVDC system in case of cooling system failure shall be provided.

(vii) The valves shall be placed in the valve hall which shall have a positive pressure over atmospheric pressure and humidity control feature. The pressurization will be maintained by ventilation system.

12. Converter Station DC Yard

(a) The DC yard shall comprise of equipment such as HVDC bushings, smoothing reactors, DC filters, DC current and voltage measuring instruments and switchgear, surge arrester, insulators, clamps and connectors.

(b) The creepage distance for DC yard and other areas shall be maintained as indicated below:

Insulator type	Under light and Medium pollution	Under heavy and very heavy pollution
Indoor porcelain or composite insulators for valve hall (other than valves) and indoor smoothing reactor area	20 mm/kV	
Thyristor Valves	14 mm/kV	
Indoor DC yard (other than smoothing reactor)	30 mm/kV	
Outdoor porcelain insulators or bushings with RTV coating	50 mm/kV	60 mm/kV
Outdoor composite insulators or bushings	50 mm/kV	

Note:- Creepage distances less than 50 mm/kV but not less than 45mm/kV can be accepted for outdoor silicone rubber bushings due to manufacturing limitations and for HVDC equipment's requiring necessary internal/ external insulation co-ordination. However, creepage distance less than 50 mm/ kV and flash distance less than 12 mm/ kV shall not be acceptable for outdoor jointed bushing.

The base voltage applicable for calculation of valve arrester creepage distance shall be

$$U_{creepage} = \left(\sqrt{\frac{1}{3} + \frac{\sqrt{3}}{8\pi}}\right) * CCOV$$

(c) **DC wall bushing-** DC wall bushings, used for electrical connection between the equipment inside the valve hall and the outdoor DC yard shall be of polymer housing as per relevant standards. All bushings inside the valve hall including HVDC wall bushing shall be dry type / SF6 gas filled or combination of both.

(d) **Smoothing Reactor-** The smoothing reactor shall be of air core type. The reactors shall comply with relevant standards and shall have successfully passed DC tests as per their application. The smoothing reactor shall be divided between pole and neutral for DC voltage above 500kV. Each converter station shall be provided with one spare coil of smoothing reactor.

For the design of smoothing reactor, the **Si factor** has to be within the limits (0.22 <Si< 1) where Si factor is defined as

Si= Udn/ Ld*Idn

Udn = Nominal HVDC Voltage level per pole

Idn = Nominal HVDC Current

Ld= Total DC side inductance = L_{dr} + 3.5 L_{tr} where L_{dr} - Smoothing Reactor inductance L_{tr} - Converter transformer inductance

The smoothing reactor shall be designed for Class H for inter turn insulation as per IEC 60085, however, the maximum allowed hot-spot temperature rise shall be limited to one class lower i.e Class F insulation.

(e) **DC Voltage and Current Measuring Devices**- The DC voltage **measuring** equipment shall be installed at each pole. The DC measuring equipment at pole and neutral bus shall be suitably located based on the control philosophy and different protection zones such that complete pole and neutral equipment are protected.

(f) **DC Filters**- DC harmonic filters shall be provided in DC yard to limit harmonic voltages present on the DC lines (pole lines and electrode lines / DMR line). The DC Filters shall consist of Blocking Filter, Low order filters, Harmonic Filters and High Frequency Filters as per the requirement of project specific studies. The main filter equipment like capacitors, reactors and resistors shall comply with the requirements of relevant IS/IEC standards/ CIGRE documents. A series blocking filter shall be provided, if required based on system studies, at each converter of the inverter station. A parallel low order (2^{nd} Harmonic) DC Filter shall be provided across each converter of the station.

(g) **DC Filter Design-** The individual harmonic current (In) at any harmonic shall not exceed the value which could cause mal-operation of the HVDC system control and protection equipment supplied.

The maximum equivalent disturbing current (Ieq), without any filter outage, for balanced bipolar and monopolar mode with metallic return or Dedicated Metallic Return (DMR) modes of operation shall be as follows:

Operating Mode	Ieq
Balanced bipolar operation	1500 mA
Monopolar mode with metallic or DMR mode	2200 mA

The DC filter components shall be adequately rated to allow unrestricted operation of the HVDC system in all operating modes and for all power levels upto 1 p.u with any possible combination of filter branches connected.

The rating of the dc filter components shall be based on the assumption that the per pole harmonic voltage is individually maximized at each harmonic for any particular operating mode, and the filter component currents due to the harmonic voltages at the terminals shall be assumed to add as RSS (Root sum squared) at each harmonic.

Blocking filter reactor shall be designed for Class H for inter turn insulation as per IEC 60085, however, the maximum allowed hot-spot temperature rise shall be limited to one class lower i.e Class F insulation. The AC/DC/PLC/RI reactor shall be designed for Class F insulation as per IEC 60085, however, the maximum allowed hot-spot temperature rise shall be limited to one class lower i.e. Class B insulation.

(h) **Surge Arresters**

Surge arresters shall be gapless Metal Oxide arresters and shall be designed, and tested as per relevant IS/ IEC. The arresters shall be designed to absorb the desired amount of energy during a system disturbance and shall be coordinated with recovery of DC system following a disturbance as applicable.

The HVDC main arresters typically found in a HVDC System are as follows:

(i) Valve Arrester
(ii) Bridge Arrester (6 pulse/12 pulse)
(iii) DC Line Arrester
(iv) DC Neutral and DC Filter Arrester
(v) Converter Transformer and AC Filter Bus Arrester
(vi) Electrode line arrestor / DMR line arresters
(vii) Smoothing Reactor Arrester
(viii) DC Neutral Switch Arresters

13. Control and Protection System

(a) **Control System:**

(i) The control system shall have redundancy with hot standby.

(ii) DC converter terminals shall be either manned by operator or controlled by remote operation of SCADA system. The control system hierarchy shall be as follows:

(A) Station/Bipole Control
(B) Pole/ Converter Control
(C) Valve control

(iii) The HVDC Bipole shall have control features including but not limited to the following:

(A) Reactive power controller
(B) Current and power controller

(C) Frequency controller

(D) Power modulator, pole power compensation The modulator shall have feature which shall provide positive damping of ac network oscillations over the range of frequencies considered during system studies.

(E) Sub Synchronous Resonance (SSR) Damping Controller (if required)

(F) All necessary studies shall be carried out to ensure that the DC system shall not excite the mechanical, electromechanical or other natural frequencies of the nearby region generators and turbines under any operating mode. It shall be demonstrated by studies (simulation as well as field test) that the nearby generators shall not be adversely affected by the HVDC system, particularly with regard to Sub Synchronous Oscillation (SSO) / Sub Synchronous Resonance (SSR) and harmonic injection and self-excitation. Sub Synchronous Damping (SSD) Controller shall be provided for converter Stations near Generating stations.

(A) Load frequency controller (LFC)

(B) Current margin controller

(C) Excessive reactive power consumption controller

(D) AC system stability function, such as power swing damping function.

(E) Run back / Run up controller with provision to be linked to SPS of System Operator

(iv) The pole control, converter control, and valve control modules shall also be provided.

(v) The control shall be designed to give fast stable and proper response to normal control actions as well as during disturbances such as AC & DC faults.

(b) **Protection System**

(i) HVDC system protection shall consist of two parts:

(A) AC side protection:

AC side protection function shall cover the zone for converter transformer, AC filters, shunt capacitors, shunt reactors, and busbars. These protections shall generally follow the same philosophy as in a typical substation i.e. detection of fault by relay and tripping of circuit breaker.

(B) DC side protection:

DC side protection shall cover the zones consisting of the valve hall, DC switchyard including smoothing reactor and DC filters, DC line, DMR line / electrode line and ground electrode. The protection equipment shall be designed to be fail safe and shall ensure high security to avoid mal-operation/ unwanted shutdown due to protection equipment failures.

(ii) Following a DC Line fault, the HVDC System shall have the facility to restart, one or more times, the faulted pole at a variable pre-selected DC voltage level(s), not below 80% of the nominal voltage rating. The dc transmission system shall be capable of recovery in a controlled and stable manner without commutation failures during recovery following ac and dc system faults. The post fault power order shall be equal to the pre-fault power order unless AC/ DC systems dictate otherwise

(iii) Protection system shall have two redundant systems with following protections.

(A) Converter differential protection;
(B) DC over current protection;
(C) DC differential protection;
(D) AC conductor ground fault protection;
(E) Commutation failure protection;
(F) DC filter protection#;
(G) DC smoothing reactor protection;
(H) DC line ground fault protection with restarts#;
(I) DC line differential protection#;
(J) DC under voltage/ over voltage protection;
(K) Ground Return mode / Dedicated Metallic Return (DMR) protection#
(L) AC filter protections
(M) Electrode line monitoring and protection#
(N) Thyristor Failure Monitoring

not applicable for back to back schemes

(iv) DC online fault locators shall be provided to monitor the entire DC line length and give location of the fault with good accuracy in the range of $\pm$ 1000 meters

(c) Software based controls and protection shall be used to permit flexibility in effecting modifications. Protection and controls shall be duplicated for reliability. The control & protection shall provide fast controllability of the HVDC system. Operation of the HVDC bipole system shall be possible in the following modes:

(i) Balanced/ unbalanced bipolar operation;

(ii) Monopolar operation with pole metallic return:

(iii) Monopolar operation with ground return / with Dedicated Metallic Return (DMR) mode;

(iv) Reduced voltage operation;

(v) Power reversal mode.

(d) The 'Sequence of events' recorder, transient fault recorder, on-line DC Line fault locator, GPS system, visual display system, operator control protection and monitoring system shall be a part of the HVDC system.

14. **Telecommunication-** For smooth operation of the HVDC system, communication network with high reliability and availability shall be provided for transmission of control and protection signals between the two or more (in case of multi-terminal DC) HVDC terminals. There shall be main and back up communication link. The main communication link shall be through OPGW and back up communication link shall be either through OPGW or PLCC.

15. **Valve Hall:** The valve hall shall mainly contain thyristor valves, its associated structure, & cooling and arresters. No oil filled equipment shall be present inside the valve hall. In case the turret of converter transformers (having oil) is protruding inside the valve hall, suitable fire barrier matching with adjacent valve hall wall fire rating shall be provided. The valve halls shall be provided with interference screening. In addition, the control cable and cable termination rooms shall be suitably screened to minimize radio interference. Two nos. scissor lift for erection and maintenance of valve modules shall be provided per station. Proper cable sealing shall be provided for cable entry into valve hall and control room to avoid entry of water and moisture. Necessary measures shall be taken to take care of high frequency noise emission from valves.

16. **Valve Hall Ventilation:** Suitable ventilation systems and filters with adequate redundancy shall be provided in the valve hall. The valve hall shall be kept at a positive pressure under all conditions.

17. **Grounding & Safety**

(a) The design of the grounding system shall be based on relevant IS/ IEEE.

(b) In order to prevent adverse effect (overheating due to induced circulating current) of magnetic field of air core reactors, special care shall be taken such that no closed loops are formed by the earthing conductors and in reinforcement bars of the foundation. Air core reactor manufacturer’s guidelines shall be followed.

(c) The electrical safety clearances for the dc side shall not be less than the clearances applicable for an ac switchyard at the equivalent BIL level.

(d) The total electric field excluding space charge at ground level shall be as prescribed in relevant standards.

(e) Fencing and electrical & mechanical key interlocking arrangements shall be provided for valve halls, smoothing reactor area, AC and DC filter areas, DC LFL Capacitor Area and for equipment mounted directly on ground without suitable height of steel structure.

18. Dedicated Metallic Return (DMR) / Earth Electrode

The current return path of a bipolar configuration shall be either via a Dedicated Metallic Return (DMR) conductor or via earth return using earth electrodes at both converter terminals. DMR mode shall be preferred if it is difficult to identify a suitable site for earth electrode station.

If earth electrodes are to be used the following requirements shall also be considered:

(a) The earth electrode station shall be connected to the terminal by means of an overhead transmission line. The earth electrode shall be located at a minimum distance of approximately 25 km (radial distance) away from the converter station. It shall be designed to operate continuously at nominal load and overload as per the requirement. The electrodes shall be designed for both types of operation, anodic and cathodic.

(b) The thorough soil investigation shall be carried out for shallow and deep resistivity, thermal conductivity and moisture content etc. at the proposed location.

(c) The earth electrode station shall have sub-electrodes. The maximum current density at the sub-electrode surface, i.e. the boundary between backfill (coke) and soil shall not exceed 0.5 A/m2 in clay soils. The number of sub-electrodes shall be determined considering that 30% of the sub-electrodes are not available. The amp hour rating for earth electrode shall be selected based on the study for duration of earth electrode current and the service life of the earth electrode station.

(d) The earth electrode station shall not affect the nearby electrical installation, buried metallic pipelines, oil & gas pipelines, and railway lines etc.

(e) Each ground electrode shall have a resistance of less than or equal to 0.3 ohm (both working as an anode and cathode) at maximum design ambient temperature.

(f) Touch voltage (Vt)- The touch voltage between any grounded metallic object in the electrode station (including the connection to the overhead electrode line) and any point in the soil which can be touched by a person simultaneously shall not exceed 40 V when the electrode is operating at the maximum overload rating.

(g) Step Voltage (Vs)- The step voltage at ground level above the ground electrode when the electrode is operating at the temporary over-load rating shall not exceed (Vs) = 5.0 + 0.03 ρs, where ρs is the local surface resistivity in ohm-m.

(h) The above values of resistance: touch and step voltages would depend on the actual geophysical characteristics of the soil at the place where the electrode station is located. Suitable mitigation measures shall have to be adopted in case the site has high resistivity.

(i) In addition, following interference effects shall be considered:

(i) Corrosion of buried metallic structure and foundations

(ii) DC Current in power lines, especially via power transformer neutrals (risk of saturation of transformers).

(iii) DC current in telephone circuits.

(iv) Effect on the cathodic protection of the buried metallic pipe lines.

19. Cables: Fibre optic cables conforming to IEC – 60793 shall be used to transmit the signals to and from various equipments and panels located in the AC/DC switchyards, Valve Halls, control rooms, valve cooling rooms, etc.

20. Auxiliary Power Supply System: The auxiliary power supply system shall have the following:

(a) Highly reliable duplicated supply sources from two separate sources, with automatic change-over facilities.

(b) Completely separated secondary distribution (415 V) systems for the auxiliaries of each converter.

(c) Duplicated supply by two different 415 V power sources to essential loads (e.g., cooling pumps, fans, heat exchangers, etc.).

(d) Provision of reliable or standby power supply system to meet essential and emergency loads and which starts-up automatically in case of loss of all the normal and stand-by supply sources. One reliable or standby power supply system per converter shall be provided at all the converter stations.

(e) Parallel operation between station service transformers shall not be permitted at any voltage level in order to limit fault currents, prevent back feed into the AC bus and to ensure independence of supply sources. Also parallel operation shall not be permitted between transformers and the reliable or standby power supply system.

(f) Suitable protection on all primary MV and LV supply connections

(g) All auxiliaries shall give rated output at voltage variation of ±10% and frequency variation of -5% to +3%.

(h) The station services DC system shall cater to the following:

(i) DC loads of HVAC and HVDC switchyards, auxiliary services control, valve and pole control, protection circuits, communication system loads, etc.

(ii) An indispensable minimum lighting load shall be connected to the station DC system.

(i) The 220VDC supply system(s) per converter shall consist of at least two independent DC systems; each system consisting of one charger, one battery bank and one distribution panel.

(j) A 48 V DC system consisting of two battery sets, two Battery chargers and two distribution boards shall also be supplied for communication panels (wherever supplied).

21. **Fire Detection, Alarm and Protection system:** A comprehensive fire detection, alarm and protection system as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations shall be provided. Valve Hall shall have Air aspiration system (fast and early smoke detection system) Suitable Infra-Red (IR) detector to detect the flashover inside the Valve Hall shall also be provided. The Valve hall wall shall be suitable for minimum 3 hour fire rating.

22. **Testing and trial Operation:** All equipment / component including Thyristor valves, Converter Transformers, smoothing reactors, EHV DC Transformer bushings and wall bushings shall be subjected to Type tests, Routine tests, Factory Acceptance Test (FAT), Site Acceptance Test (SAT) as per relevant IS / IEC/ IEEE as applicable. The SAT shall consist of sub-system & system tests and shall be carried out after installation of equipment at site. The subsystem tests cover the major sub-system like valve cooling, AC&DC filters, HVDC converter, auxiliary systems, communication etc. After completion of sub-system tests, system tests covering power transmission tests, transient & dynamic control tests, measurement of electric field and RFI etc. shall be conducted. After completion of all system tests, final trial operation of the HVDC System shall be carried out for uninterrupted continuous period of normal operation of not less than 10 days during which the converter equipment shall be fully operational.

23. **Performance Guarantee:**

(a) The power Transmission Capacity:

The rated power transmission capacity shall be defined and guaranteed at inverter end of AC yard and rated transmission voltage shall be defined at the rectifier end. The reverse Power transmission capacity shall also be indicated.

(b) HVDC System losses:

The Guaranteed losses of HVDC transmission shall include the no load loss and equivalent load loss. The equivalent load loss is the sum of load losses at specific loadings multiplied by weightage factors as per expected loading cycle. The Guaranteed losses shall be verified as per IEC 61803. No load loss shall be guaranteed corresponding to converter transformer set at principal tap with nominal AC system voltage and nominal frequency at 40^0 C ambient temperature.

(c) The system shall meet various harmonic performance parameters on both AC Side and DC side.

(d) HVDC Reliability and Availability:

1	Overall Energy availability of HVDC scheme (a) Overall Performance (b) Excluding transformer failure	Not less than 97% Not less than 98%
2	Forced Energy Unavailability (FEU)	Not more than 0.6%
3	Schedule Energy Unavailability (SEU)	Not more than 1%
4	Single Pole outage per pole per station per year	Not more than 8 (with average outage duration of 7.5 hours)
5	Bipole outage per station per year	Not more than 0.2 (with average outage duration of 8 hours)

24. Applicable Standards: All equipment and material shall be designed, manufactured, tested and commissioned in accordance with latest Indian Standards / IEC or IEEE standards, / CIGRE guidelines and the Acts, Rules, Laws and Regulations of India. Some of them are as follows:

(a) IEC 60633 - Terminology for High-Voltage Direct Current (HVDC) transmission

(b) IEC 60700 (1-2) - Thyristor valves for High Voltage Direct Current (HVDC) power transmission

(c) IEC 60919 (1-3) - Performance of High-Voltage Direct Current (HVDC) systems with line- commutated converters

(d) IEC 61803 - Determination of power losses in High-Voltage Direct

Current (HVDC) converter stations with line-commutated converters

(e) IEC-61975 - High-Voltage Direct Current (HVDC) installations - System tests

(f) IEC-62001 (1-4) - High-Voltage Direct Current (HVDC) systems - Guidance to the specification and design evaluation of AC filters

(g) IEC 65700 – Bushings for DC Applications

(h) IEC 60071 (1- 5) – Insulation Coordination

(i) CIGRE report 33/14-05: “Application guide for metal oxide arresters without gaps for HVDC converter stations”

(j) IEC 61378 - Converter transformers

(k) IEC – 60076-6 Power transformers - Part 6: Reactors

(l) IEC 60871-(1-4) Shunt capacitors for a.c. power systems having a rated voltage above 1000 V

(m) IEC 60747-6 - Semiconductor devices - Part 6: Discrete devices – Thyristors

(n) CIGRE- TB 136 1999 SC 14 TF 14.01.04 Fire aspects of HVDC thyristor valves and valve halls.

(o) PWI/TR 115-6 Ed. 1.0 -Guidelines for the system design of HVDC project

(p) IEC/TS 63014 Ed. 1.0 -High voltage direct current (HVDC) power transmission - System requirements for dc-side equipment - Part 1: Line-Commutated Converters

(q) IEC/TR 63065 Ed. 1.0 - Guidelines for operation and maintenance of HVDC converter station

(r) IEC/TR 62978 Ed. 1.0 -Guidelines on Asset Management for HVDC Installations

(s) IEC/IEEE:60076-57-129 – Transformer for HVDC applications

(t) IEC60099-9-Part -9, Surge Arresters – Metal Oxide Surge Arresters without gaps for HVDC converter stations

Part-B

Technical Details of Voltage Source Converter (VSC) based HVDC Terminals/ Stations

1. **General:** The VSC based HVDC system shall use Insulated Gate Bipolar Transistor (IGBT) technology and shall be considered primarily for the following without concerns about the available Short Circuit Ratio:

(a) Point to point transmission scheme (overhead / cable)

(b) Back to Back transmission scheme

(c) Parallel operation with LCC HVDC system

(d) Multi-terminal system

(e) Supplying load in isolated areas

2. **Design Consideration:** The following minimum technical information shall

be required for VSC based HVDC installation:

(a) The amount of active power to be transmitted

(b) The reactive power requirement at each terminal for dynamic support of AC network

(c) The transmission distance and type of DC transmission line (cable or overhead line or a combination thereof)

(d) Length of overhead line, length of cable as applicable

(e) DC transmission voltage

(f) Reliability and availability requirement

(g) Size and weight of the Converter transformers for transport

(h) Power system characteristics of sending and receiving end system to which VSC transmission system is connected, including all the parallel transmission system, if any

(i) Steady State performance requirements

(j) Dynamic performance requirements, including control and monitoring facilities

(k) Transient performance

(l) The converter configuration like Symmetrical Monopole or Bi-Pole with DMR or Bi-Pole with Ground return etc.

3. **System Data:** The following environmental, AC & DC system information, shall be considered:

(a) Environmental information:

(i) Ambient temperature

(ii) Humidity, rain fall intensity

(iii) Geographical co-ordinates

(iv) Isokeraunic level

(v) Wind velocity

(vi) Seismic Level

(vii) Altitude above sea level

(viii) Pollution level

(ix) Soil Properties

(x) Solar radiation

(xi) Snow/ice data

(b) AC System information:

(i) Short Circuit Ratio and Minimum & Maximum Short Circuit Current:

(ii) System voltage and frequency

(iii) Harmonic impedance characteristics

(iv) System Voltage distortion

(v) System Grounding

(vi) Torsional mode frequencies (Sub-synchronous Resonance)

(vii) AC system topology

(viii) AC system equivalent

(ix) MVAR exchange with AC system

(x) Data pertaining to generators in the vicinity

(xi) Frequency variation range (xii) System voltage unbalance

(c) HVDC line / Cable:

I. In case of overhead lines, the detail information shall include

(i) Line length

(ii) Conductor type

(iii) Conductor configuration

(iv) Rated DC Voltage

(v) Impulse withstand levels

(vi) Tower configuration for the Pole conductors & Dedicated Metallic Return (DMR) conductor or earth electrode

(vii) Tower footing impedance

(viii) Earth electrode station (if applicable)

II. In case of Cable, the detail information shall include

(i) Cable length

(ii) Cable size and insulation

(iii) Rated and maximum DC voltage

(iv) Current rating

(v) Capacitance and resistance at rated load

(vi) Impulse withstand levels

4. **System Studies:** HVDC control parameters and equipment shall be designed by carrying out the following studies at different stages of the project:

a) Design Studies

(i) Main Circuit Parameter

(ii) AC Over-Voltage [DOV, Temporary Over Voltage and Transient Over Voltage]

(iii) DC Over-voltage

(iv) Low Frequency Characteristics

(v) High Frequency Characteristics

(vi) Transient Stresses

(vii) External Insulation and Clearances

(viii) Insulation co-ordination

(ix) AC Circuit Breaker Requirements

(x) Equipment design studies

(xi) Station Earthing

(xii) Lightning Protection

b) Performance Studies

(i) Losses

(ii) Electrical Interference

(iii) Electric and Magnetic Fields

(iv) Reliability, Availability and Maintainability

(v) Audible Noise

c) Network Studies

(i) Stability, Modulation and Frequency Control

(ii) AC System Equivalents

(iii) Sub-Synchronous Torsional Interaction

(iv) Black start islanded operation studies

5. **HVDC Station Equipment-** A typical HVDC station shall consist of the following main equipment:

(a) VSC valves and associated equipment & cooling system

(b) Interface transformers;

(c) Converter reactors;

(d) DC reactors*;

(e) Phase reactor*

(f) DC filters*;

(g) AC filters*;

(h) Radio frequency interference filters*

(i) Valve side harmonic filters*

(j) Control and protection of AC and DC side;

(k) Electrical and mechanical auxiliaries;

(l) Earth electrode station*;

(m) AC switchyard equipment;

(n) DC switchyard equipment;

(o) AC and DC Surge arresters;

(p) AC and DC Measuring instruments;

(q) Communication system between converter stations (OPGW/ PLCC).

(r) Wall bushings (AC and DC side)

(s) Insertion resistors

(t) High Impedance Grounding of Symmetrical Monopoles

* if applicable

6. Converter Station AC Yard, Transformer yard and Valve Hall

(a) **AC bus equipment-** The AC circuit breakers, disconnectors, instrument transformers and other switchyard equipment shall be similar to that of the equipment specified under Regulation 46. The bus rating shall be adopted according to the calculation considering single bus outage. The switching duties of the AC circuit breakers will be decided based on transient over voltage study, insulation co- ordination, AC filters (if applicable) and protection studies.

(b) **Insertion resistors-** Insertion resistors shall be used to limit inrush currents during energization of the converter. They shall be located on the primary or converter side of the interface transformer. After the energization process is completed the resistor shall be bypassed by a disconnector or bypass switch.

(c) **AC harmonic filters (If required)**

(i) State-of-the-art Voltage-Sourced Converters (VSC) in modular multi-level converter (MMC) topologies generate nearly no or only a small amount of harmonics. The need of ac harmonic filters shall be evaluated based on study results. Suitable redundancy shall be provided in the filters to avoid reduction of transmission capacity of the station due to outage of any particular sub-bank for maintenance.

(ii) If filters are required, the main filter equipment namely capacitors, reactors and resistors shall comply with the requirements of following IEC or or Equivalent IS as follows:

Capacitors : IEC 60871;

Reactors : IEC 60076-6;

Resistors : IEC 62001/ As per owner's specification.

(d) If study results confirm the need for power line carrier (PLC) filtering, PLC filters shall be installed close to interface transformers to mitigate high frequency harmonic currents generated during IGBT switching.

(e) **Interface transformers**

(i) The interface transformers shall be single phase units. For smaller HVDC ratings (e.g. back-to- back schemes) three phase transformers can be used. The transformers shall comply with the requirements of relevant standards. The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall be such that under 10% continuous over voltage condition it does not exceed 1.9 Tesla.

(ii) The insulation level for the transformer AC (line side) windings and bushings shall be as given at Regulation 45 and insulation levels of the valve side windings shall be determined in accordance with studies. The impedance of the transformer shall be determined in accordance with studies and variations in impedance shall be as per requirements of relevant standards.

(iii) Interface transformers shall be equipped with On Load Tap Changer (OLTC) mechanism, Metal Oxide Varistor (MOV) devices (if applicable) shall be provided between tap leads of the OLTC. The OLTC tap steps shall be determined in accordance with the operating strategy of the converters.

(iv) The requirements of soak pits and firewalls shall be in line with Regulation 46

(f) **VSC valves**

(i) The IGBT valves shall be complete with associated auxiliaries and cooling system. The VSC valves shall be tested as per IEC 62501. Adequate redundant devices shall be provided to enable continued operation in case of failure of an individual component. Advanced converter topologies shall be used to reduce losses of VSC based HVDC converters.

(ii) The VSC valves shall be water cooled, air insulated and indoor type. The valves shall be either suspended type or floor mounted type depending upon the operating DC voltage and seismic requirements.

(iii) The VSC valve cooling system shall use de-ionized water circulated in a closed cycle. The cooling unit shall comprise of a de-ionizer, expansion vessel, conductivity, flow and temperature sensors, mechanical filters, etc. Adequate redundancies shall be provided. Necessary control and monitoring including tripping of the HVDC system in case of cooling system failure shall be provided. In case of Sub-Zero Temperature prevailing at site, suitable method e.g. use of anti- freezing medium etc. shall be adopted.

(iv) The valves shall be placed in the valve hall which shall have a positive pressure over atmospheric pressure and humidity control through HV AC system.

7. Converter Station DC Yard

(a) The DC yard shall comprise of equipment such as HVDC bushings, DC reactors, DC filters (if applicable), DC current and voltage measuring instruments and switchgear.

(b) The creepage distance for DC yard and other areas shall be maintained as indicated below:

Insulator type	Underlight and medium pollution	Under heavy and very heavy pollution
Indoor porcelain or composite insulators for valve hall (other than valves)and indoor smoothing reactor area (if applicable)	20 mm/kV	20 mm/kV
IGBT Valves	14mm/kV	14mm/kV
Indoor DC yard (other than smoothing reactor)	NA	30 mm/kV
Outdoor porcelain insulators or bushings with RTV coating	50 mm/kV	60 mm/kV
Outdoor composite insulators or bushings	50 mm/kV	50 mm/kV

Note:

(i) : RTV silicone coating shall be in accordance with IS 11310.

(ii) : The above values of creepage distance are applicable for an altitude upto 1000m above sea level. For altitude above 1000m above sea level, necessary altitude correction factor as per relevant IS/IEC shall be considered.

(c) **DC wall bushing -**DC wall bushings, used for electrical connection between the equipment inside the valve hall and the outdoor DC yard shall be of polymer housing as per relevant standards.

(d) **DC Reactors -** The DC reactors (if used) shall be of air core type. The reactors shall generally comply with relevant standards and shall also have been subjected to DCtests as per their application.

(e) **DC Voltage and Current Measuring Devices-** The DC voltage measuring equipment shall be installed at each pole. The DC measuring equipment at pole and neutral bus shall be suitably located based on the control philosophy and different protection zones such that complete pole and neutral equipment are protected.

(f) **DC Filters-** If required DC harmonic filters shall be provided in DC yard to limit harmonic voltages present on the DC lines (pole lines and electrode lines).

8. Control and Protection

(a) Control

(i) DC converter terminals shall be either manned by operator or controlled by remote Operation of SCADA system. The control system hierarchy shall be as follows:

(A) Station/ Bipole* Control (*only for bipolar arrangements, functionality offered as part of station control also acceptable);

(B) Converter /Pole Control;

(C) MMC control;

(ii) The HVDC converter shall have control features including but not limited to the following:

(D) Active power control

(E) Reactive power control;

(F) AC Voltage control

(G) DC Voltage control

(H) Frequency controller (if applicable);

(I) Power modulation control (if applicable);

(J) Runback and run-up functions (if applicable);

(K) Power Oscillation Damping (POD)

(L) Sub synchronous torsional interaction dampingcontrol (if applicable);

(b) Protection

(i) The protection equipment shall be designed to be fail-safe and shall ensure high security to avoid mal-operation/ unwanted shutdown due to protection equipment failures.

(ii) HVDC system protection shall consist of following protection zones:

(A) AC System Protection zone

(B) Converter or Interface Transformer Protection Zone

(C) Secondary Busbar Protection Zone

(D) Converter Protection Zone

(E) DC Busbar Protection Zone

(F) DC line & cable Protection Zone

(iii) Protection system shall have two red indent systems including the following protections.

(A) AC over- and under-voltage protection

(B) Over- and under-frequency protection

(C) AC busbar differential protection;

(D) Insertion resistor overload protection

(E) AC overcurrent protection

(F) Converter overcurrent protection

(G) Converter overload protection

(H) Converter module differential protection

(I) Converter current differential protection

(J) DC voltage imbalance protection

(K) DC busbar differential protection

(L) DC link differential protection

(M) DC over- and under-voltage protection

(N) Electrode line monitoring and protection (if applicable)

(O) DC filter protection (if applicable)

(P) AC filter protection (if applicable)

(Q) AC connection Harmonic protection

(R) Phase current unbalance

(S) Protection.Block Failure or Repetitive Blocking failure protection

(T)Converter arm harmonic protection

(U) DC Line + cable Overcurrent Protection

(V) DC Line + cable harmonic protection

(c) Software based controls and protection shall be used to permit flexibility in effecting modifications. Protection and controls shall be duplicated for reliability. Protection shall be provided by numerical relays to suit the requirement of the HVDC system.

(d) For bipolar schemes the following operation modes shall be possible:

(i) Balanced/ unbalanced bipolar operation;

(ii) Monopolar operation with metallic return;

(iii) Monopolar operation with ground return / DMR

(e) The 'Sequence of events' recorder, transient fault recorder, on-line DC Line fault locator, GPS system, visual display system, operator control protection and monitoring system shall be a part of the HVDC system.

9. **Telecommunication**- For smooth operation of the HVDC system, communication network with high reliability and availability shall be provided for transmission of control and protection signals between the two or more (in case of multi-terminal DC) HVDC terminals. There shall be main and back up communication link. The main communication link shall be through OPGW and back up communication link shall be either through OPGW or PLCC.

10. **Grounding & Safety**

(a) The design of the grounding system shall be based on relevant IS/ IEEE.

(b) In order to prevent adverse effect (overheating due to induced circulating current) of magnetic field of air core reactors, special care shall be taken such that no closed loops are formed by the earthing conductors and in reinforcement bars of the foundation. Air core reactor manufacturer's guidelines shall be followed.

(c) The electrical safety clearances for the dc side shall not be less than the clearances applicable for an ac switchyard at the equivalent BIL level.

(d) The total electric field excluding space charge at ground level shall be as prescribed in relevant standards.

(e) Fencing and electrical & mechanical key interlocking arrangements shall be provided for valve halls, smoothing reactor area, AC and DC filter areas, DC LFL Capacitor Area and for equipment mounted directly on ground without suitable height of steel structure.

11. Dedicated Metallic Return (DMR) or Earth Electrode –The current return path of a bipolar configuration shall be either via a Dedicated Metallic Return (DMR) conductor or via earth return using earth electrodes at both converter terminals. DMR mode shall be preferred if it is difficult to identify a suitable site for earth electrode station. If earth electrodes are to be used the following requirements shall also be considered:

(a) The earth electrode station shall be connected to the terminal by means of an overhead transmission tine or underground cable. The earth electrode shall be located at a minimum distance of approximately 25 km (radial distance) away from the converter station. It shall be designed to operate continuously at full load as per the requirement. The electrodes shall be designed for both types of operation, anodic and cathodic.

(b) The thorough soil investigation shall be carried out for shallow & deep resistivity, thermal conductivity and moisture content etc. at the proposed location.

(c) The earth electrode station shall have sub-electrodes. The maximum current density at the sub-electrode surface, i.e. the boundary between backfill (coke) and soil shall not exceed 0.5 A/m2 in clay soils. The number of sub-electrodes shall be determined considering that 30% of the sub-electrodes are not available. The amp hour rating for earth electrode shall be selected based on the study for duration of earth electrode current and the service life of the earth electrode station.

(d) The earth electrode station shall not affect the nearby electrical installation, buried metallic pipelines, oil & gas pipelines, and railway lines etc.

(e) Each ground electrode shall have a resistance of less than or equal to 0.3 ohm (both working as an anode and cathode) at maximum design ambient temperature.

(f) Touch voltage (Vt)- The touch voltage between any grounded metallic object in the electrode station (including the connection to the overhead electrode line) and any point in the soil which can be touched by a person simultaneously shall not exceed 40 V when the electrode is operating at continuous loading.

(g) Step Voltage (Vs)- The step voltage at ground level above the ground electrode when the electrode is operating at the temporary over-load rating shall not exceed (Vs) = 5.0 + 0.03 ρs, where ρs is the local surface resistivity in ohm-m.

