KERALA STATE ELECTRICITY BOARD LIMITED

(Incorporated under the Companies Act, 1956)

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ABSTRACT

Technical Standards for Communication Systems in KSEBL- Approved- Orders issued.

Corporate Office(SBU-T)

B.O.(FTD)No. **204** /2021/D(T&SO)/T4/SO/Tech Standard/2020-21 dated Thiruvananthapuram 16.03.2021

Read : 1. Letter No. CESO/Tech/Comm/Technical Standards/2020-21/2337 dated 30.12.2020 of the Chief Engineer (Transmission System Operation).

2. Note No. D (T&SO) / T4 / SO/Tech Standard/2020-21/257 dated 04.03.2021 of the Director(T&SO) to the Full Time Directors (Agenda : 16/3/21).

ORDER

The Central Electricity Authority (Technical Standards for Communication Systems in Power System Operation) Regulations 2020 came into force on 27th February 2020. To achieve standardisation of Communication systems in KSEBL in line with the CEA standards, the Chief Engineer (Transmission System Operation) has forwarded the "Technical Standards for Communication Systems in KSEBL " for approval.

The Chief Engineer (TSO) , as per letter read as 1st above reported the following with respect to the "Technical standards" submitted for approval:-

- " Technical Standards for Communication Systems in KSEBL " is written in line with the Central Electricity Authority (Technical Standards for Communication Systems in Power System Operation) Regulations 2020 and most of the clauses are same as that of the CEA Regulations.
- Explanations and some modifications are added for better understanding in KSEBL context.
- Some clauses in the CEA regulations are not included in the Standards prescribed for KSEBL as they have no relevance in the present KSEBL scenario. Chapters VII (Very Small Aperture Terminal Communication), Chapter VIII (Radio Frequency Communication) of the CEA Regulations are not included in the Technical Standards for KSEBL, as such systems are not there in KSEBL at present and may not come in future.
- Some clauses which are very relevant for KSEBL's day to day applications , but not seen explained in the CEA regulations have been included under the head " Specific Technical Requirements".

The "Technical Standards for Communication Systems in KSEBL " was placed before the Full Time Directors for approval as per note read as 2nd above .

Having considered the matter in detail, the Full Time Directors, in the meeting held on 9.03.2021 resolved to approve the " Technical Standards for Communication Systems in KSEBL ", prepared in compliance with the CEA (Technical Standards for Communication Systems in Power System Operation) Regulations ,2020, attached as Annexure and to implement in KSEBL from the date of the Board order.

Orders are issued accordingly.

By Order of the Full Time Directors
Sd/-
Lekha G.
Company Secretary (In- Charge)

To :

The Chief Engineer(Transmission System Operation)

Copy to:

The Deputy Chief Engineers, System Operation Circles (Thiruvananthapuram, Kalamassery, Kannur)
The Deputy Chief Engineer(IT)
The Financial Adviser/ The Chief Internal Auditor.
The RCAO/ RAO.
The TA to Chairman & MD/ D(T&SO)/ D(D, IT&HRM)/ D(G-C)/ D(G-E& SCM)/D(P,S&REES)
The PA to Director (Finance)/CA to Company Secretary
Fair Copy Superintendent/Library/Stock File.

Forwarded / By Order

Assistant Executive Engineer

Annexure

Kerala State Electricity Board Limited

Technical Standards for Communication Systems in KSEBL

In compliance with the Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations, 2020)

Contents

CHAPTER 1
PRELIMINARY

1. Short title and commencement

(1) These standards shall be called the Technical Standards for Communication System in KSEBL.

(2) They shall come into force on the date of their Board Order.

2. Reference

These standards are written in line with the Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations, 2020). Most of the clauses are same as that of the regulations and some explanations are added or modified for better understanding in KSEBL context. Some clauses in the regulation are not included, as these have no relevance in the present KSEBL scenario. The chapters for V-sat systems and radio systems are omitted completely from this volume, as these systems are not with KSEBL at present or may not come in near future. Some clauses which are very relevant for KSEBL's day to day applications but not explained in the regulation, are added under the head 'Specific technical requirements'. If there is any conflict between these standards and regulation arises, the regulation shall be standing.

3. Definitions

In these standards, unless the context otherwise requires –

(1) "automatic generation control" 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;

(2) "approach cable" means the underground optical cable used to connect OPGW from substation gantry to communication room;

(3) "auxiliary Power Supply" means dedicated DC power source in which the communication equipments work, which consist of battery and battery

charger;

(4) "backbone network" means a wideband network having larger bandwidth in which different sub networks are connected making way for the passage of data between these sub networks; this is also referred as core network in which SLDC and BLDC are connected;

(5) "Backup Load Despatch Centre (BLDC)" means a control centre capable of doing all functions of State Load Despatch Centre (SLDC); this will take over all activities of SLDC during the shutdown of SLDC. The SLDC is at Kalamassery and BLDC is at Thiruvananthapuram.

