

**GOVERNMENT OF INDIA
CENTRAL ELECTRICITY AUTHORITY
(MINISTRY OF POWER)
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PUBLIC NOTICE

In exercise of powers under Section 177 of the Electricity Act, 2003 (No. 36 of 2003), the Central Electricity Authority (CEA) proposes to notify the Regulations namely “**Central Electricity Authority (Technical Standards for Communication System in Power System Operations) Regulations, 2019**”. The proposed draft regulations are available at CEA website: www.cea.nic.in. The Regulations can also be seen in the office of Chief Engineer (Legal), Room No. 622 (N), Sewa Bhawan, R. K. Puram, New Delhi-110066 on any working day before **10th May, 2019** between 1100 hrs to 1600 hrs. All the Stakeholders including the public are requested to send their comments on the draft Regulations to Chief Engineer (Legal), Room No. 622 (N), Sewa Bhawan, R.K. Puram, New Delhi-110066 by post or through e-mail latest by **10th May, 2019**.

**(P C Kureel)
Secretary, CEA**

Ministry of Power
(Central Electricity Authority)
Draft NOTIFICATION
New Delhi, the, 2019

No. Comm._Std./PCD/CEA – Whereas the draft of the Central Electricity Authority (Communication Standards for Power System Operations) Regulations, 2019 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 (1) of Section 177 read with clause (b) of Section 73 of the Electricity Act, 2003, the Central Electricity Authority hereby makes the following regulations, namely: -

1. Short title and commencement – (1) These regulations shall be called the Central Electricity Authority (Communication Standards for Power System Operation) Regulations 2019.

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

2. Definitions - (1) Words and expressions used in these regulations shall have the same meaning assigned in the Electricity Act, 2003, Central Electricity Authority (Technical Standards for connectivity to the Grid) Regulation, 2007 & (Technical Standards for construction of Electrical Plants and Electrical Lines) Regulation, 2010, Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulation, 2010 & (Communication System for Inter-State transmission of Electricity) Regulation, 2017 and amendments thereof

(2) Other words have been explained as per the context in these regulations.

3. Objective - These regulations shall provide for planned development of communications infrastructure to ensure seamless integration, reliable, redundant and secure communication for power system operations.

4. Application - All Users, SLDCs, Discom LDCs, RLDCs, NLDC, CTU, STUs, RPCs, REMC, FSP (Forecasting Service Provider) and Power Exchanges.

5. Functional Requirement – (1) To provide reliable data communication and tele-protection for power system at National, Regional, Inter-State and Intra-State level. The Communication System shall provide integration with SCADA, WAMS, Video Conferencing System (VCS), Automatic Meter Reading (AMR), EPABX and tele-protection. The required communication interfaces shall be provided both at sending (User) and receiving (Control Centre) ends. The Standards for Interfacing to Communication System are enclosed at Schedule I.

(2) The Communication System shall form a wideband Network to support the requirement of Power System Operation. The Standards of Wideband Network are enclosed at Schedule II.

6. Standards and Codes of Practice – (1) Follow the industry best practices and applicable industry standards in respect of the equipment installation and O&M (Operation and Maintenance).

(2) The communication equipment shall comply with the relevant standards of Bureau of Indian Standards (BIS). If BIS Standards are not available for a particular equipment or material, the relevant British Standard (BS), International Electro-Technical Commission (IEC) Standard, Institute of Electrical and Electronics Engineers (IEEE), EIA (Electronic Industries Association) Standards, American National Standards Institute (ANSI) Standards, ITU-T (International Telecommunications Union – Telecommunication) / CCITT (Consultative Committee for International Telephony and Telegraphy) Standards, CISPR (International Special Committee on Radio Interference) Standards, Fiber Optic Association (FOA) or any other equivalent International Standard shall be followed. 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 latest version of Standards shall be followed.

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

7. Lightning & Surge Protection – Earth connection of communication equipment (indoor & outdoor) shall be proper and preferably separate to avoid failure due to earthing. Sufficient protection shall be provided for lightning and electric surge as per relevant standards of IEC (model by IEC 61000-4-5 and compliant to relevant parts of IEC 62305). Earth connection shall be done in accordance with the norms of IEEE-80 or BIS:3043. The resistibility of communication equipment installed against over voltage and over current shall be as per ITU-T (K 20) recommendations.