(h) The above values of resistance: touch and step voltages would depend on the actual geophysical characteristics of the soil at the place where the electrode station is located. Suitable mitigation measures shall have to be adopted in case the site has high resistivity.

(i) In addition, following interference effects shall be considered.

   (i) Corrosion of buried metallic structure of foundations

   (ii) DC Current in power lines, especially via power transformer neutrals (risk of saturation of transformers).

   (iii) DC current in telephone circuits.

   (iv) Effect on the cathodic protection of the buried metallic pipe lines.

12. Cables: Fibre optic cables conforming to IEC – 60793 shall be used to transmit the signals to and from various equipments and panels located in the AC/DC switchyards, Valve Halls, control rooms, valve cooling rooms, etc.

13. Auxiliary Power Supply System: The auxiliary power supply system shall have the following:

   (a) Highly reliable duplicated supply sources from two separate sources, with automatic change-over facilities.

   (b) Completely separated secondary distribution (415 V) systems for the auxiliaries of each converter.

   (c) Duplicated supply by two different 415 V power sources to essential loads (e.g., cooling pumps, fans, heat exchangers, etc.).

   (d) Provision of reliable or standby power supply system to meet essential and emergency loads and which starts-up automatically in case of loss of all the normal and stand-by supply sources. One reliable or standby power supply system per converter shall be provided at all the converter stations.

   (e) Parallel operation between station service transformers shall not be permitted at any voltage level in order to limit fault currents, prevent back feed into the AC bus and to ensure independence of supply sources. Also parallel operation shall not be permitted between transformers and the reliable or standby power supply system.

(f) Suitable protection on all primary MV and LV supply connections

(g) All auxiliaries shall give rated output at voltage variation of ±10% and frequency variation of - 5% to +3%.

(h) The station services DC system shall cater to the following:

(i) DC loads of HVAC and HVDC switchyards, auxiliary services control, valve and pole control, protection circuits, communication system loads, etc.

(ii) An indispensable minimum lighting load shall be connected to the station DC system.

(i) The 220VDC supply system(s) per converter shall consist of at least two independent DC systems; each system consisting of one charger, one battery bank and one distribution panel.

(j) A 48 V DC system consisting of two battery sets, two Battery chargers and two distribution boards shall also be supplied for communication panels (wherever supplied).

14. **Fire Detection, Alarm and Protection system:** A comprehensive fire detection, alarm and protection system as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 or any successor or subsequent Regulations shall be provided. Valve Hall shall have Air aspiration system (fast and early smoke detection system). Suitable Infra-Red (IR) detector to detect the flashover inside the Valve Hall shall also be provided. The Valve hall wall shall be suitable for minimum 3 hour fire rating.

15. **Testing and trial Operation:** All equipment / component including Thyristor valves, Converter Transformers, smoothing reactors, EHV DC Transformer bushings and wall bushings shall be subjected to Type tests, Routine tests, Factory Acceptance Test (FAT), Site Acceptance Test (SAT) as per relevant IS / IEC/ IEEE as applicable. The SAT shall consist of sub-system & system tests and shall be carried out after installation of equipment at site. The subsystem tests cover the major sub-system like valve cooling, AC&DC filters, HVDC converter, auxiliary systems, communication etc. After completion of sub-system tests, system tests covering power transmission tests, transient & dynamic control tests,

measurement of electric field and RFI etc. shall be conducted. After completion of all system tests, final trial operation of the HVDC System shall be carried out for uninterrupted continuous period of normal operation of not less than 10 days during which the converter equipment shall be fully operational.

16. Performance Guarantee:

(a) The power Transmission Capacity:

The rated power transmission capacity shall be defined and guaranteed at inverter end of AC yard and rated transmission voltage shall be defined at the rectifier end. The reverse Power transmission capacity shall also be indicated.

(b) HVDC System losses:

The Guaranteed losses of HVDC transmission shall include the no load loss and equivalent load loss. The equivalent load loss is the sum of load losses at specific loadings multiplied by weightage factors as per expected loading cycle. The Guaranteed losses shall be verified as per IEC 62751-1 & IEC 62751-2. No load loss shall be guaranteed corresponding to converter transformer set at principal tap with nominal AC system voltage and nominal frequency at 40^0 C ambient temperature.

(c) The system shall meet various harmonic performance parameters on both AC Side and DC side.

(d) HVDC Reliability and Availability:

1	Overall Energy availability of HVDC scheme (c) Overall Performance (d) Excluding transformer failure	Not less than 97% Not less than 98%
2	Forced Energy Unavailability (FEU)	Not more than 0.6%
3	Schedule Energy Unavailability (SEU)	Not more than 1%
4	Single Pole outage per pole per station per year	Not more than 8 (with average outage duration of 7.5 hours)
5	Bipole outage per station per year	Not more than 0.2 (with average outage duration of 8 hours)

17. Applicable Standards: All equipment and material shall be designed, manufactured, tested and commissioned in accordance with latest Indian Standards / IEC standards, IEEE / CIGRE guidelines and the Acts, Rules, Laws and Regulations of India. Some of them are for guidance purpose as follows:

(a) IEC 60633 - Terminology for High-Voltage Direct Current (HVDC) transmission

(b) IEC 62747 - Terminology for Voltage Source Converters for high-voltage direct current (HVDC) transmission

(c) IEC 62751 - Power losses in voltage sourced converter (VSC) valves for high-voltage direct current (HVDC) systems - Part 2: General Requirement

(d) IEC 62751 - Power losses in voltage sourced converter (VSC) valves for high-voltage direct current (HVDC) systems - Part 2: Modular multilevel converters

(e) IEC 62543 - High Voltage Direct Current (HVDC) Power transmission using Voltage Source Converters (VSC)

(f) IEC 62501 - Voltage sourced converter (VSC) valves for high-voltage direct current (HVDC) power transmission - Electrical testing

(g) IEC 60747-9 - Semiconductor devices - Part 9: Discrete devices – Insulated-Gate Bipolar Transistors (IGBTs)

(h) IEC 61378 (2-3) - Converter transformers

(i) IEC 60076-6 - Power transformers - Part 6: Reactors

(j) IEC 60071 (1- 5) – Insulation Coordination

SCHEDULE-VII

(See sub-regulation (4) of regulation 84)

Right-of-way (ROW) for normal route, forest area, urban area, populated area and approach section near substation

Voltage level	***Configuration***	***Conductor type***	***Terrain***	***Design Span***	***String Type***	***RoW width in m (for compensation purpose)***
			Normal route without constraint	400	"I" String	**67**
					"V" String	
					Tension	
			Forest		"V"	**56**

765kV D/C	Vertical	ACSR ZEBRA		300	String	
					Tension	
			Urban area / populated area / approach section near substation	250	"V" String	**54**
					Tension	
765kV S/C	Vertical /Delta	ACSR BERSIMIS	Normal route without constraint	400	"I" String	**64**
					"V" String	
					Tension	
			Forest	300	"V" String	**54**
					Tension	
			Urban area / populated area / approach section near substation	250	"V" String	**52**
					Tension	
765kV S/C	Horizontal	ACSR BERSIMIS	Normal route without constraint	400	"I" String	**74**
					"V" String	
					Tension	
			Forest	300	"V" String	**65**
					Tension	
			Urban area / populated area / Approach section near substation	250	"V" String Tension	**62**
±800kV HVDC	Horizontal	ACSR Lapwing	Normal route without constraint/Forest/ Urban	400	"Y" String	**69**
±500kV			Normal		"V"	

HVDC	Horizontal	ACSR Lapwing	route without constraint/Forest/ Urban	400	String	**52**
400kV D/C	Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	**46**
					"V" String	
					Tension	
			Forest	300	"V" String	**40**
					Tension	
			Urban area / populated area / approach section near substation	250	"V" String	**38**
					Tension	
400kV S/C	Horizontal/ Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	**52**
					"V" String	
					Tension	
			Forest	300	"V" String	**47**
					Tension	
			Urban area / populated area / approach section near substation	250	"V" String	**44**
					Tension	
1200kV	Horizontal	ACSR Moose	Normal route without constraint/Forest/ Urban	400	"V" String	**89**
220kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	350	"I" String	**32**
					"V" String	
					Tension	

		ACSR PANTHER	Forest	300	"V" String	**28**
					Tension	
			Urban area / populated area / approach section near substation	200	"V" String	**24**
					Tension	
132kV D/C	Vertical		Normal route without constraint	320	"I" String	**25**
					"V" String	
					Tension	
			Forest	200	"V" String	**21**
					Tension	
			Urban area / populated area / approach section near substation	150	"V" String	**19**
					Tension	
			Normal route without constraint	305	"I" String	**22**
110 kV D/C		ACSR PANTHER			"V" String	
					Tension	
			Forest	200	"V" String	**19**
					Tension	
			Urban area / populated area / approach section near substation	150	"V" String	**17**
					Tension	
66kV	Vertical	ACSR PANTHER	Normal route without constraint	250	"I" String	**18**
					"V" String	

					Tension	
			Forest	150	"V" String	**14**
					Tension	
			Urban area / populated area / approach section near substation	100	"V" String	**13**

Note: D/c : double circuit; S/c: single circuit

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the 25th January, 2023

CEA-TH-17-13/4/2022-TETD Division.—Whereas the draft of the Central Electricity Authority (Flexible Operation of Coal based Thermal Power Generating Units) Regulations, 2022 was published in six newspaper dailies, as required by sub-section (3) of Section 177 of the Electricity Act, 2003 (36 of 2003) read with sub-rule (2) of rule 3 of the Electricity (Procedure for Previous Publication) Rules, 2005 for inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of forty-six days, from the date on which the copies of the newspaper containing the said draft regulations were made available to the public;

And whereas copies of the said newspapers containing the public notices and the said draft regulations on the website of the Central Electricity Authority were made available to the public on the 12^{th} July, 2022;

And whereas the objections and suggestions received from the public on the said draft regulations were considered by the Central Electricity Authority;

Now, therefore, in pursuance of clause (e) of sub-section (2) of Section 177 of the Electricity Act, 2003 read with clause (b) of Section 73 of the said Act, the Central Electricity Authority hereby makes the following regulations, namely:

1. **Short title and commencement.-** (1)These regulations may be called the Central Electricity Authority (Flexible Operation of Coal based Thermal Power Generating Units) Regulations, 2023.

(2) They shall come into force on the date of their final publication in the Official Gazette.

2. **Definitions.-** (1)In these regulations, unless the context otherwise requires,

   (a) "Act" means the Electricity Act, 2003 (36 of 2003);

   (b) "flexible operation" means the ability of coal based thermal power generating units to generate power at specified levels mentioned in these regulations, as per the requirement of the grid;

   (c) "maximum continuous power rating" means maximum continuous output power expressed in Mega Watt at the generator terminals as guaranteed by the manufacturer of generating units at the rated parameters;

   (d) "minimum power level" means the minimum output power expressed in percentage of maximum continuous power rating that the coal based thermal power generating unit can sustain continuously without oil support;

   (e) "ramp rate" means the rate of change of output power, expressed in percentage of maximum continuous power rating, per minute.

   (2) Words and expressions used herein and not defined but defined in the Act and the rules made thereunder shall have the meanings assigned to them in that Act and rules made thereunder.

3. **Applicability.-** These regulations shall apply to all coal based thermal power generating units owned or under control of the Central Government, State Governments or owned by any private company, connected with the grid and to the load despatch centers.

4. **General requirements.-** (1) The coal based thermal power generating units shall be designed or suitably retrofitted, if required, to comply with these regulations for full range of ambient and environmental conditions prevailing at the site.

(2) All equipment and systems installed shall comply with the provisions of statutes, regulations and safety codes, as applicable.

5. **Flexible operation of coal based thermal power generating units.-** (1) The coal based thermal power generating units shall be capable of providing the flexible operation as per these regulations.

(2) The implementation of flexible operation of the coal based thermal power generating units shall be as per the phasing plan specified by the Authority from time to time.

(3) All load despatch centers shall schedule the coal based thermal power generating units, under their jurisdiction, considering the flexible operation capabilities as specified in these regulations.

6. **Minimum power level capabilities of coal based thermal power generating units for flexible operation.-** The coal based thermal power generating units shall have flexible operation capability with minimum power level of forty percent.

Provided that the generating units which are not capable of achieving minimum power level of fifty-five percent, shall achieve the same within one year of the notification of these regulations.

Provided further that the generating units which are not capable of achieving minimum power level of forty percent, shall achieve the same as per phasing plan mentioned in the sub-regulation (2) of regulation 5 of these regulations.

7. **Ramp rates capabilities of coal based thermal power generating units for flexible operation.-** (1) The coal based thermal power generating units shall have ramp rate capability of minimum three percent per minute for their operation between seventy percent to hundred percent of maximum continuous power rating and shall have ramp rate capability of minimum two percent per minute for their operation between fifty-five percent to seventy percent of maximum continuous power rating.

Provided that the generating units which are not capable to comply with this regulation, shall comply with the same within one year of the notification of these regulations.

(2) The coal based thermal power generating units shall achieve ramp rate capability of minimum one percent per minute for their operation between forty percent to fifty-five percent of maximum continuous power rating as per phasing plan mentioned in the sub-regulation (2) of regulation 5 of these regulations.

8. **Relaxation of regulations. -** The Authority may, by an order and for the reasons to be recorded in writing, relax any provision of these regulations in respect of the matter referred to the Authority, on case to case basis.

CENTRAL ELECTRICITY AUTHORITY

NOTIFICATION

New Delhi, the 8th June, 2023

No. CEA-PS-16/1/2021-CEI Division.—Whereas the draft of the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2022 was published in six newspaper dailies, as required by sub- section (3) of section 177 of the Electricity Act, 2003 (36 of 2003) read with sub-rule (2) of rule 3 of the Electricity (Procedure for Previous Publication) Rules, 2005 for inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of forty-five days, from the date on which the copies of the newspaper containing the said draft regulations were made available to the public;

And whereas copies of the said newspapers containing the public notices and the said draft regulations on the website of the Central Electricity Authority were made available to the public on 14th June, 2022;

And whereas the objections and suggestions received from the public on the said draft regulations were considered by the Central Electricity Authority;

Now, therefore, in exercise of the powers conferred by clause (b) of sub-section (2) of section 177 and read with section 53 of the Electricity Act, 2003, and in suppression of the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010, except as respects things done or omitted to be done before such suppressions, the Central Electricity Authority hereby makes the following regulations, namely: –

Chapter I

Preliminary

1. **Short title and Commencement. –** (1) These regulations may be called the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023.

(2) These regulations shall come into force on the date of publication in the Official Gazette.

(3) **Scope and extent of application. –** These regulations shall be applicable to electrical installation including electrical plant and electric line, and the person engaged in the generation or transmission or distribution or trading or supply or use of electricity.

2. **Definitions. –** (1) In these regulations, unless the context otherwise requires,

(a) "Act" means the Electricity Act, 2003 (36 of 2003);

(b) "accessible" means within physical reach without the use of any appliance or special effort;

(c) "aerial bunched cable" means polyethylene or cross linked polyethylene insulated cable having three or four cores with aluminium conductors twisted over a central bare or insulated aluminium alloy or steel messenger wire;

(d) "apparatus" means electrical apparatus and includes all machines, fittings, accessories and appliances in which conductors are used;

(e) "bare" means not covered with insulating materials;

(f) "bonding conductor" means the inter connecting conductors for the purpose of equipotential bonding with the main earth;

(g) “cable” means a length of insulated single conductor, solid or stranded, or two or more such conductors each provided with its own insulation, which are laid up together;

(h) “chartered electrical safety engineer” means a person authorised by the Appropriate Government as referred in regulation 6;

(i) “circuit” means an arrangement of conductor or conductors for conveying electricity and forming a system or a branch of a system and protected at the origin;

(j) “circuit breaker” means a mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified duration and breaking currents under specified abnormal circuit condition;

(k) “concentric cable” means a composite cable comprising an inner conductor which is insulated and one or more outer conductors which are insulated from one another and are disposed over the insulation of, and more or less around, the inner conductor;

(l) “conductor” means any wire, cable, bar, tube, rail or plate used for conducting electricity;

(m) “conduit” means rigid or flexible metallic tubing or mechanically strong and fire resisting non-metallic tubing into which a cable or cables may be drawn for the purpose of affording it for mechanical protection;

(n) “connected load" means the sum of the ratings in kilowatt or kilovolt-ampere of the apparatus connected to the installation of the consumer which may be connected simultaneously to the source;

(o) “contact potential” means electric potential difference across the junction of two different objects in the absence of electric current;

(p) “covered with insulating material” means adequately covered with insulating material of such quality and thickness as to prevent danger;

(q) “cut out” means any device for automatically interrupting the flow of electricity through the conductor when the current increases above a pre-determined value, and shall also include fusible cut-out;

(r) “danger” means risk to health or life or any part of body from electric shock, burn or other injuries to person, or property, or from fire or explosion, attendant upon the generation, transmission, transformation, conversion, distribution or use of electricity;

(s) “dead” means at or about earth potential and disconnected from any live system and is used only with reference to current carrying parts when these parts are not live;

(t) “designated person” means a person whose name appears in the record maintained under sub-regulation (2) of regulation 3 by the supplier or consumer, or the owner, agent or manager of all electrical installations including mine, or the agent of any company operating in an oil-field or the owner of a drilled well in an oil-field or a contractor;

(u) “earthing” means connection of the exposed conductive and extraneous parts of an installation to the main earthing terminal of that installation or connection of neutral of transformer or generator or equipment to general mass of earth or earth bonded bar of that installation;

(v) “earthing arrangement or earthing system” means all the electric connections and devices involved in the earthing of a system, an installation or equipment;

(w) "electric vehicle" means any vehicle propelled, partly or wholly, by an electric motor drawing current from a rechargeable storage battery, or other portable energy storage devices or other self-generating electric source;

(x) "electric vehicle supply equipment" means an element in electric vehicle charging infrastructure that supplies electric energy for recharging the battery of electric vehicles;

(y) "enclosed substation" means any premises or enclosure or part thereof, being large enough to enable the entry of a person after the apparatus therein is in position, containing apparatus for transforming or converting electricity to or from a voltage at or exceeding six hundred fifty volt (other than transforming or converting solely for the operation of switch gear or instruments) with or without any other apparatus for switching, controlling or otherwise regulating the electricity, and includes the apparatus therein;

(z) "enclosed switching station" means any premises or enclosure or part thereof, being large enough to enable the entry of a person, after the apparatus therein is in position, containing apparatus for switching, controlling or otherwise regulating electricity at or exceeding six hundred fifty volt but not for transforming or converting electricity (other than for transforming or converting solely for the operation of switchgear or instruments) and includes the apparatus therein;

(za) "equipotential bonding" means an electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential;

(zb) "exposed conductive part" means a conductive part which can readily be touched and which is not normally live, but which may become live under fault conditions;

(zc) "extraneous conductive part" means a conductive part not forming part of the electrical installation and liable to introduce an electric potential, generally the electric potential of a local earth;

(zd) "flameproof enclosure" means an enclosure in which the parts which can ignite an explosive atmosphere are placed and which can withstand the pressure developed during an internal explosion of an explosive mixture and which prevents the spread of explosion to the explosive atmosphere surrounding the enclosure;

(ze) "flexible cable" means a cable consisting of one or more cores each formed of a group of wires, the diameter and the physical properties of the wires and insulating material are to allow flexibility;

(zf) "guarded" means covered, shielded, fenced or otherwise protected by means of suitable casings, barrier, rails or metal screens to remove the possibility of dangerous contact or approach by persons or objects to a point of danger;

(zg) "hand-held portable apparatus" means an apparatus designed to be capable of being held in the hands and moved while connected to a supply of electricity;

(zh) "high voltage direct current" means direct current voltage one hundred kilovolt and above used for transmission of power;

(zi) "inspector of mines" means an inspector appointed under the mines Act, 1952 (35 of 1952);

(zj) "installation" means any composite electrical unit used for the purpose of generating, transforming, transmitting, converting, distributing or utilizing electricity;

(zk) "Installation Manager" has the same meaning as defined in the Oil Mines Regulations, 2017;

(zl) "intrinsically safe circuit" means any circuit in which any spark or any thermal effect produced in the conditions specified in the relevant standards, which include normal operation and specified fault conditions and not capable of causing ignition of a given explosive gas atmosphere;

(zm) "intrinsically safe apparatus" means an electrical apparatus in which all the circuits are intrinsically safe circuits;

(zn) "lightning arrester" means a device which has the property of diverting to earth any electrical surge of excessively high amplitude applied to its terminals and is capable of interrupting follow on current, if present, and restoring itself thereafter to its original operating conditions;

(zo) "linked switch" means a switch with all the poles mechanically linked to operate simultaneously;

(zp) "live" means electrically charged;

(zq) "load despatcher" means the personnel engaged in operation of Load Despatch Centre;

(zr) "metallic covering" means mechanically strong metal covering surrounding one or more conductors;

(zs) "mine" shall have the same meaning as defined in clause (j) sub-section (1) of section 2 of the Mines Act, 1952 (35 of 1952);

(zt) "neutral conductor" means 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 a single phase system;

(zu) "notified voltage" means a voltage notified by the Appropriate Government under intimation to the Authority for the purpose of specifying the voltage level up to which self-certification is to be carried out under regulation 32 and regulation 45;

(zv) "occupier" means the owner or person in occupation of the premises where electricity is used or proposed to be used;

(zw) "open sparking" means 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;

(zx) "owner or agent or manager of a mine" have the same meanings as are assigned to them in the Mines Act, 1952 (35 of 1952);

(zy) "portable apparatus" means an apparatus which is so designed as to be capable of being moved while in operation;

(zz) "portable hand lamp" means a portable light-fitting provided with suitable handle, guard and flexible cord connected to a plug;

(zza) "protective conductor" means a conductor used for protection against electric shock and intended for connecting together which may include exposed conductive parts, extraneous conductive parts, the main earthing terminal, and the earthed point of the source, or an artificial neutral;

(zzb) "self-certification" means a certification by a supplier or owner or consumer in the prescribed format as required under regulation 32 and regulation 45;

(zzc) "socket outlet" means an electrical device that is for fixing at a point where fixed wiring terminates, and provides a detachable connection with the pins of a plug, and has two or more contacts and includes a cord extension socket attached to a flexible cord that is permanently connected to installation wiring;

(zzd) "span" means the horizontal distance between two adjacent supporting points of an overhead conductor;

(zze) "standard" means Indian Standard and in absence of Indian Standard, International Electrotechnical Commission Standard, Institute of Electrical and Electronic Engineers Standard, European Norms Standard in the sequence of their appearance unless stated otherwise;

(zzf) "street box" means an enclosed structure, either above or below ground containing apparatus for transforming, switching, controlling or otherwise regulating electricity;

(zzg) "supplier" means any generating company or licensee from whose system electricity flows into the system of another generating company or licensee or consumer;

(zzh) "supply lead" means a piece of equipment used to establish the connection between the electric vehicle and either a socket-outlet or a charging point;

(zzi) "switch" means a manually operated device for opening and closing or for changing the connection of a circuit;

(zzj) "switchboard" means an assembly including the switchgear for the control of electrical circuits, electric connections and the supporting frame;

(zzk) "switchgear" shall denote switches, circuit breakers, cut-outs and other apparatus used for the operation, regulation and control of circuits;

(zzl) "system" means an electrical system in which all the conductors and apparatus are electrically connected to a common source of electric supply;

(zzm) "telecommunication line" means any equipment, structure and cable designed or intended for use in telecommunication;

(zzn) "transportable apparatus" means apparatus which is operated in a fixed position but which is so designed as to be capable of being moved readily from one place to another;

(zzo) "watt" is a unit of active power; and

(zzp) "MW" means megawatt and is equal to 10^6 watts.

(2) Words and expressions used herein and not defined in these regulations but defined in the Act shall have the meanings respectively assigned to them in the Act.

Chapter II

Designated Person, Chartered Electrical Safety Engineer, Training and Certification

3. Designated person to operate and carry out the work on electrical lines and apparatus. – (1) The supplier or consumer, or owner of electrical installation, owner or agent or manager of a mine, or agent of any company operating in an oil-field or owner of a drilled well in an oil-field or a contractor who has entered into a contract with a supplier or a consumer, or owner of electrical installation, owner or agent or manager of a mine, or agent of any company operating in an oil-field or owner of a drilled well in an oil-field to carry out duties incidental to the generation, transformation, transmission, conversion, distribution or use of electricity shall designate person for the purpose to operate and carry out the work on electrical lines and apparatus.

(2) The supplier or consumer, or owner or agent or manager of a mine, or agent of any

company operating in an oil-field or the owner of a drilled well in an oil-field or a contractor referred to in sub-regulation (1) shall maintain a record, in paper or electronic form, wherein the names of the designated person and the purpose for which they are designated, shall be entered.

(3) No person shall be designated under sub-regulation (1) unless,-

(i) he possesses a certificate of competency or electrical work permit, issued by the Appropriate Government; and

(ii) his name is entered in the register referred to in sub-regulation (2).

4. **Inspection of record of designated person. –** (1) The record maintained under sub-regulation (2) of regulation 3 shall be produced before the Electrical Inspector as and when required.

(2) If on inspection, the Electrical Inspector finds that the designated person does not comply with sub-regulation

(3) of regulation 3, he shall recommend the removal of the name of such person from the record.

5. **Electrical Safety Officer. –** (1) All suppliers of electricity including generating companies, transmission companies and distribution companies shall designate an Electrical Safety Officer for ensuring observance of safety measures specified under these regulations in their organisation for construction, operation and maintenance of electrical system of all generating stations, transmission lines, substations, distribution systems and supply lines.

(2) The Electrical Safety Officer shall possess a degree in Electrical Engineering with at least five years experience in operation and maintenance of electrical installations or a Diploma in Electrical Engineering with at least ten years experience in operation and maintenance of electrical installations:

Provided that the Electrical Safety Officer designated for mines shall possess educational qualification as mentioned in sub-regulation (2) with at least five years of experience in operation and maintenance of electrical installations relevant to mines.

(3) For every electrical installation including factory registered under the Factories Act, 1948 (63 of 1952) with more than 250 kW connected load and mines and oil-field as defined in the Mines Act, 1952 (35 of 1952), with more than 2000 kW connected load, the owner of the installation or the management of the factory or mines, as the case may be, shall designate Electrical Safety Officer under sub-regulation (1) and having qualification and experience specified in sub-regulation (2), for ensuring the compliance of the safety provisions laid under the Act and the regulations made thereunder:

Provided that the Electrical Safety Officer shall carryout recommended periodic tests as per the relevant standards, and inspect such installations at intervals not exceeding one year, and keep a record thereof in Form I or Form II or Form III or Form IV, as the case may be, of Schedule II of these regulations; test reports and a register of recommendations in regard with safety duly acknowledged by owner; compliances made thereafter; and such records shall be made available to the Electrical Inspector, as and when required.

6. **Chartered Electrical Safety Engineer. –** (1) The Appropriate Government shall authorise Chartered Electrical Safety Engineer from amongst persons having the qualification and experience as per the guidelines issued by the Authority to assist the owner or supplier or consumer of electrical installations for the purpose of self-certification under regulation 32 and regulation 45 of these regulations.

(2) The Appropriate Government shall upload the name of the Chartered Electrical Safety Engineer, as soon as any person is authorised as Chartered Electrical Safety

Engineer, on the web portal of the Government or the Department dealing with matters of inspection of electrical installations for the information of the owner or supplier or consumer.

7. **Safety measures for operation and maintenance of generating station. –** (1) The Engineers and Supervisors engaged or appointed to operate or undertake maintenance of any part or whole of a generating station shall hold degree or diploma in Engineering relevant to the electrical installations from a recognised institute or university.

(2) The Engineers and Supervisors engaged or appointed for operation and maintenance of generating station shall have successfully undergone the type of training as specified by the Authority in its guidelines issued under sub-regulation (4) from time to time, within two years from the date of engagement or appointment.

(3) The Technicians to assist Engineers or Supervisors shall possess a certificate in appropriate trade, preferably with a two years course from an Industrial Training Institute recognised by the Central Government or the State Government and shall have successfully undergone the type of training as specified in sub-regulation (4), within two years from the date of engagement or appointment:

Provided that the existing employees, as on the date of notification of these regulations, who are extending technical assistance to Engineers or Supervisors and do not have requisite qualification as mentioned in this regulation, shall have to undergo the training either from Power Sector Skill Council or from training institute recognised by the Authority for carrying out trade specific course as per the guidelines issued by the Authority and get certificate as mentioned above within two years from the date of notification of these regulations.

(4) The Authority shall issue guidelines for the training for operation and maintenance of generating station within six months of the notification of these regulations:

Provided that the duration and content of the training course shall be as specified in the guidelines.

(5) The owner of every generating station shall arrange for training of personnel engaged or appointed to operate and undertake maintenance of the generating station from its own institute or any other institute recognised by the Authority or State Government as per the guidelines and shall maintain records of the assessment of these personnel issued by the training institute in the format prescribed in guidelines and such records shall be made available to the Electrical Inspector, as and when required.

(6) The certificate of recognition of the training institute under these regulations shall be displayed by the Institute on its website at home page.

(7) Notwithstanding anything contained in sub-regulation (4), the training syllabus may be customised by the owner of the generating station of capacity below 100 MW owning the training institute for the purpose of imparting training to its employees under intimation to the Authority.

8. **Safety measures for operation and maintenance of transmission and distribution systems. –** (1) The Engineers or Supervisors engaged or appointed to operate or undertake maintenance of transmission and distribution systems shall hold degree or diploma in appropriate trade of Engineering from a recognised institute or university.

(2) The Engineers and Supervisors engaged or appointed to operate or undertake maintenance of transmission and distribution systems shall have successfully undergone the type of training specified in guidelines as per sub- regulation (4), within two years from the date of engagement or appointment.

(3) The Technicians to assist Engineers or Supervisors shall possess a certificate in

appropriate trade, preferably with a two years course from an Industrial Training Institute recognised by the Central Government or State Government and should have successfully undergone the type of training as specified in guidelines as per sub-regulation (4), within two years from the date of engagement or appointment:

Provided that the existing employees, as on the date of notification of these regulations, who are extending technical assistance to Engineers or Supervisors and do not have requisite qualification as mentioned in this regulation, shall have to undergo the training either from Power Sector Skill Council or from training institute recognised by the Authority for carrying out trade specific course as per the guidelines issued by the Authroity and get certificate as mentioned above within two years from the date of notification of these regulations.

(4) The Authority shall issue guidelines for the training for operation and maintenance of transmission, distribution systems within six months of the notification of these regulations:

Provided that the duration and content of the training course shall be as specified in the guidelines.

(5) Owner of every transmission or distribution system shall arrange for training of their personnel engaged or appointed to operate and undertake maintenance of transmission and distribution system, in his own institute or any other institute recognised by the Authority or State Government as per the guidelines and shall maintain records of the assessment of these personnel issued by the training institute in the format prescribed in guidelines and such records shall be made available to the Electrical Inspector, as and when required.

9. **Training and Certification of personnel engaged for operation and maintenance at Load Despatch Centres. –** (1) The personnel engaged for operation and maintenance at the control room shall hold degree or diploma in Electrical Engineering or in related trade of Engineering from a recognised institute or university.

(2) The Authority shall issue guidelines for the training and certification of personnel engaged for operation and maintenance at control room within six months of the notification of these regulations:

Provided that the roles and responsibilities of the certification agency, duration and content of the basic and advance certification and training course shall be as specified in the guidelines.

(3) The certification agency shall be a training institute recognised by the Authority:

Provided that the Load Despatch Centre shall arrange for training and certification of load despatcher from the certification agency recognised by the Authority as per guidelines issued under sub-regulation (2) of this regulation within six months of their engagement:

Provided further that no personnel shall be engaged as load despatcher without certification:

Provided also that existing employee engaged in Load Despatch Centre shall be trained as per guidelines specified under sub-regulation (2) of this regulation within two years from the date of coming in force of these regulations.

(4) The training institute shall maintain records of the assessment of load despatcher in electronic form in the format prescribed in guidelines specified under sub-regulation (2) of this regulation and such records shall be made available to the Secretary, Central Electricity Authority on annual basis.

(5) The personnel other than the load despatcher engaged in the Load Despatch Centre shall undergo requisite training in their related work in the Load Despatch Centre within

six months of their engagement.

(6) The Load Despatch Centre shall submit the details of certified load despatchers and the training details of the other personnel to Secretary, Central Electricity Authority on annual basis in the prescribed format:

Provided that Appropriate Government may provide suitable incentive to load despatchers on successful completion of training.

10. Keeping of records and inspection thereof. – (1) The generating company or licensee shall maintain records of the maps, plans and sections relating to supply or transmission of electricity in physical or digital form and provide the same to the Electrical Inspector for inspection as and when required.

(2) The Electrical Inspector shall supply a copy of the report of inspection referred to in sub-regulation (1), to the generating company or licensee, as the case may be.

11. Deposit of maps. – Whenever a licence is granted by the Appropriate Commission, two sets of maps specifying the particular for which the licence is granted shall be signed and dated corresponding to the date of notification of the licence by an officer designated by the Appropriate Commission:

Provided that one set of maps shall be retained by the designated officer and the other set shall be furnished to the licensee.

12. Deposit of printed copies. – (1) Every person who is granted a licence shall, within thirty days of the grant thereof, have physical or digital copies of the licence and maps showing the area of supply as specified in the licence to exhibit the same for public inspection at all reasonable times at its head office, local offices, if any, and at the office of every local authority within the area of supply.

(2) Every such licensee shall, within the aforesaid period of thirty days, supply free of charge one copy of the licence along with the relevant maps to every local authority within the area of supply and shall also make necessary arrangements for the sale of physical or digital copies of the licence and maps to all persons applying for the same, at a price to be notified by the Appropriate Government from time to time.

13. Plan for area of supply to be made and kept open for inspection. – (1) The licensee shall, after commencing supply of electricity, forthwith cause a plan, to be made in physical or digital form, of the area of supply, and shall cause to be marked thereon the alignment and in the case of underground works, the approximate depth below the surface of all the existing electric supply lines, street distribution boxes and other works, and shall once in every year cause that plan to be duly corrected so as to show the electric supply lines, street distribution boxes and other works for the time being in position and shall also made sections showing the approximate level of all his existing underground works other than service lines.

(2) Every plan shall be drawn to such horizontal and vertical scale as the Appropriate Commission may require:

Provided that no scale shall be required unless maps of the locality on that scale are for the time being available to the public.

(3) Every plan and section so made or corrected, or a copy thereof, marked with the date when it was made or corrected, shall be kept by the licensee at his principal office or place of business within the area of supply, and shall at all reasonable times be open to the inspection of all applicants, and copies thereof shall be supplied.

(4) The licensee shall ensure that all new and old plans and sections shall be compatible to the Global Positioning System mapping or mapping through any other latest technology.

(5) The licensee shall, if required by an Electrical Inspector, and, where the licensee is not a local authority, by the local authority, if any, concerned, supply free of charge to such Electrical Inspector or local authority a duplicate copy of every such plan or section or a part of the same duly corrected.

(6) The copies of plans and sections under this regulation shall be supplied by the licensee to every applicant on the payment of such fee as the Appropriate Commission may, by regulation, specify.