(6) "bulk consumer" means a consumer who avails supply at 33kV or above;

(7) "communication channel" means a dedicated virtual path configured from one user node to another user node, either directly or through intermediary node(s) to facilitate voice, video and data communication and tele-protection system;

(8) "communication field units" means the communication section/subdivision/division responsible for the operation and maintenance of communication system entrusted to them;

(9) "communication interface" means a dedicated physical connectivity to the communication network for exchange of data and information for the data provider and intervening communication system;

(10) "communication network" means an interconnection of communication nodes through combination of media, either directly or through intermediary node(s);

(11) "communication protocol" means a system of rules and well-defined formats that allow two or more entities of a communications system to exchange information via any kind of physical medium;

(12) "communication system" is a collection of individual communication networks, communication media, relaying stations, tributary stations, terminal equipment usually capable of interconnection 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 fibre and radio communication system and their auxiliary power supply system, used for regulation of inter-State and intra-State transmission of electricity;

(13) "control centre" means National Load Despatch Centre (NLDC) or Regional Load Despatch Centres (RLDC) or State Load Despatch Centres (SLDC) or Renewable Energy Management Centres or Area Load Despatch Centres or Sub -Load Despatch Centres or Transmission Control centres or Load Despatch Centres of distribution licensee including main and backup as applicable;

(14) "core ring" means a wideband network having larger bandwidth passing throughout the state connecting almost all critical stations, SLDC and BLDC; this has at least n-1 route redundancy;

(15) "critical station" means a substation or generating station whose data is very much important for load despatch operation or any station housing communication equipments of core/backbone network; Generally, 220kV and above voltage level stations and generating stations having capacity 50MW or above is considered in this category;

(16) "critical applications" means that applications required for maintaining power system. The voice, data and tele-protection signalling applications shall be under this category. Other applications like video conferencing, e-office etc. will be non-critical;

(17) "cyber security" means protecting information, equipment, devices, computer, computer resources, 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);

(18) "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;

(19) "earthing" means connection between conducting parts and general mass of earth by an earthing device such as earth rod, earth plate, earth mat etc.

Usually this is stated for the earth strip extended from the substation earth riser / control room earth strip. The equipment body earthing (safety) and auxiliary dc supply positive earthing (system) are one and same earthing referred here;

(20) "HMI" means human machine interface, a tool used for configuration, fault diagnosis and checking the working status of communication equipment;

(21) "IPP" means Independent Power Producer;

(22) "interface agreement" means an agreement signed between the parties sharing the communication system;

(23) "node" means 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; this can be a data input or output or transit point or its combination;

(24) "open access" means the non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with open access regulations;

(25) "open access customer/ consumer" means a consumer, trader, distribution licensee or a generating company who has been granted open access under the open access regulations;

(26) "regulation" means Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations, 2020) unless otherwise stated;

(27) "renewable energy management centre" means the centre being established to enable forecasting, scheduling and monitoring of renewable energy generation; It is located at Thiruvananthapuram;

(28) "renewable energy power plant" means the power plant 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;

(29) "SCADA" means supervisory control and data acquisition system that acquires data from remote locations over communication system/ LAN and processes it at centralised control location for monitoring, supervision, control as well as decision support;

(30) "SLDC" means State Load Despatch Centre;

(31) "TNMS" means a centralised telecommunication network management system having management systems of all communication systems in the wideband network having tools for configuration, fault diagnosis, status checking etc. and which is capable of generating reports for communication system performance analysis. It is at Kalamassery;

(32) "user" means a person other than KSEBL, such as, a generating company including captive generating plant, renewable energy power plant, transmission licensee, distribution licensee or a bulk consumer, whose communication system is connected to the KSEBL's communication system;

(33) "wideband node" means interface point on the wideband network with an ability to simultaneously transport multiple signals of very high-capacity bandwidth requirement; this can be an interface point for data input or output or transit point or its combination;

4. Applicability of the Standards

These Standards are applicable to KSEBL transmission and generation wings or any user who requires KSEBL's communication infrastructure for transmitting data to control centre or meeting any communication requirement envisaged in the Electricity act 2003 with latest amendments or any regulation by CEA/CERC/KSERC.

5. Maintainability of these standards

These standards shall be maintained by the Technical committee under Chief Engineer (Transmission – System Operation) by conducting yearly review and any amendments shall be got approved by the Board.

CHAPTER 2

REQUIREMENTS

6. Functional Requirement

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.

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.

The communication system shall be a part of wideband backbone of national power system to support the requirement of the National Grid Operation.

7. Performance Requirement

(1) The communication system 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.

8. Interface Requirement

(1) The required communication interfaces shall be provided at both sending and receiving ends.

(2) All the interfaces shall be provided with status indication to indicate its normal operation through audio/visual/network management as per relevant standards.

(3) The standards for interfacing to communication system shall be as specified

in Schedule II.

9. 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. All critical stations are to be connected for voice and SCADA applications to SLD/BLD Centres through redundant channels.

10. Design and planning

(1) Communication system shall be designed as per communication planning criteria for development of reliable communication system for the power system.

(2) Communication network shall be designed in such a way that, any one of the control centres (SLDC/BLDC) shall be capable of working with all functions even in the case of shutdown of all systems including communication equipments of the other control centre.