8. Access to Data - Data & Information is a valuable asset for the Power System where strict confidentiality shall be maintained. Protecting information assets from unauthorized, incorrect or accidental access, use, modification, destruction or disclosure shall be responsibility and obligation of the concerned person. Communication System access shall be designed, developed, built, configured and maintained in such a way that only authorized users have access.

9. Design & 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 RF 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/State Transmission Utility while planning shall consider design of the intervening communication system for seamless integration to have Wideband network.

(5) User shall ensure centralized monitoring / management of its communication network and shall provide necessary facilities for identification of fault and generation of various reports on availability of the communication system.

(6) User shall be responsible for planning, design, implementation and secured operation of its own equipment 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 prescribed 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. The interface agreement 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 GPS clock to achieve the desired functionality.
- (11) At least 10 hours battery backup shall be provided for the communication equipment for all the nodes. Extended backup shall be provided depending upon requirement.
- (12) Supply voltage shall be 48V DC +15%, -10%. (positive pole earthed).
- (13) The minimum guaranteed life for all the wideband communication equipment shall be 10 years.

10. Site Responsibility Schedule – (1) A Site Responsibility Schedule (SRS) for every interface point shall be prepared by the owner of the communication interface equipment at the interfacing location.

(2) SRS 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 STM level, E-1 level, 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 OEM (Original Equipment Manufacturer);
- f) Site / Node Common Drawings for each interface point and
- g) Responsible person (s) for the site

(3) If Packet technology is used in backhaul network, following additional information shall be included:

- (a) Mode of Connectivity
- (b) Protocol used (Level 2/Level 3)
- (c) Bandwidth Provisioning

11. Access to Connection Site / Node - Owner of the interface site / node shall provide reasonable access and space to the User or its authorized representative, whose equipment is installed or proposed to be installed at the interface site for installation, configuration, testing and O&M of the equipment.

12. Performance – (1) User shall be capable of transmitting all operational data as required by appropriate Control Centre.

(2) Communication System shall be planned with required bandwidth to conform the data interval time, as specified below:

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
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/ Weather	Value	60			60		

* 132kV may be replaced with 110kV wherever 110kV is used in transmission system,

13. Control Command Delay - Communication System shall relay the Control Command from the Control Centre to relevant equipment within 2 seconds for SCADA and within 1 second for WAMS, whether the command is transmitted directly or via Data Concentrator.

14. Reliability – (1) Total outage period shall be less than 16 hours on monthly basis respectively for interface node, wideband node and communication media. The total outages in a rolling 12-months assessment period shall be less than 48 hours

(2) While designing the communication system, adequate redundancy shall be kept.

15. Cyber Security – (1) All Users and Control Centre Owner 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 and supporting system and infrastructure.

(2) The cyber security program shall address the following:

- Compliance with provisions of Information Technology Amendment Act, 2008 (IT Act, 2008) and National Cyber Security Policy, 2013 (NCSP, 2013), as amended from time to time.
- Implementation of NCIIPC (National Critical Information Infrastructure Protection Centre) Guidelines.
- Implementation of guidelines and advisories issued by Computer Emergency Response Team (CERT– India) and applicable Sectoral CERT.
- Compliance to CEA (Central Electricity Authority)'s Cyber Security Regulations, as and when they come into force.

16. Safety & 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 / upgraded to confirm the compliance to these standards.

17. Maintenance – Monthly Outage shall be planned and got approved by the owner of communication equipment in the concerned RPC (Regional Power Committee), as per detailed procedure finalized by the respective RPC.

18. System Upgradability & Expandability - All Communication interfaces shall be sized (though not necessarily equipped) to support system / subsystem expansion / upgradation to full capacity as provided by specified aggregate transmission rates. Equipment units provisioned for equipped subunits shall be terminated with appropriate termination interfaces.

19. Training - Specialized training shall be provided to the persons manning the centralized monitoring center and the field support staff to ensure quick fault detection and restoration of the communication system. Training shall be provided to the maintenance persons on all communication equipment for its operation and maintenance.