Chapter III

General safety requirements

14. General safety requirements pertaining to construction, installation, protection, operation and maintenance of electric supply lines and apparatus. – (1) All electric supply lines and apparatus shall be of sufficient rating for power, insulation and estimated fault current and of sufficient mechanical strength, for the duty cycle which they may be required to perform under the environmental conditions of installation, and shall be constructed, installed, protected, worked and maintained in such a manner as to ensure safety of human beings, animals and property.

(2) Save as otherwise provided in these regulations, the relevant standards including National Electrical Code and National Building Code shall be followed to carry out the purpose of these regulations and where relevant Indian standards are not available, International standards shall be followed and in the event of any inconsistency, the provisions of these regulations shall prevail.

(3) The material and apparatus used shall conform to the relevant standards.

(4) All electrical equipment shall be installed above the Highest Flood Level and where such equipment is not possible to be installed above Highest Flood Level, it shall be ensured that there is no seepage or leakage or logging of water.

15. Service lines and apparatus on consumer's premises. – (1) The supplier shall ensure that all electric supply lines, wires, fittings and apparatus belonging to him or under his control, up to the point of commencement of supply, which are on a consumer's premises, are in a safe-condition and in all respects fit for supplying electricity and the supplier shall take precautions to avoid danger arising on such premises from such supply lines, wires, fittings and apparatus.

(2) The service lines placed by the supplier on the premises of a consumer which are underground or which are accessible shall be so insulated and protected by the supplier as to be secured under all ordinary conditions against electrical, mechanical, chemical or other injury to the insulation.

(3) The consumer shall, as far as circumstances permit, take precautions for the safe custody of the equipment on his premises belonging to the supplier.

(4) The consumer shall also ensure that the installation of the licensee under his control is kept in a safe condition.

16. Switchgear on consumer's premises. – (1) The supplier shall provide a suitable switchgear in each conductor of every service line other than an earthed or earthed neutral conductor or the earthed external conductor of a concentric cable within a consumer's premises, in an accessible position and such switchgear shall be contained within an adequately enclosed fireproof receptacle:

Provided that where more than one consumer is supplied through a common service line, each such consumer shall be provided with an independent switchgear at the point of rigid junction to the common service.

(2) Every electric supply line other than the earthed or earthed neutral conductor of any system or the earthed external conductor of a concentric cable shall be protected by a suitable switchgear by its owner.

17. **Identification of earthed and earthed neutral conductors and position of switches and switchgear therein. –** Where the conductors include an earthed conductor of a two-wire system or an earthed neutral conductor of a multi-wire system or a conductor which is to be connected thereto, the following conditions shall be complied with, -

(i) an indication of a permanent nature shall be provided by the owner of the earthed or earthed neutral conductor, or the conductor which is to be connected thereto, to enable such conductor to be distinguished from any live conductor and such indication shall be provided as per relevant standards, namely: –

(a) where the earthed or earthed neutral conductor is the property of the supplier, at or near the point of commencement of supply;

(b) where a conductor forming part of a consumer's system is to be connected to the supplier"s earthed or earthed neutral conductor, at the point where such connection is to be made; and

(c) in all other cases, at a point corresponding to the point of commencement of supply.

(ii) no cut-out, link, switch or circuit breaker other than a linked switch arranged to operate simultaneously on the earthed or earthed neutral conductor and live conductors shall be inserted or remain inserted in any earthed or earthed neutral conductor of a two wire-system or in any earthed or earthed neutral conductor of a multi-wire system or in any conductor connected thereto:

Provided that the above requirement shall not apply in case of a link for testing purposes, or a switch for controlling a generator or transformer.

18. **Earthed terminal on consumer's premises. –** (1) The supplier shall provide and maintain on the consumer's premises for the consumer's use, a suitable earthed terminal in an accessible position at or near the point of commencement of supply as per relevant standards:

Provided that in the case of installation of voltage exceeding 250 V the consumer shall, in addition to the aforementioned earthing arrangement, provide his own earthing system with an independent electrode and the same shall be interlinked with the earthed terminal mentioned in sub-regulation (1) through a suitable link.

(2) The consumer shall take all reasonable precautions to prevent mechanical damage to the earthed terminal and its lead belonging to the supplier.

19. **Accessibility to bare conductors**. – Where bare conductors are used in a building, the owner of such conductors shall, -

(a) ensure that they are inaccessible to general public;

(b) provide in readily accessible position switches for rendering them dead whenever necessary; and

(c) take such other safety measures as are specified in the relevant standards.

20. **Danger Notices**. – The owner of every installation of voltage exceeding 250 V shall affix permanently in a conspicuous position a danger notice in Hindi or English and the local language of the district, with a sign ofskull and bones of a design as per relevant standards on, -

(a) every motor, generator, transformer and other electrical plant and equipment together with apparatus used for controlling or regulating the same;

(b) all supports of overhead lines of voltage exceeding 650 V which can be easily climbed upon without the aid of ladder or special appliances; and

(c) luminous tube sign requiring supply, X-ray and similar high frequency installations of voltage exceeding 650 V but not exceeding 33 kV:

Provided that where it is not possible to affix such notices on any generator, motor, transformer or other apparatus, they shall be affixed as near as possible thereto, or the word 'danger' and the voltage of the apparatus concerned shall be permanently painted on it:

Provided further that where the generator, motor, transformer or other apparatus is within an enclosure one notice affixed to the said enclosure shall be sufficient for the purposes of this regulation.

Explanation. – For the purposes of clause (b) rails, tubular poles, wooden supports, reinforced cement concrete poles and pre stressed cement concrete poles without steps, I-sections and channels, shall be deemed as supports which cannot be easily climbed upon.

21. Handling of electric supply lines and apparatus. – (1) Before any conductor or apparatus is handled, adequate precautions shall be taken, by earthing or other suitable means, to discharge electrically such conductor or apparatus, and any adjacent conductor or apparatus if there is danger therefrom, and to prevent any conductor or apparatus from being accidentally or inadvertently electrically charged when persons are working thereon shall be followed as per the relevant standards.

(2) Every person who is working on an electric supply line or apparatus or both shall be provided with, –

(a) personal protective equipment, tools and devices such as rubber gloves and safety footwear suitable for working voltage, safety belts for working at height, nonconductive ladder, earthing devices of appropriate class, helmet, line tester, hand lines, voltage detector and hand tools as per the relevant standards; and

(b) any other device for protecting him from mechanical and electrical injury due to arc flash and such personal protective equipment, tools and devices shall conform to the relevant standards and shall always be maintained in sound working condition.

(3) No person shall operate and undertake maintenance work on any part or whole of an electrical plant or electric supply line or apparatus and no person shall assist such person on such work, unless he is designated in that behalf and observes the safety precautions given in Part-I, Part-II, Part-III and Part-IV, as the case may be, of Schedule I.

(4) Every telecommunication line on supports carrying an overhead line of voltage exceeding 650 V but not exceeding 33 kV shall, for the purpose of working thereon, be deemed to be a line of voltage exceeding 650 V:

Provided that prior permission shall be taken from the concerned licensee before laying telecommunication lines on electric supports.

(5) For the safety of operating personnel, all non-current carrying metal parts of switchgear and control panels shall be properly earthed and insulating floors or mat conforming to the relevant standards, of appropriate voltage level shall be provided in front and rear of the panels where such personnel are required to carry out operation, maintenance or testing work.

(6) All panels shall be painted with the description of their identification at front and at the rear.

22. Supply to vehicles and cranes. – Every person owning a vehicle, travelling crane, or the like to which electricity is supplied from an external source shall ensure that it is efficiently controlled by a suitable switch enabling all voltage to be cut off in one operation and, where such vehicle, travelling crane or the like runs on metal rails, the owner shall ensure that the rails are electrically continuous and earthed at multiple points to ensure equipotential.

23. Cables for portable or transportable apparatus. – (1) Flexible cables shall not be used for portable or transportable motors, generators, transformers, rectifiers, electric drills, electric sprayers, welding sets or any other portable or transportable apparatus unless they are insulated for required voltage as per the relevant standards and adequately protected from mechanical damage.

(2) Where the protection is by means of metallic covering, the covering shall be in metallic connection with the frame of any such apparatus and earthed.

(3) The cables shall be three core type and four core type for portable and transportable apparatus working on single phase and three phase supply, respectively and the core meant to be used for earth connection shall be easily identifiable.

24. Cables protected by bituminous materials. – (1) Where the supplier or the owner has brought into use an electric supply line, other than an overhead line, which is not completely enclosed in a continuous metallic covering connected with earth and is insulated or protected in situ by composition or material of a bituminous character, –

(i) any pipe, conduit, or the like into which such electric supply line may have been drawn or placed shall, unless other arrangements are approved by the Electrical Inspector in any particular case, be effectively sealed at its point of entry into any street box so as to prevent any flow of gas to or from the street box; and

(ii) such electric supply line shall be periodically inspected and tested where accessible, and the result of each such inspection and test shall be duly recorded by the supplier or the owner.

(2) The supplier or the owner shall not bring into use any further electric supply line as aforesaid which is insulated or protected in situ by any composition or material known to be liable to produce noxious or explosive gases on excessive heating.

25. Street boxes. – (1) Street boxes shall not contain gas pipes, and precautions shall be taken to prevent, any influx of water or gas.

(2) Where electric supply lines forming part of different systems pass through the same street box, they shall be readily distinguishable from one another and all electric supply lines at or in street boxes shall be adequately supported and protected so as to prevent risk of damage to or danger from adjacent electric supply lines.

(3) All street boxes shall be regularly inspected for the purpose of detecting the presence of gas and if any influx or accumulation is discovered, the owner shall give immediate notice to the agency or company owning gas pipeline in the neighborhood of the street box and in cases where a street box is large enough to admit the entrance of a person therein have been placed in position, provision shall be made, -

(i) to ensure that any gas which may by accident have obtained access to the box shall escape before a person is allowed to enter and the box shall have provision for sufficient cross ventilation; and

(ii) for the prevention of danger from sparking.

(4) The owners of all street boxes or pillar boxes containing circuits or apparatus shall ensure that their covers and doors are kept closed and locked and are so provided that they can be opened only by means of a key or a special appliance.

(5) The street or pillar boxes shall be erected with the live parts at least 0.6 metre above the ground level or above the flood level of the local site condition, whichever is higher.

26. **Distinction of different circuits. –** The owner of every generating station, substation, junction box or pillar box in which there are any circuits or apparatus, whether intended for operation at different voltages or at the same voltage, shall ensure by means of indication of a permanent nature that the respective circuits are readily distinguishable from each other.

27. **Distinction of the installations having more than one feed. –** The owner of every installation including substation, double pole structure, four pole structure or any other structure having more than one feed, shall ensure by means of indication of a permanent nature, that the installation is readily distinguishable from other installations.

28. **Accidental charging. –** (1) The owners of all circuits and apparatus shall so arrange them that there shall be no danger of any part thereof becoming accidentally charged to any voltage beyond the limits of voltage for which they are intended.

(2) Where alternating current and direct current circuits are installed on the same box or support, they shall be so arranged and protected that they shall not come into contact with each other.

29. **Provisions applicable to protective equipment. –** (1) Fire buckets filled with clean dry sand and ready for immediate use for extinguishing fires, in addition to fire extinguishers suitable for dealing with fires, shall be conspicuously marked and kept in all generating stations, enclosed substations and enclosed switching-stations in convenient location.

(2) Appropriate type of fire extinguisher conforming to the relevant standards, shall be installed, maintained, periodically inspected and tested as per the relevant standards for extinguishing and controlling fire and record of such tests shall be maintained.

(3) Sufficient number of first-aid boxes or cupboards conspicuously marked and equipped with such contents as the State Government may specify or as per the relevant standards, shall be provided and maintained at appropriate locations in every generating station, enclosed substation, enclosed switching station and in vehicles used for maintenance of lines so as to be readily available and accessible at all the times and all such boxes and cupboards shall, except in the case of unattended substations and switching stations, be kept under the charge of responsible persons who are trained in first-aid treatment and one of such persons shall be available during working hours.

(4) Two or more gas masks shall be provided conspicuously and installed and maintained at accessible places in every generating station with capacity of five megawatt and above and enclosed substation with transformation capacity of five megavolt-ampere and above for use in the event of fire or smoke:

Provided that where more than one generator with capacity of five megawatt and above is installed in a power station, each generator shall be provided with at least two separate gas masks in an accessible and conspicuous place.

(5) In every generating station, substation or switching station, an artificial respirator, fire extinguishers, first-aid boxes and gas masks shall be provided and kept in good working condition and locations of the same shall be displayed in the control room and operator cabin.

(6) Address and contact number of the nearest Doctor, Hospital with a facility for first-aid treatment for electric shock and burns, ambulance service and fire service shall be prominently displayed near the electric shock treatment chart in control room and operator cabin.

30. **Display of instructions for resuscitation of persons suffering from electric shock. –** (1) 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 resuscitation of persons suffering from electric shock, shall be affixed by the owner in a conspicuous place in

every generating station, enclosed substation, enclosed switching station, mines and in every factory as defined in the Factory Act, 1948 (63 of 1952) in which electricity is used and in such other premises where electricity is used as the Electrical Inspector may, by notice in writing served on the owner, direct.

(2) The owner of every generating station, enclosed substation, enclosed switching station and every factory or other premises to which these regulations apply, shall ensure that all designated persons or persons engaged or appointed to operate and maintain electrical plants or transmission or distribution systems are acquainted with and are competent to apply the instructions referred to in sub-regulation (1).

31. Precautions to be adopted by consumers, owners, occupiers, electrical contractors, electrical workmen and suppliers. – (1) No electrical installation work, including additions, alterations, repairs and adjustments to existing installations, except such replacement of lamps, fans, fuses, switches, domestic appliances of voltage not exceeding 250 V and fittings as in no way alters its capacity or character, shall be carried out upon the premises of or on behalf of any consumer, supplier, owner or occupier for the purpose of supply to such consumer, supplier, owner or occupier except by an electrical contractor licenced in this behalf by the State Government and on its behalf under the direct supervision of a person holding a certificate of competency and by a person holding a permit issued or recognised by the State Government:

Provided that in the case of works executed for or on behalf of the Central Government and in the case of installations in mines, oil-fields and railways, the Central Government and in other cases the State Government, may, by notification in the Official Gazette, exempt on such conditions as it may impose, any such work described therein either generally or in the case of any specified class of consumers, suppliers, owners or occupiers:

Provided further that in the case of works executed for or on behalf of the Central Government and in the case of installations in mines, oil-fields and railways, an electrical contractor having licence issued by any State Government or Union Territory administration shall not require licence from other State Government in which the works are to be executed.

(2) No electrical installation work which has been carried out in contravention of sub-regulation (1) shall either be energised or connected to the works of any supplier.

32. Periodic inspection and testing of installations. – (1) The periodic inspection and testing of installation of voltage above the notified voltage belonging to the owner or supplier or consumer, as the case may be, shall be carried out by the Electrical Inspector:

Provided that the electrical installation below or equal to the notified voltage shall be self-certified by the owner or supplier or consumer, as the case may be.

(2) The periodicity of electrical inspection by the Electrical Inspector or the self-certification by the supplier, owner or consumer shall be as directed by the Appropriate Government:

Provided that the periodicity of electrical inspection and self-certification shall not exceed five years:

Provided further that in respect of the electrical installation belonging to mines, oil-fields and railways, such direction shall be issued by the Central Government.

(3) The periodic inspection and testing of installation of voltage equal to or below the notified voltage belonging to the owner or supplier or consumer, as the case may be, shall be carried out by the owner or supplier or consumer and shall be self-certified for ensuring observance of safety measures specified under these regulations and the owner

or supplier or consumer, as the case may be, shall submit the report of self-certification to the Electrical Inspector in the Form I or Form II or Form III or Form IV, as the case may be, of Schedule II:

Provided that the electrical installation so self-certified shall be considered as duly inspected and tested only after the report of self-certification is duly received by the office of Electrical Inspector and if not acknowledged by the Electrical Inspector within three working days, it shall be deemed to be received:

Provided further that the owner or supplier or consumer has the option to get his installation inspected and tested by the Electrical Inspector of the Appropriate Government.

(4) Notwithstanding anything contained in sub-regulation (3), every electrical installation covered under section 54 of the Act including every electrical installation of mines, oil-fields and railways shall be periodically inspected and tested by the Electrical Inspector of the Appropriate Government.

(5) Where the supplier is directed by the Central Government or the State Government, as the case may be, to inspect and test the installation, such supplier shall report on the condition of the installation to the consumer concerned in the Form I, Form II, Form III and Form IV as provided in Schedule II and shall submit a copy of such report to the Electrical Inspector.

(6) The Electrical Inspector may, on receipt of such report, accept the report submitted by the supplier or record variations as the circumstances of each case may require and may recommend that the defects may be rectified as per report.

(7) In the event of the failure of the owner of any installation to rectify the defects in his installation pointed out by the Electrical Inspector in his report and within the time indicated therein, such installation shall be liable to be disconnected under the directions of the Electrical Inspector after serving the owner of such installation with a notice for a period not less than forty eight hours:

Provided that the installation shall not be disconnected in case an appeal is made under sub section (2) of section 162 of the Act and appellate authority has stayed the orders of disconnection.

(8) It shall be the responsibility of the owner of all installations to maintain and operate the installations in a condition free from danger and as recommended by the manufacturer or by the relevant standards.

33. Testing of consumer's installation. – (1) Upon receipt of an application for a new or additional supply of electricity and before commencement of supply or recommencement of supply after the supply has been disconnected for a period of six months, the supplier shall either test the installation himself or accept the test results submitted by the consumer when same has been duly signed by the licenced electrical contractor:

Provided that in case of voltage level equal to or below the notified voltage, Chartered Electrical Safety Engineer can also test the installation on request of owner.

(2) The testing and verifications shall be carried out as per relevant standards.

(3) The testing equipment shall be calibrated by a Government authorised or National Accreditation Board for Testing and Calibration Laboratories accredited laboratory at periodical interval as per the periodicity specified by them.

(4) The supplier shall maintain a record of test results obtained at each supply point to a consumer, as per the forms provided in Schedule III.

(5) If as a result of such inspection and test, the supplier is satisfied that the installation

is likely to be dangerous, he shall serve on the applicant a notice in writing requiring him to make such modifications as are necessary to render the installation safe and may refuse to connect or reconnect the supply until the required modifications have been completed.

34. **Generating units required to be inspected by Electrical Inspector. –** The capacity above which generating units including generating units producing electricity from renewable sources of energy shall be required to be inspected by the Electrical Inspector before commissioning, shall be as per the notification issued by the Appropriate Government in this regard.

Chapter IV

General conditions relating to supply and use of electricity

35. **Precautions against leakage before connection. –** (1) The supplier shall not connect its works with the apparatus in the premises of any applicant seeking supply unless the supplier is satisfied that at the time of making the connection cause a leakage from that installation or apparatus of a magnitude detrimental to safety which shall be checked by measuring the installation's or apparatus‟ insulation resistance as stipulated in the relevant standards.

(2) If the supplier declines to make a connection under the provisions of sub-regulation (1) the supplier shall convey to the applicant the reasons thereof, in writing for so declining.

36. **Leakage on consumer's premises. –** (1) If the Electrical Inspector or the supplier has reasons to believe that there is leakage in the system of a consumer which is likely to affect injuriously the use of electricity by the consumer or by other persons, or which is likely to cause danger, he may give notice to the consumer in writing to inspect and test the consumer's installation.

(2) If after such notice, the consumer fails to provide access to its installation for inspection and testing, or an insulation resistance of the consumer's installation is so low as to prevent safe use of electricity, the supplier may, and if directed so by the Electrical Inspector shall discontinue the supply of electricity to the installation but only after giving to the consumer forty eight hours notice in writing for disconnection of supply and shall not recommence the supply until he or the Electrical Inspector is satisfied that the cause of the leakage has been removed.

37. **Supply and use of electricity. –** (1) The electricity shall not be supplied, transformed, converted, inverted or used or continued to be supplied, transformed, converted, inverted or used unless the conditions provided in sub- regulations (2) to (8) are complied with.

(2) The following controls of requisite capacity to carry and break the current shall be installed as near as possible after the point of commencement of supply so as to be readily accessible and capable of completely isolating the supply to the installation, such equipment being in addition to any control switch installed for controlling individual circuits or apparatus, namely: –

Supplied at voltage	Control
Below 11 kV.	Switch fuse unit or a circuit breaker by consumers.
11 kV and above.	A circuit breaker by consumers.

(3) In case of every transformer the following shall be provided, namely: –

(i) on primary side of transformer, a linked switch with fuse or gang operated air break switch with fuse or circuit breaker of adequate capacity:

Provided that the linked switch with fuse on the primary side of the transformer may be of such capacity as to carry the full load current and to break only the magnetising current of the transformer:

Provided further that for transformer having capacity of 1000 kVA and above, a circuit breaker shall be provided:

Provided also that the linked switch with fuse or gang operated air break switch with fuse or circuit breaker on the primary side of the transformer shall not be required for the unit auxiliary transformer and generator transformer;

(ii) on the secondary side of all transformers a circuit breaker of adequate rating shall be installed:

Provided that for supplier"s transformers of capacity below 1000 kVA, a linked switch with fuse or circuit breaker of adequate rating shall be installed on secondary side.

(4) Except in the case of composite control gear designed as a unit each distinct circuit is to be protected against excess energy by means of a suitable fuse link or a circuit breaker of adequate breaking capacity, suitably located and so constructed as to prevent danger from overheating, arcing or scattering of hot metal when it comes into operation and to permit for ready renewal of the fuse link without danger.

(5) The supply of electricity to each motor or a group of motors or other apparatus meant for operating one particular machine shall be controlled by a suitable linked switch or a circuit breaker or an emergency tripping device with manual reset of requisite capacity placed in such a position as to be adjacent to the motor or a group of motors or other apparatus readily accessible to and easily operated by the person incharge and so connected in the circuit that by its means all supply of electricity can be cut off from the motor or group of motors or apparatus from any regulating switch, resistance of other device associated therewith.

(6) All insulating materials shall be as per their applicaton and their mechanical strength shall be sufficient for the purpose so as to maintain adequately their insulating property under all working conditions in respect of temperature, moisture, salinity and pollution.

(7) Adequate precautions shall be taken to ensure that no live parts are exposed as to cause danger.

(8) Every consumer shall use all reasonable means to ensure that where electricity is supplied by the supplier, no person other than the supplier shall interfere with service lines and apparatus placed by the supplier on the premises of the consumer.

38. Provisions for supply and use of electricity in multi-storeyed building more than fifteen metre in height. –

(1) The connected load and voltage of supply above which inspection is to be carried out by an Electrical Inspector for a multi-storeyed building of more than fifteen metre height shall be notified by the Appropriate Government.

(2) Before making an application for commencement of supply or recommencement of supply after an installation has been disconnected for a period of six months or more, the owner or occupier of a multi-storeyed building shall give not less than thirty days notice in writing to the Electrical Inspector specifying therein the particulars of installation and the supply of electricity shall not be commenced or recommenced within this period, without the approval in writing of the Electrical Inspector.

(3) The following safety measures shall be provided in the multi-storeyed buildings of more than fifteen metre height and other premises such as airports, hospitals, hotels, places of entertainment, places of worship, cultural centers, stadium, academic

buildings, test labs, industrial installations, installation with explosive or flammable material, railway or metro stations and other public buildings, namely: –

(i) the supplier or owner of the installation shall provide at the point of commencement of supply a suitable isolating device with cut-out or breaker to operate on all phases except neutral in the three-phase, four-wire circuit and fixed in a conspicuous position at not more than 1.70 metre above the ground so as to completely isolate the supply to the building in case of emergency;

(ii) the owner or occupier of a multi-storeyed building shall ensure that electrical installations and works inside the building are carried out and maintained in such a manner as to prevent danger due to shock and fire hazards, and the installation is carried out as per the relevant standards;

(iii) no other service pipes and cables shall be taken through the ducts provided for laying of power cables and all ducts provided for power cables and other services shall be provided with fire barrier at each floor crossing;

(iv) the Fire Retardant Low Smoke and Low Halogen power cables shall be used in building of more than fifteen metre height as per relevant standards:

Provided that Halogen Free Flame Retardant power cables as per the relevant standards shall be used in airports, hospitals and hotels irrespective of height;

(v) distribution of electricity to the floors shall be done using bus bar trunking system;

(vi) lightning protection of the building shall be as per the relevant standards;

(vii) verification of electrical wiring of the building shall be carried out as per the relevant standards; and

(viii) electricity meter shall not be installed in the passage of staircase.

39. Conditions applicable to installations of voltage exceeding 250 Volts. – The following conditions shall be complied with where electricity of voltage above 250 V is supplied, converted, transformed or used, namely: –

(i) all conductors, other than those of overhead lines, shall be completely enclosed in mechanically strong metal casing or metallic covering which is electrically and mechanically continuous and adequately protected against mechanical damage unless the said conductors are accessible only to a designated person or are installed and protected so as to prevent danger:

Provided that non-metallic conduits conforming to the relevant standards may be used for installations of voltage not exceeding 650 V;

(ii) all metal works, enclosing, supporting or associated with the installation, other than that designed to serve as a conductor shall be connected with an earthing system as per relevant standards and the provisions of regulation 43;

(iii) every switch board shall comply with the following, namely: –

(a) a clear space of not less than one metre in width shall be provided in front of the switchboard;

(b) if there are any attachments or bare connections at the back of the switchboard, the space, if any, behind the switchboard shall be either less than twenty centimetre or more than seventy five centimetre in width, measured from the farthest protruding part of any attachment or conductor; and

(c) if the space behind the switchboard exceeds seventy five centimetre in width, there shall be a passage way from either end of the switchboard, clear to a height of 1.8 metre;

(iv) in case of installations provided in premises where inflammable materials including gases and chemicals are produced, handled or stored, the electrical installations, equipment and apparatus shall comply with the requirements of flame proof, dust tight, totally enclosed or any other suitable type of electrical fittings depending upon the hazardous zones as per the relevant standards;

(v) where an application has been made to a supplier for supply of electricity to any installation, the supplier shall not commence the supply or where the supply has been discontinued for a period of six months or more, recommence the supply unless the consumer has complied with the relevant provisions in these regulations;

(vi) where a supplier proposes to supply or use electricity at or to recommence supply of voltage exceeding 250 V but not exceeding 650 V after it has been discontinued for a period of six months, he shall, before connecting or reconnecting the supply, give notice in writing of such intention to the Electrical Inspector; and

(vii) if at any time after connecting the supply, the supplier is satisfied that any provision of these regulations have not been complied with, the supplier shall give notice of the same in writing to the consumer and the Electrical Inspector, specifying the defects and to rectify such defects in a reasonable time:

Provided that if the consumer fails to rectify such defects the supplier may discontinue the supply after giving the consumer a reasonable opportunity of being heard and recording reasons in writing and the supply shall be discontinued only on written orders of an officer duly notified by the supplier in this behalf and shall be restored with all possible speed after such defects are rectified by the consumer to the satisfaction of the supplier.

40. Appeal to Electrical Inspector in regard to defects. – (1) If any applicant for a supply or a consumer is aggrieved by the action of the supplier in declining to commence, to continue or to recommence the supply of electricity to his premises on the grounds that the installation is defective or is likely to be dangerous, he may appeal to the Electrical Inspector to test the installation and the supplier shall not, if the Electrical Inspector intimates that the installation is free from the defect or danger complained of, refuse supply to the consumer on the grounds aforesaid, and shall, within twenty four hours after the receipt of such intimation from the Electrical Inspector, commence, continue or recommence the supply of electricity.

(2) Any test for which application has been made under sub-regulation (1), shall be carried out within seven days after the receipt of such application.

41. Precautions against failure of supply and notice of failures. – (1) The layout of the electric supply lines of the supplier for the supply of electricity throughout his area of supply shall under normal working conditions be sectionalised and so arranged, and provided with switchgear or circuit-breakers, so located, as to restrict within reasonable limits the extent of the portion of the system affected by any failure of supply.

(2) The supplier shall take all reasonable precautions to avoid any accidental interruptions of supply, and also to avoid danger to the public or to any employee or designated person when engaged on any operation during and in connection with the installation, extension, replacement, repair and maintenance of any works.

(3) The supplier shall send to the Electrical Inspector a notice of failure of supply of such kind as the Electrical Inspector may from time to time require to be notified to him, and such notice shall be sent by the earliest mode of communication after the failure occurs or after the failure becomes known to the supplier and shall be in the Form given in Schedule IV.

(4) For the purpose of testing or for any other purpose connected with the efficient working of the supplier‟s installations, the supply of electricity may be discontinued by

the supplier for such period as may be necessary, subject to not less than twenty four hours notice being given by the supplier to all consumers likely to be affected by such discontinuance:

Provided that no such notice shall be given in cases of emergency.

Chapter V

Safety provisions for electrical installations and apparatus of voltage not exceeding 650 V

42. Test of insulation resistance. – Where any electric supply line for use at voltages not exceeding 650 V has been disconnected from a system for the purpose of addition, alteration or repair, such electric supply line shall not be reconnected to the system until the supplier or the owner has carried out the test.

43. Connection with earth. – The following conditions shall apply to the connection with earth of systems at voltage exceeding 50 V but not exceeding 650 V, namely: –

(i) neutral conductor of a three phase, four-wire system and the middle conductor of a two-phase, three-wire system shall be earthed as per the relevant standards;

(ii) neutral conductor shall also be earthed at one or more points along the distribution system or service line in addition to any connection with earth which shall be at the consumer's premises;

(iii) in the case of a system comprising electric supply lines having concentric cables, the external conductor or armour of such cables shall be earthed by two separate and distinct connections with earthing system;

(iv) in a direct current system, earthing and safety measures shall be as per the relevant standards;

(v) every building shall have protective equipotential bonding by interconnecting the exposed and extraneous conductive parts as per the relevant standards;

(vi) the alternating current systems which are connected with the earth as provided in this regulation shall be electrically interconnected:

Provided that each connection with the earth is bonded to the metal sheathing and metallic armouring, if any, of the electric supply lines;

(vii) the frame of every generator, stationary motor, portable motor, and the metallic parts, not intended as conductors, all transformers and any other apparatus used for regulating or controlling electricity, and all electricity consuming apparatus, of voltage exceeding 250 V but not exceeding 650 V shall be earthed by two separate and distinct connections with earth by the owner as specified in the relevant standards;

(viii) all metal casing or metallic coverings containing or protecting any electric supply line or apparatus shall be connected with the earth and shall be so joined and connected across all junction boxes and other openings as to provide good mechanical and electrical connection throughout the length:

Provided that the conditions mentioned in this regulation shall not apply, where the supply voltage does not exceed 250 V and the apparatus consists of wall tubes or brackets, electroliers, switches, ceiling fans or other fittings, other than portable hand lamps and portable and transportable apparatus, unless provided with the earth terminal and to class-II apparatus and appliances of the relevant standards:

Provided further that where the supply voltage is not exceeding 250 V and where the installations are either new or renovated, all plug sockets shall be of the three pin type, and the third pin shall be permanently and effectively earthed;

(ix) All earthing systems shall, –

(a) consist of equipotential bonding conductors capable of carrying the prospective earth fault current without exceeding the allowable temperature limits as per relevant standards in order to maintain all non- current carrying metal works reasonably at earth potential and to avoid dangerous contact potentials being developed on such metal works;

(b) have earth fault loop impedance sufficiently low to permit adequate fault current for the operation of protective device within the time stipulated in the relevant standards; and

(c) be mechanically strong, withstand corrosion and retain electrical continuity during the life of the installation and all earthing systems shall be tested to ensure effective earth bonding as per the relevant standards, before the electric supply lines or apparatus are energised;

(x) all earthing systems belonging to the supplier shall in addition, be tested for resistance on dry day during the dry season at least once in a year;

(xi) earth fault loop impedance shall be tested to ensure the automatic operation of the protective device and a record of every earth test made and the result thereof shall be kept by the supplier for a period of not less than two years after the day of testing and shall be available to the Electrical Inspector when required;

(xii) earth fault loop impedance of each circuit shall be limited to a value determined by the type and current rating of the protective device used such that, on the occurrence of an earth fault, disconnection of the supply shall occur before the prospective touch voltage reaches a harmful value; and

(xiii) the neutral point of every generator and transformer shall be earthed by connecting it to the earthing system not by less than two separate and distinct connections.

44. Residual Current Device. – The use of electricity to electrical installation, shall be controlled by a residual current device to disconnect the supply having rated residual current and duration as per the relevant standards:

Provided that in domestic installation, residual current device having residual operating current not exceeding 30 milliampere shall be used:

Provided further that such protective device shall not be required for supply lines having protective devices which are effectively bonded to the neutral of supply transformers and conforming to regulation 76.

Chapter VI

Safety provisions for electrical installations and apparatus of voltage exceeding 650 V

45. Approval by the Electrical Inspector and self-certification. – (1) (a) Every electrical installation of notified voltage and below shall be inspected, tested and self-certified by the owner or supplier or consumer, as the case may be, of the installation before commencement of supply or recommencement after shutdown for six months or more for ensuring observance of safety measures specified under these regulations and such owner or supplier or consumer, as the case may be, shall submit the report of self-certification to the Electrical Inspector in the forms as provided under Schedule II of these regulations:

Provided that the self-certified electrical installation shall be considered fit for the commencement of supply or recommencement after shutdown for six months only after the report of self-certification is duly received by the office of Electrical Inspector and if not acknowledged by the Electrical Inspector within three working days, it shall be deemed to be received:

Provided further that the owner or supplier or consumer, as the case may be, has the option to get his installation inspected and tested by the Electrical Inspector of the Appropriate Government;

(b) Notwithstanding anything contained in clause (a), every electrical installation covered under section 54 of the Act including every electrical installation of railways shall be inspected and tested by the Electrical Inspector of the Appropriate Government as specified in sub-regulation (3).

(2) The voltage above which inspection and testing of electrical installations including installations of supplier or consumer to be carried out by the Electrical Inspector, shall be notified by the Appropriate Government;

(3) Every electrical installation of voltage above the notified voltage and all the apparatus of the generating units above the capacity specified under regulation 34, shall be inspected and tested by the Electrical Inspector before commencement of supply or recommencement after shutdown for six months or more for ensuring observance of safety measures specified under these regulations.

(4) Before making an application to the Electrical Inspector for permission to commence or recommence supply in installations above the notified voltage after an installation has been disconnected for six months or more, the supplier shall ensure that electric supply lines or apparatus of more than notified voltage belonging to him are placed in position, properly joined, and duly completed and examined, and the supply of electricity shall not be commenced by the supplier for installations of voltage needing inspection under these regulations unless the provisions of regulations 14 to 31, regulations 35 to 37, regulations 46 to 53 and regulations 57 to 80 have been complied with and the approval in writing of the Electrical Inspector has been obtained by him:

Provided that the supplier may energise the aforesaid electric supply lines or apparatus for the purpose of tests specified in regulation 48.

(5) The owner of any installations of voltage above the notified voltage shall, before making application to the Electrical Inspector for approval of his installation or additions thereto, test every circuit or additions thereto, other than an overhead line, and satisfy himself that they withstand the application of the testing voltage set out in regulation 48 and shall duly record the results of such tests and submit them to the Electrical Inspector:

Provided that the Electrical Inspector may direct such owner to carry out such tests, as he deems necessary or accept the certified tests of the manufacturer in respect of any particular apparatus in place of the tests required by this regulation.