(3) The communication equipments in the network shall have scalability.

(4) Communication system shall be designed in such a way that any wideband node is capable of meeting the communication requirements of users of that area by paying usage charges. Necessary interfaces shall be provided or added as per the user requirement.

(5) There shall be centralised monitoring and management of communication network (TNMS), which have necessary tools for configuration, identification of fault and generation of various reports on availability of the communication system.

(6) Communication equipment installed shall be interoperable, so as to allow seamless integration between different vendors.

(7) Network equipment shall be synchronized through provision of global

positioning system clock to achieve the desired functionality.

(8) 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.

(9) The working voltage of all communication equipments shall be 48V DC (positive earthed). 220V AC supply with UPS with minimum 10hr backup shall be used for any subsystems like PC/HMI, servers etc. Some equipment feasible in working in control DC of substation/generating station is included under chapter 6 'Specific technical requirements'.

(10) The minimum guaranteed life for all the wideband communication equipment shall be ten years.

(11) Cellular and radio frequency-based communication technology shall not be considered for control and protection functions.

11. Responsibility of users

(1) Every interfacing with the intervening communication system of users 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.

(2) User shall be responsible for planning, design, implementation, secured operation and maintenance of its own communication infrastructure to be interfaced with the KSEBL's communication system.

(3) User, whose system is proposed to be interfaced with the communication system, shall furnish the requisite interface information to the SLDC. The SLDC will issue permission as per the feasibility recommendation from the respective communication field units.

(4) Any users who wish to use KSEBL's infrastructure for placing their communication interface shall submit a site responsibility schedule for every interface point. This 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 fibre 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.

(5) 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.

(6) The interface connection between KSEBL's equipment and user's equipment/port shall be optically isolated. In absence of optical ports, necessary converters shall be used for achieving galvanic isolation.

(7) All services of KSEBL to user shall be on chargeable basis

12. KSEBL's responsibility to other users

Access to connection site or node: - The communication field unit responsible 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. This shall be done by taking all security measures and practices of KSEBL in force from time to time.

13. Outage planning and reporting

Monthly outage shall be planned and got approved from SRPC. The outage request shall be submitted in one-month advance to SRPC for approval. Previous month's outage shall be reported to SRPC in the succeeding month.

The outage request and reporting shall be in the format approved by SRPC. All communication field units shall submit outage request and reporting to TNMS unit. All coordination work with SRPC shall be the responsibility of TNMS unit.

14. Connection with earth

(1) All communication outdoor equipment shall be grounded to the station earthing grid in compliance with the existing power system standards and practices.

(2) Earth grid for indoor communication equipment shall be extended from the power system grounding using insulated conductors. Star configuration shall be used for connecting multiple communication equipment to avoid loop currents. If communication electrode is provided, it shall be bonded to the power system grounding/earth-mat.

(3) The standards applicable for earth connection of communication equipment (indoor and outdoor) shall be 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.

15. 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.

(3) The grounding of auxiliary power supply transformer and surge protection grounding for communication also bonded to the power system earth grid. Earth connection shall be done in accordance with the norms of the Institute of Electrical and Electronics Engineers (IEEE)-80 & IEEE 1100.

(4) Communication circuits which are running between different grounds shall be converted to optical media. This is a very safe practice and is recommended for data communication between different locations, like between communication rooms and control rooms/substation automation kiosks.

(5) In any stations, damage of battery charges occurs frequently due to surges, the AC input side of the battery charger shall be protected by connecting isolation transformer with surge protection units of required ratings. The secondary side neutral of isolation transformer shall be effectively earthed.

16. Safety and testing

(1) The safety of all equipments related to communication shall be ensured by the custodian of the equipments.

(2) Safety Test (if any) shall be carried out to the communication equipment as per the recommendation of the manufacturer to conform the compliance to the safety standards.

(3) Documented information on safety during working on communication system shall be available with the custodian of equipments. Important safety instructions shall be displayed in communication room/equipment wherever necessary.

17. 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) Public internet shall not be interfaced with KSEBL's communication system without firewall as per the cyber security standards (National Critical Information Infrastructure Protection Centre (NCIIPC) Guidelines etc.).

(3) 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.

18. 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 centre.

(3) Communication system access shall be designed, developed, built, configured and maintained in such a way that only authorised person has access.

19. Data retention

(1) The custodian 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.

20. System upgradability and expandability

(1) All Communication interfaces shall be sized, though not necessarily equipped, to support system/subsystem expansion or up gradation 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 or covering blocks to keep ready to connect as when the requirement comes.

21. Centralised Monitoring

(1) SLDC shall have centralised supervision and monitoring system (Unified Network Management System – UNMS) for the communication systems, by integrating its network management system with network management system of KSEBL and other users.

(2) Centralised monitoring system of SLDC (UNMS) shall be in main and back-up control centre architecture with centralised database and twenty-four hours maintenance on all days.

(3) This centralised monitoring system can be a part of the centralised monitoring system of SRPC or independent system which can be integrated to the centralised monitoring system of SRPC.