20. 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 directions of the Appropriate Commission or pursuant to the reforms programme of the Appropriate Government. The Standards related to some existing communication technologies in Power System operation are enclosed at Schedule III to VII.

21. Relaxation and Interpretation of Regulations – (1) The Authority by order in writing may relax any provision of the said regulations on its own or in respect of the matters referred to the Authority on case to case basis.

(2) If a question arises relating to the interpretation of any provision of these regulations or its relationship and interplay with any other regulation of Central Electricity Authority, the decision of the Authority shall be final.

SCHEDULE-I

(see regulation 5(1))

STANDARDS FOR INTERFACING TO COMMUNICATION SYSTEM

1. INTERFACE STANDARDS

Interfaces	Type	Standards
Electrical Interface	Ethernet	IEEE 802.3 / IEEE 802.3u
	Ethernet VLAN	IEEE 802.1 P/Q
	Serial	RS-232 / RS 422 / RS 485 / X.21 / X.25 / G.703 / V.35
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 Mesh		IEEE 802.11s
Cyber Security		MD5 Authentication, 3.SNMPv3, Radius/TACS+
Video		H.323

2. LOCAL MONITORING

All the interfaces shall be provided with audio/visual status indication to indicate its normal operation as per respective standards.

3. CENTRALISED MONITORING

3.1 Control Centre shall have centralized supervision and monitoring system by integrating its Network Management/Monitoring System (NMS) with NMS of other users within its jurisdiction. Users shall provide necessary support to interface their NMS. However, these users shall take necessary action for O&M of their respective interfaces.

3.2 NMS 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/weekly/monthly basis.

3.3 NMS shall have displays for audio/visual alarm generation and logging facility to facilitate the operator for quick fault detection. NMS shall facilitate access to the equipment for configuration and fault restoration as well to facilitate monitoring the performance of the communication system.

4. DATA RETENTION

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. Historical data of 90 days shall also be kept.

5. MAINTENANCE & TESTING

User shall permit in-service diagnostic testing to be executed both locally and from remote (NMS) locations to facilitate performance trending, efficient diagnosis and corrective resolution of all the interfaces in operation. The required 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.

SCHEDULE-II

(see regulation 5(2))

STANDARDS FOR WIDEBAND NETWORK**1. STANDARDS AND CODES OF PRACTICE**

- a) Transmission quality shall be as per ITU-T G.821, G.823, G.826
- b) Terminal equipment shall be designed as per ITU-T G.783
- c) Optical interface shall be FC-PC and shall be as per ITU-T G.957, G.958
- d) Wideband communication (wideband network) shall be optical interface LC (Lucent Connector) conforming to IEC 61754-20 (part 20)
- e) Network synchronization shall be as per ITU-T G.813
- f) Management Functions shall be as per ITU-T G.774, G.784
- g) Protection architecture shall be as per ITU-T G.841
- h) Built-in testing and Alarm shall be as per ITU-T G.774, G.783, G.784
- i) The link performance for ES, SES and BER for the fiber optic links shall correspond to National Network as defined in ITU-T G.826

2. FUNCTIONAL REQUIREMENT

2.1 The wideband network shall be designed in a manner to ensure absolute channel delay less than 25 ms and channel delay asymmetry less than 0.1 ms required for protection applications.

2.2 Network shall be configured for automatic switchover to the alternate path/route in case of failure of one path and the switching time delay shall be less than 50 ms.

2.3 Terminal Equipment shall support automatic switchover function between the redundant modules. All required modules and hardware to support the automatic switch over shall be provided.

2.4 The 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 NMS either at State level or at Central level for complete monitoring, reconfiguration and control.