(6) The owner of any installation who makes any addition or alteration to his installation shall not connect to the supply his apparatus or electric supply lines, comprising the said alterations or additions, unless and until such alteration or addition has been approved in writing by the Electrical Inspector or self-certified by the owner of the installation, as the case may be.

(7) In case of installations of mines and oil-fields, the electrical installations of voltage 650 V and above shall not be connected to supply, unless and until such installation work including alterations or additions or recommencement after shutdown for six months are approved in writing by the Electrical Inspector of Mines:

Provided that the electrical installations of voltage below 650 V in mines and oil-fields are to be self- certified by the owner or agent or manager of the mine before commencement of supply or recommencement after shutdown for six months or more in the manner specified in sub-regulation (1).

46. Use of electricity at voltage exceeding 650 V. – (1) The Electrical Inspector where the supply voltage exceeds the notified voltage shall not authorise the supplier to commence supply or recommence the supply, where the supply has been discontinued for a period of six months or more, or the supplier, where the supply voltage is equal to or below the notified voltage but exceeds 650 V, shall not commence supply or recommence the supply where supply has been discontinued for a period of six months or more, to any consumer unless, –

(a) all conductors and apparatus situated on the premises of the consumer are so placed as to be inaccessible except to the designated person;

(b) the consumer has provided and agreed to maintain a separate building or a locked weather proof and fire proof enclosure of agreed design and location, to which the supplier at all times shall have access for the purpose of housing his apparatus and metering equipment, or where the provision for a separate building or enclosure is impracticable, the consumer has segregated the aforesaid apparatus of the supplier from any other part of his own apparatus:

Provided that the segregation shall be made by the fire walls, if the Electrical Inspector considers it to be necessary:

Provided further that in the case of an outdoor installation the consumer shall suitably segregate the aforesaid apparatus belonging to the supplier from his own;

(c) all pole type substations are constructed and maintained in accordance with regulation 52.

(2) Where electricity at voltage exceeding 650 V is supplied, converted, transformed or used, the owner shall,–

(i) maintain safety clearances for electrical apparatus as per relevant standards specification so that sufficient space is available for easy operation and maintenance without any hazard to the operating and maintenance personnel working near the equipment and for ensuring adequate ventilation:

Provided that in case of mines, the safety clearances for electrical apparatus to be as per relevant mining regulations;

(ii) not allow any encroachment below such installation:

Provided that where the Electrical Inspector comes across any such encroachment, he shall direct the owner to remove such encroachments;

(iii) maintain minimum safety working clearances specified in Schedule V for the bare conductors or live parts of any apparatus in outdoor substations excluding overhead lines of installations of voltage exceeding 650 V;

(iv) ensure that the live parts of all apparatus within the reach from any position in which a person may require to be, are suitably protected to prevent danger;

(v) ensure that where the transformer is used, suitable provision shall be made, either by connecting with earth, a point of the circuit at the lower voltage or otherwise, to guard against danger by reason of the said circuit becoming accidentally charged above its normal voltage by leakage from or contact with the circuit at the higher voltage;

(vi) not install a substation or a switching station with apparatus having more than 2000 litre of oil in the basement where proper oil draining arrangement cannot be provided;

(vii) undertake the following measures, where a substation or a switching station with oil-filled apparatus, such as transformer, static condenser, switchgear or oil circuit breaker having more than 2000 litre of oil is installed, whether indoor or outdoors,-

(a) the separation wall or fire barrier walls of thickness and dimensions as specified in the relevant standards shall be provided between the apparatuses and between the apparatus and adjacent building if building wall adjacent to the apparatuses is not rated for four hours fire withstand rating;

(b) provisions shall be made for suitable oil soakpit and where use of more than 9000 litre of oil in any one oil tank, receptacle or chamber is involved, provision shall be made for the draining away or removal of any oil which may leak or escape from the tank, receptacle or chamber containing the same, 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; and

(d) all the transformers and switchgears shall be maintained in accordance with the maintenance schedules prepared in accordance with the relevant standards;

(viii) without prejudice to the above measures, undertake adequate fire detection and protection arrangement for quenching the fire of the apparatus;

(ix) ensure that every transformer of 10 MVA or reactor of 10 MVAR and above rating shall be provided with automatic fire fighting system as per relevant standards;

(x) undertake the following measures, where it is necessary to locate the substation, or switching station in the basement, namely: –

(a) the transformer room be in the first basement at the periphery;

(b) the direct access to the transformer room be provided from outside and the surrounding walls of four hours fire withstand rating be provided as per relevant standards;

(c) the entrances to the transformer room be provided with fire resistant doors of two hour fire rating and the door shall always be kept closed and a notice of this effect be affixed on outer side of the door;

(d) a curb of a suitable height be provided at the entrance in order to prevent the flow of oil from a ruptured transformer into other parts of the basement;

(e) the cables to primary side and secondary side have sealing at all floors and wall opening of atleast two hours fire withstand rating; and

(f) Fire Retardant Low Smoke Low Halogen cable as per relevant standards be used;

(xi) ensure that oil filled transformers installed indoors in other than residential or commercial buildings are placed on the ground floor or not below the first basement;

(xii) ensure that only dry type transformer shall be used inside the residential and commercial buildings;

(xiii) ensure that cable trenches inside the substations and switching stations containing cables are filled with sand, pebbles or similar non-inflammable materials or completely covered with non-inflammable slabs; and

(xiv) ensure that unless the conditions are such that all the conductors and apparatus may be made dead at the same time for the purpose of cleaning or for other work, the said conductors and apparatus shall be so arranged that these may be made dead in sections, and that work on any such section may be carried on by the person designated or appointed or engaged or permited under these regulations without danger.

(3) The minimum clearances specified in Schedule VI shall be maintained for bare conductors or live parts of any high voltage direct current apparatus in outdoor substations, excluding high voltage direct current overhead lines.

(4) There shall not be tapping of another transmission line from the main line for 66 kV and above class of lines:

Provided that during natural calamities, tapping may be allowed to ensure emergency power supply to affected areas till normalcy is restored.

47. Inter-locks and protection for use of electricity at voltage exceeding 650 V. – (1) The owner shall ensure the following, namely: –

(i) isolators and the controlling circuit breakers shall be inter-locked so that the isolators cannot be operated unless the corresponding breaker is in open position;

(ii) isolators and the corresponding earthing switches shall be inter-locked so that no earthing switch can be closed unless and until the corresponding isolator is in open position;

(iii) 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 inter-locked to prevent possibility of any inadvertent paralleling or backfeed;

(iv) when two or more transformers are operated in parallel, the system shall be so arranged as to trip the secondary breaker of the transformer in case the primary breaker of that transformer trips;

(v) all gates or doors which provide access to live parts of an installation shall be inter-locked in such a way that these cannot be opened unless the live parts are made dead and proper discharging and earthing of these parts shall be ensured before any person comes in close proximity of such parts; and

(vi) where two or more generators operate in parallel and neutral switching is adopted, inter-lock shall be provided to ensure that the generator breaker cannot be closed unless one of the neutrals is connected to the earthing system.

(2) The following protection shall be provided in all systems and circuits to automatically disconnect the supply under abnormal conditions, namely: –

(i) over current protection 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;

(ii) 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 values;

(iii) buchholz relay, pressure relief device and winding and oil temperature protection with alarm and trip contacts shall be provided on all transformers of ratings 1000 kVA and above;

(iv) transformers of capacity 10 MVA and above shall be protected against incipient faults by differential protection;

(v) all generators with rating of 100 kVA and above shall be protected against earth fault or leakage;

(vi) all generators of rating 1000 kVA and above shall be protected against faults within the generator winding using restricted earth fault protection or differential protection or by both;

(vii) high speed bus bar differential protection along with local breaker back up protection shall be commissioned and shall always be available at all 132 kV and above voltage substations and switching stations and generating stations connected with the grid:

Provided that in respect of existing 132 kV substations and switching stations having more than one incoming feeders, the high speed bus bar differential protection along with local breaker back up protection, shall be commissioned and shall always be available; and

(viii) in addition to above, all electrical protection system for generating stations, substations and transmission lines shall be as per the regulations notified by the Authority under clause (e) of sub-section (2) of section 177 of the Act.

48. Testing, Operation and Maintenance. – (1) Before the approval is accorded by the Electrical Inspector under regulation 45, the manufacturer's test certificates shall, if required, be produced for all the type, acceptance and routine tests as required under the relevant standards.

(2) No new apparatus, cable or supply line of voltage exceeding 650 V shall be commissioned unless such apparatus, cable or supply line are subjected to site tests as per relevant standards.

(3) No apparatus, cable or supply line of voltage exceeding 650 V which has been kept disconnected for a period of six months or more from the system for alterations or repair, shall be connected to the system until such apparatus, cable or supply line are subjected to the site tests as per relevant standards.

(4) Notwithstanding the provisions of this regulation, the Electrical Inspector may require certain tests to be carried out before or after charging the installations.

(5) All apparatus, cables and supply lines shall be maintained in healthy conditions and tests shall be carried out periodically as per the relevant standards.

(6) Records of all tests, trippings, maintenance works and repairs of all apparatus, cables and supply lines shall be duly kept in such a way that these records can be compared with the past records.

(7) It shall be the responsibility of the owner of all installations of voltage exceeding 650 V to maintain and operate the installations in a condition free from danger and as recommended by the manufacturer or by the relevant standards.

(8) Failures of any 220 kV and above voltage level transformer, reactor and transmission line towers shall be reported by the owner of electrical installation, within forty eight hours of the occurrence of the failure, to the Authority and the reasons for failure and measures to be taken to avoid recurrence of failure shall be sent to the Authority within one month of the occurrence in the forms provided in Schedule VII:

Provided that in case of mines and oil-fields, the failure of 10 MVA or above transformers shall be reported to Electrical Inspector of mines.

49. Precautions to be taken against excess leakage in case of metal sheathed electric supply lines. – The following precautions shall be taken in case of electric supply lines other than overhead lines, for use at voltage exceeding 650 V, namely: –

(i) the conductors of the cable except the cable with thermoplastic or cross linked polyethylene, insulation without any metallic screen or armour shall be enclosed in metal sheathing which shall be electrically continuous and connected with earth, and the conductivity of the metal sheathing shall be maintained and reasonable precautions shall be taken where necessary to avoid corrosion of the sheathing;

(ii) the resistance of the earth connection with metallic sheath shall be kept low enough to permit the controlling circuit breaker or cut-out to operate in the event of any failure of insulation between the metallic sheath and the conductor.

Explanation. – For the purposes of this regulation;

(a) in the case of thermoplastic insulated and sheathed cables with metallic armour, the metallic wire or tape armour shall be considered as metal sheathing; and

(b) where an electric supply line as aforesaid has concentric cables and the external conductor is insulated from an outer metal sheathing and connected with earth, the external conductor may be regarded as the metal sheathing for the purposes of this regulation provided that the foregoing provisions as to conductivity are complied with.

50. Connection with earth for apparatus exceeding 650 V. – (1) The entire switchyard or substation equipment and buildings including all non-current carrying metal parts associated with an installation shall be effectively earthed to an earthing system or mat which shall, –

(i) limit the touch and step potential to tolerable values as per relevant standards;

(ii) limit the earth potential rise to tolerable values as per relevant standards, so as to prevent danger due to transfer of potential through ground, earth wires, cable sheath, fences, pipe lines or other such equipment; and

(iii) maintain the resistance of the earth connection to such a value as to make operation of the protective device effective.

(2) In the case of star connected system with earthed neutrals or delta connected system with earthed artificial neutral point,-

(i) the neutral point of every generator and transformer shall be earthed by connecting it to the earthing system not by less than two separate and distinct connections:

Provided that the neutral point of a generator may be connected to the earthing system through an impedance to limit the fault current:

Provided further that in the case of multi-machine systems, neutral switching may be resorted to, for limiting the injurious effect of harmonic current circulation in the system;

(ii) the generator or transformer neutral shall be earthed through a suitable impedance where an appreciable harmonic current flowing in the neutral connection causes interference with the communication circuits; and

(iii) in case of the delta connected system, the neutral point shall be obtained by the insertion of a earthing transformer and current limiting resistance or impedance wherever considered necessary at the commencement of such a system.

(3) In case of generating stations, substations and other installations of voltage exceeding 33 kV, the system neutral earthing and protective frame earthing may be, if system design so warrants, integrated into common earthing grid provided the resistance to earth of combined mat does not cause the step and touch potential to exceed the values as per relevant standards.

(4) Single phase systems of voltage exceeding 650 V shall be effectively earthed.

(5) In the case of a system comprising electric supply lines having concentric cables, the external conductor shall be connected with the earth.

(6) Where a supplier proposes to connect with earth an existing system for use at voltage exceeding 650 V which has not hitherto been so connected with earth, he shall give not less than fourteen days notice in writing together with particulars of the proposed connection with earth to the telegraph authority established under the Indian Telegraph Act, 1885 (13 of 1885).

(7) Where the earthing lead and earth connection are used only in connection with earthing guards laid under overhead lines of voltage exceeding 650 V but not exceeding 33 kV where they cross a telecommunication line or a railway line, and where such lines are equipped with earth leakage protective device, the earth resistance shall not exceed twenty five ohms and the project authorities shall obtain no objection certificate from Railway Authorities and Power and Telecommunication Coordination Committee before energisation of the facilities.

(8) Every earthing system belonging to either the supplier or the consumer shall be tested for its resistance to earth on a dry day during dry season not less than once in a year and records of such tests shall be maintained and produced, if so required, before the Electrical Inspector.

51. General conditions for transformation and control of electricity. – Where electricity of voltage exceeding 650 V is transformed, converted, regulated or otherwise controlled in substations or switching stations including outdoor substations and outdoor switching stations or in street boxes constructed underground, the following provisions shall be ensured, namely: –

(i) substations and switching stations shall preferably be erected above ground, but where necessarily constructed underground due provisions for ventilation and drainage shall be made and any space housing switchgear shall not be used for storage of any materials especially inflammable and combustible materials or refuse; and

(ii) (a) outdoor substations except pole type substations and outdoor switching stations shall, unless the apparatus is completely enclosed in a metal covering connected with earth, the said apparatus also being connected with the system by armoured cables, be protected by fencing not less than 1.8 metre in height or other means so as to prevent access to the electric supply lines and apparatus therein by an unauthorised person and the fencing of such area shall be earthed efficiently; and

(b) transformer mounting structure shall be as per the regulations notified by the Authority under clause (e) of sub-section (2) of section 177 of the Act.

52. Pole type substations. – Where platform type construction is used for a pole type substation and sufficient space for a person to stand on the platform is provided, a proper hand rail shall be built around the platform and if the hand rail is of metal, it shall be connected with the earth:

Provided that in the case of pole type substation on wooden supports and wooden platform, the metal hand rail shall not be connected with the earth.

53. Condensers. – Suitable arrangement shall be made for immediate and automatic or manual discharge of every static condenser on disconnection of supply.

54. Supply to luminous tube sign installations of voltage exceeding 650 V but not exceeding 33 kV. – (1) Any person who proposes to use or who is using electricity for the purpose of operating a luminous tube sign installation, or who proposes to transform or is transforming electricity to a voltage exceeding 650 V but not exceeding 33 kV for any such purpose shall comply with the following conditions, namely: –

(i) all live parts of the installation, including all apparatus and live conductors in the secondary circuit, but excluding the tubes except in the neighbourhood of their terminals, shall be inaccessible to undesignated persons and such parts shall be effectively screened;

(ii) irrespective of the method of obtaining the voltage of the circuit which feeds the luminous discharge tube sign, no part of any conductor of such circuit shall be in metallic connection, except in respect of its connection with earth, with any conductor of the supply system or with the primary winding of the transformer;

(iii) all live parts of an exterior installation shall be so disposed as to protect them against the effects of the weather and such installation shall be so arranged and separated from the surroundings as to limit, as far as possible, the spreading of fire;

(iv) the secondary circuit shall be permanently earthed at the transformer and the core of every transformer shall be earthed;

(v) where the conductors of the primary circuit are not in metallic connection with the supply conductors, one phase of such primary circuit shall be permanently earthed at the motor generator or convertor, or at the transformer and an earth leakage circuit breaker of sufficient rating shall be provided on the side of voltage not exceeding 250 V to detect the leakage in such luminous tube sign installations;

(vi) a sub-circuit which forms the primary circuit of a fixed luminous discharge tube sign installation shall be reserved solely for such purpose;

(vii) a separate primary final sub-circuit shall be provided for each transformer or each group of transformers having an aggregate input not exceeding 1000 volt-amperes of a fixed luminous discharge tube sign installation;

(viii) an interior installation shall be provided with suitable adjacent means for disconnecting all phases of the supply except the “neutral” in a three-phase, four-wire circuit;

(ix) for installations on the exterior of a building a suitable emergency fire-proof linked switch to operate on all phases except the neutral in a three-phase, four-wire circuit shall be provided and fixed in a conspicuous position at not more than 1.70 metre above the ground;

(x) a special “caution” notice shall be affixed in a conspicuous place on the door of every enclosure of voltage exceeding 650 V but not exceeding 33 kV to the effect that the supply must be cut off before the enclosure is opened;

(xi) where static condensers are used, they shall be installed on the load side of the fuses and the primary side of the transformers where the voltage does not exceed 250 V;

(xii) where static condensers are used on primary side, provision shall be made for automatic or manual discharging of the condensers when the supply is cut off; and

(xiii) before using the static condensers or any interrupting device on the voltage exceeding 650 V, the executing agencies shall test and ensure that automatic discharging device is functional thereon.

(2) The owner or user of any luminous tube sign or similar installation of voltage exceeding 650 V but not exceeding 33 kV shall not bring the same into use without giving to the Electrical Inspector not less than fourteen days‟ notice in writing of his intention so to do.

55. Supply to electrode boilers of voltage exceeding 650 V but not exceeding 33 kV. – (1) Where a system having a point connected with earth is used for supply of electricity to an electrode boiler of voltage exceeding 650 V which is also connected with earth, the owner or user of electrode boiler shall comply with the following conditions, namely: –

(i) the metal work of the electrode boiler shall be efficiently connected to the metal sheathing and metallic armouring, if any, of the electric supply line of voltage exceeding 650 V but not exceeding 33 kV whereby electricity is supplied to the electrode boiler;

(ii) the supply of electricity at voltage exceeding 650 V to the electrode boiler shall be controlled by a suitable circuit-breaker so set as to operate in the event of the phase currents becoming unbalanced to the extent of ten per cent of the rated current consumption of the electrode boiler under normal conditions of operation:

Provided that if in any case a higher setting is essential to ensure stability of operation of the electrode boiler, the setting may be increased so as not to exceed fifteen per cent of the rated current consumption of the electrode boiler under normal conditions of operation;

(iii) an inverse time element device may be used in conjunction with the aforesaid circuit breaker to prevent the operation thereof unnecessarily on the occurrence of unbalanced phase currents of momentary or short duration; and

(iv) the supplier or owner shall serve a notice in writing on the telegraph authority at least seven days prior to the date on which such supply of electricity is to be afforded specifying the location of every point, including the earth connection of the electrode boiler, at which the system is connected with earth.

(2) The owner or user of any electrode boiler of voltage exceeding 650 V shall not bring the same into use without giving the Electrical Inspector not less than fourteen days" notice in writing of his intention so to do.

56. Supply to X-ray and high frequency installations. – (1) Any person, who proposes to use or who is using electricity for the purpose of operating an X-ray or similar high-frequency installation, other than portable units or shock-proof self contained and stationary units shall comply the following conditions, namely: –

(i) mechanical barriers shall be provided to prevent too close an approach to any parts of the X-ray apparatus of voltage exceeding 650 V but not exceeding 33 kV, except the X-ray tube and its leads, unless such parts of voltage exceeding 650 V but not exceeding 33 kV have been rendered shock proof by being shielded by earthed metal or adequate insulating material;

(ii) where generators operating at 300 kV peak or more are used, such generators shall be installed in rooms separate from those containing the other equipment and any step-up transformer employed shall be so installed and protected as to prevent danger;

(iii) a suitable switch shall be provided to control the circuit supplying a generator and shall be so arranged as to be open except while the door of the room housing the generator is locked from the outside;

(iv) X-ray tubes used in therapy shall be mounted in an earthed metal enclosure; and

(v) every X-ray machine shall be provided with a milliammeter or other suitable measuring instrument, readily visible from the control position and connected, if practicable, in the earthed lead, but guarded if connected in the lead of voltage exceeding 650 V but not exceeding 33 kV:

Provided that earth leakage circuit breaker of sufficient rating shall be provided on the side wherein voltage does not exceed 250 V to detect the leakage in such X-ray installations.

Explanation. – For the purposes of this regulation "shock proof", as applied to X-ray and high-frequency equipment, shall mean that such equipment is guarded with earthed metal so that no person may come into contact with any live part.

(2) In the case of nonshock proof equipment.-

(i) the overhead conductors of voltage exceeding 650 V but not exceeding 33 kV, unless suitably guarded against personal contact, shall be adequately spaced and high voltage leads on tilting tables and fluoroscopes shall be adequately insulated or so surrounded by barriers as to prevent inadvertent contact;

(ii) the circuit of voltage not exceeding 250 V of the step up transformer shall contain a manually operated control device having overload protection, in addition to the over current device for circuit protection, and these devices shall have no exposed live parts and for diagnostic work there shall be an additional switch in the said circuit, which shall be of one of the following types:-

(a) a switch with a spring or other mechanism that will open automatically except while held close by the operator; or

(b) a time switch which will open automatically after a definite period of time for which it has been set;

(iii) if more than one piece of apparatus be operated from the same source of voltage exceeding 650 V, each shall be provided with a switch of voltage exceeding 650 V to give independent control;

(iv) low frequency current-carrying parts of a machine of the quenched-gap or open gap type shall be so insulated or guarded that they cannot be touched during operation but the high frequency circuit- proper which delivers high-frequency current normally for the therapeutic purposes shall be exempt from such insulation;

(v) all X-ray generators having capacitors shall have suitable means for discharging the capacitors manually; and

(vi) except in the case of self-contained units, all 200 kV peak or higher X-ray generators shall have a sphere gap installed in the system of voltage exceeding 650 V but not exceeding 33 kV adjusted so that it will break down on over voltage surges.

(3) (i) all non-current carrying metal parts of tube stands, fluoroscopes and other apparatus shall be properly earthed and insulating floors, mats or platforms shall be provided for operators in proximity to parts of voltage exceeding 650 V unless such parts have been rendered shock proof; and

(ii) where short wave therapy machines are used, the treatment tables and examining chairs shall be wholly non-metallic.

(4) The owner of any X-ray installation or similar high frequency apparatus shall not bring the same into use without giving to the Electrical Inspector not less than fourteen days" notice in writing of his intention to do so:

Provided that the aforesaid notice shall not be necessary in the case of shock-proof portable X-ray and high-frequency equipment which have been inspected before the commencement of their use and periodically thereafter.

Chapter VII

Safety requirements for overhead lines and underground cables

57. Material and strength. – (1) All conductors of overhead lines other than those provided in regulation 70 shall have a breaking strength of not less than 350 kgf.

(2) Where the voltage does not exceed 250 V and the span is less than fifteen metre and is drawn through the owner's or consumer's premises, a conductor having an actual breaking strength of not less than 150 kgf may be used.

58. Joints. – (1) No conductor or earthwire of an overhead line shall have more than one joint in a span:

Provided that there shall be no joints in the conductor or earthwire in a span of crossing over the highways, expressways and railway lines.

(2) The joint between conductors or earthwires of overhead lines shall be mechanically and electrically secured under the conditions of operation and the ultimate strength and the electrical conductivity of the joint shall be as per relevant standards.

59. Maximum stresses and factors of safety. – (1) The load and permissible stresses on the structural members, conductors and earth wire of self supporting steel lattice towers or steel monopole towers for overhead transmission lines shall be as per relevant standards.

(2) Overhead lines not covered in sub-regulation (1) shall have the minimum factors of safety as per the table given below:-

Description	Minimum factor of safety
metal supports	1.5
mechanically processed concrete supports	2.0
hand-moulded concrete supports	2.5
wood supports	3.0

(3) The minimum factor of safety shall be based on such load as may cause failure of the support to perform its function, assuming that the foundation and other components of the structure are intact.

(4) The load shall be equivalent to the yield point stress or the modulus of rupture, as the case may be, for supports subject to bending and vertical loads and the crippling load for supports used as strut.

(5) The strength of the supports of the overhead lines in the direction of the line shall not be less than one-fourth of the strength required in the direction transverse to the line.

(6) The minimum factor of safety for stay-wires, guard-wires or bearer-wires shall be 2.5 based on the ultimate tensile strength of the wire.

(7) The tension limit for conductor and earth wire shall be as per relevant standards.

(8) For the purpose of calculating the factors of safety in sub-regulation (2), the following conditions shall be observed, namely: –

(i) the maximum wind pressure shall be as specified in the relevant standards;

(ii) for cylindrical bodies the effective area shall be taken as full projected area exposed to wind pressure; and

(iii) the maximum and minimum temperatures shall be as specified in the relevant standards.

(9) Notwithstanding anything contained in sub-regulation (2) to (8), in localities where overhead lines are likely to accumulate ice or snow, the load and permissible stresses on the structural members, conductors and earth wire of self supporting steel lattice towers

and steel monopole towers for overhead transmission lines shall be as per relevant standards and in accordance with the specifications laid down, from time to time, by the Appropriate Government by order in writing.

60. Clearance in air of the lowest conductor of overhead lines. – (1) The minimum clearance above ground and across road surface of National Highway or Expressway or State Highway or other road or highest traction conductor of railway corridor or navigational or non-navigational river of the lowest conductor of an alternating current overhead line, including service lines, of nominal voltage shall have the values specified in Schedule VIII A.

(2) The minimum clearances regarding high voltage direct current line shall be as per Schedule VIII B.

(3) In case of Electric lines of 33 kV and below passing through the protected areas (National Parks, Wildlife Sanctuaries, Conservation Reserves, Community Reserves), Eco-sensitive zones around the protected areas and Wildlife Corridors, only underground cable shall be used.

(4) No tower footing or structure of an overhead line of voltage 33 kV or above or high voltage direct current, shall be closer than twenty five metre from the edge of the right of way of a Petroleum or Natural Gas pipeline.

(5) Wherever overhead line of voltage 33 kV or above or high voltage direct current intending to cross the right of way of a Petroleum or Natural Gas pipeline, the angle of crossing of the overhead line with respect to the pipelines shall preferably be at right angles and, in any case, the crossing angle shall not be less than seventy five degrees.

61. Clearance between conductors and trolley wires. – (1) No conductor of an overhead line crossing a tramway or trolley bus route using trolley wires shall have less than the following clearances above any trolley wire, namely: –

(i) lines of voltage not exceeding 650 V - 1.2 metre:

Provided that where an insulated conductor suspended from a bearer wire crosses over a trolley wire the minimum clearance for such insulated conductor shall be 0.6 metre.

(ii) lines of voltage exceeding 650 V up to and including 11000 V - 1.8 metre;

(iii) lines of voltage exceeding 11000 V but not exceeding 33000 V - 2.5 metre;

(iv) lines of voltage exceeding 33 kV - 3.0 metre.

(2) In any case of a crossing specified in sub-regulation (1), whoever lays his overhead line later, shall provide the clearance between his own overhead line and the overhead line which will be crossed in accordance with the provisions of the sub-regulation (1):

Provided that if the later entrant is the owner of the lower overhead line and is not able to provide adequate clearance, he shall bear the cost for modification of the upper line so as to comply with sub-regulation (1).

62. Clearance from buildings of lines of voltage and service lines not exceeding 650 V. – (1) An overhead line shall not cross over an existing building as far as possible and no building shall be constructed under an existing overhead line.

(2) Where an overhead line of voltage not exceeding 650 V passes above or adjacent to or terminates on any building, the following minimum clearances from any accessible point, on the basis of maximum sag, shall be observed, namely: –

(i) for any flat roof, open balcony, varandah roof and lean-to-roof, –

(a) when the line passes above the building, a vertical clearance of 2.5 metre from the highest point; and

(b) when the line passes adjacent to the building, a horizontal clearance of 1.2 metre from the nearest point;

(ii) for pitched roof, –

(a) when the line passes above the building, a vertical clearance of 2.5 metre immediately under the line; and

(b) when the line passes adjacent to the building, a horizontal clearance of 1.2 metre.

(3) Any conductor so situated as to have a clearance less than that specified in sub-regulation (2) shall be replaced with Aerial Bunched Cable and to be attached at suitable intervals to a bare earthed bearer wire having a breaking strength of not less than 350 kgf.

(4) The horizontal clearance shall be measured when the line is at a maximum deflection from the vertical due to wind pressure.

(5) The vertical and horizontal clearances shall be measured as per illustration provided in Schedule VIII C.

Explanation. – For the purposes of this regulation, the expression "building" shall be deemed to include any structure, whether permanent or temporary.

63. Clearances from buildings of lines of voltage exceeding 650 V. – (1) An overhead line shall not cross over an existing building as far as possible and no building shall be constructed under an existing overhead line.

(2) Where an overhead line of voltage exceeding 650 V passes above or adjacent to any building or part of a building it shall have on the basis of maximum sag a vertical clearance above the highest part of the building immediately under such line, of not less than, –

(i)	for lines of voltages exceeding 650 V and up to and including 33 kV	-	3.7 metre;
(ii)	for lines of voltages exceeding 33 kV	-	3.7 metre plus 0.30 metre for every additional 33 kV or part thereof.

(3) The horizontal clearance between the nearest conductor and any part of such building shall, on the basis of maximum deflection due to wind pressure, be not less than, –

(iii)	for lines of voltages exceeding 650 V and up to and including 11 kV	-	1.2 metre;
(iv)	for lines of voltages exceeding 11kV and up to and including 33 kV	-	2.0 metre;
(v)	for lines of voltages exceeding 33 kV	-	2.0 metre plus 0.3 metre for every additional 33 kV or part thereof.

(4) For high voltage direct current systems, the vertical and horizontal clearances, on the basis of maximum deflection due to wind pressure, from buildings shall be maintained as below:

Sl. No.	**High Voltage Direct Current**	**Vertical Clearance (metre)**	**Horizontal Clearance (metre)**
1.	100 kV	4.6	2.9
2.	200 kV	5.8	4.1
3.	300 kV	7.0	5.3
4.	400 kV	7.9	6.2
5.	500 kV	9.1	7.4
6.	600 kV	10.3	8.6
7.	800 kV	12.4	10.7

(5) The vertical and horizontal clearances shall be as measured as illustrated in Schedule VIII C.

Explanation. – For the purposes of this regulation, the expression "building" shall be deemed to include any structure, whether permanent or temporary.

64. Conductors at different voltages on same supports. – Where conductors of different voltages are laid on the same supports, the owner shall make adequate provision to guard against danger to linemen and others, from the lower voltage system being charged above its nominal voltage, by leakage from or contact with the higher voltage and the methods of construction and the applicable minimum clearances between the conductors of the two systems shall be as provided in regulation 71.

65. Erection or alteration of buildings, structures, flood banks and elevation of roads. – (1) If at any time subsequent to the erection of an overhead line, whether covered with insulating material or not or underground cable, any person proposes to erect a new building or structure or flood bank or to raise any road level or to carry out any other type of work whether permanent or temporary or to make in or upon any building, or structure or flood bank or road, any permanent or temporary addition or alteration, such person and the contractor whom he employs to carry out the erection, addition or alteration, shall give intimation in writing of his intention to do so, to the supplier or owner and to the Electrical Inspector and shall furnish therewith a scale drawing showing the proposed building, structure, flood bank, road or any addition or alteration and scaffolding thereof required during the construction.

(2) On receipt of such intimation, the supplier or owner shall examine,-

(a) whether the overhead line or underground cable under reference was laid in accordance with the provisions of these regulations and any other law for the time being in force;

(b) whether it is technically feasible;

(c) whether it meets the requirement of right of way; and

(d) whether such person was liable to pay the cost of alteration of the overhead line or underground cable and if so, issue a notice within a period of thirty days to such person together with an estimate of the cost of the expenditure likely to be incurred to alter the overhead line or underground cable and require him to deposit, within thirty days of the receipt of the notice, with the supplier or owner, the amount of the estimated cost.

(3) If such person disputes the cost of alteration of the overhead line or underground cable estimated by the supplier or owner or even the responsibility to pay such cost, the dispute may be referred to the Electrical Inspector who shall after hearing both parties decide upon the issue in accordance with sub-regulation (4).

(4) The Electrical Inspector shall estimate the cost of alteration of overhead line or underground cable on the following basis, namely: –

(a) the cost of material used for the alteration after accounting for the depreciated cost of the material of the existing line or underground cable;

(b) the wages of labour employed in the alteration; and

(c) the supervision charge to the extent of fifteen per cent of the wages mentioned in clause (b) and charges incurred by the owner or supplier or consumer in complying with the provisions of section 67 of the Act, in respect of alterations.

(5) Any addition or alteration to the building or structure shall be allowed only after the deposit of such estimated cost to the supplier or owner.

(6) No work upon such building, structure, flood bank, road and addition or alteration thereto shall commence or continue until the Electrical Inspector certifies that regulations 60, 62 , 63, 66 and regulation 79 have not been contravened either during or after the construction:

Provided that the Electrical Inspector may, if he is satisfied that the overhead line or underground cable has been so guarded as to secure the protection of persons or property from injury, certify within fifteen days that the work may be executed prior to the alteration of the overhead line or underground cable or in the case of temporary addition or alteration, without alteration of the overhead line or underground cable.

(7) The supplier or owner shall, on receipt of such deposit, alter the overhead line or underground cable in such a way that it does not contravene the regulations 60, 62, 63 and 79 either during or after such construction within two months from the date of such deposit or within such longer period as the Electrical Inspector may permit for reasons to be recorded in writing.

66. Transporting and storing of material near electric lines. – (1) No rods, pipes or similar materials shall be taken below, or in the vicinity of any bare overhead conductors or lines:

Provided that if these materials contravene the regulations 62 and 63, such materials shall be transported under the direct supervision of a person designated or appointed or engaged or permitted under these regulations.

(2) No rods, pipes or other similar materials shall be brought within the flash over distance of bare live conductors or overhead lines.

(3) No material or earth work or agricultural produce shall be dumped or stored, no trees grown below or in the vicinity of bare overhead conductors or lines in contravention to the regulations 62 and 63.

(4) No flammable material shall be stored under the electric line.

(5) No fire shall be allowed below overhead lines and above the demarcated underground cables.

67. General clearances. – (1) For the purpose of computing the vertical clearance of an overhead line, the maximum sag of any conductor shall be calculated on the basis of the maximum sag in still air and the maximum temperature as specified under regulation 59 and computing any horizontal clearance of an overhead line the maximum deflection of any conductor shall be calculated on the basis of the wind pressure specified under regulation 59.

(2) No blasting for any purpose shall be done within three hundred metre from the boundary of a substation or from the electric supply lines of voltage exceeding 650 V or tower structure thereof without the written permission of the owner of such substation or electric supply lines or tower structures; and in case of mining lease hold area, without the written permission of the Electrical Inspector of mines.

(3) No cutting of soil within ten metre from the tower structure of 110 kV and above voltage level shall be permitted without the written permission of the owner of tower structure.

(4) No person shall construct brick kiln or other polluting units near the installations or transmission lines of 220 kV and above within a distance of 500 metre.