(4) TNMS unit of KSEBL shall have network management systems of all communication equipments for configuration, supervision and monitoring of various systems being used by KSEBL.

(5) All the network management systems under TNMS unit shall be capable of integrating with UNMS system of SLDC/SRPC.

(6) Network management system shall have features to store necessary information and facility to generate report on communication system availability of all communication equipment as well as the data channels on daily or weekly or monthly or annually basis.

(7) Network management system shall have alarm facility to alert the operator for quick fault detection with alarm logging facility.

(8) 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.

(9) TNMS unit is responsible for all correspondence with SRPC for outage requesting and reporting activity. They shall compile outage request and

report obtained from communication field units, in the format prescribed by SRPC and shall be sent to SRPC for sanction.

22. Maintenance and testing

(1) TNMS unit shall perform in-service diagnostic testing from network management system to facilitate performance trending, diagnosis and corrective resolution of all the interfaces in operation and shall be communicated to remote equipment custodians (communication field units/users) for any corrective action required from their end.

(2) All necessary testing equipment and tools shall be maintained by TNMS/Communication field units to facilitate testing of the interfaces of the communication system at the time of fault and during the course of maintenance.

(3) Preventive maintenance shall be done as per the KSEBL maintenance schedule/recommendation by the manufacturer by the communication field unit /TNMS unit. Maintenance done shall be documented and kept for producing before inspection/ audits by any authorities.

23. Training

(1) Specialised training shall be provided to the persons maintaining the communication systems and NMS on its operation & maintenance to ensure quick fault detection and restoration of the communication system.

(2) Training shall be provided to the planning and designing persons on latest technologies in the communication field for adapting suitable technologies demanded from time to time.

24. Adaptation of new technologies

Plan shall be made for introduction and adoption of new technologies, with the approval of the CEA or appropriate Commission or as per the regulations or pursuant to the reforms programme of the appropriate Government.

25. 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 standards, 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 standards 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 3

WIDEBAND NETWORKS USING OPTICAL FIBRE TECHNOLOGY

26. General requirements

(1) A wideband communication system shall be established throughout the state by connecting all substations of and above 110kV to cater the need of all communication application for power system operation.

(2) The wide band system shall be established by using optical fibre technology.

(3) 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.

(4) The Core network/backbone 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.

(5) Fibre optic terminal equipment provided in the core ring / backbone network shall support automatic switchover function between the redundant modules,

and hardware required for supporting the automatic switch over shall be provided.

(6) Fibre optic terminal equipment in the core ring /backbone shall have redundant DC supply inputs. These equipments shall be powered from two independent DC supply systems.

(7) The communication network shall be designed in multiple ring topology. Failure of total communication systems of any node shall not affect the communication of other stations connected in the ring.

(8) 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. But, when larger expansion of the network is planned, by adapting new communication technology, the whole network may be upgraded with new technology equipments after considering the cost effectiveness. In that case, the communication equipment of other users and interstate links shall be suitably integrated with the new technology systems, in such a way that, there shall not be any loss of data, voice and protection connectivity.

(9) Terminal equipment shall be designed with required number of directions considering the route redundancy and future expansion.

(10) Tele-protection channels shall always use same path for transmission and reception signals.

(11) The interfaces used for critical applications shall be separate from non-critical applications. Critical application communication channels shall be separately routed or in bandwidth sharing systems, these applications shall have highest priority routing over all other applications.

(12) The wideband network shall be capable of connecting the following communication interfaces as per the requirement, namely: -

(a) ethernet, gigabit ethernet (GbE) optical and electrical ports for data, VoIP and other business applications;

(b) high speed E1 channel support;

(c) 2mbps/ nX64kpbs for tele-protection applications.

(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 tele-protection of lines.

(h) number of interface ports shall be decided as per the applications required

(13) 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), Institute of Electrical and Electronics Engineers (IEEE) and the International Electro-Technical Commission (IEC) shall be followed.

27. Requirement of fibre optic communication

(1) The fibre optic communication network shall be established by using any of the following type of fibre optic cable or combination of the following cables

a) optical ground wire (OPGW)

b) underground fibre optic cable (UGFO)

c) All dielectric self-supporting (ADSS).

(2) The OPGW shall be terminated in the substation gantry. The earth wire part of OPGW shall be connected to earth mat riser in the substation yard. The fibers shall be terminated in suitable joint box, which shall be housed in the gantry. Approach cable shall be laid from this joint box to communication room.

(3) Approach cable for optical ground wire termination to fibre optic distribution panel (FODP) shall be non-metallic armoured UGFO cable with same type of fibre and the fibre count equal to optical ground wire cable to maintain uniformity and ease of utilisation of fibres.

(4) The UGFO shall be non-metallic armoured and shall be laid within a permanently lubricated high-density polyethylene (PLB HDPE) pipe. The

cable shall be rodent and termite proof.

(5) The OPGW/UGFO/ADSS cable shall contain 12 or 24 or 48 numbers dual window single mode (DWSM) fibre depending on the network design and requirement envisaged and shall consider the overall design and requirement of the wideband network.