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

2.6 The communication interfaces for wideband network shall be:

- (a) High speed bundled $n \times E1$ support including Ethernet, GbE (Gigabit Ethernet)
- (b) High speed E1 channel support
- (c) 64kbps & $n \times 64$ kbps data & Protection channel support
- (d) Low speed (300 -1200 bps) data channel support
- (e) Voice (2 wires, 4 wires) channel support.
- (f) Data transport supporting Network Management channels
- (g) C37.94 Interface card for tele protection of lines

SCHEDULE-III

(see regulation 20)

STANDARDS FOR FIBRE OPTIC COMMUNICATION**1. GENERAL REQUIREMENT**

1.1 All wideband communications shall be established using fibre optic communication consisting of underground fibre optic cable, OPGW (Optical Ground Wire) and ADSS (All Dielectric Self Supporting).

1.2 Unarmoured cable shall be laid within a PVC/ Hume duct pipe. The cable shall be rodent and termite proof.

1.3 The cable shall contain 12/24/48 nos. 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.

1.4 Approach cable for OPGW termination to FODP (Fibre Optic Distribution Panel) shall be armoured/unarmored cable with suitable protection and matching the fiber count equal to OPGW cable to maintain uniformity and ease of utilization of fibers.

1.5 The overall optical fibre path attenuation shall not be more than calculated below:

a) Maximum attenuation @ 1550nm: $0.21 \text{ dB/km} \times \text{total km} + 0.05 \text{ dB/splice} \times \text{no. of splices} + 0.5 \text{ dB/connector} \times \text{no. of connectors}$.

b) Maximum attenuation @ 1310nm: $0.35 \text{ dB/km} \times \text{total km} + 0.05 \text{ dB/splice} \times \text{no. of splices} + 0.5 \text{ dB/connector} \times \text{no. of connectors}$.

Induced attenuation due to temperature shall be $\leq 0.05 \text{ dB}$ (-60° C to $+85^{\circ} \text{ C}$). Attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 dB.

1.6 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.

1.7 Short circuit current for OPGW shall be $\geq 6.32 \text{ kA}$ for 1.0 second (for 220kV and above lines) and $\geq 5.60 \text{ kA}$ for 1.0 second (for 132kV and 66kV lines). D.C. resistance at 20° C shall be $< 1.0 \text{ ohm/km}$.

1.8 EDT (Everyday Tension) of OPGW shall be $\leq 20\%$ of UTS (Ultimate Tensile Strength).

1.9 Maximum permissible dynamic strain shall be ± 150 micro strains.

1.10 Proof Stress Level shall be $\geq 0.69 \text{ Gpa}$.

1.11 Maximum chromatic dispersion shall be $18 \text{ ps}/(\text{nm} \times \text{km})$ @ 1550 nm, $3.5 \text{ ps}/(\text{nm} \times \text{km})$ @ 1288-1339, $5.3 \text{ ps}/(\text{nm} \times \text{km})$ @ 1271-1360 nm.

1.12 Zero dispersion wavelength shall be 1300 to 1324 nm.

1.13 Maximum zero dispersion slope shall be $0.092 \text{ ps}/(\text{nm}^2 \times \text{km})$ maximum.

1.14 Cable cut-off wavelength (λ_{cc}) shall be $< 1260 \text{ nm}$.

1.15 Bend Performance shall be:

- @ 1310 nm (75±2 mm dia Mandrel), 100 turns: Attenuation Rise < 0.05 dB
- @ 1550 nm (30±1 mm radius Mandrel), 100 turns; Attenuation Rise < 0.05 dB
- @ 1550 nm (32±0.5 mm dia Mandrel), 1 turn; Attenuation Rise < 0.50 dB