68. Routes in proximity to airport or aerodromes. – Overhead lines shall not be laid in the vicinity of airport or aerodromes unless the Airport Authorities or concerned defence authorities have approved in writing the route of the proposed overhead lines as per relevant standards.

69. Maximum interval between supports. – All conductors shall be attached to supports at intervals not exceeding the safe limits based on the ultimate tensile strength of the conductor and the factor of safety specified under regulation 59:

Provided that in the case of overhead lines carrying conductors of voltage not exceeding 650 V when laid over, along or across any street, the interval shall not, without the consent in writing of the Electrical Inspector, exceed sixty five metre.

70. Conditions to apply where telecommunication lines and power lines are carried on same supports. – (1) Every overhead telecommunication line laid on supports of an electric line shall consist of conductors each having a breaking strength of not less than 270 kgf.

(2) Every telecommunication line laid on supports of an electric line shall be protected against lightning as per relevant standards.

(3) Where a telecommunication line is laid on supports of an electric line of voltage exceeding 650 V, a suitable arrangement shall be made to safeguard any person against injury resulting from contact, leakage or induction between such electric and telecommunication lines.

71. Lines crossing or approaching each other and lines crossing street and road. – Where an overhead line crosses or is in proximity to any telecommunication line, the owner of the overhead line or the telecommunication line, whosoever lays his line later, shall arrange to provide for protective devices or guarding arrangement as per code of practice or guidelines issued by Power and Telecommunication Coordination Committee and shall observe the following provisions, namely: –

(i) when it is intended to lay a telecommunication line or an overhead line which will cross or be in proximity to an overhead line or a telecommunication line, as the case may be, the person proposing to lay such line shall give one month notice of his intention so to do along with the relevant details of protection and drawings to the owner of the existing line;

(ii) guarding arrangement shall be provided where a line of voltage not exceeding 33 kV crosses a road or street or telecommunication line;

(iii) where an overhead line crosses or is in proximity to another overhead line, guarding arrangements shall be provided so as to safeguard against the possibility of their coming into contact with each other; and

(iv) where an overhead line crosses another overhead line, minimum clearances as provided in the table below shall be ensured:-

Minimum clearances in metre between lines crossing each other

Sl. No.	Nominal System Voltage (kV)	11-66 kV	110-132 kV	220 kV	400 kV	765 kV	1200 kV
1.	below 11	2.44	3.05	4.58	5.49	7.94	**10.44**
2.	11-66	2.44	3.05	4.58	5.49	7.94	**10.44**
3.	110-132	3.05	3.05	4.58	5.49	7.94	**10.44**
4.	220	4.58	4.58	4.58	5.49	7.94	**10.44**
5.	400	5.49	5.49	5.49	5.49	7.94	**10.44**
6.	765	7.94	7.94	7.94	7.94	7.94	**10.44**
7	**1200**	**10.44**	**10.44**	**10.44**	**10.44**	**10.44**	**10.44**

Provided that no guarding arrangement is required when an electric line of voltage exceeding 33 kV crosses over another line of 250 V and above voltage or a road or a tram subject to the condition that adequate clearances are provided between the lowest conductor of the line of voltage exceeding 33 kV and the top most conductor of the overhead line crossing underneath the line of voltage exceeding 33 kV and the clearances as stipulated in regulation 60 from the topmost surface of the road maintained;

(v) where an overhead direct current line crosses another overhead line, minimum clearances as provided in the table below shall be ensured:-

Minimum clearances in metre between AC and DC lines crossing each other

Sl. No.	System Voltage AC/DC	100 kV DC	200 kV DC	300 kV DC	400 kV DC	500 kV DC	600 kV DC	800 kV DC
1.	below 11 kV AC	3.05	4.71	5.32	6.04	6.79	7.54	9.04
2.	11-66 kV AC	3.05	4.71	5.32	6.04	6.79	7.54	9.04
3.	110-132 kV AC	3.05	4.71	5.32	6.04	6.79	7.54	9.04
4.	220 kV AC	4.58	4.71	5.32	6.04	6.79	7.54	9.04
5.	200 kV DC	4.71	4.71	5.32	6.04	6.79	7.54	9.04
6.	300 kV AC	5.32	5.32	5.32	6.04	6.79	7.54	9.04
7.	400 kV AC	5.49	5.49	5.49	6.04	6.79	7.54	9.04
8.	400 kV DC	6.04	6.04	6.04	6.04	6.79	7.54	9.04
9.	500 kV DC	6.79	6.79	6.79	6.79	6.79	7.54	9.04

10.	600 kV DC	7.54	7.54	7.54	7.54	7.54	7.54	9.04
11.	765 kV AC	7.94	7.94	7.94	7.94	7.94	7.94	9.04
12.	800 kV DC	7.94	7.94	7.94	7.94	7.94	9.04	9.04
13.	1200 kV AC	10.44	10.44	10.44	10.44	10.44	10.44	10.44

(vi) a person laying or proposing to lay a line which may cross or be in proximity with an existing line, shall provide arrangements on his own line or require the owner of the other overhead line to provide guarding arrangements as referred to in clause (iii) and (iv);

(vii) in all cases referred to in this regulation the expenses of providing the guarding arrangements or protective devices shall be borne by the person whose line was laid later;

(viii) where two lines cross each other, the crossing shall be made as nearly at right angles as the nature of the case admits and as near the support of the line as practicable, and the support of the lower line shall not be placed in the right of way of the upper line; and

(ix) the guarding arrangement shall be carried out by the owner of the support on which it is made and he shall be responsible for its proper maintenance.

72. Guarding. – (1) Where guarding arrangement is required under these regulations, the following shall be observed, namely: –

(i) every guard wire shall be connected with the earth at each point at which its electrical continuity is broken;

(ii) every guard wire shall have an actual breaking strength of not less than 635 kgf and if made of iron or steel, shall be galvanised; and

(iii) every guard wire or cross-connected system of guard wires shall have sufficient current carrying capacity to ensure them rendering dead, without risk of fusing of the guard wire, till the contact of any live wire has been removed.

(2) In the case of a line crossing over a trolley wire, the guarding arrangement shall be subjected to the following conditions, namely: –

(i) where there is only one trolley-wire, two guard-wires shall be provided as illustrated in DIAGRAM-A;

(ii) where there are two trolley wires and the distance between them does not exceed forty centimetre, two guard-wires shall be provided as illustrated in DIAGRAM-B;

(iii) where there are two trolley wires and the distance between them exceeds forty centimetre but does not exceed 1.2 metre, three guard-wires shall be provided as illustrated in DIAGRAM-C;

(iv) where there are two trolley-wires and the distance between them exceeds 1.2 metre, each trolley-wire shall be separately guarded as illustrated in DIAGRAM-D;

DIAGRAM-A

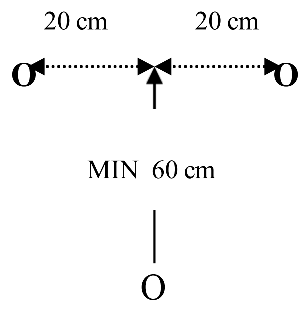


DIAGRAM-B

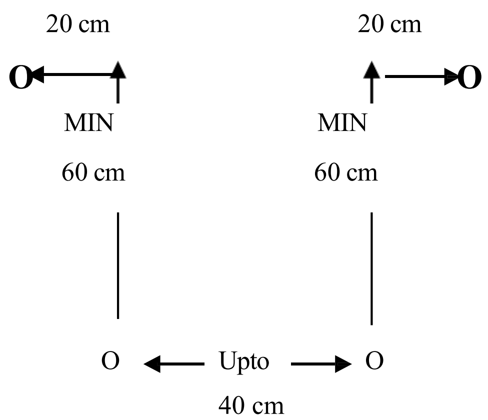


DIAGRAM-C

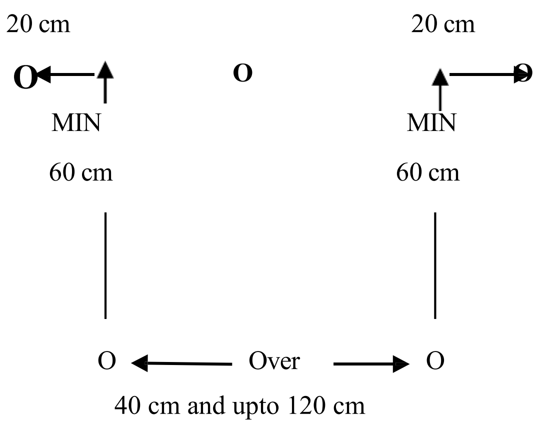
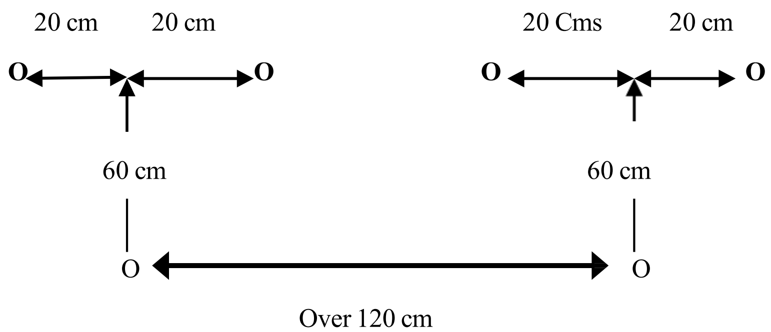


DIAGRAM-D



(v) the rise of trolley boom shall be limited such that the trolley wire shall not foul the guard wires; and

(vi) where a telegraph-line is liable to fall or be blown down upon an arm, stay-wire or span-wire and so slide-down upon a trolley-wire, guard hooks shall be provided to prevent such sliding.

73. Service lines from overhead lines. – No service line or tapping shall be taken off an overhead line except at a point of support:

Provided that the number of tappings per conductor shall not be more than six in case of connections at voltage not exceeding 650 V.

74. Earthing. – (1) Earthing of support of overhead lines up to 33 kV shall be provided as under, namely: –

(a) all metal supports and all reinforced and pre-stressed cement concrete supports of overhead lines and metallic fittings attached thereto, shall be permanently and effectively earthed by providing a continuous earth wire and securely fastened to each pole and connected with the earth at each support and the metallic fittings attached thereto shall also be permanently and effectively earthed;

(b) metal cross arms and insulator pins for Plain Cement Concrete and Pre-Stressed Cement Concrete poles shall be bonded together and normally earthed at every pole;

(c) for locations involving railways, electric line crossings and special structures, pipe or rod type earthing shall be provided;

(d) all steel poles on which switches, transformers, fuses are mounted shall be earthed;

(e) for poles of the electric lines below 650 V guarding arrangement with continuous earth wire or messenger wire in case of aerial bunched cable shall be provided and shall be connected to earth at three equidistant points in every km; and

(f) each stay-wire shall be similarly earthed unless insulator of same voltage class as that of line has been placed in it at a height not less than three metre from the ground and shall be provided with insulated tube up to three metre height from the ground.

(2) For 66 kV and above voltage class overhead line, earthing and requirement of earth wire shall be as per the regulations notified by the Authority under clause (e) of sub-section (2) of section 177 of the Act.

75. Anti-climbing devices. – The owner of every overhead line of voltage exceeding 650 V shall make adequate arrangements as per relevant standards to prevent unauthorised persons from climbing any of the supports of such overhead lines which can be easily climbed upon without the help of a ladder or special appliances:

Provided that the barbed wires conforming to relavant standards for a vertical distance of 30 to 40 cm, at a height of 3.5 metre to 4 metre from ground level or clamps with protruding spikes at a height of 3 to 4 metre shall be provided on each pole or tower of 11 kV line and above.

Explanation. – For the purposes of this regulation, rails, reinforced cement concrete poles and pre-stressed cement concrete poles without steps, tubular poles, wooden supports without steps, I-sections and channels shall be deemed as supports which cannot be easily climbed upon.

76. Safety and protective devices. – (1) Every overhead line which is not being suspended from a dead bearer wire, not being covered with insulating material and not being a trolley-wire, is laid over any part of a street or other public place or in any factory or mine or on any consumer's premises shall be protected with earth guarding for rendering the line electrically harmless in case its conductor breaks.

(2) An Electrical Inspector may, by notice in writing, require the owner of any such overhead line, wherever it may be laid, to protect it in the manner specified in sub-regulation (1) of this regulation.

(3) To prevent bird dropping on the suspension insulator strings, suitable bird guards as per relevant standards, shall be provided on cross arms of suspension tower or suspension pole structures, over the suspension insulator strings.

77. Protection against lightning. – (1) The owner of every overhead line, substation or generating station which is exposed to lightning shall adopt means as per relevant standards for diverting electrical surges to the earth due to lightning which may result into injuries.

(2) The earthing lead for any lightning arrester shall be as short as possible and shall not pass through any iron or steel pipe, but shall be taken as directly as possible from the

lightning arrester without touching any metal part to a separate vertical earth electrode or junction of the earth mat already provided for the substation of voltage exceeding 650 V subject to the avoidance of bends wherever practicable:

Provided that a vertical earth electrode shall be connected to the junction of the earth mat.

78. Unused overhead lines. – Where an overhead line ceases to be used as an electric supply line, namely: –

(i) the owner shall maintain it in a safe mechanical condition in accordance with regulation 59 or remove it; and

(ii) the Electrical Inspector shall, by a notice in writing served on the owner, require him to maintain it in a safe mechanical condition or to remove it within thirty days of the receipt of the notice.

79. Laying of cables. – (1) No underground power cable of voltage level up to 33 kV shall be laid without a minimum underground depth from ground surface to top of the cable as per relevant standards:

Provided that the underground power cable meant for use exceeding 33 kV shall be laid with a minimum underground depth of 1.2 metre.

(2) No underground telecommunication cable shall be laid without a minimum separation distance of 0.3 metre and 0.6 metre to the underground power cable of voltage up to 33 kV and exceeding 33 kV, respectively.

80. Protection against electromagnetic interference. – The owner of every electric supply line of voltage level 11 kV or above shall obtain the clearance of Power Telecommunication Co-ordination Committee to ensure the safety of the personnel and telecommunication line as per the requirement of section 160 of the Act.

Chapter VIII

Additional Safety requirements for electric traction

81. Application of Chapter. – (1) The regulations in this chapter shall apply only where electricity is used for the purposes of traction:

Provided that nothing in this chapter shall apply to electricity used for the public carriage of passengers, animals or goods on, or for the lighting or ventilation of the rolling stock of any railway or tramway subject to the provisions of the Railways Act, 1989 (24 of 1989).

(2) In this chapter the conductor used for transmitting electricity to a vehicle is referred to as the "line" and the other conductor as the "return".

(3) The owner of the line, return, rails or trolley wire, as the case may be, shall be responsible for the observance of regulations 82 to 95.

(4) Before an application is made by the owner of an installation of voltage exceeding 650 V to the Electrical Inspector for permission to commence or recommence supply after such installation has been disconnected for six months and above, the supplier shall ensure that the electric supply lines or apparatus at voltage exceeding 650 V belonging to him are placed in position, properly connected and duly completed.

(5) The supply of electricity shall not be commenced by the supplier unless and until the Electrical Inspector is satisfied that the provisions of regulations 46 to 52 and regulations 82 to 95 have been complied with and the approval in writing of the Electrical Inspector has been obtained by him.

82. Voltage of supply to vehicle. – No person shall supply electricity to any trolley wire or other conductor at voltage exceeding 650 V used in direct electrical and mechanical connection with any vehicle, except with the written approval of the Central

Government or the State Government, as the case may be, and subject to such conditions as the State Government may think reasonable to impose.

83. Insulation of lines. – Every line shall be insulated throughout and a line may consist of either bare conductors supported on structures through insulators or insulated cable.

84. Insulation of returns. – (1) Where any rails on which cars run, or any conductors laid between or within 0.9 metre of such rails, form any part of a return, such part may be uninsulated and all other returns or parts of a return, shall be insulated, unless they are of such conductivity as to secure the conditions under sub-regulations s(2) and (3) of regulation 85.

(2) Where any part of a return is uninsulated, it shall be connected with the negative or neutral of the system.

85. Proximity to metallic pipes. – (1) Where an uninsulated return is in proximity to any metallic pipe, structure or substance not belonging to the owner of the return, the owner of uninsulated return shall, if so required by the owner of such pipe, structure or substance, connect his return therewith at his own expense.

(2) Where the return is partly or entirely uninsulated, the owner shall, in the construction and maintenance of his system, adopt such means for reducing the difference produced by the current between the potential of the uninsulated return at any one point and the potential of the uninsulated return at any other point as to ensure that the difference of potential between the uninsulated return and any metallic pipe, structure or substance in the vicinity shall not exceed four volts where the return is relatively positive, or one and one-third volts where the return is relatively negative.

(3) The owner of any such pipe, structure or substance in respect of it require the owner of the uninsulated return at reasonable times and intervals to ascertain by test in his presence or in the presence of his representative, whether the condition specified in sub-regulation (2) is fulfilled, and, if such condition is found to be fulfilled, all reasonable expenses of, and incidental to, carrying out of the test shall be borne by the owner of the pipe, structure or substance.

(4) The potential of uninsulated return with respect to earth at any point shall not exceed 50 V under normal conditions.

(5) The petroleum sidings installation earth shall be connected to the uninsulated return to make it equipotential and pipelines in the vicinity of the track should be properly earthed.

86. Difference of potential on return. – Where the return is partly or entirely uninsulated, the owner shall keep a continuous record of the difference of potential, during the working of his system, between every junction of an insulated return with an uninsulated return and the point on the route most distant from that junction, and the difference of potential shall not, under normal running conditions, exceed a mean value of seven volts between the highest momentary peak and the average for the hour of maximum load.

87. Leakage on conduit system. – Where both the line and the return are placed within a conduit, the following conditions shall be fulfilled in the construction and maintenance of the system, namely: –

(i) where the rails are used to form any part of the return, they shall be electrically connected at distances not exceeding thirty metre apart, with the conduit by means of copper strips having a cross-sectional area of at least 0.40 sq. cm or by other means of equal conductivity and where the return is wholly insulated and contained within the conduit, the latter shall be connected with earth at the generating station or substation through an instrument suitable for the indication of any contact or partial contact of either the line or the return with the conduit; and

(ii) the leakage current shall be ascertained daily, before or after the hours of running, when the line is fully charged and if at any time it is found to exceed 0.6 ampere per km of single tramway track, the transmission and use of electricity shall be suspended unless the leakage is stopped within twenty four hours.

88. Leakage on system other than conduit system. – Where both the line and the return are not placed within a conduit, the leakage current shall be ascertained daily before or after the hours of running, when the line is fully charged and if at any time it is found to exceed 0.3 ampere per km of single tramway track, the transmission and use of electricity shall be suspended unless the leakage is stopped within twenty four hours.

89. Passengers not to have access to electric circuit. – Precautions to the satisfaction of an Electrical Inspector shall be taken by the owner of every vehicle to prevent, -

(i) the access of passengers to any portion of the electric circuit where there is danger from electric shock; and

(ii) any metal, hand-rail or other metallic substance liable to be handled by passengers, becoming charged.

90. Isolation of sections. – Every trolley wire shall be constructed in sections not exceeding 1.6 km in length, and means shall be provided for isolating each section.

91. Minimum size and strength of trolley wire. – No trolley-wire shall be of less cross-sectional area than 0.5 sq. cm or shall have an actual breaking load of less than 2000 kg.

92. Height of trolley wire and length of span. – A trolley wire or a traction feeder on the same supports as a trolley wire shall, at no place be, at a height from the surface of the street of less than 5.2 metre except, where it passes under a bridge or other fixed structure, or through or along a tunnel or mineshaft or the like in which case it shall be suspended to the satisfaction of an Electrical Inspector.

93. Earthing of guard wires. – Every guard wire shall be connected with earth at each point at which its electrical continuity is broken and shall also be connected with the rails at intervals of not more than five spans.

94. Proximity to magnetic observatories and laboratories. – Traction works shall not be carried out in the vicinity of geomagnetic observatories and laboratories without the concurrence of the Central Government or of any officer authorised by it in this behalf.

95. Records. – (1) The owner shall keep the following records, namely: –

(i) daily records showing, –

(a) the maximum working current from the source of supply;

(b) the maximum working voltage at the source of supply;

(c) the difference of potential, as required under regulation 86; and

(d) the leakage current, if any, as required under regulations 87 and 88;

(ii) occasional records showing, –

(a) every test made under sub-regulation (2) and (3) of regulation 85;

(b) every stoppage of leakage, together with the time occupied; and

(c) particulars of any abnormal occurrence affecting the electrical working of the system.

(2) The records so kept under sub-regulation (1) shall be open to examination by Electrical Inspector.

Chapter IX

Additional Safety requirements for mines and oil-fields

96. Application of chapter. – The regulation in this chapter shall apply only where electricity is used in mines as defined in the Mines Act, 1952 (35 of 1952) and oil-fields.

97. Responsibility for observance. – (1) It shall be the duty of every person in charge of and responsible to the mine including the owner, agent, manager, engineer and installation manager and Engineer of mine and oil-field to comply with and enforce the regulations and it shall be the duty of all persons employed to conduct their work in accordance with the regulations:

Provided that in case of power stations, transformer substations, converter substations, rectifier substations and accumulator, storage stations for supplying electricity to solely and mainly for the purpose of working of the mine or number of mines and which do not fall in the precincts of a mine, Engineer holding a degree in electrical engineering from university with adequate experience may be appointed as manager of that installations.

Explanation. – For the purposes of this regulation, the word "Engineer" shall, –

(i) in the case of a coal mine, have the same meaning as assigned to it in the Coal Mines Regulations, 2017;

(ii) in the case of a metalliferous mine, have the same meaning as assigned to it in the Metalliferous Mines Regulations, 1961, as amended from time to time; and

(iii) in the case of an oil-field, means the Installation Manager" under the Oil Mines Regulations, 2017.

98. Notices. – (1) On or before the first day of February in every year, in respect of every mine or oil-field, returns giving the size and type of apparatus, together with such particulars in regard to circumstances of its use as may be required, shall be sent to the Electrical Inspector of mines by the persons specified in regulation 97 in the Form provided in Schedule IX or, as the case may be, Schedule X, whichever is applicable.

(2) The persons specified in regulation 97, shall also give to the Electrical Inspector of mines not less than seven days notice in writing of the intention to bring into use any new installation in a mine or oil-field giving details of apparatus installed and its location:

Provided that in case of any additions or alterations to an existing installation of voltage not exceeding 650 V, immediate notice in writing shall be sent to the Electrical Inspector of mines before such additions or alterations are brought into use:

Provided further that this regulation shall not apply to telecommunication or signalling apparatus:

Provided also that in case of emergency which may lead to loss of life or machinery and is detrimental to safety of mine, intimation shall be given within twenty four hours to the Electrical Inspector of mines giving the healthiness of the apparatus alongwith self-certification report of such additions or alterations undertaken.

99. Plans. – (1) A correct plan, on the same scale as the plan kept at the mine in fulfillment of the requirements of the Mines Act, 1952 (35 of 1952), and Single Line Diagram of the electrical installations from point of commencement of supply shall be available in the office at the mine showing the position of all fixed apparatus and conductors therein, other than lights, telecommunication or signalling apparatus, or cables for the same.

(2) A similar plan on the scale not less than 25 cm to a km (1:4000) shall be kept by the manager or owner of one or more wells in any oil-field.

(3) A similar plan and Single Line Diagram on such scale as the Central Government may direct and Single Line Diagram showing the position of all electric supply lines shall be kept in the office of any licensee, owner or other person transmitting or distributing electricity in a mine or oil-field.

(4) The plans specified under this regulation shall be examined and corrected as often as necessary to keep them up-to-date and the dates of such examinations shall be entered thereon by the manager or owner of the mine or wells and such plans shall be available to the Inspector, or inspector of mines, at any time and in case extent of hazardous area is revised, equipment covered under such area shall be reviewed as per the relevant standards and or ATmosphere EXplosible.

100. Lighting, overhead lines, communication and fire precautions. – (1) Adequate illumination by electricity as per relevant standards shall be provided in the mines:

Provided that in a belowground coal mine, such lighting fixtures shall be of a type approved by the Chief Inspector of mines:

Provided further that one or more flame safety lamps or such lighting system approved by the Chief Inspector of mines shall be maintained in all places where failure of the electric light at any time shall be prejudicial to safety:

Provided also that in a belowground metalliferous mine or any open cast mine or oil-fields, such lighting fixtures shall be suitable for the type of application conforming to the relevant standards or harmonised standards, and adequate emergency lighting system shall be maintained in all places where failure of the electric light at any time shall be prejudicial to safety.

(2) Efficient means of communication shall be provided in every mine between the point where the switchgear under sub-regulation (1) of regulation 107 is erected, the shaft bottom and other distributing centres in the mines.

(3) Fire extinguishing appliances of adequate capacity and of an approved type as per relevant standards as amended from time to time shall be installed and properly maintained in every place in a mine containing apparatus, other than cables, telecommunication and signalling apparatus.

(4) In case of mines, minimum clearance above ground of the lowest conductor of overhead lines or overhead cables where dumpers or trackless vehicles are being operated, shall not be less than twelve metre in height from the ground across the road where dumpers or trackless vehicles cross:

Provsided that where dumper bucket in raised position, the clearance between the top of dumper body and to the lowest conductor of overhead lines or overhead cables shall not be less than one metre.

101. Isolation and fixing of transformer and switchgear. – (1) Transformers and switchgear shall be placed in a separate room, compartment or box where necessary or in a manner to prevent danger of mechanical damage and spread of fire.

(2) Unless the apparatus is so constructed, protected and worked as to obviate the risk of fire, no inflammable material shall be used in the construction of any room, compartment or box containing apparatus, or in the construction of any of the fittings therein and each such room, compartment or box shall be substantially constructed and shall be kept dry and illuminated and efficient ventilation shall be provided for all apparatus installed therein.

(3) All apparatus that has to be worked or attended to and all handles intended to be

operated shall be placed at a spacious working place which is accessible, clear of obstruction and free from danger, so far as circumstances permit.

102. Method of earthing. – (1) Where earthing is necessary in a mine, it shall be carried out by connection to an earthing system at the surface substation of the mine.

(2) All metallic sheaths, coverings, handles, joint boxes, switchgear frames, instrument covers, switch and fuse covers of boxes, all lamp holders, unless efficiently protected by an insulated covering made of fire resisting material, and the frames and bedplates of generators, transformers and motors, including portable motors, shall be earthed by connection to an earthing system in the manner specified in sub-regulation (1).

(3) Where cables are provided with a metallic covering constructed and installed in accordance with clause (iv) (d) of regulation 108, such metallic covering may be used as a means of connection to the earthing system.

(4) All conductors of an earthing system shall have conductivity, at all parts and all joints, at least equal to fifty per cent of that of the largest conductor used solely to supply the apparatus, a part of which is desired to be earthed:

Provided that no conductor of an earthing system shall have a cross-sectional area less than 0.15 sq. cm except in the case of the earth conductor of a flexible cable used with portable apparatus where the voltage does not exceed 125 V, and the cross-sectional area and conductance of the earthcore is not less than that of the largest of the live conductors in the cable.

(5) All joints in earth conductors and all joints in the metallic covering of cables shall be properly soldered or otherwise effectively made.

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

(7) This regulation shall not apply, except in the case of portable apparatus, to any system in a mine in which the voltage does not exceed 30 V.

103. Protective equipment. – (1) In the interest of safety, the earth fault current shall not be more than 750 milliampere in installations of voltage exceeding 250 V and up to 1100 V for below ground mines and oil-fields, and 50 ampere in installations of voltage exceeding 1100 V and up to 11 kV in open cast mines and the magnitude of the earth fault current shall be limited to these specified values by employing suitably designed, restricted neutral system of power supply including neutral-ground monitoring protection system:

Provided that all electrical installations, in or after notification of these regulations, of voltage exceeding 1100 V and up to 11 kV for below ground mines, open cast mines and oil mines or oil-fields, the magnitude of the earth fault current shall be limited up to 10 A by employing suitably designed, restricted neutral system of power supply including neutral-ground monitoring protection system:

Provided further that the settings of protective relays thereof shall be set between 200 to 400 milliampere for individual apparatus of voltage up to 1100 V with suitable time delay protection.

(2) The operation of the switchgear and the relays shall be recorded daily at the generating station, substation or switch station in a register kept for the purpose and in electronic form also.

(3) The effectiveness of switchgear and protective system shall always be kept in working order and shall be checked by calibrating and testing at least once in a year and the result thereof shall be recorded in separate register kept for the purpose and in electronic form:

Provided that wherever numerical relays are being used they shall be checked by testing procedure as per guidelines of original equipment manufacturer or the relevant standards and periodicity of such checking shall be at least once in a year.

104. Voltage limits. – Electricity shall not be transmitted into a belowground mine at a voltage exceeding 11000 V and shall not be used therein at a voltage exceeding 6600 V:

Provided that, -

(i) where hand-held portable apparatus is used, the voltage shall not exceed 125 V;

(ii) where electric lighting is used, –

(a) in belowground mines, the lighting system shall have a mid or neutral point connected with earth and the voltage shall not exceed 125 V between phases;

(b) on the surface of a mine or in an open cast mine or oil mines or oil-fields, the voltage may be raised to 250 V, if the neutral or the mid-point of the system is connected with earth and the voltage between the phases does not exceed 250 V;

(iii) where portable hand-lamps are used in belowground mines and hazardous area of oil mines or oil-fields, the voltage shall not exceed 30 V;

(iv) where any circuit is used for the remote control or electric inter-locking of apparatus, the circuit voltage shall not exceed 30 V for below ground mine or hazardous area of oil-fields:

Provided that in hazardous areas of oil mines or oil-fields, the said voltage can be up to 250 V, if the on- off control push-button stations or remote controls are housed in an appropriate enclosure like:

(i) Flame proof enclosure type 'd';

(ii) Pressurised enclosure type 'p';

(iii) Sand filled apparatus type 'q';

(iv) Increased safety enclosure type 'e', 'n', and 'o':

Provided further that the control circuit shall have suitable protection against shock hazards, and the trippings due to faults do not adversely affect the operational safety:

Provided also that in fixed plants on surface of the mines or opencast mines, the said voltage for the remote control or electric inter-locking may be permitted up to 250 V.

105. Transformers. – In mines or oil-fields, the transformers used for providing voltages to control circuits or remote control or interlocking or for hand held apparatus, shall have suitable provision to guard against danger by reason of the lower voltage apparatus becoming accidentally charged above its normal voltage by leakage from or contact with the higher voltage apparatus.

106. Switchgear and terminals. – Switchgear and all terminals, cable ends, cable joints and connections to apparatus shall be totally enclosed and shall be constructed, installed and maintained as to comply with the following requirements, namely: –

(i) all parts shall be of mechanical strength sufficient to resist rough usage;

(ii) all conductors and contact areas shall be of adequate current-carrying capacity and all joints in conductors shall be properly soldered or otherwise efficiently made;

(iii) the lodgement of any matter likely to diminish the insulation or affect the working of any switchgear shall be prevented;

(iv) all live parts shall be so protected or enclosed as to prevent persons accidentally coming into contact with them and to prevent danger from arcs, short-circuits, fire, water, gas or oil;

(v) where there may be risk of igniting gas, coal-dust, oil or other inflammable material, all parts shall be so protected as to prevent open sparking; and

(vi) every switch or circuit-breaker shall be so constructed as to be capable of opening the circuit it controls and dealing with any short-circuit without danger.

107. Disconnection of supply. – (1) Properly constructed switchgear for disconnecting the supply of electricity to a mine or oil-field shall be provided at a point recommended by the Electrical Inspector of mines.

(2) At any time, when any cable or overhead line supplying electricity to the mine from the aforesaid switchgear is live, a person designated to operate the said switchgears shall be available within easy reach thereof:

Provided that in the case of gassy coal seam of second degree and third degree gassiness, the main mechanical ventilator operated by electricity shall be interlocked with the switchgear so as to automatically disconnect the power supply in the event of stoppage of main mechanical ventilator.

(3) When necessary in the interest of safety, any apparatus suitably placed, shall be provided for disconnecting the supply from every part of a system.

(4) If the Electrical Inspector of mines, in the interest of safety considered it necessary, he may direct that the apparatus specified in sub-regulation (3) shall be so arranged as to disconnect automatically, from the supply, any section of the system subjected to a fault.

(5) Every motor shall be controlled by switchgear which shall be so arranged as to disconnect the supply from the motor and from all apparatus connected thereto and such switchgear shall be so placed as to be easily operated by the person designated to operate the motor.

(6) A suitably rated switchgear incorporated with protective mechanism to disconnect automatically the supply in the event of conditions of over-current, earth fault or leakage, under voltage and single phasing.

(7) Auxiliary fan shall be interlocked with the switchgear controlling power supply to the in-bye face equipment of below ground coal mine for automatic disconnection of power supply in the event of the stoppage of the auxiliary fan.

(8) Every feeder of the mine shall be controlled by a suitably rated switchgear incorporated with protective mechanism in a manner so as to disconnect the supply automatically in the event of conditions of over-current, short circuit, single phasing, under voltage and earth fault or leakage as relevant.

108. Cables. – All cables, other than flexible cables for portable or transportable apparatus, shall fulfill the following requirements, namely: –

(i) all such cables, other than the outer conductor of a concentric cable, shall be covered with insulating material and shall be efficiently protected from mechanical damage and supported at sufficiently frequent intervals and in such a manner as to prevent damage to such cables;

(ii) (a) except as provided in clause (iii) no cables other than concentric cables or single core or two core or multi core cables protected by a metallic covering and which contain all the conductors of a circuit shall be used where the voltage exceeds 125 V or when an Inspector considers that there is risk of igniting gas or coal dust or other inflammable material, and so directs;

(b) the sheath of metal-sheathed cables and the metallic armouring of armoured cables shall be of a thickness not less than that recommended from time to time in the relevant standard of the Bureau of Indian Standards;

(iii) where a voltage exceeding 250 V but not exceeding 650 V direct current system is used, two single core cables may be used for any circuit provided that their metallic coverings are bonded together by earth conductors so placed that the distance between any two consecutive bonds is not greater than thirty metre measured along either cable;

(iv) The metallic covering of every cable shall be. –

(a) electrically and mechanically continuous throughout;

(b) earthed, if it is required, to be earthed by a connection to the earthing system of conductivity;

(c) efficiently protected against corrosion where necessary;

(d) of a conductivity at all parts and at all joints at least equal to fifty per cent of the conductivity of the largest conductor enclosed by the said metallic covering; and

(e) where there may be risk of igniting gas, coal-dust, or other inflammable material, so constructed as to prevent, as far as practicable, the occurrence of open sparking as the result of any fault or leakage from live conductors;

(v) cables and conductors where connected to motors, transformers, switchgear and other apparatus, shall be installed so that, -

(a) they are mechanically protected by securely attaching the metallic covering to the apparatus; and

(b) the insulating material at each cable end is efficiently sealed so as to prevent the diminution of its insulating properties;

(vi) where necessary to prevent abrasion or to secure gas-tightness, properly constructed glands or bushes shall be provided;

(vii) unarmoured cables or conductors shall be conveyed either in metallic pipes or metal casings or suspended from efficient insulators by means of non-conducting materials which will not cut the covering and which shall prevent contact with any timbering or metal work and if separate insulated conductors are used, they shall be installed at least 3.75 cm apart and shall not be brought together except at lamps, switches and fittings.