(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 nanometre: 0.21 decibel (dB)/kilometre x total kilometre + 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 nanometre: 0.35 decibel (dB)/ kilometre x total kilometre + 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.

c) The attenuation shall be confirmed by conducting actual testing by using optical power meter and power source.

(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 $\leq$ 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 kA for 1.0 second (for 110kV and 66kV lines)

(14) Direct current (D.C.) resistance at 20 deg. C shall be < 1.0 ohm/kilometre.

(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/ (nanometre X kilometre) at 1550 nanometre, 3.5 picosecond/(nanometre X kilometre) at 1288-1339 nanometre, 5.3 picosecond /(nanometre) X kilometre) at 1271-1360 nanometre, as the case may be.

(19) Zero dispersion wavelength shall be 1300 to 1324 nanometre.

(20) Maximum zero dispersion slope shall be 0.092 picosecond /(nanometre^{2}Xkilometre).

(21) Cable cut-off wave length shall be≤1260 nanometre.

(22) Bend performance shall be-

a) at 1310 nanometre (nm) (75±2millimetrediameter Mandrel), 100 turns: Attenuation Rise ≤ 0.05 decibel (dB);

b) at 1550 nanometre (nm) (30±1millimetre radius Mandrel), 100 turns; Attenuation Rise ≤ 0.05 decibel (dB);

c) at 1550 nanometre (nm) (32±0.5millimetre diameter Mandrel), 1 turn; Attenuation Rise ≤ 0.50 decibel (dB).

(23) Polarisation mode dispersion coefficient shall be ≤ 0.2 picosecond/kilometer½.

(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 4

POWER LINE CARRIER COMMUNICATION

28. Requirement of PLCC

(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 (DPLCC) or mixed mode.

(4) Power line carrier communication shall be suitable for use with the outdoor equipment viz. line traps, capacitive voltage transformer (CVT) or coupling capacitor, 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) 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.

(7) Phase to phase coupling/ inter circuit coupling arrangement shall be used.

(8) Coupling device (line matching unit and protective devices) shall be

interposed between the capacitive voltage transformer/coupling capacitor and the connection line (co-axial cable) to the power line carrier communication terminals. The coupling device shall conform to the carrier frequency operating characteristics as specified in following Table.

Sl. no.	Characteristics	Units	Values
(1)	(2)	(3)	(4)
1	Nominal impedance (equipment side)	Ohm	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
4	Transmission band	Kilo Hertz (kHz)	40 to 500

(9) The coupling device shall be suitable for outdoor mounting and shall be fitted on the steel switchyard 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.

(10) 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.

Frequency (kilohertz)	Attenuation (decibel/Kilometre) (dB/km)
10	0.8
60	1.4
300	3.3
500	4.7

(11) The nominal bandwidth for transmitting or receiving shall be programmable from 4 kilohertz (kHz) to 8 kilohertz (kHz) in steps of 4 kilohertz (kHz) for analog PLCC and 4 kilohertz (kHz) to 16 kilohertz (kHz) in steps of 4 kilohertz (kHz) for DPLCC. Power Line Carrier Communication terminal at bandwidth of 4 kilohertz (kHz) shall be suitable for following configuration, namely: -

a) speech + 1 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 for DPLCC;

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 decibels(dB) (minimum).

(12) 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) In case of DPLCC, 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).

(13) Power line carrier communication equipment shall be capable of transmitting protection signalling as an inbuilt feature. The following shall be complied.

a) The transmission delay shall not exceed 20 milliseconds.

b) There shall be minimum two coded commands for connecting direct tripping

c) There shall be minimum two uncoded commands for connecting permissive tripping

d) The tripping commands shall have priority over speech and data and power boosting feature.

(14) Power line carrier communication equipment shall have the following interfaces for connecting EPAX and express phone

a) 4W E&M

b) 4W/2W express phones and remote subscriber

c) Ethernet port for VoIP in case of DPLCC

(15) Earthing of PLCC system: - Never earth coaxial cable shield and armouring at LMU/LMDU end in the substation yard. Earthing shall be done only at PLCC panel side.

(16) 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 5
CELLULAR COMMUNICATION

29. Requirement 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. If the link availability is less than 99.5%, dual or more Subscriber Identification Module (SIM) with different service provider with automatic changeover shall be provided to ensure 99.5% 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% non-condensing.

(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 as per requirement.

(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 centre.

(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) Receiving device shall have Internet Protocol Security (IPsec), Point-to-Point Tunnelling Protocol (PPTP), and Layer 2 Tunnelling Protocol Virtual Private Network (L2TP VPN) support up to eight concurrent tunnels with max 70 Mbps throughput.

(13) Communication equipment or modem shall comply with Ingress Protection (IP) rating suitable for the installation condition as agreed between the user and provider.

(14) 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 6
SPECIFIC TECHNICAL REQUIREMENTS

30. SLDC/BLDC requirements

(1) Complete redundancy shall be ensured in respect of all systems viz. server systems, auxiliary power supply system and telecommunication systems, so that shut down of any one system shall not affect the operation of the SLDC/BLDC.