1.16 Polarization mode dispersion coefficient shall be < 0.2 ps/km^½

2. STANDARDS AND CODES OF PRACTICE

- i) ITU-T recommended G.652D
- ii) IEEE – 1138- 1994, IEEE – 1138-2009
- iii) Electronics Industries Association (EIA)/Telecommunications Industry Association (TIA) 455-78A, 455-3A, 455-62A, 455-164A/167A/174, 455-168A/168A/175A, 455-176, 455-59, EIA/TIA 598, EIA 455-104.
- iv) International Electro Technical Commission Standards, IEC 60304, IEC 60794-1-2, IEC60811-5-1, IEC 60794 – 4 – 10, IEC 60793 – 1 – 20, IEC 60793 – 1 – 40, IEC 60793 – 1 – 42, IEC 60793 – 1 – 45, IEC 60793 – 1 – 47
- v) Bell core GR-20
- vi) Telecommunication Engineering Centre (TEC) Specification no. GR/OFC-17/01 June 2007 (including all subsequent amendments)
- vii) American Society for Testing and Materials (ASTM): AI67-92, ASTM:751-92b, ASTM: A370-82, ASTM: D2581-91, ASTM: D2287-81, ASTM: D638 for FRP, ASTM: D217, 556,93-IP-34 for Jelly, ASTM: D 570,211 for PBTP, ASTM: D1505 for poly Carbonate, ASTM: D1633, 150 for HDPE, ASTM: D1248 for Jacket density.
- viii) Standards for testing the cables shall be:
 - a. Max. Tensile Strength – IEC60794 – I – E 1 (Under Ground Cable), IS 802:1995 and IS 875:1987 (OPGW), IEEE 1138-2009 clause 6.4.1.4 (OPGW)
 - b. Cable bend test – IEC 60794 – 1 – E 11
 - c. Repeated bending test – EIS – 455 – 104 IEC 60794 – 1 – E6
 - d. Crush Strength – IEC60794 – 1 – E3 (UG Cable) IEC 60794 – 1 – 2 Method E3 or EIA/TIA 455 – 41B (OPGW)
 - e. Impact Test IEC60794 - 1 – E4 (UG Cable), IEC60794 - 1 – 2 E4 or EIA/TIA 455-25B (OPGW)
 - f. Torsion Resistance – IEC 60794 – 1 – E 7
 - g. Kink Test IEC 60794 – 1 - E 10
 - h. Drip Test IEC 60811 – 5 – 1 or IEC 60794 – 1 – E14
 - i. Water ingress test IEC60794 – 1 – 2 F 5 or EIA/TIA 455-82B
 - j. Attenuation variation with Wavelength IEC 60793 – 1 – 40 or EIA/TIA 455 – 78A
 - k. Attenuation at water Peak IEC 60793 – 1 – 40 or EIA/TIA 455 – 78A

- l. Temperature Dependence on Attenuation IEC 60793 – 1 – 52 or EIA/TIA 455 – 3A (UG Cable) IEEE 1138-2009 clause 6.4.3.7 or IEC 60794 – 1 – 2 Method F1 (OPGW)
- m. Bend Performance IEC 60793 – 1 – 47 or EIA/TIA 455 – 62A (UG cable), IEEE 1138-2009 clause 6.4.2.3 or IEC 60794 – 1 – 2 method E11 (for OPGW)
- n. Mode Field diameter IEC 60793 – 1 – 45 or EIA/TIA 455 – 164A/167A/174
- o. Chromatic dispersion IEC 60793 – 1 – 42 or EIA/TIA 455 – 168A/169A/175A
- p. Cladding diameter IEC 60793 – 1 – 20 or EIA/TIA 455-176
- q. Point discontinuities of attenuation IEC 60793 – 1 – 40 or EIA/TIA 455 – 59
- r. Core – Clad concentricity error IEC 60793 – 1 – 20 or EIA/TIA 455 – 176
- s. Fibre tensile Performance IEC 60793 – 1 – 31 or EIA/TIA 455 – 31B (UG cable), IEEE 1138-2009 clause 6.4.1.3 or IEC60794 – 1 – 2 E1 or EIA/TIA 455 – 33B (OPGW)
- t. Seepage of filling compound EIA/TIA 455 – 81B
- u. Short Circuit Test IEC 60794 – 4 – 10 or IEC 60794 – 1 – 2 (2003) Method H1 or IEEE 1138-2009 clause 6.4.3.3
- v. Aeolian Vibration Test IEC 60794 – 4 – 10 or IEC 60794 – 1 – 2 Method E19 or IEEE 1138-2009 clause 6.4.3.1
- w. Galloping IEEE 1138 – 2009
- x. Sheave Test IEC 60794 – 1 – 2 (2003) Method E18 B or IEEE 1138-2009 clause 6.4.2.1
- y. Creep Test IEEE 1138 – 2009
- z. Fibre Strain Test IEEE 1138 – 1994
- aa. Strain Margin Test IEEE 1138 – 2009
- bb. Stress Strain Test IEEE 1138 – 2009
- cc. Cable cut off wavelength Test IEEE 1138 – 1994
- dd. Fault current / Lightning Test IEC 60794 – 4 – 10 or IEC 60794 – 1-2 (2003)
- ee. D.C. Resistance Test IEC 60228 or IEEE 1138-2009 clause 6.4.1.5
- ff. Mechanical Strength Test for suspension Assembly IEC 61284: 1997