109. Flexible cables. – (1) Flexible cables for portable or transportable apparatus shall be two core or multi core, unless required for electric welding, and shall be covered with insulating material which shall be efficiently protected from mechanical injury.

(2) If flexible metallic covering is used either as the outer conductor of a concentric cable or as a means of protection from mechanical injury, it shall not be used by itself to form an earth conductor for such apparatus, but it may be used for that purpose in conjunction with an earthing core.

(3) Every flexible cable intended for use with portable or transportable apparatus shall be connected to the system and to such apparatus by properly constructed connectors:

Provided that for machines of voltage exceeding 650 V but not exceeding 11 kV a bolted type connector shall be used and the trailing cable shall be suitably anchored at the machine end.

(4) At every point where flexible cables are joined to main cables, a circuit breaker shall be provided which is capable of automatically disconnecting the supply from such flexible cables.

(5) Every flexible cable attached to a portable or transportable machine shall be examined periodically by the person designated to operate the machine, and if such cable is used underground, it shall be examined at least once in each shift by such person and if such cable is found to be damaged or defective, it shall forthwith be replaced by a cable in good condition.

(6) If the voltage of the circuit exceeds 250 V, all flexible cables attached to any transportable apparatus shall be provided with flexible metallic screening or pliable armouring and cables of portable apparatus shall be provided with flexible metallic screening on all the power and pilot cores:

Provided that the provision of this regulation shall not apply to flexible cables attached to any transportable or portable apparatus used in open cast mines or below ground mines where reeling and unreeling of such cables is necessary as per design features of the equipment.

(7) All flexible metallic screening or armouring specified in sub-regulation (6) shall fulfill the requirement specified in clause (iv) of regulation 108:

Provided that in the case of separately screened flexible cables the conductance of each such screen shall not be less than twenty five per cent of that of the power conductor and the combined conductance of all such screens shall in no case be less than that of 0.15 sq. cm copper conductor.

(8) Flexible cable exceeding hundred metre in length shall not be used with any portable or transportable apparatus:

Provided that such flexible cable when used with coal cutting machines or cutter or loader or armoured face conveyor for long wall operation, or with shuttle cars or load haul dumper or cutter loader or all alike equipment for development and de-pillaring operation shall not exceed two hundred fifty metre in length:

Provided further that the aforesaid cable in case of an open cast mine when used with electrically operated heavy earth moving machinery shall not exceed six hundred metre in length and for bucked wheel excavator at 11 kV shall not exceed one thousand metre in length:

Provided also that in case of dragline or 42 cubic metre capacity shovel, flexible cable length may be raised up to 600 metre.

(9) Flexible cable, when installed in a mine, shall be efficiently supported and protected from mechanical injury.

(10) Flexible cables shall not be used with apparatus other than portable or transportable apparatus:

Provided that, in case of applications like, submersible pumps, and skid mounted pumps, installed in the mines, the use of flexible cable is allowed subject to the follow of measures as to prevent the mechanical damage to the cables.

(11) Where flexible cables are used they shall be detached or otherwise isolated from the source of supply when not in use, and arrangements shall be made to prevent the energising of such cables by undesignated persons.

110. Portable and transportable machines. – The person designated to operate an electrically driven coal-cutter, or other portable or transportable machine, shall not leave the machine while it is in operation and shall, before leaving the area in which such machine is operating, ensure that the supply is disconnected from the flexible cable which supplies electricity to the machine and when any such machine is in operation, steps shall be taken to ensure that the flexible cable is not dragged along by the machine:

Provided that all portable and transportable machines used in underground mines shall operate on remote control from the concerned switchgear with pilot core protection:

Provided further that the portable and transportable machines used in open cast mines shall have the provision such that the power supply to the machine from concerned switchgear is remotely controlled from the machine:

Provided also that the portable or transportable machines used in open cast mine, provision of tripping device or switch device from the operator"s cabin shall be provided to disconnect power supply to such machine from the field switchgear.

111. Sundry precautions. – (1) All apparatus shall be maintained reasonably free from dust, dirt and moisture, and shall be kept clear of obstruction.

(2) All apparatus other than portable and transportable apparatus shall be housed in a room, compartment or box so constructed as to protect the contents from damage occasioned by falling material or passing traffic.

(3) Inflammable or explosive material shall not be stored in any room, compartment or box containing apparatus, or in the vicinity of any apparatus.

(4) In case of a fault in any circuit, the part affected shall be made dead without delay and shall remain so until the fault has been remedied.

(5) While lamps are being changed the supply shall be disconnected.

(6) No lamp holder shall have metallic connection with the guard or other metal work of a portable hand lamp.

(7) The following notices in Hindi and local language of the district, so designed and protected as to be easily legible at all times, shall be exhibited at the following places, namely: –

(i) where electrical apparatus is in use, a notice forbidding undesignated persons to operate or otherwise interfere with such apparatus;

(ii) in the interior or at the surface of the mine where a telephone or other means of communication is provided, a notice giving full instructions to person, at the surface of the mine, designated to effect the disconnection of the supply of electricity to the mine.

(8) All apparatus, including portable and transportable apparatus, shall be operated only by those persons who are designated for the purpose.

(9) Where a plug-and-socket-coupling other than of bolted type is used with flexible cables, an electrical inter- lock or other approved device shall be provided to prevent the opening of the coupling while the conductors are live.

112. Precautions where gas exists. – (1) In any part of a coal-seam of the first degree gassiness, –

(i) all cables shall be constructed, installed, protected, operated and maintained in such a manner as to prevent risk of open sparking;

(ii) all signalling, telecommunication, remote control and insulation tester circuits shall be so constructed, installed, protected, operated and maintained as to be intrinsically safe;

(iii) all apparatus including portable and transportable apparatus including lighting fittings used at any place which lies in-bye of the last ventilation connection shall be flame-proof:

Provided that electrically operated or battery operated portable or transportable apparatus such as shuttle car, men or material transporting equipment of increased safety type “e” shall be permitted at any place with suitable monitoring devices for detection of gases, if any;

(iv) all electric lamps at any place which lie in-bye of the last ventilation connection and return airways shall be in flame proof enclosure and at other places these shall be in increased safety enclosure type ‘e’.

(2) At any place which lies in any part of a coal-seam of second and third degree gassiness, –

(i) all signalling, telecommunication, remote control and insulation tester circuits shall be so constructed, installed, protected, operated and maintained as to be intrinsically safe;

(ii) all cables shall be constructed, installed, protected, operated and maintained in such a manner as to prevent risk of open sparking;

(iii) all apparatus, including portable and transportable apparatus used at any place within ninety metre of any working face or goaf in case of a second degree gassy mine and within two hundred seventy metre of any working face or goaf in case of third degree gassy mine or at any place which lies in-bye of the last ventilation connection or in any return airways shall be flame-proof; and

(iv) all electric lamps shall be enclosed in flame-proof enclosures.

(3) In any oil mine or oil-field, at any place within the zone-2 hazardous areas, –

(i) all signalling and telecommunication, remote control and insulation tester circuits shall be so constructed, installed, operated, protected and maintained as to be intrinsically safe;

(ii) all cables shall be so constructed, installed, operated and maintained as to prevent risk of open sparking;

(iii) all apparatus including portable and transportable apparatus shall have the enclosures conforming to the relevant standards; and

(iv) all electric lamps shall be enclosed in increased safety enclosure type ‘e'.

(4) In oil mine or oil-fields at any place within the zone-1 hazardous areas, –

(i) all signalling and telecommunication, remote control and insulation tester circuits shall be so constructed, installed, operated, protected and maintained as to be intrinsically safe;

(ii) all cables shall be so constructed, installed, operated and maintained as to prevent risk of open sparking;

(iii) all apparatus including portable and transportable apparatus shall have enclosures conforming to the relevant standards; and

(iv) all electric lamps shall be enclosed in flame-proof enclosures.

(5) In any oil mine at any place within zone-0 hazardous area, no electrical equipment shall be used and where it is not practicable, intrinsically safe apparatus are only to be used which shall be conforming to relevant standards and such installation of apparatus shall conform to relevant standards and the details of installation, certified by the owner or agent or manager or installation manager shall be submitted to the Electrical Inspector of mines.

(6) In any coal-seam of degree second and degree third gassiness or the hazardous area the supply shall be discontinued,-

(i) immediately, if open sparking occurs;

(ii) during the period required for examination or adjustment of the apparatus, which shall necessitate the exposing of any part liable to open sparking;

(iii) the supply shall not be reconnected until the apparatus has been examined by the electrical supervisor or one of his duly appointed assistants and until the defect, if any, has been remedied or the necessary adjustment made; and

(iv) a flame safety lamp shall be provided and maintained in a state of continuous illumination near an apparatus, including portable or transportable apparatus, which remains energised and where the appearance of the flame of such safety lamps indicates the presence of inflammable gas, the supply to all apparatus in the vicinity shall be immediately disconnected and the incident reported forthwith to an official of the mine and such apparatus shall be interlocked with the controlling switch in such a manner as to disconnect power supply automatically in the event of percentage of inflammable gas exceeding one and one quarter in that particular district:

Provided that where apparatus for automatic detection of the percentage of inflammable gas or vapor are employed in addition to the flame safety lamps, such apparatus shall be approved by the inspector of mines and maintained in perfect order.

(7) In any part of a coal-seam of any degree of gassiness or in any hazardous area of an oil-fields, if the presence of inflammable gas in the general body of air is found at any time to exceed one and one quarter per cent, the supply of energy shall be immediately disconnected from all cables and apparatus in the area and the supply shall not be reconnected so long as the percentage of inflammable gas remains in excess of one and one quarter per cent.

(8) In oil-fields where concentration of inflammable gas exceeds twenty percent of its lower explosive limit a system should be in place to activate an audio alarm at appropriate location. On activation of such alarm immediate action shall be taken to make operations safe and to isolate the cause in order to ensure safety of men, equipment, environment. In case the lower explosive limit rises to forty percent, the supply of electricity shall be cut-off immediately from all cables and apparatus lying within thirty metre of the installation and all sources of ignition shall also be removed from the said area and normal work shall not be resumed unless the area is made gas-free:

Provided that such disconnection shall not apply to intrinsically safe environment monitoring scientific instruments.

(9) Any such disconnection or reconnection of the supply shall be noted in the log sheet in hard copy and electronic form which shall be maintained in the form set out in Schedule XI and shall be reported to the Electrical Inspector of mines.

(10)The provisions of this regulation shall apply to any metalliferrous mine which may be notified by the inspector of mines if inflammable gas occurs or if the inspector of mines is of the opinion that inflammable gas is likely to occur in such mine.

Explanation. – For the purposes of this regulation, –

(1) The expression 'coal-seam of first degree gassiness', 'coal-seam of second degree gassiness', 'coal- seam of third degree gassiness' and 'flame-proof apparatus' shall have the meanings respectively assigned to them in the Coal Mines Regulations, 2017.

(2) The following areas in oil mine or oil-fields shall be known as hazardous areas, namely:–

(i) an area of not less than ninety metre around an oil-well where a blow-out has occurred or is likely to occur, as may be designated by the Installation Manager or the senior most official present at the site;

(ii) an area within sixteen metre of an open discharge of petroleum bearing fluid from a well under production test;

(iii) an area within fifteen metre of:

(a) a producing well-head or any point of open discharge of the crude there from or other point where emission of hazardous atmosphere is normally likely to arise; or

(b) any wildcat or exploration well-head being drilled in an area where abnormal pressure conditions are known to exist;

(iv) any area within three metre of:

(a) any producing well-head where a closed system of production is employed such as to prevent the emission or accumulation in the area in normal circumstances of a hazardous atmosphere; or

(b) exploration or interspaced well-head being drilled in an area where the pressure conditions are normal and where the system of drilling employed includes adequate measures for the prevention in normal circumstances of emission or accumulation within the area of a hazardous atmosphere;

(3) “hazardous atmosphere” means “an atmosphere containing any inflammable gases or vapours in a concentration capable of ignition”.

(4) “Zone 0 hazardous area” means “an area in which hazardous atmosphere is continuously present”.

(5) “Zone 1 hazardous area” means “an area in which hazardous atmosphere is likely to occur under normal operating conditions”.

(6) “Zone 2 hazardous area” means “an area in which hazardous atmosphere is likely to occur under abnormal operating conditions”.

113. Shot-firing. – (1) When shot-firing is in progress adequate precautions shall be taken to protect apparatus and conductors, other than those used for shot-firing, from injury.

(2) Current from lighting or power circuits shall not be used for firing shots.

(3) The construction of shot firing cables shall conform to relevant standards and adequate precautions shall be taken to prevent such cable touching other cables and apparatus.

114. Signalling. – Where electrical signalling is used, -

(i) adequate precsautions shall be taken to prevent signal and telephone wires coming into contact with other cables and apparatus;

(ii) the voltage used in any one circuit shall not exceed 30 V;

(iii) contact-makers shall be so constructed as to prevent the accidental closing of the circuit; and

(iv) bare conductors, where used shall be installed in suitable insulators.

115. Haulage. – Haulage by electric locomotives on the overhead trolley-wire system, at voltage not exceeding 650 V and haulage by storage battery locomotives may be used with the prior permission in writing of the Electrical Inspector of mines, and subject to such conditions as he may impose in the interests of safety.

116. Earthing of neutral points. – Where the voltage of an alternating current system exceeds 30 V, the neutral or mid-point shall be earthed by connection to an earthing system in the manner specified in regulation 102:

Provided that when the system concerned is required for blasting and signalling purposes, the provisions of this regulation shall not apply:

Provided further, that in case of unearthed neutral system, it shall be equipped with a suitable ground protection system approved by the Electrical Inspector of Mines to ensure isolation of power supply to the faulty section in appropriate manner.

117. Supervision. – (1) One or more electrical supervisors shall be appointed in writing by the owner, agent or manager of a mine or by the agent or the owner, of one or more wells in an oil-field to supervise the installation and such number of supervisors shall be on duty as per guidelines issued by Directorate General of Mines Safety from time to time under intimation in writing to the Authority or as directed by the Electrical Inspector of mines.

(2) The electrical supervisor so appointed shall be the person holding a valid Electrical Supervisor's Certificate of Competency, covering mining installations issued by the Appropriate Government.

(3) Adequate number of electricians as per guidelines issued by Directorate General of Mines Safety from time to time under intimation in writing to the Authority and or as directed by the Electrical Inspector of mines shall be appointed in writing by owner, agent or manager of a mine or by the owner or Agent of oil-field for carrying out the duties.

(4) The Electrician shall be a person holding license under sub-regulation (1) of regulation 31.

(5) For small open cast mines and below ground mines receiving supply at voltage not more than 650 V and not having portable or transportable apparatus, electrical supervisor and electrician shall be appointed for more than one mine with the approval of the Electrical Inspector of Mines.

(6) Every person appointed to operate, supervise, examine or adjust any apparatus shall be competent to undertake the work which he is required to carry out as directed by the Engineer.

(7) The electrical supervisor shall be responsible for the proper performance of the following duties, by himself or by an electrician appointed under sub-regulation (1), –

(i) thorough examination of all apparatus, including the testing of earth conductors and metallic coverings for continuity, as often as may be necessary to prevent danger; and

(ii) examination and testing of all new apparatus, and of all apparatus, re-erected in the mine before it is put into service in a new position.

(8) In the absence of any electrical supervisor, the owner, agent or manager of the mine and oil-field shall appoint in writing a substitute electrical supervisor.

(9) The electrical supervisor or the substitute electrical supervisor appointed under sub-regulation (8) to replace him shall be personally responsible for the maintenance at the mine or oil-field, of a log-book made up of the daily log sheets prepared in the form set out in Schedule XI and the results of all tests carried out in accordance with the provisions of sub-regulation (7) shall be recorded in the log-sheets prepared in the form set out in Schedule XI.

118. Training of personnel engaged for operation and maintenance of electrical installations in mines and oil- fields. – (1) The persons engaged for operation and maintenance of electrical installations in mines are required to undergo the type of training meant for the particular mining installations of Coal or Oil or Metal, training syllabus as issued by Directorate General of Mines Safety from time to time under intimation in writing to the Authority.

(2) The owner or manager or agent of the mine shall arrange for training of their personnel engaged in the operation and maintenance of electrical installations of mines in his own institute or any other institute recognized by the Central Government or State Government.

(3) The refresher training shall be imparted at a periodicity of intervals not more than two years. A register or in electronic form by the Owner or Manager or Agent of a mine or by the owner or agent, of one or more wells in an oil-fields of the mine shall be maintained wherein the names of the persons trained, due date of refresher training and the like shall be entered and the register maintained shall be produced before the Electrical Inspector of mines whenever required by him.

Chapter X

Additional safety requirements for renewable generating stations

119. Additional safety requirements for renewable generating stations. – The regulations under this chapter shall be applicable to renewable generating stations which shall be in addition to the regulations provided from chapter I to VII.

120. Safety requirements for biomass and waste to energy installations. – All biomass plants and waste to energy plants including Municipal solid waste or refuse derived fuel shall comply with the safety standards as mentioned in Regulations notified by the Authority under clause (e) of sub-section (2) of section 177 of the Act.

121. Safety requirements for solar installations. – (1) The following general safety requirement for solar installations shall be ensured, namely: –

(i) clear pathways of minimum seventy five centimetre in width with hand rails for roof access and emergency exit shall be provided for roof top system;

(ii) there shall be clear pathways, walkways between the rows or columns of solar panels which is necessary for cleaning and maintenance;

(iii) cables shall be laid in trenches for ground based photovoltaic installation;

(iv) ground mounted solar installations shall be protected by fencing or other means not less than 1.8 metre in height so as to prevent unauthorised entry;

(v) disconnection switches or circuit breakers provided in combiner boxes to disconnect the photovoltaic system from all other conductors of the system shall be located at a readily accessible location;

(vi) three phases on the alternating current side, and positive and negative conductor on the direct current side shall be marked and identified with different colours;

(vii) inverter unit for solar photovoltaics shall be installed in the periphery of the building and as near as the solar panel:

Provided that the direct current cable shall be ultraviolet protected or routed through ultraviolet protected pipe;

(viii) there shall be a manual disconnection switch to isolate the system from grid and shall be situated outside the alternating current combiner box; and

(ix) protection shall be deployed (for both input and output) on site for overload, surge current, surge voltage, short circuit, high temperature, over voltage, under voltage and over frequency, under frequency, reverse polarity and lightning.

(2) The following earthing requirements for solar installations shall be ensured, namely: –

(i) solar earthing shall be as per the relevant standard;

(ii) the frame of inverter cabinet shall be connected with the earthing bus bar through the earthing terminals using flexible braided copper wire;

(iii) all metal casing and shielding of the plant, each array structure of the photovoltaic yard, equipment, inverters and control systems shall be earthed through proper earthing;

(iv) earthing system shall connect all non-current carrying metal receptacles, electrical boxes, appliance frames, chasis and photovoltaic module mounting structures in one long run and the earth strips shall be interconnected by proper welding and shall not be bolted;

(v) there shall be adequate number of interconnected earth pits provided in each location and minimum required gap shall be provided in between earth pits as per relevant standard.

(3) The followings protection, testing and interlocking requirement for solar installations shall be ensured; namely: –

(i) the solar photovoltaic power plant shall be provided with lightning and over voltage protection by deploying required number of lightning arresters as per the relevant standards;

(ii) every combiner box shall be provided with suitable surge protective device with arc extinguishing capability as per the relevant standards to avoid any risk of fire;

(iii) the input circuits of combiner box shall be provided with over current protection as per the relevant standards;

(iv) the output circuits of combiner box shall be provided with isolation protection;

(v) earth fault protection and insuslation monitoring for photovoltaic arrays and inverters shall be provided;

(vi) all photovoltaic modules safety qualification shall comply with relevant standards.

(4) **Requirement to prevent fire for solar installations.** – A fire detection system and automatic fire suppression system shall comply with the relevant standards.

(5) Additional safety requirements for floating solar photovoltaic energy installations. – Photovoltaic modules and associated structure of floating solar power plant shall comply with the relevant standards for tests such as salt mist, ammonia corrosion, environmental stress cracking of High Density Poly Ethylene, stress cracking resistance of High Density Poly Ethylene and standard test method for tensile properties of plastics.

122. Safety requirements for wind energy installations. – (1) All wind energy generation systems including wind turbines, wind power plants onshore and offshore connected with the grid shall be as per relevant standards.

(2) Transformers for wind turbine applications shall be as per the relevant standards.

(3) Portable fire extinguishers shall also be kept at various locations in plants to take immediate action in case of fire.

(4) Any wind turbine workers exposed to a potential fall shall be supported by a certified fall arrest system such as a full body safety harness.

Chapter XI

Additional safety requirements for electric vehicle charging station

123. Additional safety requirements for electric vehicle charging station. – The regulations under this chapter shall be applicable to electric vehicle charging stations which shall be in addition to the regulations provided from chapter I to VII.

124. General safety requirements for electric vehicle charging station. – (1) Electric vehicle charging stations shall be provided with separate protection against the overload of input supply and output supply as per relevant standards.

(2) Socket-outlet of supply of electric vehicle charging points shall be installed at least 800 millimetre above the finished ground level.

(3) A cord extension set or second supply lead shall not be used in addition to the supply lead for the connection of the electric vehicle to the charging point and shall not be used as a cord extension set.

(4) No adaptor shall be used to connect a vehicle connector to a vehicle inlet.

(5) The distance between the charging point and the connection on the electric vehicle shall not be more than five metre during charging.

(6) The portable socket outlets shall not be permitted for electric vehicle charging.

(7) The lightning protection system shall be provided for the electric vehicle charging stations as per relevant standards.

(8) The electric vehicle charging station shall be equipped with a protective device against the uncontrolled reverse power flow from electric vehicle to the charging point.

(9) One second after disconnecting the electric vehicle from the supply mains, the voltage between accessible conductive parts or any accessible conductive part and earth shall be less than or equal to 42.4 V_{peak} (30 V_{rms}), or 60 V DC, and the stored energy available shall be less than 20 J:

Provided that, if the voltage is greater than 42.4 V_{peak} (30 V_{rms}) or 60 V DC, or the energy is 20 J or more, a warning label shall be attached in a conspicuous position on the charging stations.

(10) A vehicle connector used for direct current charging shall be locked on the vehicle inlet if the voltage is higher than 60 V DC and in case of charging system malfunction, a means for safe disconnection shall be provided.

(11) The electric vehicle charging point shall disconnect supply of electricity to prevent overvoltage at the battery, if the output voltage exceeds maximum voltage limit permissible for the vehicle.

(12) The electric vehicle charging points shall not energise the charging cable when the vehicle connector is in unlock position.

(13) The electric vehicle connector shall not unlock if the voltage between the vehicle connector and the earth is more than 60 V.

(14) Safety clearance between the oil or gas dispenser and electric vehicle charging point shall be as per the order issued by the Authority.

(15) Only four core cable shall be used for charging points which require three phase power supply.

(16) Underground cables shall not cross the underground oil tank or oil pipeline.

(17) Underground cables through the charging area or vehicles passage shall be avoided and if provided shall be at a minimum depth of one metre from the finished ground

surface.

125. Earth protection system for the charging station. – (1) Each electric vehicle charging points shall be supplied individually by a dedicated sub-circuit protected by an overcurrent protective device complying with the relevant standards and the overcurrent protective device shall be part of a switchboard.

(2) Co-ordination of all protective devices in the charging stations shall be ensured.

(3) All electric vehicle charging stations shall be provided with an earth continuity monitoring system that disconnects the supply in the event of the earthing connection to the vehicle becomes ineffective.

(4) The charging lead shall be fitted with an earth-connected metal shielding and the cable insulation shall be wear resistant and maintain flexibility over the operating temperature range.

(5) A protective earth conductor shall be provided to establish an equipotential connection between the earth terminal of the supply and the conductive parts of the vehicle which shall be as per the relevant standards.

126. Requirement to prevent fire for electric vehicle charging station. – (1) The enclosure of electric vehicle supply equipment shall be made of fire retardant material with self-extinguishing property and free from halogen.

(2) The fire detection, alarm and control system shall be provided as per relevant standards.

127. Testing of charging station. – The owner of the charging station shall ensure that the tests as specified in the manufacturer‟s instructions for the residual current devices and the charging station have been carried out.

128. Maintenance of records. – (1) The owner of the charging station shall keep records of design, construction and labelling to be compatible with a supply of standard voltage at a nominal frequency of 50 Hz of the charging station.

(2) The owner of the charging station shall keep records of the relevant test certificates as indicated in these regulations and as per the relevant standards.

(3) The owner of the charging station shall keep records of the results of every inspection, testing and periodic assessment and details of any issues observed during the assessment and any actions required to be taken in relation to those issues.

(4) The owner of the charging station shall retain a copy of all records, as specified in sub-regulation (1), (2) and (3) of above, either in hard form or in electronic form, for at least seven years and shall provide a copy of the records to the officials during the inspection.

Chapter XII

Additional safety requirements for high voltage direct current

129. Additional safety requirements for high voltage direct current. – The regulations under this chapter shall be applicable to high voltage direct current which shall be in addition to the regulations provided from chapter I to VII.

130. General safety requirements. – (1) A wire mesh shall be provided beneath the walk way; wherever constructed above the hanging valves in the valve hall.

(2) Cables used for sensitive measurements shall be laid in separate and completely screened or covered channels or galvanised steel pipes.

(3) A separate emergency source of illumination with automatic initiation shall be provided in every room or compartment of high voltage direct current station.

(4) No oil immersed apparatus shall be kept within the valve hall.

(5) All doors of compartments containing modules equipped with laser diodes and junction boxes of the fibre optic cables shall be locked and marked with laser warning symbols.

131. Fencing of filter banks. – (1) Alternating Current and Direct Current filter banks area shall be efficiently protected by fencing or other means, not less than 1.8 metre in height, so as to prevent access to the conductors and apparatus therein by any unauthorised person and the fencing of such area shall be effictively earthed.

(2) The gate of fencing and earth switch of the filter bank shall be interlocked such that the gate can be opened only after the disconnection and discharging of the filter bank completely.

(3) The air core smoothing reactor shall be fenced all around and the fence shall not fall in the Magnetic Clearance Contour of the smoothing reactor.

(4) Common neutral bus in Alternating Current filters shall be earthed at one point only.

132. Earthing requirements. – (1) Converter transformer shall be provided with separate perimeter earthing conductor.

(2) The line side neutral of the converter transformer bank shall be earthed at one point only.

(3) Every part of support structure circumference of the air cored reactor shall be earthed in a manner such that it is not forming closed loops.

(4) Radio Frequency Interference screen of valve hall shall be electrically connected and effectively earthed.

(5) Metallic sheet, prefabricated structure members and trusses housing high voltage direct current apparatus shall be electrically connected and effectively earthed.

(6) Insulating pads or sleeves shall be provided between the steel reinforcement components, in foundation beneath the smoothing reactor, wherever they are crossing each other.

Chapter XIII

Additional safety requirements for gas insulated substation

133. Additional safety requirements for gas insulated substation. – The regulations under this chapter shall be applicable to gas insulated substation which shall be in addition to the regulations provided from chapter I to VII.

134. General safety requirements. – (1) A separate emergency source of illumination with automatic initiation shall be provided in every room or campartment of gas insulated substation.

(2) Cable cover protection unit shall be provided between flanges of gas insulated substation and cable termination unit.

(3) Gas insulated substation installation of 220 kV and above voltage shall be provided with partial discharge monitoring system.

(4) SF6 gas leakage rate from any single compartment of gas insulated substation to atmosphere and between compartments shall not exceed as stipulated in the relevant standards.

135. Earthing requirements. – (1) Enclosure of gas insulated substation bay shall be earthed for high frequency transient voltage as per original equipment manufacturer recommendations, apart from the regular earthing.

(2) Earthing of gas insulated substation installation shall be as per relevant standards.

(3) Travelling wave energy generated inside the gas insulated substation due to switching operations shall be diverted to the earth by providing effective earthing from bushing shroud to the earth.

Chapter XIV

Miscellaneous

136. Deviations. – (1) The Central Government or the State Government, as the case may be, by an order in writing, allow deviations in respect of matters referred in these regulations except regulation 32.

(2) The Electrical Inspector or the Electrical Inspector of mines may, by an order in writing, and reasons to be recorded allow deviation in respect of matters referred in regulations 14 to 19, regulation 30, sub-regulations (2), (3) and (5) of regulation 37, sub-regulation (3) of regulation 38, clauses (i) to (iv) of regulation 39, clause (xii) of regulation 43, regulation 45, sub-regulation (2) of regulation 46, regulations 48, regulations 54 to 56, regulations 59 to 63, regulation 67, regulation 74, regulation 77, regulations 81 to 94, regulation 104, sub-regulations (6), (8) and (10) of regulation 109, regulation 116 and regulations 119 to 135 on case to case basis.

Explanation. – Every order allowing the deviations by the Electrical Inspector or the Electrical Inspector of Mines under sub-regulation (2) shall be placed before the Central or State Government which shall have the final decision.

Schedule I

Handling of electric supply lines and apparatus

[See sub-regulation (3) of regulation (21)]

Part-I

Precautions to be observed: -

(1) Hotline maintenance trained personnel only shall be designated to do work on line.

(2) Work permit shall be taken from the terminal substations at each end of the line.

(3) Work shall be performed with proper planning and prior understanding and clarity.

(4) Favourable climatic condition for hotline operations is sunny weather. If the weather forecasts rain or thunderstorms work will not begin.

(5) Organisation of work shall be discussed among the members and responsibility of each team member fixed.

(6) Before going to the work site, all equipment and tools shall be inspected and checked for correct operation.

(7) Auto re-closure shall be in `OFF" position for the line at both ends.

(8) The work procedure shall be discussed with the team member at the tower location and the responsibility of each member shall be properly defined.

(9) The land in close vicinity to the tower/poles shall be cleared to provide a site area for the required tools.

(10) All cleaned hot sticks, strain carrier and other assemblies shall be kept on the hotline

tool rack to avoid ground contact.

(11) Helmet, safety shoes and safety belt shall compulsorily be used.

(12) All hot sticks and ladders shall be cleaned and checked for integrity by the hot sticks tester.

(13) All linemen in the hotline team shall be equipped with personal protective equipment during the work.

(14) No live-line team members on the tower and conductor shall wear any metallic chain, wristwatch or ring to avoid any circulating current.

(15) The team of linemen shall wear conductive socks, boots, helmets and hand gloves. The `hot-end‟ lineman shall wear complete bare hand suit.

(16) Tarpaulin sheet should be laid on the work area.

(17) A light vehicle shall be kept nearby during entire work period.

Tools normally required for hot line maintenance operation: -

The following tools conforming to the relevant standards or equivalent specifications shall be used in on-line working:

(1) Wire tongs;

(2) Wire tongs saddle;

(3) Tie sticks;

(4) Strain link sticks;

(5) Roller link sticks;

(6) Suspension link sticks;

(7) Auxiliary arms;

(8) Strain carrier;

(9) Gin poles;

(10) Cum-a-along clamp;

(11) Safety equipment like conductor guards, X-arm guards, insulator covers, hand gloves and the like; and

(12) Hot sticks.

Safe Working Distance: -

The following safe working distances shall be observed for hot line maintenance operations:

Phase to Phase	**Safe Clearance**
kV	**Metre**
11	0.61
33	0.71
66	0.91
110	1.02
132	1.07
220	1.52
400	2.13

Handling electric supply lines and apparatus for carrying out shutdown work or testing [See sub-regulation (3) of regulation (21)]

Part-II

Precautions to be observed: -

(1) Before commencement of any shutdown work or testing in an electric supply line or apparatus, the Engineer or Supervisor in-charge of the work or testing shall identify the possible hazards, such as; electrocution, flash over, fall of person from height, fall of objects from height, failure of tools and plants, fire, and the like, that may be encountered while carrying out the work or testing near charged area and take necessary precaution to protect the working personnel.

(2) The Engineer or Supervisor in-charge of the work shall, before commencement of any work, brief the entire working group or gang regarding the hazards that may be encountered and the necessary precautions to be taken by them.

(3) The Engineer or Supervisor in-charge of the work shall obtain proper permit-to-work from the concerned Operation In-charge(s) and ensure that the electric supply line or apparatus or section is isolated from all sources of energy, de-energised and earthed.

(4) The Engineer or Supervisor in-charge of the work shall ensure that adequate and appropriate local earths are fixed at the zone of working, and the earthing rods remain connected to the isolated section of the electric supply line or apparatus or section till all men and materials have been moved away to safe zone and permit to work is returned on completion of the work.

(5) If the local earths are required to be removed for any testing purpose, the same shall be done only when all the working personnel are in the safe zone, on the ground or on the tower, and in the presence of the Engineer or Supervisor. If the working personnel are required to go up or approach the conductor(s) subsequently for any work, such as removal of test leads, tightening or adjustment, they shall be permitted to proceed only after re-fixing the local earths, as required.

(6) The Engineer or Supervisor in-charge of the work shall positively confirm by suitable means that the electric supply line or apparatus or section is totally dead before giving clearance for the working personnel to approach the same.

(7) The Engineer or Supervisor in-charge of the work shall, while carrying out the shutdown work or testing, ensure that working personnel are maintaining safe distance from the adjacent charged electric supply line or apparatus or section, and also, no objects, such as tools and plants, ladders, cranes, man-lifts, and the like, are moved, so as to infringe the safe distance, endangering the working personnel.

(8) Mobile cranes, derricks, man lifts and wheel mounted ladders shall be effectively earthed when being moved or operated in close proximity with energised apparatus or section.

(9) Portable ladders and poles shall be carried only in the horizontal position when being moved in close proximity with energised lines or equipment or area.

Further Precautions to be observed: -

(1) Adequate and effective supervision shall be ensured by the owner as well as the contractor for all activities while working or testing on electric supply lines and apparatus when any shutdown work or testing is done near charged electric supply line or apparatus or section.

(2) Lone worker shall never be allowed to work on electric supply lines, equipment and apparatus or while testing.

(3) Sufficient supervisory personnel shall be deployed for close monitoring while various type of works are under progress at the same or different locations. Supervising work shall never be delegated to the sub-contractors' personnel.

(4) The deployed Supervising Personnel shall not leave the working spot when shutdown work at height or testing is in the progress, as the working personnel may not be aware of the consequences of unsafe practices. No other work, which requires them to move out of the location, shall be undertaken by Supervising personnel, when shutdown work or testing is in the progress.

(5) Wherever shutdown activities are required to be carried out for more than one day on any electric supply lines, apparatus or section, earthing provided at the said work site shall be inspected by the Engineer or Supervisor everyday morning for their healthiness, fitness and proper tightening, before giving clearance for the working personnel to climb the tower or structure to resume the work.

Handling high voltage direct current apparatus for carrying out shutdown work or testing

[See sub-regulation (3) of regulation (21)]

Part-III

Precautions to be observed: -

(1) The Engineer or Supervisor in-charge of the work shall obtain proper Permit-To-Work (PTW) from the concerned Operation In-charge(s) and ensure that the electric supply line or apparatus or section is isolated from all sources of energy, de-energised and earthed.

(2) Before commencement of any shutdown work or testing of high voltage direct current apparatus, the Engineer or Supervisor in-charge of the work or testing shall identify the possible hazards, such as; electrocution, flash over, fall of person from height, fall of objects from height, failure of tools and plants, fire, and the like, that may be encountered while carrying out the work or testing near charged area and take necessary precaution to protect the working personnel.