(2) The substations and generating stations of and above 110kV shall be connected to SLDC and BLDC through communication channel for data and

voice communication.

(3) The communication channel for data and voice from various substations to SLDC and BLDC shall be configured in such a manner that, the shutdown of any control centre including communication systems in that station, shall not affect the functioning of other control centre. Redundancy shall be maintained for exchanges provided for voice communication also.

31. Bulk/ Open access consumers/ IPPs connectivity to SLDC and BLDC

(1) The bulk consumers and IPPs shall provide their own communication system up to the nearest KSEBL node and get connectivity through KSEBL's wideband network. Refer clause 11 and 12 for more details.

(2) In case, connecting to KSEBL's network is not feasible; they may use any communication medium prescribed in the regulation.

(3) All services provided by KSEBL for communication including KSEBL's end sharing, shall be done on chargeable basis. The user has to pay any additional expenditure required for establishing connectivity and shall bear recurring charges by way of rental and maintenance charges.

32. Communication room

(1) All the communication equipments of a station shall be placed in a room having air-conditioned environment. Only in exceptional cases communication equipments to be placed in the air- conditioned control room.

(2) The size of the Communication room shall be minimum 6 metre x 4 metre for all critical stations. For non-critical stations 4.5 metre x 3 metre is preferable.

(3) Air-conditioning shall be done with n-1 redundancy.

(4) The Size of the trench in Communication room is preferably 30cm x 50 cm (Width X Depth) for all stations and suitable trench cover shall be provided. This trench shall be connected to the Control room trench without sharp bending to avoid damage of optical fibre cable, if any. Avoid using pipe for interconnection between control room and communication room cable trenches.

(5) Earthing and surge protection of communication equipments shall be as per clause 14 and 15 of this standard. All communication equipment and battery charger shall be earthed with minimum 10 sq. mm stranded insulated copper protective earth-wire (PE).

(6) Single point grounding principle shall be followed for earthing communication room. The earth strip in the control room/earth mat shall be extended to the communication room earth bus. From each communication equipment, redundant PE shall be connected to the earth bus in the communication room.

(7) Three phase 4 wire 415V, AC supply from the station LT distribution panel shall be terminated in the wall mounting type LT DB provided in the control room. Industrial type RCCB shall be provided in the LTDB to Prevent Earth leakage. The AC supply to Air conditioner, Battery charger and Communication equipment shall be extended from this LTDB

(8) General Lay out of the communication room is shown in Schedule III

33. Auxiliary power system

(1) All the communication equipments shall be powered from 48V DC, positive earthed power supply system which consisting of battery and battery charger

(2) Battery charger capacity shall be 100A or 50A according to the load requirement of that station. Stations having more than 20A load current shall have 100A battery charger. 400AH battery shall be connected to 100A system and 200AH battery system shall be connected to 50A system. The load current shall be assessed by adding 25% above the present requirement.

(3) All critical stations shall have redundant power supply system (DC source I & DC source II) with dc distribution panel having manual change over arrangement. There shall be provision for coupling two sources by using diode of suitable rating for avoiding interruption during the shutdown of any of the sources. Communication equipments having redundant power supply

inputs shall be powered from both the sources. (See schedule IV for DCDB cum changeover panel details)

(4) Wall mountable dc distribution board shall be provided in stations having only one dc power source.

(5) The positive terminal of the dc distribution board shall be grounded using minimum 16 sq. mm stranded copper wire.

(6) DC source failure alarms shall be extended to control room with accept and reset facilities.

34. Remote terminal units (RTU)/ SAS gateway

(1) The RTU shall be used for collecting data from substations/generating stations where compatible substation automation system (SAS) is not available.

(2) In the substation/generating stations where SAS system is available, the data as per SLDC requirement shall be transmitted from SAS gateway by using IEC 60870 – 5 – 104 protocol.

(3) The working voltage of the RTU shall be 48V DC (positive earthed). For low-capacity plants and 33kV and below substations working voltage can be changed according to the site conditions.

(4) The communication protocol for data transmission to control centres shall be IEC 60870-5-104. The existing IEC 60870 -5-101 systems shall be renovated to IEC 60870 – 5 - 104 in phased manner.

(5) The RTU shall be capable of reporting simultaneously to more than 2 masters.

(6) Communication Protocol with MFTs / Energy-meters shall be MODBUS

(7) Communication Protocol with IEDs shall be IEC 61850 edition 2 or latest

(8) The RTU shall have time stamping feature with the accuracy of 1ms for digital signals.

(9) Accuracy of different parameters shall be: -

Voltage	±0.5%
Current	±0.5%
Frequency	± 0.2%
Active Power/Reactive power	±0.5%
Import-export Energy(active/reactive)	±0.5%

(10) The interface between RTU/SAS gateway and communication equipment shall be optically isolated. If optical port is not available in RTU/SAS gateway/communication equipment suitable ethernet to optical convertor or serial to optical convertor shall be used. The DC input power supply for Convertor at RTU/SAS gateway shall be same as that of RTU/SAS gateway. Similarly, the DC input power supply for Convertor at communication equipment shall be same as that of Communication equipment.