3. FUNCTIONAL REQUIREMENT

- 3.1 Splice enclosures shall be provided to encase the optical cable splices in protective, moisture and dust free environment. Splice enclosures shall comply ingress protection class IP 66 or better.
- 3.2 Maximum 12 fibres shall be terminated in a single splice tray.
- 3.3 FODP (Fibre Optic Distribution Panel) shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays. Ground lugs shall be provided. FODP shall meet ingress protection class IP55 specifications.

SCHEDULE-IV

(see regulation 20)

STANDARDS FOR PLCC (POWER LINE CARRIER COMMUNICATION)**1. GENERAL REQUIREMENT**

1.1 PLCC shall be used in the grid network between two consecutive substations and PLCC shall provide Speech, Data and Tele-protection requirements of the Power system.

1.2 PLCC shall be duplex, independent TX and RX channels, operating in the carrier frequency spectrum 40 to 500 kHz.

1.3 PLCC terminal could be operated in APLC (Analogue), DPLC (Digital) or Mixed mode.

1.4 PLCC shall be suitable for use with the outdoor equipment viz. line traps, CVT, coupling device, HF cable

1.5 Input circuit of the PLCC terminal shall be provided with protective device to eliminate any surge transfer.

1.6 Companders and expanders shall be provided to improve voice transmission characteristics for the system.

1.7 Fail safe devices shall be provided to avoid a malfunction in one unit or damage of any sub-assembly.

1.9 PLCC set shall be designed to give guaranteed performance from 0 to 50°C. Thermal capability of the equipment shall be so designed to be operational up to 55°C for 24 hours continuously.

2. STANDARDS AND CODES OF PRACTICE

2.1 PLCC equipment comprising of not limited to the following shall be provided:

- i) Coupling devices (Line matching unit and protective devices).
- ii) Coupling filters
- iii) High frequency cable
- iv) Power line carrier terminals
- v) Tele Protection Equipment
- vi) Private Automatic Exchange
- vii) 48V DC power supply equipment
- viii) Wave Trap for the above transmission lines

2.2 Equipment shall comply:

- Line Trap: IEC-60353, IS-8792,
- Coupling Device: IEC 60481, IS-8997,
- Power Line Carrier Terminal: IEC60495,
- CVT: IS-3156,
- Coupling Capacitor & CVT: IEC60358,
- Coupling Capacitor: IS-9348,
- RF cables: IS-11967,
- Planning of SSB PLCC: IEC-663,
- Surge Arrestors: IEC-60099,

- HF Cable Testing: IEC-60096,
- Performance and testing of Tele-protection equipment: IEC-60834 Part-I,
- Characteristics values for inputs and outputs of single side band PLCC Terminals: IS-9428,
- Frequency planning of power Line carrier equipment: IS-9528/IC62488 Part-I.
- IEC 60255-27 for product safety requirements (Relays and Protection equipment)
- IEC 60834-1 for Command Systems (Tele Protection equipment)
- IEC 61000 Series for Electromagnetic compatibility (EMC)
- IEC 60950 Series for Electrical safety
- IEC 60068 series for Environmental testing
- Radiated Emissions as per CISPR 22
- Vibration as per EN60068 – 2 – 6
- Shocks parameter as per IEC 68 – 2- 27

3. FUNCTIONAL REQUIREMENT

3.1 Coupling device (Line matching unit and protective devices) shall be interposed between the CVT and the connection line (co-axial cable) to the PLCC terminals and shall conform to the following carrier frequency operating characteristics between phase to earth coupling units:

1)	Nominal impedance (equipment side)	Ω	150 (for balanced secondary circuit) 75 (for unbalanced secondary circuit)
2)	Maximum composite loss	dB	2
	Return Loss	dB	Equal to or greater than 12 dB
3)	Transmission band	kHz	40 to 500

3.2 The coupling device shall be suitable for outdoor mounting and shall be fitted on the steel structure. Temperature of metallic equipment mounted outdoor is expected to rise up to 65°C with ambient temperature of 50°C.