(3) The Engineer or Supervisor in-charge of the work shall, before commencement of any work, brief the entire working group or gang of the hazards that may be encountered and the necessary precautions to be taken by them.

(4) Attach warning labels to all neighboring installation parts (to be removed after the works have been carried out).

(5) The Engineer or Supervisor in-charge of the work shall allow access to the valve hall, DC Filter Area, AC Filter Area and DC hall (if any) only when the apparatus therein are completely de-energised and effectively earthed.

(6) The work on AC/DC filter bank shall only begin after earthing the entire capacitor bank.

(7) There shall be at least ten minute time gap between earthing the entire capacitor bank and starting the work on bank. There after unit must be short circuited.

(8) The de-energised bushing shall be checked for stored charge by touching all the surfaces of both indoor and outdoor side composite insulators and all other parts of the bushing using a proper test instrument.

(9) The gas pressure inside high voltage direct current through wall bushing shall be reduced to a level prescribed by the manufacturer before starting any work or handling of the bushing.

Handling Gas Insulated Switchgear (GIS) apparatus for carrying out shutdown work

or testing [See sub-regulation (3) of regulation (21)]

Part-IV

Precautions to be observed: -

(1) The Engineer or Supervisor in-charge of the work shall obtain proper Permit-To-Work from the concerned Operation In-charge(s) and ensure that the electric supply line or apparatus or section is isolated from all sources of energy, de-energised and earthed.

(2) Operation, maintenance and repair must be carried out by trained and certified personnel only.

(3) Before commencement of any shutdown work or testing of gas insulated switchgear apparatus, the Engineer or Supervisor in-charge of the work or testing shall identify the possible hazards, such as; electrocution, flash over, fall of person from height, fall of objects from height, failure of Tools and Plants, fire, and the like, that may be encountered while carrying out the work or testing near charged area and take necessary precaution to protect the working personnel.

(4) The Engineer or Supervisor in-charge of the work shall, before commencement of any work, brief the entire working group or gang of the hazards that may be encountered and the necessary precautions to be taken by them.

(5) Wear hearing protection during operation.

(6) Take care while touching the enclosure at any time as enclosures may heat up to the temperature of 70°C.

(7) Observe the procedures for storage, transportation, and the use of filling equipment.

(8) Wear the personal protective equipment: respirator mask (self-contained breathing equipment if necessary), protective overall, protective gloves, safety shoes, safety glasses.

(9) Attach warning labels to all neighboring installation parts (to be removed after the works have been carried out).

(10) Provide proper electrical clearance as required by interlocking rules. Mark e.g. main circuits and control circuits with appropriate tags.

(11) Block off neighboring live parts with screens, insulating mats or spacer grids in order to prevent unintended contacts.

(12) While working on any compartment in gas insulated switchgear, the immediate adjacent compartment(s) must be also depressurised for safety of the working person.

(13) SF6 gas becomes contaminated and contains poisonous substances after events such as arc faults. Hence, handling of SF6 in such cases must be done using proper PPEs and by a trained personnel, preferably from the original equipment manufacturer.

(14) The switchgear installation shall not be operated if the density of SF6 gas indicated at the density monitors is not in the operating range.

(15) Do not remove any protective covers if an assembly is energized.

(16) The Engineer or Supervisor in-charge of the work shall ensure that adequate and appropriate local earths are fixed at the zone of working, and the earthing rods remain connected to the isolated section of the electric supply line or apparatus or section till all men and materials have been moved away to safe zone and Permit-To-Work is returned on completion of the work.

Schedule II

Forms of Inspection Report

[See regulation (32) and (45)]

FORM I

(Installations of voltage up to and including 250V)

Report _______

Date of inspection by Electrical Inspector or self-certification by supplier/owner/consumer___________

Date of last inspection or self-certification _____________

1. Consumer No. _________________
2. Voltage and system of supply:

(i) Volts ___________(ii) No. of Phases ___________(iii) AC/DC _____________

3. Type of wiring* ________________

**State type of wiring whether casing capping, lead covered of teak wood batten, concealed conduit, Tough Rubber Sheathed and any other type.*

4. Name of the consumer or owner
5. Address of the consumer or owner
6. Location of the premises
7. Particulars of the installations:

		Number	Connected Load in kW
(a) (i)	Light Points	_______	_______
(ii)	Fan Points	_______	_______
(iii)	Plug Points	_______	_______

(b) Other equipment (complete details to be furnished):

(i) ____________________________

(ii) ____________________________

Total connected load in kW _________________________

Maximum current demand in Amps _________________________

(on the basis of total connected load)

(c) Generators: (complete detail to be enclosed)

Make	S. No.	kVA rating	Voltage rating	Type

(i) ____

(ii) ____

8. General conditions of the installation:

Sl. No.	Regulation No.	Requirements	Report
1.	Regulation 14	(i) Is/Are there any visible sign(s) of overloading in respect of any apparatus wiring?	Yes/No
		(ii) Condition of flexible cords, sockets, switches, plug- pins, cut-outs and lamp holders and such other fittings.s	Satisfactory/ Not Satisfactory
		(iii) General condition of wiring.	Satisfactory/ Not Satisfactory
		(iv) Whether any unauthorised temporary installation exist?	Yes/No
		(v) State if sockets are controlled by individual switches.	Yes/No
		(vi) Any other defect or condition which may be a source of danger. If yes, give details.	Yes/No
2.	Regulation 15	Give report on condition of service lines, cables, wires, apparatus and such other fittings placed by the supplier or owner of the premises. If not satisfactory, give details.	Satisfactory/ Not Satisfactory
3. 1	Regulation 16	Whether suitable cut-outs provided by the supplier at the consumer's premises are within enclosed fire proof receptacle?	Yes/No
4. 1	Regulation 17	(i) State if switches are provided on live conductors.	Yes/No
		(ii) State if indication of a permanent nature is provided as per regulation so as to distinguish earthed or earthed neutral conductor from the live conductor.	Yes/No
		(iii) Whether a direct line is provided on the neutral in the case of single-phase double pole iron clad switches instead of fuse?	Yes/No
5.	Regulation 18	(i) State if earthed terminal is provided by the supplier.	Yes/No
		(ii) Have three pin plugs been provided for plug points?	Yes/No
		(iii) General visible condition of the earthing arrangement.	Satisfactory/ Not Satisfactory
6.	Regulation 19	Are the live parts in building inaccessible?	Yes/No
7.	Regulation 36	State insulation resistance between conductors and earth in Mega Ohms.	------- Mega Ohms
8.	Regulation 37	(i) State if linked switches of requisite capacity are provided near the point of commencement of supply.	Yes/No
		(ii) State if the wiring is divided in suitable number of circuits and each such circuit is protected by suitable cut-out.	Yes/No
		(iii) State if supply to each motor or apparatus is controlled by suitable linked switch.	Yes/No

9.	Regulation 43	(i) Have the frames of every generator, stationary motor and so far as practicable portable motor and the metallic parts (not intended as conductors) of all other apparatus used for regulating* or controlling electricity been earthed by two separate and distinct connections with earth?	Yes/No
		(ii) Is the earth wire free from mechanical damage?	Yes/No
		(iii) In the case of conduit, or lead covered wiring, has the conduit or lead-cover been efficiently earthed?	Yes/No
		(iv) If the consumer has his own earth-electrode, state if it is properly executed and has been tested. If yes, give value of earth resistance	------ Ohms
10.	Regulation 44	Whether residual current device of appropriate capacity as defined in Regulation have been provided?	Yes/No
11.	Overhead Lines	(i) State if the consumer has any overhead lines.	Yes/No
		(ii) Does the overhead line near the premises of consumer meets the requirement of regulation 60, 61 and 62? If not, give details.	Yes/No
		(iii) Is guarding provided for overhead lines as per Regulation 76?	Yes/No
		(iv) Any other remarks.	

Date:

Signature of the supplier/ Owner / Consumer

Name ____________________________

Designation _______________________

File No. __________________________

To: Office of Electrical Inspector for ………………...

* Not applicable to isolated wall tubes or to brackets, electroliers, switches, ceiling fans and such other fittings (other than portable hand lamps and transportable apparatus) unless provided with earth terminal.

FORM II

[See Regulation (32) and (45)]

(Installations of voltage level more than 250 V up to and including 650 V)

Report / Application No. ________

Date of inspection by Electrical Inspector or self-certification by supplier/owner/consumer ___________________

Date of last inspection or self-certification _______________

1. Consumer No. ____________________
2. Voltage and system of supply:

   (ii) Volts ___________(ii) No. of Phases ___________(iii) AC/DC ______________
3. Name of the consumer or owner __________________________
4. Address of the consumer or owner __________________________
5. Location of the premises __________________________
6. Particulars of the installations:

   (a) Motors:

Make	S. No.	kW/MW rating	Voltage rating	Type

   (i) ____

   (ii) ____

   (b) Other equipment (complete details to be furnished):

   (i) ____

   (ii) ____

   (c) Total connected load kW / kVA

   ____

   (d) Generators: (complete detail to be enclosed)

Make	S. No.	kVA rating	Voltage rating	Type

   (iii) ____

   (iv) ____

7. General condition of the installation:

Sl. No.	**Regulation No.**	**Requirements**	**Report**
1.	Regulation 3	Is the record of the designated persons properly made and kept up to date and duly attested?	Yes/No
2.	Regulation 14	(i) Is/Are there any visible sign(s) of overloading in respect of any apparatus wiring?	Yes/No
		(ii) Whether any unauthorised temporary installation exist?	Yes/No
		(iii) Are the electric supply lines and apparatus so installed, protected, worked and maintained as to prevent danger?	Yes/No
		(iv) Any other general remarks.	
3.	Regulation 15	Give report on condition of service lines, cables, wires, apparatus and such other fittings placed by the supplier or owner of the premises. If not satisfactory, give details.	Satisfactory/ Not Satisfactory

4.	Regulation 16	Whether suitable cut-outs/CBs provided by the supplier at the consumer's premises are within enclosed fire proof receptacle?	Yes/No
5.	Regulation 17	(i) Whether switches are provided on live conductors?	Yes/No
		(ii) Whether indication of a permanent nature is provided as per regulation so as to distinguish earthed or earthed neutral conductor from the live conductor as per IS color code?	Yes/No
		(iii) Whether a direct line is provided on the neutral in the case of single-phase double pole iron clad switches/Isolators/CBs instead of fuse?	Yes/No
6.	Regulation 18	(i) Whether earthed terminal is provided by the supplier?	Yes/No
		(ii) General visible condition of the earthing arrangement.	Satisfactory/ Not Satisfactory
7.	Regulation 19	(i) Are bare conductors in building inaccessible?	Yes/No
		(ii) Whether readily accessible switches have been provided for rendering them dead?	Yes/No
8.	Regulation 20	Whether "Danger Notice" in Hindi and the local language of the district and of a design as per the relevant standards is affixed permanently in conspicuous position?	Yes/No
9.	Regulation 21	(i) Whether insulating floor or mats have been provided?	Yes/No
		(ii) Whether identification of panel has been provided on the front and the rear of the panel?	Yes/No
10.	Regulation 23	Whether flexible cables used for portable or transportable equipment covered under the regulation, are heavily insulated and adequately protected from mechanical injury?	Yes/No
11.	Regulation 24	State the condition of metallic coverings provided for various conductors.	Satisfactory/ Not Satisfactory
12.	Regulation 26	Whether the circuits or apparatus intended for operating at different voltage(s) are distinguishable by means of indication(s) of permanent nature?	Yes/No
13.	Regulation 28	Whether all circuits and apparatus are so arranged that there is no danger of any part(s) becoming accidentally charged to any voltage beyond the limits of voltage for which it/they is/are intended?	Yes/No
14.	Regulation 29	(i) In the case of generating stations, whether fire-buckets filled with clean dry sand have been conspicuously marked and kept in convenient location in addition to fire-extinguishers suitable for dealing with fires ?	Yes/No

		(ii) Whether First Aid Boxes or cupboards conspicuously marked and properly equipped are provided and maintained?	Yes/No
		(iii) Is adequate staff trained in First Aid Treatment and firefighting?	Yes/No
15.	Regulation 30	(i) Whether 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 resuscitation of persons suffering from electric shock have been affixed in a "conspicuous place"?	Yes/No
		(ii) Are the persons specified under this Regulation able to apply instructions for resuscitation of persons suffering from electric shock?	Yes/No
16.	Regulation 36	State insulation resistance between conductors and earth in Mega Ohms.	- --- Mega Ohms
17.	Regulation 37	(i) Whether a suitable linked switch, or circuit breaker is placed near the point of commencement of supply so as to be readily accessible and capable of being easily operated to completely isolate the supply?	Yes/No
		(ii) Whether every distinct circuit is protected against excess electricity by means of a suitable circuit breaker or cut-out ?	Yes/No
		(iii) Whether suitable linked switch or circuit breaker is provided near each motor or apparatus for controlling supply to the motor or apparatus?	Yes/No
		(iv) Whether adequate precautions are taken to ensure that no live parts are so exposed as to cause danger?	Yes/No
18.	Regulation 39	(i) Whether clear space of 100 cm is provided in front of the main switchboard?	Yes/No
		(ii) Whether the space behind the switchboard exceeds 75 cm in width or is less than 20 cm?	Yes/No
		(iii) In case the clear space behind the switchboard exceeds 75 cm, state whether a passage way from either end of the switchboard to a height of 1.80 metre is provided.	Yes/No
19.	Regulation 43	(i) Have the frame of every generator, stationary motor and so far as practicable, portable motor and the metallic parts (not intended as conductors) of all transformers and any other apparatus used for regulating or controlling electricity and all apparatus consuming electricity at voltage exceeding 250 V but not exceeding 650 V been earthed by two separate and distinct connections with earth?	Yes/No

		(ii) Have the metal casings or metallic coverings containing or protecting any electric supply line or apparatus been properly earthed and so joined and connected across all junction boxes as to make good mechanical and electrical connection?	Yes/No
		(iii) Whether the consumer's earth-electrode is properly executed and has been tested. If yes, give value of earth resistance?	Yes/No _____Ohm
		(iv) Is the earth wire free from any mechanical damage?	Yes/No
		(v) Whether record of earth resistance value maintained?	Yes/No
		(vi) Is the protective equipotential bonding tested?	Yes/No
		(vii) Is the fault loop impedance at origin of installation tested?	Yes/No
		(viii) Is the fault loop impedance of each circuit tested?	Yes/No
		(ix) Is the fault loop impedance tested for all sources?	Yes/No
20.	Regulation 44	Whether Residual Current Device of Appropriate capacity as defined in Regulation have been provided?	Yes/No
21.	Regulation 47	Have the protections and interlocks for the generating units been provided. Details of the protections shall be given.	Yes/No
22.	Overhead Lines	(i) State if the consumer has any overhead lines.	Yes/No
		(ii) Does the overhead line near the premises of consumer meets the requirement of regulations 60, 61 and 62? If not, give details.	Yes/No
		(iii) Is guarding provided for overhead lines as per regulation 76?	Yes/No
		(iv) Any other remarks.	Yes/No

Date:

Signature of the supplier/ Owner / Consumer

Name ____________________________

Designation _______________________

File No. _________________________

To: Office of Electrical Inspector for ………………...

FORM III

(See Regulation 32 and 45)

(Installations of voltage exceeding 650 V)

Report / Application No. ________

Date of inspection by Electrical Inspector or self-certification by supplier/owner/consumer

Date of last inspection or self-certification _______________

1. Consumer No. ____________________
2. Voltage and system of supply:

   (iii) Volts ____________(ii) No. of Phases ___________(iii) AC/DC ______________
3. Name of the consumer or owner __________________________
4. Address of the consumer or owner __________________________
5. Location of the premises __________________________
6. Particulars of the installations:

(a) Transformers: (complete detail to be enclosed)

Make	S. No.	kVA/MVA rating	Voltage rating	Type

(i) ____

(ii) ____

(b) Generators: (complete detail to be enclosed)

Make	S. No.	kVA/MVA rating	Voltage rating	Type

(v) ____

(vi) ____

(c) List of Motors with rating, protection, overload setting, size of earth conductor used to be furnished Make S. No. kW/MW rating Voltage rating Type

(iii) ____

(iv) ____

(d) List of equipment with complete details of HT /LT switchgears/ apparatus with their rating to be furnished):

(iii) ____

(iv) ____

(e) Total connected load kW / kVA ______________________________________

Complete list of connected loads to be furnished.

7. General condition of the installation:

Sl. No.	Regulation No.	Requirements	Report
1.	Regulation 3	Is the record of the designated persons properly made and kept up to date and duly attested?	Yes/No
2.	Regulation 5	Whether Electrical Safety Officer as required under the Regulation is designated?	Yes/No
3.	Regulation 14	(i) Is/Are there any visible sign(s) of overloading in respect of any apparatus?	Yes/No
		(ii) Whether any unauthorised temporary installation exist?	Yes/No
		(iii) Whether the motors and controlling equipment are being overhauled periodically and record kept of the same in a register?	Yes/No
		(iv) Whether the transformer oil samples are being tested periodically and results recorded in a register? State value of dielectric strength of oil.	Yes/No ---- kV/mm
		(v) Whether suitable lightning arresters have been provided near the transformers for protection against lightning?	Yes/No
		(vi) Whether earth resistance is being measured periodically once a year and results recorded in a register? Copy of record to be enclosed.	Yes/No
		(vii) Any other defect or condition which may be a source of danger. If yes, please explain?	Yes/No
		(viii) Whether operation and maintenance data has been clarified, categorised and computerised for prompt and easy retrieval?	Yes/No
		(ix) Whether residual life assessment and life extension programmes are being undertaken for installations or equipment of voltage exceeding 650 V (applicable for installations or equipment more than 15 years old)?	Yes/No
		(x) Whether all required type and routine tests at factory done for equipment? Deficiencies and discrepancies in above test report and results, if any, shall be reported.	Yes/No
		(xi) Are there deficiencies in construction with reference to Indian Standard requirements? Please specify.	Yes/No
4.	Regulation 15	Give report on condition of service lines, cables, wires, apparatus and such other fittings placed by the supplier or owner of the premises. If not satisfactory, give details.	Satisfactory/ Not Satisfactory

5.	Regulation 16	Whether suitable cut-outs/CBs provided by the supplier at the consumer's premises are within enclosed fire proof receptacle?	Yes/No
6.	Regulation 17	(i) Whether switches are provided on live conductors?	Yes/No
		(ii) Whether indication of a permanent nature is provided as per Regulation so as to distinguish earthed or earthed neutral conductor from the live conductor?	Yes/No
		(iii) Whether a direct line is provided on the neutral in the case of single-phase double pole iron clad switches/CBs instead of fuse?	Yes/No
7.	Regulation 18	(i) Whether earthed terminal is provided by the supplier?	Yes/No
		(ii) General visible condition of the earthing arrangement.	Satisfactory/ Not Satisfactory
8.	Regulation 19	(i) Are live parts in building inaccessible?	Yes/No
		(ii) Whether readily accessible switches have been provided for rendering them dead?	Yes/No
9.	Regulation 20	Whether "Danger Notice" in Hindi and the local language of the district and of a design as per the relevant standards is affixed permanently in conspicuous position?	Yes/No
10.	Regulation 21	(i) Whether the practice of working on live lines and apparatus is adopted? If so, have the safety measure been adopted as per Schedule I?	Yes/No
		(ii) Whether insulating floor or mats conforming to the relevant standards have been provided?	Yes/No
		(iii) Whether identification of panel has been provided on the front and the rear of the panel?	Yes/No
11.	Regulation 23	Whether flexible cables used for portable or transportable equipment covered under the Regulation, are heavily insulated and adequately protected from mechanical injury?	Yes/No
12.	Regulation 24	State the condition of metallic coverings provided for various conductors.	Satisfactory/ Not Satisfactory
13.	Regulation 26	Whether the circuits or apparatus intended for operating at different voltage(s) are distinguishable by means of indication(s) of permanent nature?	Yes/No
14.	Regulation 28	Whether all circuits and apparatus are so arranged that there is no danger of any part(s) becoming accidentally charged to any voltage beyond the limits of voltage for which it/they is/are intended?	Yes/No

15.	Regulation 29	(i) In the case of generating stations and enclosed sub stations, whether fire-buckets filled with clean dry sand have been conspicuously marked and kept in convenient location in addition to fire-extinguishers suitable for dealing with electric fires?	Yes/No
		(ii) Whether First Aid Boxes or cupboards conspicuously marked and properly equipped are provided and maintained?	Yes/No
		(iii) Is adequate staff trained in First Aid Treatment and firefighting?	Yes/No
16.	Regulation 30	(i) Whether 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 resuscitation of persons suffering from electric shock have been affixed in a "conspicuous place"?	Yes/No
		(ii) Are the persons mentioned in this regulation able to apply instructions for resuscitation of persons suffering from electric shock?	Yes/No
17.	Regulation 36	State insulation resistance between conductors and earth in Mega Ohms.	-----Mega Ohms
18.	Regulation 37	(i) Whether a suitable linked switch, or a circuit breaker, or an emergency tripping device is placed near the point of commencement of supply so as to be readily accessible and capable of being easily operated to completely isolate the supply?	Yes/No
		(ii) Whether suitable linked switch or a circuit breaker to carry and break the full load current is provided on the secondary side of a transformer?	Yes/No
		(iii) Whether every distinct circuit is protected against excess electricity by means of a suitable circuit breaker or cut- out?	Yes/No
		(iv) Whether linked switch or circuit breaker or emergency tripping device is provided near the motor or other apparatus at voltage exceeding 650 V but not exceeding 33kV for controlling supply to the motor or apparatus?	Yes/No
		(v) Whether adequate precautions are taken to ensure that no live parts are so exposed as to cause danger?	Yes/No
19.	Regulation 39	(i) Whether clear space of 100 cm is provided in front of the main switchboard?	Yes/No
		(ii) Whether the space behind the switchboard exceeds 75 cm in width or is less than 20 cm?	Yes/No
		(iii) In case the clear space behind the switchboard exceeds 75 cm, state whether a passage way from either end of the	Yes/No

		switchboard to a height of 1.80 metre is provided.	
20.	Regulation 46	(i) Whether all conductors and apparatus including live parts thereof are inaccessible	Yes/No
		(ii) Whether all windings of motors or other apparatus are suitably protected?	Yes/No
		(iii) Whether the separation wall or fire wall between apparatuses or consumer premises, in a substation or a switching station with apparatus having more than 2000 litres of oil are installed, have been provided as required under the regulation?	Yes/No
		(iv) Where 9000 litre or more of oil is used in any one oil tank, has provision been made for draining away or removal of oil which may leak or escape from such tank(s)?	Yes/No
		(v) Whether suitable firefighting system as per the regulation has been provided?	Yes/No
		(vi) Whether trenches inside substation containing cables are filled with non-inflammable material or completely covered with non-inflammable slabs?	Yes/No
		(vii) Are conductors and apparatus so arranged that they may be made dead in sections for carrying out work thereon?	Yes/No
21.	Regulation 47	Whether protections and interlocks have been provided? Give the details of the protection schemes and their settings.	Yes/No
22.	Regulation 50	(i) Have all non-current carrying metal parts associated with the installation been effectively earthed with the earthing system or mat by two separate and distinct connections?	Yes/No
		(ii) Is the earth wire free from any mechanical damage?	Yes/No
		(iii) Has the neutral point at the transformer and generator been earthed by two separate and distinct connections with earth?	Yes/No
		(iv) Have the metal casings or metallic coverings containing or protecting any electric supply line or apparatus been properly earthed and so joined and connected across all junction boxes as to make good mechanical and electrical connections throughout their whole length?	Yes/No
		(v) Whether earthing has been properly executed and has been tested. If yes, give value of earth resistance.	Yes/No ___Ohm
23.	Regulation 51	(i) Is the outdoor (except pole type) substation efficiently protected by fencing	Yes/No

		not less than 1.8 metre in height?	
		(ii) Whether the mounting of a transformer on a single pole or H pole is done as per relevant standard.	Yes/No
24	Regulation 52	(i) Where platform type construction is used for pole type substation, has sufficient space for a man to stand on the platform been provided?	Yes/No
		(ii) Has hand-rail been provided and connected with earth (if metallic and if substation has not been erected on wooden supports and wooden platform)?	Yes/No
25.	Regulation 53	Has suitable provision been made for immediate and automatic or manual discharge of every static condenser on disconnection of supply?	Yes/No
26	Overhead Lines	(i) What is the minimum size of the conductors of overhead lines used? State the type of conductors. (Regulation 57)	Minimum size of Conductor - --
		(ii) Whether clearances above ground of the lowest conductor of overhead lines are as per regulation 60? State clearance.	Yes/No --- metre
		(iii) On the basis of maximum sag, whether vertical clearances where the line of voltage exceeding 650 V passes above or adjacent to any building or part of a building as per regulation 63? State clearance.	Yes/No --- metre
		(iv) On the basis of maximum deflection due to wind pressure, whether horizontal clearances between the nearest conductor and any part of such building are as per regulation 63? State clearance.	Yes/No --- metre
		(v) Where conductors forming parts of system at different voltages are erected on the same supports, whether adequate provision has been made as per regulation 64 to guard against danger to linemen and others from the lower voltage system being charged above its normal working voltage by leakage from or contact with the higher voltage system?	Yes/No
		(vi) Where overhead lines cross or are in proximity to each other whether they have been suitably protected to guard against possibility of their coming in contact with each other as per regulation 71?	Yes/No
		(vii) Has every guard wire been properly earthed as per regulation 72 at each point at which its electrical continuity is broken?	Yes/No

		(viii) (a) Whether metal supports of overhead lines and metallic fittings attached thereto are permanently earthed as per regulation 74? (b) Has each stay-wire (except in case where an insulator has been placed in it at a height not less than 3 metre from the ground) been earthed as per regulation 74?	Yes/No Yes/No
		(ix) (a) Whether overhead line is suitably protected with a device for rendering the line electrically harmless in case it breaks as per regulation 76? (b) Whether anti-climbing devices have been provided at each support as per regulation 75?	Yes/No Yes/No
		(x) (a) Has the owner of overhead lines adopted efficient means for diverting to earth any electrical surges due to lightning in every overhead line which is so exposed as to be liable to injury from lightning as per regulation 77? (b) Whether earth lead from the lightning arresters is connected to a separate earth electrode as per regulation 77?	Yes/No Yes/No
		(xi) Whether unused overhead lines are maintained in a safe mechanical condition as per regulation 78?	Yes/No
		(xii) Whether statutory clearances from Authorities i.e. Forest Department/Railways/PTCC/Defence (AHQ) /Civil Aviation have been taken as per the relevant standards. If yes, enclose copies of the same.	Yes/No
		(xiii) Any other remarks.	Yes/No

In addition to above, following electrical equipment wise test details to be given, if applicable:

Sl. No.	Equipment	Test Conducted	Test Results	Remarks
1.	Linked Switch with fuses (s)	(i) Mechanical operation	Smooth/Trouble some	
		(ii) Rating of Fuse	- ---- Amps	
		(iii) Contact of blades	Full/Partial	
2.	Isolator (Sl. No.--- Make: Capacity:	(i) Mechanical operation	Ok/Not Ok	
		(ii) Remote Operation	OK/Not OK	
		(iii) Local Operation	OK/Not OK	
		(iv) Measurement of contact resistance		
		(v) Interlocking with earth switch	OK/Not OK	

		(vi) Interlocking with Circuit Breaker	OK/Not OK	
		(vii) IR Values • Open condition • Closed condition	Phase to Phase and Phase to Earth --- M Ohm - -- M Ohm --- M Ohm - -- M Ohm	
3.	Circuit Breaker (Circuit breaker location and no.) Circuit breaker control circuits	(i) Rating of Circuit Breaker • Type • Voltage • Normal Current • Rupturing Current	------------- - -------------kV - ------------ Amps - ------------- kA	
		(ii) IR Values • Open condition • Closed Condition	Phase to Phase and Phase to Earth --- M Ohm - -- M Ohm --- M Ohm - -- M Ohm	
		(iii) Contact Resistance including Dynamic Contact Resistance Measurement	- ---------- micro ohm	
		(iv) Mechanical Operation	Instant smooth /time gap (Sec.)	
		(v) Remote operation	OK/Not OK	
		(vi) Local Operation	OK/Not OK	
		(vii) Interlocking with Isolator	OK/Not OK	
		(viii) Interlocking with earth switch	OK/Not OK	
		(ix) Alarm and Trip for OTI/WTI/Buchholz/PRV /etc.,	OK/Not OK	
		(x) Earth Fault Relay	OK/Not OK	
		(xi) Over Current Relay	OK/Not OK	
		(xii) Under Voltage Relay	OK/Not OK	
		(xiii) other safety Alarms	OK/Not OK	
		(xiv) Whether all the provisions of Regulation 37 are satisfactory?	OK/Not OK	
4.	Transformer Transformer No., Location, (Transformer Sl. No. Make, Capacity, Voltage Ratio)	(i) Insulation Resistance Values • HT to LT • HT to Earth • LT to Earth	- -----------M ohm - -----------M ohm - -----------M ohm	
		(ii) Break down Voltage test • Oil sample I (Top) • Oil Sample II (Bottom)	- ------------kV - ------------kV	
		(iii) Vector Group Test	OK/Not OK	

		(iv) Polarity Tests	OK/Not OK	
		(v) Magnetic Balance	OK/Not OK	
		(vi) Tan Delta Test	OK/Not OK	
		(vii) Oil level in conservator tank	OK/Not OK	
		(viii) Oil level in breather cup	OK/Not OK	
		(ix) OTI/WTI settings	A/T--- ^{0}C/--- ^{0}C A/T--- ^{0}C/--- ^{0}C	
		(x) OTI/WTI alarm and trip operation	OK/Not OK	
		(xi) Operation of Buchholz relay	OK/Not OK	
		(xii) Operation of PRV	OK/Not OK	
		(xiii) Oil leakage	OK/Not OK	
		(xiv) Interlock of door switch of dry transformer	OK/Not OK	
		(xv) Clearances • Side Clearance: • Between two Transformers:	 - ------ cm - ------- Metre	
		(xvi) Body Earth Resistance	- -------- Ohm	
		(xvii) Neutral Earth Resistance	N_1---Ohm, N_2---Ohm	
		(xviii) Earth Flat Size Material used • Body: • Neutral:	 ----------- -----------	
		(xix) Operation of ON LOAD & OFF LOAD Tap Changers	OK/Not OK	
		(xx) Sweep Frequency Resonance Analysis Test (SFRA)	OK/Not OK	
		(xxi) Dielectric Frequency Resonance Analysis (DFRA) Test	OK/Not OK	
		(xxii) Partial Discharge Tests	OK/Not OK	
5	DG Generators: Generator No., Location, (Alternator and Engine Sl. No. Make, Capacity)	(i) Type of Generator		
		(ii) Interlocking with other supply sources	OK/Not OK	
		(iii) Body earth resistance	- -------- Ohm	
		(iv) Neutral earth resistance	N_1---Ohm N_2---Ohm	
		(v) Earth Flat Size, Material used (Cu/Al) • Body: • Neutral:	 ------------------ ------------------	
		(vi) Generator Protection details	------------------	

6.	Cable (Details to be given: size, length, type)	(i) Insulation Resistance Values: • Ph - Ph: • Ph – Earth: • Ph – Earth + other Ph:	- ------- M Ohm - ------- M Ohm - ------- M Ohm	
		(ii) Cable trays	Provided/ Not provided	
		(iii) Cable tray earthing	OK/Not OK	
		(iv) Cables bending radius	OK/Not OK ------------------------metre	
7.	Panels	(i) No. of panels	___Nos	
		(ii) Location of panel	To be enclosed	
		(iii) Rating of the panel	____Amp	
		(iv) Size and current rating of the main Bus bars and the distribution Bus bars of the panel	____mm, ____Amp	
		(v) Whether the Bus bar size of the panel suitable to rating of the panel	Yes/No	
		(vi) IP Protection of panel	________	
		(vii) Type of cable entry	Top Entry/Bottom Entry	
		(viii)No. of Incomers and Bus couplers in a Panel	___Nos	
		(ix) Ratings of the Circuit Breakers	____Amp	
		(x) No. of MCCBs of each rating in the panel	___Nos	
		(xi) No. of spare MCCBs of each rating	___Nos	
		(xii) Panel Clearance from the wall	____mm	
		(xiii)Clearance between two panels i.e. adjacent panels	____mm	
		(xiv) Whether all the provisions of Regulation 39 followed	Yes / No	
		(xv) Size of the Earth strip used for earthing of the panel	___sqmm	
8.	Earthing	(i) Metal and size of Earth Strips	Cu/Al/GI --- Sqmm	
		(ii) Type of earthing	Plate/Pipe/Counterpoise	
		(iii) Location and No. of earth electrode	____Nos	
		(iv) Values of Earth resistance of each earth electrode and Grid	_____Ω	
		(v) Earth mat resistance	_____Ω	

9.	Potential Transformer	(i) Ratio test	OK/not OK	
		(ii) Polarity test	OK/not OK	
		(iii) BDV of oil	- -------- kV	
		(iv) IR test	(R) P-E----- M Ohm (Y) P-E----- M Ohm (B) P-E----- M Ohm	
		(v) Tan Delta and Capacitance measurement	_______	
10.	Current Transformer	(i) Ratio test	OK/not OK	
		(ii) Polarity test	OK/not OK	
		(iii) BDV of oil	- -------- kV	
		(iv) IR test	(R) P-E----- M Ohm (Y) P-E----- M Ohm (B) P-E----- M Ohm	
		(v) Tan Delta and Capacitance measurement	_______	
11.	Overhead lines and DP structure	(i) Size of the poles of DP structure	_______	
		(ii) Clearance between phases to phase and phase to earth.	_______	
		(iii) Ground clearance of the conductors.	_______	
		(iv) Check of electrical clearance along the route of overhead line,	Ok/ Not Ok	
		(v) Check of guarding and clearance at road crossings.	Ok/ Not Ok	
		(vi) Check the footings of the poles.	Ok/ Not Ok	
		(vii) Earthing arrangements	Ok/ Not Ok	
		(viii) What is the minimum size of the conductors of overhead lines used? State the type of conductors.	_______	
		(ix) Whether all the provisions of regulation 60, 62, 63, 64, 71, 72 and 74 are satisfied.	Yes / No	

General Observations:		
1.	Check of phase to phase, phase to ground and sectional clearance	
2.	Check of Manufacture test reports of individual equipment (Copies to be enclosed)	
3.	General observation and views (Specific deviation from the requirements of the Regulations shall be clearly brought out)	

Date:

Signature of the supplier/ Owner / Consumer

Name ____________________________

Designation ________________________

File No. __________________________

To: Office of Electrical Inspector for ………………...

(For Self-certification by supplier /owner /consumer)

CERTIFICATE

[Under Regulation (32) and (45) of CEA (Measures relating to Safety & Electricity Supply) Regulation, 2023]

This is to certify that the electrical installation is complete in all respects and the work has been carried out conforming to the CEA (Measures relating to Safety & Electric Supply) Regulation, 2023 and relevant standards. The site tests done are found to be in order and it is electrically safe to operate the apparatus free from any danger.

Encl: Test reports

(Signature) (Signature)

Self-certifying supplier / owner / consumer Chartered Electrical Safety Engineer

Name ____________________ Name ____________________

File No. __________________

To: Office of Electrical Inspector for ………………...