35. Electronic Private Automatic Exchange (EPAX)

(1) EPAX based voice communication subscriber shall be for providing voice communication between SLDC/BLDC and substations/generating stations above 110kV.

(2) Independent EPAX systems shall be provided from SLDC and BLDC so that there will be two subscriber phones from each system shall be available at all critical stations. At least one subscriber phone shall be provided in non-critical stations.

(3) The EPAX shall be of capable of working in VoIP mode.

(4) The working voltage shall be 48V DC (positive grounded).

36. Tele-protection requirements

(1) PLCC equipment with integrated protection couplers or digital protection

couplers shall be used for transmitting tele-protection signals from one station to other.

(2) The interconnection between protection couplers and protection relays shall be electrical wiring using 2.5mm sq. cable.

(3) The protection couplers can be installed in the communication room or in the relay panel, considering the technical feasibility, electromagnetic interference and cost effectiveness.

(4) The working voltage of the protection coupler shall be 48V DC / station control dc as per the site conditions.

(5) **PLCC equipment with protection couplers** shall be as per clause 28(13).

(6) **Digital protection couplers** can be used when wideband communication system by optical fibre system is available between stations.

a) This equipment shall have same requirement as of PLCC protection couplers given under clause 28(13).

b) The output interface shall be DWSM 1310nm/1550nm in case of direct fibre connection.

c) The output interface to wideband equipment shall be 2Mbps E1 or RJ45 or IEEE C37.94 optical communication using multimode fiber, as per the site requirement.

(7) **C37.94 to E1 Converter** shall be used as an interface for connecting with protection IED, in case the communication equipment is not compatible for C37.94standard.

a) The working voltage of this converter shall be 48V DC and shall be housed in the communication room.

b) It shall be suitable for connecting multimode optical cable at the input side and E1 electrical at output side.

(8) PLCC communication shall be established for long lines for protection applications as optical communication could not be established without repeater in between stations due to optical signal loss. If the line length is greater than 80km, PLCC based protection system is mandatory.

37. Line differential protection requirements

(1) Line differential protection shall be established through direct DWSM optical fibre or wideband communication network or both as per the KSEBL's protection philosophy.

(2) Two dedicated fibres are required for establishing one channel for relay-to-relay communication.

(3) In case of direct fibre connectivity, the relay optical signal output shall be suitable for the line length, which shall be arrived based on the optical link loss in the transmission path. Long lines, greater than 80km, generally not suitable for establishing line differential protection using direct fibre connectivity due to higher optical link loss. For the feeders having line length greater than 80km, PLCC based tele-protection system is mandatory.

(4) Line differential protection through wideband system shall be established through C37.94 optical interface using multimode fibre. In case, the communication equipment is not compatible for C37.94, suitable convertor as per clause 36(7) shall be used.

CHAPTER 7
RELAXATION AND INTERPRETATION OF STANDARDS

38. Relaxation and interpretation of standards -The sanctioning authority may, by order and for reasons to be recorded in writing, relax any of provisions of these standards on case-to-case basis. Any standards adopted from regulation shall be relaxed only with the concurrence of CEA.

SCHEDULE I

See standard 7(3)

Category	Data type	Time Interval (Sec)			Time Interval (Sec) via Data Concentrator		
		400 kV	220kV or 110kV	Below 110kV	400 kV	220kV or 110kV	Below 110kV
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 – 0.01		-	0.04 – 0.01		
Forecast/ Weather	Value	60			60		

SCHEDULE II

See standard 8(3)

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-	Relay	IEEE C37.94, ITU-T G.703

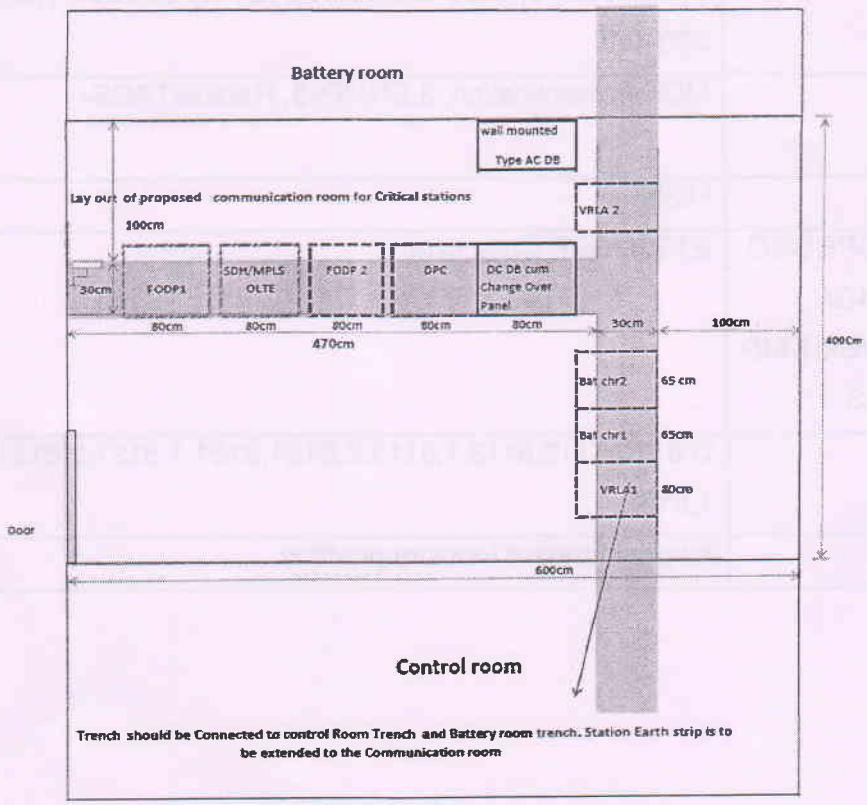
protection /Control		
Voice		2-wire FXO/2-wire FXS/ 4- wire E&M, VoIP
SDH		ITU-T G.821/G.826
IP - Packet Switched Networks	Layer 2.5 OSI	RFC 2702, RFC 4379, RFC 4090 & RFC 4553 Circuit Emulation
RF		IEEE 802.11s, IEEE 802.15.4, ETSI EN 300 220-1, ETSI EN 300 440.
Cyber Security		MD5 Authentication, 3.SNMPv3, Radius/TACS+
Video		H.323
Cellular	GPRS/3G /4G/ NBIoT/MP LS	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.

SCHEDULE III

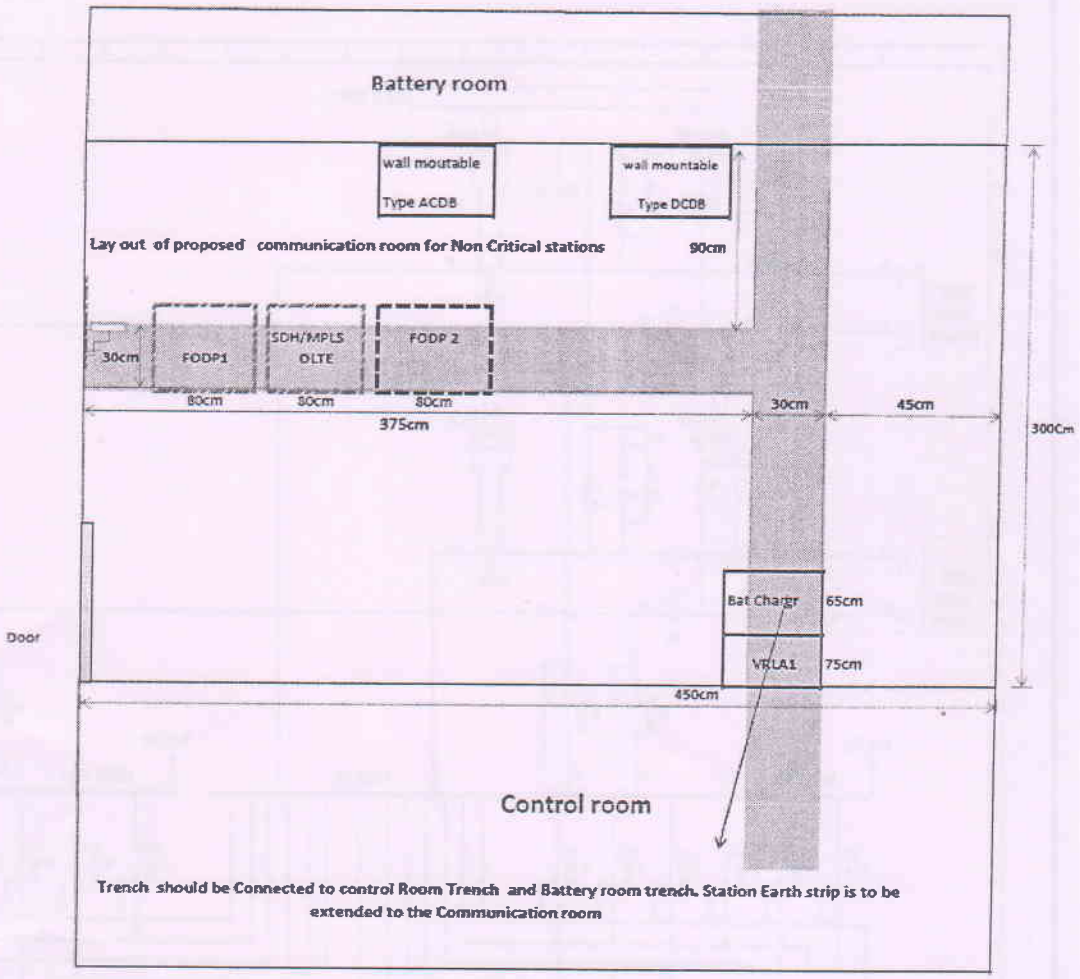
See standard 32(8)

Layout of Communication room

Critical station



Non-Critical station



SCHEDULE IV

See standard 33(3)

DCDB cum changeover panel

(Number of output may vary according to the requirement)