Forms of Inspection Report

[See sub-regulation (3) of regulation (32)]

FORM IV

(Electrical Installations in Mine)

Report No.: ____________ Date of Inspection: ____________

Date of last inspection: ____________ Name of the Inspecting Officer: ___________

1. Name of the Mine:
2. Name of the Owner:
3. Name of the Agent:
4. Name of the Mine Manager:
5. Name of the Colliery Engineer:

6. Name of the Safety Officer:
7. Name of the designated Electrical Safety Officer:
8. Name of the Electrical Supervisor:
9. Name of the workman Inspector (Electrical) :
10. Name of the Engineer (concerned Section) :
11. Name of the working seam:
12. Working district Inspected:
13. Name of the persons accompanied during inspection:
14. Voltage and system of supply:
    (i) Volts _______________
    (ii) No. of Phases ___________
    (iii) AC/DC ______________
15. Particulars of the installations/ apparatus installed and their location as per mine plan:
16. Illumination level:
17. Percentage of methane/other explosive gas:
18. Dry bulb temperature, wet bulb temperature in case of underground mine:
19. Velocity/speed of air in case of underground mineL:
20. General conditions of the installation:

Sl. No.	Regulation No.	Requirements	Report
1.	Regulation 98	On or before the first day of February in every year, notice in the form set out in Schedule IX or Schedule X whichever is applicable is sent.	Yes/No
2.	Regulation 99	The plans specified under this regulation are kept in the office of the mine manager and available to the Inspector or inspector of mines.	Yes/No
3.	Regulation 100	(i) Whether adequate illumination by electricity without causing glare and strain has be provided in the mines?	Yes/No Satisfactory/ Not satisfactory
		(ii) Whether efficient means of communication is provided between the point where the switchgear under sub- regulation (1) Regulation 107 is erected, the shaft bottom and other distributing centers in the mine.	Yes/No Satisfactory/ Not Satisfactory
		(iii) Whether fire extinguishing appliances of adequate capacity and of an approved type are installed and properly maintained in every place containing apparatus, other than cables, telecommunication and signalling apparatus.	Yes/No Satisfactory/ Not Satisfactory

		(iv) Is minimum clearance above ground of the lowest conductor of overhead lines or overhead cables where dumpers or trackless vehicles are being operated, not less than twelve metre in height.	Yes/No
4.	Regulation 101	(i) Are transformers and switchgear placed in a separate room, compartment or box where necessary to prevent danger of mechanical damage?	Yes/No
		(ii) Is the room, compartment or box substantially constructed and kept dry and illuminated?	Yes/No
		(iii) Is efficient ventilation provided for all apparatus installed therein?	Yes/No
5.	Regulation 102	(i) Is earthing carried out by connection to an earthing system at the surface of the mine and in a manner approved by Electrical Inspector of mines?	Yes/No
		(ii) Are all metallic sheaths, coverings, handles, joint boxes, switchgear frames, instrument covers, switch and fuse covers of boxes, all lamp holders, unless efficiently protected by an insulated covering made of fire resisting material, and the frames and bedplates of generators, transformers and motors, including portable motors, earthed by connection to an earthing system in the manner specified in regulation 102?	Yes/No Satisfactory/ Not satisfactory
		(iii) Are all conductors, of an earthing system having conductivity, at all parts and all joints, at least equal to fifty per cent of that of the largest conductor used solely to supply the apparatus?	Yes/No
6.	Regulation 116	Whether the neutral or mid-point is earthed by connection to the earthing system in the manner specified in regulation 102.	Yes/No
7.	Regulation103	(i) Is automatically disconnection of supply to any part of the system, where a fault, including an earth fault, occurs and is the fault current limited to the specified values, by employing suitably designed, restricted neutral system of power supply?	Yes/No

		(ii) Whether the operation of the switchgear and the relays are recorded daily at the generating station, substation or switch station in a register kept for the purpose?	Yes/No
		(iii) Whether the effectiveness of the switchgear and the protective system being always kept and maintained in working order?	Yes/No
		(iv) Whether the switchgear and the protective system checked once every three months and the result thereof recorded in a separate register kept for the purpose?	Yes/No
8.	Regulation 104	(i) Is electricity transmitted into a mine at a voltage exceeding 11000 V and used therein at a voltage exceeding 6600 V?	Yes/No
		(ii) Is the voltage of hand-held portable apparatus used, not exceeding 125 V?	Yes/No Applicable/ Not applicable
		(iii) In belowground mines, whether the lighting system has a mid or neutral point connected with earth and the voltage not exceeds 125 V between phases is used?	Yes/No Applicable/ Not applicable
		(iv) On the surface of a mine or in an open cast mine, has the neutral or the midpoint of the lighting system is connected with earth and the voltage between the phases not exceeds 250 V?	Yes/No
		(v) Is the voltage of portable hand-lamps used in underground working of mine or oil-fields not exceeding 30 V?	Yes/No Applicable/ Not applicable
9.	Regulation 105	Where electricity is transformed, has suitable provision made to guard against danger by reason of the lower voltage apparatus becoming accidentally charged above its normal voltage by leakage from or contact with the higher voltage apparatus.	Yes/No
10.	Regulation 107	(i) Whether properly constructed switchgear for disconnecting the supply of electricity provided at a point approved by Electrical Inspector of mines?	Yes/No
		(ii) When any cable or overhead line supplying electricity from the aforesaid switchgear is live, whether a person designated to operate the said switchgears is available within	Yes/No

		easy reach thereof?	
		(iii) Whether the main mechanical ventilator operated by electricity interlocked with the switchgear so as to automatically disconnect the power supply in the event of stoppage of main mechanical ventilator?	Yes/No Applicable/ Not applicable
		(iv) Whether every motor is controlled by switchgear, arranged so as to disconnect the supply from the motor and from all apparatus connected thereto and whether such switchgear be so placed to easily operate by the person designated to operate the motor?	Yes/No
		(v) Is the switchgear so placed, disconnects the supply automatically, in the event of conditions of over-current, over-voltage and single phasing?	Yes/No
		(vi) Is the Auxiliary fan interlocked with the switchgear controlling power supply to the in bye face equipment of below ground coal mine for automatic disconnection of power supply in the event of the stoppage of the auxiliary fan?	Yes/No Applicable/ Not applicable
11.	Regulation 108	(i) Whether all cables are covered with insulating material and efficiently protected from mechanical damage and supported at sufficiently frequent intervals and in such a manner as to prevent damage to such cables?	Yes/No Satisfactory/Not satisfactory
		(ii) Whether all cables are protected by a metallic covering and which contain all the conductors of a circuit and the sheath of metal-sheathed cables and the metallic armouring of armoured cables is of a thickness not less than that recommended in the relevant Standard?	Yes/No Satisfactory/Not satisfactory
		(iii) Is the metallic covering of every cable electrically and mechanically continuous throughout, earthed by a connection to the earthing system of conductivity specified therein and efficiently protected against corrosion?	Yes/No Satisfactory/Not satisfactory

		(iv) Whether the metallic covering of every cable is having a conductivity at all parts and at all joints at least equal to fifty per cent of the conductivity of the largest conductor enclosed by the said metallic covering?	Yes/No Satisfactory/Not satisfactory
		(v) Are the cables and conductors where connected to motors, transformers, switchgear and other apparatus, installed so that they are mechanically protected by securely attaching the metallic covering to the apparatus and the insulating material at each cable end is efficiently sealed so as to prevent the diminution of its insulating properties?	Yes/No Satisfactory/Not satisfactory
		(vi) Whether properly constructed and certified glands or bushes are used to prevent abrasion or to secure gas-tightness?	Yes/No
12.	Regulation 109	(i) Whether flexible cables used for portable or transportable apparatus are covered with insulating material which shall be efficiently protected from mechanical injury?	Yes/No
		(ii) Is the flexible metallic covering of a cable, used by itself to form an earth conductor for such apparatus without an earth conductor?	Yes/No
		(iii) Whether every flexible cable intended for use with portable or transportable apparatus connected to the system and to such apparatus by properly constructed connectors?	Yes/No
		(iv) At every point where flexible cables are joined to main cables, is a circuit breaker provided which is capable of automatically disconnecting the supply from such flexible cables?	Yes/No
		(v) Is every flexible cable attached to a portable or transportable machine examined periodically by the designated person?	Yes/No
		(vi) Whether flexible cable exceeding in specified length being used with any portable or transportable?	Yes/No
		(vii) Are flexible cables used with apparatus other than portable or transportable apparatus?	Yes/No
13.	Regulation 110	Whether all portable and transportable machines operate on remote control from the concerned switchgear with relevant provision?	Yes/No

14.	Regulation 111	(i) Whether all apparatus maintained reasonably free from dust, dirt and moisture, and kept clear of obstruction?	Yes/No Satisfactory/ Not satisfactory
		(ii) Whether the following notices in Hindi and local language of the district, so designed and protected as to be easily legible at all times, be exhibited at the following places, namely: – • where electrical apparatus is in use, a notice forbidding undesignated persons to operate or otherwise interfere with such apparatus; • in the interior or at the surface of the mine where a telephone or other means of communication is provided, a notice giving full instructions to person, at the surface of the mine, designated to effect the disconnection of the supply of electricity to the mine?	Yes/No Yes/No
		(iii) Whether all apparatus, including portable and transportable apparatus, operated only by those persons who are designated for the purpose?	Yes/No
		(iv) Where a plug-and-socket-coupling other than of bolted type is used with flexible cables, whether an electrical inter-lock or other approved device provided to prevent the opening of the coupling while the conductors are live?	Yes/No
15.	Regulation 112	Give report on the compliance of provisions of this regulation as the case maybe.	Satisfactory/Not satisfactory
16.	Regulation 114	(i) Whether adequate precautions are taken to prevent signal and telephone wires coming into contact with other cables and apparatus?	Yes/No
		(ii) Is the voltage used in any one circuit not exceeding 30 V?	Yes/No
17.	Regulation 115	(i) Whether haulage by electric locomotives on the overhead trolley-wire system, at voltage not exceeding 650V?	Yes/No
		(ii) Whether haulage by storage battery locomotives used with the prior consent in writing of the Electrical Inspector of mines?	Yes/No

18.	Regulation 117	(i) Whether electrical supervisors, as directed by Electrical Inspector of mines are appointed in writing by the owner, agent or manager of a mine or by the agent or the owner, of one or more wells in an oil-field to supervise the installation?	Yes/No
		(ii) Whether electricians as directed by the Electrical Inspector of mines, are appointed in writing by the owner, agent or manager of a mine or by the agent or the owner, of one or more wells in an oil-field for compliance with the duties specified in this regulation?	Yes/No
		(iii) Whether persons appointed to operate, supervise, examine or adjust any apparatus are competent to undertake the work which he is required to carry out as directed by the Engineer?	Yes/No Satisfactory/Not satisfactory
		(iv) Whether the electrical supervisor is maintaining log-book made up of the daily log sheets prepared in the form set out in Schedule-XI?	Yes/No
19.	Regulation 118	Whether the persons engaged for operation and maintenance of electrical installations have undergone training meant for the particular mining installations	Yes/No Satisfactory/Not satisfactory

Date:

Signature of the Inspecting Officer

Name ____________________

Designation _______________

File No. __________________

Copy forwarded to Electrical Inspector for ………………....

Schedule III

Form for obtaining test results by supplier at each supply point to consumer [See sub-regulation (4) of regulation (33)]

1. Name and address of the consumer
2. Details of installation
3. Short circuit fault level of the installation
4. Date of commissioning of installation (in case of additional supply or reconnection)
5. Results of tests conducted:

Sl. No.	Equipment	Test Conducted	Test Results	Remarks
1.	Linked Switch with fuse(s)	(i) Mechanical operation	Smooth/troublesome	
		(ii) Rating of fuse	- -------- Amp.	
		(iii) Contact of blades	Full/Partial	
2.	Isolator	(i) Mechanical operation	OK/not OK	
		(ii) Remote operation	OK/Not OK	
		(iii) Local operation	OK/Not OK	
		(iv) Measurement of contact resistance	- ----------- micro Ohm	
		(v) Interlocking with earth switch	OK/Not OK	
		(vi) Interlocking with CB	OK/Not OK	
		(vii) IR Values • Open condition • Closed condition	Ph-Ph Ph-E --- M Ohm --- M Ohm --- M Ohm --- M Ohm	
3.	Circuit Breaker Sl. No. ------ Circuit Breaker Control Circuits	(i) Rating of Circuit Breaker (a) Type (b) Voltage (c) Normal Current (d) Rupturing capacity	------------------- -------------------- kV ------------------- Amps ------------------- KA	
		(ii) IR Values • Open condition • Closed condition	Ph-Ph Ph-E --- M Ohm --- M Ohm --- M Ohm --- M Ohm	
		(iii) Contact Resistance	- ---------- micro Ohm	
		(iv) Mechanical operation	Instant smooth/ time gap (Sec.)	
		(v) Remote operation	OK/Not OK	
		(vi) Local operation	OK/Not OK	
		(vii) Interlocking with isolator	OK/Not OK	
		(viii) Interlocking with earth switch	OK/Not OK	
		(ix) Alarm and Trip for OTI/ WTI/ Buchholz / PRV	OK/Not OK	
		(x) Earth Fault Relay	OK/Not OK	
		(xi) Over Current Relay	OK/Not OK	

		(xii) Under Voltage Relay	OK/Not OK	
		(xiii) SF_6 pressure alarm and trip operation test	OK/Not OK	
4.	Transformer Sl. No. ----	(i) Insulation Resistance Values: • HT to LT • HT to Earth • LT to Earth	- -----------M ohm - -----------M ohm - -----------M ohm	
		(ii) Break down Voltage Test • Oil Sample – I (Top) • Oil Sample – II (Bottom)	------------ kV ------------ kV	
		(iii) Vector Group Test	OK/Not OK	
		(iv) Polarity Tests	OK/Not OK	
		(v) Magnetizing Balance	OK/Not OK	
		(vi) Tan Delta Test (as per capacity)	OK/Not OK	
		(vii) Oil level in conservator Tank:	OK/Not OK	
		(viii) Oil level in breather cup	OK/Not OK	
		(ix) OTI/WTI settings	A/T---- ^{0}C A/T -------------------- ^{0}C	
		(x) OTI/WTI alarm and trip operation	OK/Not OK	
		(xi) Operation of Buchholz relay	OK/Not OK	
		(xii) Operation of PRV	OK/Not OK	
		(xiii) Oil leakage	OK/Not OK	
		(xiv) Interlock of door switch for dry transformer	OK/Not OK	
		(xv) Clearances for • Side clearance • Between two Transformers	- --------Cms - -------- Metre	
		(xvi) Body earth resistance	- -------- Ohm	
		(xvii) Neutral earth resistance	N_1---Ohm N_2---Ohm	
5.	DG Set Sl. no. for • Alternator : • Engine:	(i) Interlocking with other Supply Sources	OK/Not OK	
		(ii) Body earth resistance	- -------- Ohm	
		(iii) Neutral earth resistance	N_1---Ohm N_2---Ohm	

6.	Cables Size---- Sq. mm	(i) Insulation Resistance Values: • Ph - Ph : • Ph – Earth: • Ph – Earth + other Ph:	-------- M Ohm ------- M Ohm ------- M Ohm	
		(ii) Bending Radius	OK/Not OK	
7.	Earthing	(i) Metal and Size of Earth Strips	Cu/Al/GI --- Sq. mm	
		(ii) Type of Earthings: • Plate Earthing • Pipe Earthing • Counter poise Earthing	Yes/No Yes/No Yes/No	
		(iii) Values of earth resistances of earth electrodes for • Reactor Neutral: • LAs: • Structure: • Frames/Bodies of equipment: • Motors:	N_1 ----ohm N_2 ------------------- ohm (R) ---ohm (Y) ------------------- ohm (B) --- ohm ------ ohm ------ ohm ------ ohm	
8.	Potential Transformer	(i) Ratio test	OK/Not OK	
		(ii) Polarity test	OK/Not OK	
		(iii) BDV of oil	-------- kV	
		(iv) IR test	(R) P-E----- M Ohm (Y) P-E----- M Ohm (B) P-E----- M Ohm	
9.	Current Transformer	(i) Ratio test	OK/Not OK	
		(ii) Polarity test	OK/Not OK	
		(iii) BDV of oil	-------- kV	
		(iv) IR test	(R) P-E----- M Ohm (Y) P-E----- M Ohm (B) P-E----- M Ohm	
10.	Transmission line	(i) Physical condition of conductor/tower (ii) Check of tower accessories	OK/Not OK OK/Not OK	
		(iii) Tower footing resistance	-------- Ohm	
		(iv) Conductor continuity test	OK/Not OK	

		(v) Check of ground clearance	OK/Not OK	
		(vi) Check of electrical clearance along the route	OK/Not OK	

General Observations:

Sl. No.	Item	Observations
1.	Check of required phase to phase, phase to ground and sectional clearance.	
2.	Check of equipment lay out and over all installation details.	
3.	Test of resistance of earth mat or earth electrodes as applicable.	
4.	Check of consumer's pre-commissioning test reports of individual equipment.	
5.	Check of manufacturer‟s routine/type test reports of individual equipment.	
6.	Whether Inspector‟s approval if applicable is obtained?	
7.	Whether owner‟s self-certification about compliance with the Regulations is obtained?	
8.	General observation and views (specific deviation from the requirements of the Regulations shall be clearly brought out).	

Name, Signature and Seal of the Authority

Schedule IV

Form for notice in respect of failure of supply
[See sub-regulation (3) of regulation (41)]

(1) Name and address of the supplier :
(2) Date and time of failure of supply :
(3) Areas affected due to failure :
(4) Causes of failure :
(5) Probable time for restoration of supply :
(6) Additional information, if any :

Date :

(Name, Signature, Designation and Seal of Authoity)

Place:

Time:

Schedule V

Minimum safety working clearances where electricity at voltage exceeding 650 V is supplied, converted, transformed or used

[See sub-regulation (2)(iii) of regulation (46)]

Highest System Voltage (kV)	Safety Working Clearance (Metre)
12	2.6
36	2.8
72.5	3.1
145	3.7
245	4.3
420	6.4
800	10.3

(1) The above values are valid for altitude not exceeding 1000 m. A correction factor of 1.25 per cent per 100 m is to be applied for increasing the clearance for altitude more than 1000 m and up to 3000 m;
(2) The above safety working clearances are based on an insulation height of 2.44 m which is the height of lowest point on the insulator, where it meets the earthed metal, from the ground;
(3) "Safety Working Clearance" is the minimum clearance to be maintained in air between the live part of the equipment on one hand and earth or another piece of equipment or conductor on which it is necessary to carry out the work, on the other;
(4) The "Highest System Voltage" is defined as the highest rms phase to phase voltage which occurs under normal operating conditions at any time and at any point of the system. It excludes voltage transients (such as those due to system switching) and temporary

voltage variations due to abnormal system conditions (such as those due to fault conditions or the sudden disconnection of large loads).

Schedule VI

Minimum safety clearances to be maintained for bare conductors or live parts of any apparatus in out- door HVDC substations, excluding overhead lines of HVDC istallations

[See sub-regulation (3) of regulation (46)]

Sl. No.	DC Voltage (kV)	Pole to Earth Clearance (Metre)	Ground Clearance (Metre)
1.	100 kV	1.17	4.55
2.	200 kV	1.80	5.65
3.	300 kV	2.45	6.75
4.	400 kV	3.04	8.00
5.	500 kV	3.65	9.00
6.	600 kV	3.98	10.10
7.	800 kV	5.30	11.20

(1) The above ground clearances are not applicable to equipment that are housed within fence or a building and where access is prevented under energised condition through a suitable safety interlocking scheme;

(2) The above pole to earth clearances are for conductor-structure electrode configuration using gap factor k equal to 1.35.

(3) It is recognised that within a substation many different types of electrode configurations shall be there with different values of k, therefore, the above clearance shall be modified based upon the values of gap factor for a particular electrode configuration subjected to the minimum ground clearance.

(4) Clearance shall be provided for electrical apparatus so that sufficient space is available for easy operation and maintenance without any hazard to the operating and maintenance personnel working near the equipment and for ensuring adequate ventilation.

Schedule VII

Part-A

Form for reporting failure of transformer & reactor of 220 kV and above voltage class

[See sub-regulation (8) of regulation (48)]

1.	Name of Substation	:	

2.	Utility	:	
3.	Faulty Equipment (ICT/auto-transformer/GT/reactor etc.)	:	
4.	Rating (MVA/MVAR, Voltage ratio, 1-phase/3phase)	:	
5.	Make (Original equipment manufacturer)	:	
6.	Serial No.	:	
7.	Date and time of occurrence of fault	:	
8.	Fault discovered during operation or periodic testing/ maintenance	:	
9.	Year of manufacturing	:	
10.	Date of commissioning	:	
11.	Sequence of events/Description of fault (SoE with time stamp, protection operated during fault)	:	
12.	Details of tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	
13.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer/ reactor and nearby equipment/ material etc.)	:	
14.	Probable cause of failure	:	
15.	If original equipment manufacturer representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	
16.	Present condition of equipment (Whether repairable or beyond repair)	:	
17.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	
18.	Details of any previous failure on the same unit	:	
19.	Is tertiary winding provided	:	Yes/No

20.	Is tertiary loaded? If yes, specify load on tertiary	:	Yes/No
21.	Whether tertiary terminals are bare/ insulated?		
22.	Details of protection for tertiary	:	
23.	Whether relay time is synchronised with UTC?	:	Yes/No
24.	Bushing details (OIP/RIP/RIS, porcelain /polymer housing)	:	
25.	On Load Tap Changer or Off Circuit Tap Changer	:	
26.	Tap position of OLTC at the time of failure	:	
27.	Past record of operation of OLTC	:	
28.	Tap range	:	
29.	Details of P\protection providedfor transformer/GT/reactor	:	
30.	Details of Protection operated	:	
31.	Whether equipment is properly earthed	:	
32.	Earth resistance of substation and date of its measurement	:	
33.	Surge arrester: (a) Is SA provided for protection? (b) Whether healthiness of SA is monitored? (c) Whether reading of SA counter changed during failure?	:	Yes/No Yes/No Yes/No
34.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	
35.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	
36.	Type of fire protection provided (Emulsifier system/ N_2 Injection based fire protection system/ foam based protection etc.)	:	
37.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	
38.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ oil-field illed	:	

39.	Whether short circuit test was carried out on this transformer or same design transformer/reactor or short circuit withstand capability was verified on the basis of calculation?	:	
40.	Number of through faults the equipment was subjected to before failure	:	
41.	Attach the following: (a) Single Line Diagram of the substation (b) Photographs of the failed equipment (c) Disturbance Recorder/Even Logger Data (d) Reports of tests conducted after (e) failure (f) Factory test results (g) Pre-commissioning test results (h) Protection schematic diagram	:	

(Signature and name of Manager/

Executive Engineer of the installation)

Contact details (Address /Mobile No./Phone No./Email)

To,

The Secretary

Central Electricity Authority

Sewa Bhawan, R .K. Puram

New Delhi-110066

Part-B

Form for reporting failure of towers of 220 kV and above voltage class transmission lines

[See sub-regulation (8) of regulation (48)]

1. Name of Transmission line with voltage level:
2. Date and time of occurrence/discovery of failure:
3. Length of line (km):
4. Type of configuration: (S/C, D/C, M/C, S/C strung on D/C towers, narrow base and the like):
5. Number of Towers and Type of Towers failed:

   [Suspension/ tension/ dead end/ special tower/ river crossing tower/ Power line crossing/ Railway Crossing etc., with/ without extension (indicate the type & length of extension)]

6. Tower location no. with reference to nearest substation (indicate Name):
7. Name and size of conductor:
8. No. of sub-conductors per bundle and bundle spacing:
9. Number and size of earth wire/ OPGW (if provided):
10. Type of insulators in use (Porcelain/ Glass/ Polymer):
11. Configuration of insulators (I/ V/ Y/ tension):
12. No. of insulators per string and no. of strings per phase:
13. Year of construction/ commissioning:
14. Executing agency:
15. Weather condition on the date of failure:
16. Terrain category:
17. Reliability level:
18. Wind zone (1/2/3/4/5/6) and velocity of wind:
19. Details of earthing of tower (pipe type/ counter poise):
20. Line designed as per IS:802 (1977/1995/2015 any other code):
21. The agency who designed the line:
22. Any special consideration in design:
23. Details of last maintenance activity along with date:
24. Power flow in the line prior to failure:
25. Any missing member found before/ after failure of towers:
26. Condition of foundation after failure:
27. Brief description of failure:
    [Along with photographs (if available), other related information like tower schedule, newspaper clipping for cyclone / wind storm etc.]
28. Probable cause of failure:
29. Details of previous failure of the line/ tower:
30. Whether line will be restored on ERS or spare tower will be used:
31. Likely date of restoration:
32. Present status:
33. Details of any tests carried out after failure (attach test reports):
34. Wind speed data of date & time of failure from nearby authorised observatory:
35. Location of failed tower:
    a. Location Coordinates:
    b. Nearest Airport:
    c. District and State:
36. Single line diagram/ clearance diagram of failed tower(s) with all dimensions (horizontal & vertical dimensions including base width of tower):
37. Tower weight:

38. Tower spotting data:
39. Tower schedule of affected section:
40. Sag-tension calculation considered for design of tower:
41. Design document of failed towers:
42. Any other relevant information:

Date:

(Signature and name of Manager/
Executive Engineer/ Incharge of the installation)
Contact details (Address /Mobile No./Phone No./Email)

To,

The Secretary

Central Electricity Authority

Sewa Bhawan, R.K. Puram

New Delhi-110066

Schedule VIII A

Minimum clearance in air above ground and across road surface of Highways or roads or railway corridors or navigational or non-navigational rivers for lowest conductor of an alternating current overhead lines, including service lines of nominal voltage system.

[See sub-regulation (1) of regulation (60)]

Nominal voltage of system	Clearance above ground			Clearance between conductor and road surface across Highway (m)	Clearance between conductor and rail level across Railway Corridor (m)		Clearance above HFL for River crossing	
	Across Street (m)	Along Street (m)	Elsewhere (m)		Normal OHE (where no double stack containers are to be run on railway tracks.)	High rise OHE for running of double stack containers on railway tracks.	Navigational river (m)	Non-navigatiional river (m)
Up to 650 V	5.80	5.50	4.60	U/G Cable	U/G Cable	U/G Cable	16.50	5.80
11 kV	6.50	5.80	4.60	U/G Cable	U/G Cable	U/G Cable	19.00	6.50
22 kV	6.50	5.80	5.20	U/G Cable	U/G Cable	U/G Cable	19.00	6.50
33 kV	6.50	5.80	5.20	11.60 or U/G Cable	U/G Cable	U/G Cable	19.00	6.50
66 kV	6.50	6.10	5.50	11.60 or U/G Cable	U/G Cable	U/G Cable	19.00	6.50
110 kV	6.50	6.10	6.10	11.60	15.56	17.56	19.00	6.50
132 kV	6.50	6.10	6.10	11.60	15.56	17.56	19.22	6.50
220 kV	7.02	7.02	7.02	12.52	16.46	18.46	20.10	7.02
400 kV	8.84	8.84	8.84	14.00	18.26	20.26	21.90	8.84
765 kV	18.00*	18.00*	18.00*	18.80	21.86	23.86	25.55	18.00
1200 kV	24.00*	24.00*	24.00*	30.00	25.46	27.46	29.90	24.00

For navigable rivers, clearances shall be fixed in relation to the tallest mast in consultation with the concerned navigational/port authorities.

* Higher clearance due to predominantly induction effects and time varying electric field (ICNIRP limit: 10kV/m for occupational exposure) at voltage exceeding 400 kV.

Schedule VIII B

The minimum clearance in air above ground and across road surface of Highways, or Minimum clearance between conductor and Rail Level or navigational or non-navigational rivers for lowest conductor of high voltage direct current overhead line of nominal voltage system [See sub- regulation (2) of regulation (60)]

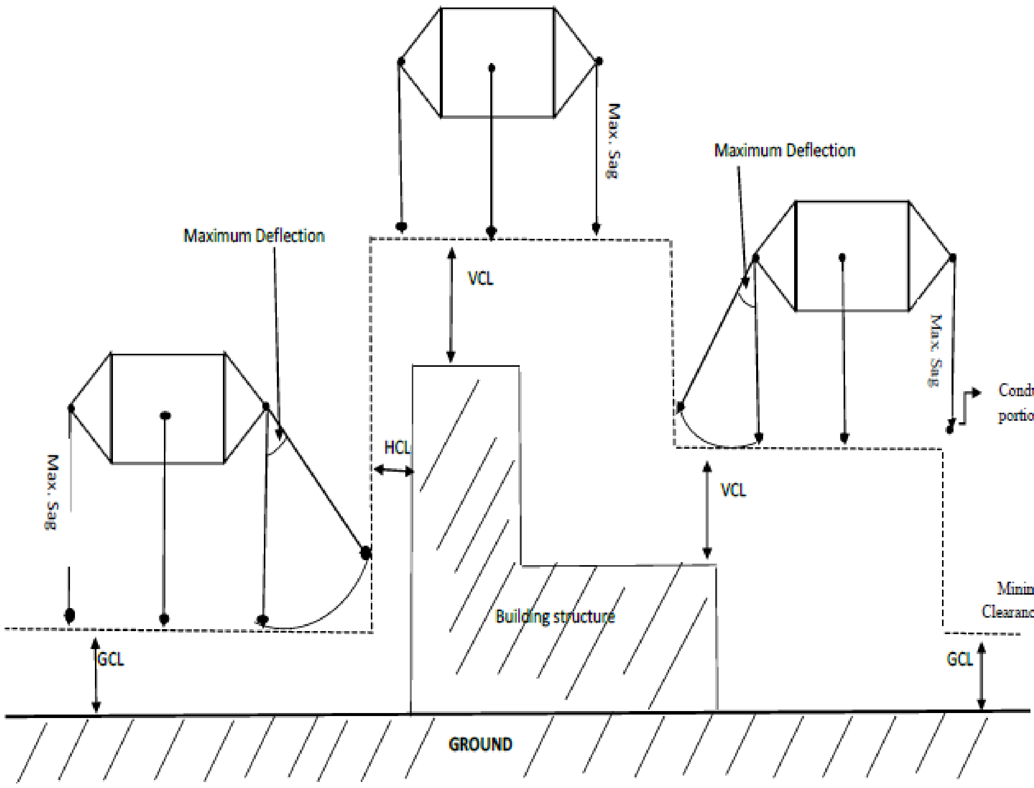
Sl. No.	DC Voltage	Ground Clearance (m)	Clearance between conductor and road surface across Highway (m)	Minimum clearance between conductor and Rail Level (m)	Clearance above HFL for River crossing	
					Navigational River (m)	Non-navigatiional River (m)
1.	100 kV	6.50	11.25	#	19.00	6.50
2.	200 kV	7.30	12.05	#	19.90	7.30
3.	300 kV	8.50	13.25	#	20.90	8.50
4.	400 kV	9.40	14.15	#	21.90	9.40
5.	500 kV	12.50	17.25	21.23	22.90	12.50
7.	800 kV	18.00	22.75	25.74	25.90	18.00

1. Highway clearances required 4.75 m higher then ground clearances (considering the vehicle hight is 4.75, as mentioned in the Indian Road Congress documents, 1983).
2. # Railway clearances required 10% higher value than HVAC values (HVAC values are mentioned in Indian Railway document: IRSOD, 2004).
3. Navigational River clearances as mentioned in the Regulation of Inland Waterways Authority of India (Classification of Inland Waterways in India), Regulation, 2006.

Schedule VIII C

Ground, Vertical and Horizontal clearances

[See sub-regulation (1) of regulation 60, sub-regulation (5) of regulation 62 and sub-regulation (5) of regulation 63]



GCL: Ground Clearance as per regulation 60

VCL: Vertical Clearance as per regulation 62 and 63

HCL: Horizontal Clearance as per regulation 62 and 63

Schedule IX

FORM OF ANNUAL RETURN FOR MINES

[See sub-regulation (1) of regulation 98]

This form must be correctly filled up by the owner, agent, manager or engineer and sent to the Electrical Inspector of mines not later than the first day of February every year.

Part A

Year ending: ___

Name of Mine: State:

Situation of Mine: District:

Postal address of Mine:

Name and address of owner:

Name of agent:

Name of manager:

Name of engineer:

Name of Electrical Supervisor:

Part B

(1) System of supply (whether direct current or alternating current): Voltage of supply:

Periodicity (if alternating current): Source of supply:

(2) Voltage at which electricity is used for: -

Lighting:

Power:

(3) Particulars of motor etc.: -

POWER

(a) On Surface

Type of Motor (HP/KW)/ apparatus and voltage	Type of control gear	Location	Purpose for which used

(b) In Mine

Type of Motor (HP/KW)/ apparatus and voltage	Type of control gear	Location	Purpose for which used	Ventilation	Percentage of inflammable gas or vapour

(c) Lighting

Type of light fitting	Wattage	Location	Percentage of inflammable gas or vapor

Schedule X

FORM OF ANNUAL RETURN FOR OIL-FIELDS

[See sub-regulation (1) of regulation 98]

This form must be correctly filled up by the owner, agent, manager or engineer and sent to the Electrical Inspector of mines not later than the first day of February every year.

Part A

Year ending: ___

Name of Oil-field: State:

Situation of Oil-field: District:

Postal address of Oil-field:

Name and address of owner:

Name of agent:

Name of manager:

Name of engineer:

Name of Electrical Supervisor:

Part B

(1) System of supply (whether direct current or alternating current): Voltage of supply:

Periodicity (if alternating current): Source of supply:

(2) Voltage at which electricity is used for: -

Lighting:

Power:

(3) Particulars of motor etc.: -

(a) On wells

No. or other identifying mark of well	Drilling or pumping	Type and H.P of motor	No. of lamps and type	Other electrical appliances
1	2	3	4	5

(b) Not on wells

Type and rating of motor	Purpose for which used	Identifying mark on map
1	2	3

(4) Other electrical appliances, not including in item 3, in use on the field: -

Appliances type and size in KW	Purpose for which used	Identifying mark on map

Schedule XI

LOG SHEET FOR MINES AND OIL-FIELDS

[See sub-regulation (9) of regulation 112, sub-regulation (9) of regulation (117)]

Daily log sheet for:

(1) Name of Electrical Supervisor

(2) Report as to:-

(a) Condition of the insulation of the system.

(b) Specified defects of insulation (particulars of each failure of apparatus should be given).

(c) Accidents or dangerous occurrence (including any cases of electric shock and any cases of open sparking in apparatus in use in places where regulation 112 applies.

(d) Disconnection and reconnection of supply as required by sub-regulation (9) of regulation 112.

(e) Examination of earth fault detectors or recorders as provided by sub-regulation (3) of regulation 102.

(f) Examinations of apparatus as provided by regulation 117.

(i) Routine examinations as required by of sub-regulation (9) of regulation 117.

(ii) Special examination* as required by of sub-regulation (9) of regulation 117.

(3) Remarks: -

Signed

Examined by

Electrical Supervisor:

Engineer:

Manager.

*State which apparatus has been examined or tested and its result.

Note: - This log sheet should be filled in as completely as possible. If, for instance, there are no defects of insulation to report, the word ‘none’ should be written in the vacant space.