3.3 High frequency cable shall be provided to connect coupling unit installed in the switchyard to the PLCC terminals installed indoors, and values of attenuation per km of the cable shall be as follows:

Frequency (kHz)	Attenuation (dB/km)
10	0.8
60	1.4
300	3.3
500	4.7

3.4 The nominal bandwidth for transmitting or receiving shall be programmable from 4 to 8 kHz in steps of 4 kHz. PLCC terminal at bandwidth of 4 kHz shall be suitable for following configuration:

- Speech + 4 x 1200 Baud Data (minimum)
- Data rates shall be selectable in steps, compliant with commonly used standardized data rates such as 200, 300, 600 and 1200 Bauds; and for digital PLCC 1200, 2400, 4800 and 9600 Bauds.

- Gross speed and transmission bandwidth shall be programmable for up to 28.800kbit/s in 4 kHz spectral bandwidth, up to 72 kbit/s in 8 kHz bandwidth.
- Return loss in the transmitter band shall be >10dB
- Tapping loss shall be <1.5dB (as per IEC:60495)
- AGC range of the receiver shall be 40dB (minimum)

3.5 Regarding Data multiplexing

- i) PLCC terminal shall be provided with an internal multiplexer for the time division multiplexing of up to 8 serial data channels which can be allocated individually to the internal modems.
- ii) Data ports shall be compliant with V.24/V.28, RS232 and/ or V.11/ X.21/ X.24 s per functional requirement.
- iii) Ethernet port shall be provided for equipment configuration via LAN, or for general IP forwarding and shall have facility to operate @ 9600bits/s at good SNR of 35dB and above within the nominal Band width of 4 kHz. Above functionality shall be possible for SNR of 25dB for Band width of 8 kHz.

SCHEDULE-V

(see regulation 20)

STANDARDS FOR CELLULAR COMMUNICATION

1. GENERAL REQUIREMENT

1.1 Cellular communication shall be used below 132kV / 110kV system for low speed data acquisition system, where feasibility of access to wideband network is not possible.

1.2 Cellular communication shall be adopted after ensuring the available signal level up to the required strength and dual or more SIM with different service provider with automatic changeover to ensure 99.5 % link availability for interruption free operation of the communication system.

1.3 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% noncondensing.

2. STANDARDS AND CODES OF PRACTICE

2.1 EMI / EMC requirements

- i) Electrostatic Discharge as per IEC 61000 – 4 -2
- ii) Fast transient Burst as per IEC 61000 – 4 – 4
- iii) Surges immunity as per IEC 61000 – 4 – 5
- iv) Conducted Emissions as per IEC 61000 – 3 – 2 and CISPR 22
- v) Radiated Emissions as per CISPR 22
- vi) Radiate Immunity as per IEC 61000 – 4 – 3
- vii) Vibration as per EN600068 – 2 – 6
- viii) Shocks parameter as per IEC 68 – 2- 27

2.2 Modem shall be compliant with ETSI GSM Phase 2+ standards.

2.3 Receiving device shall have IPsec, PPTP, and L2TP VPN support up to 8 concurrent tunnels with max 70Mbps throughput.

2.4 Communication equipment / modem shall comply with IP 65 rating.

3. FUNCTIONAL REQUIREMENT

3.1 Field interface shall be optical port / RS 232 / RS 485 / RJ 45 IP/ any other suitable port.

3.2 Receiving device shall support IEC - 60870 -5- 101 & IEC - 60870 -5-104 protocol & DLMS (IS15959/IEC 62056), MODBUS for interfacing.

3.3 Receiving end shall have multi WAN VPN concentrator with built in facility to manage at least 250 remote nodes for a fixed IP provided.

3.4 Receiving end shall have redundant Multi WAN VPN Concentrator with a fail over – fall back feature for uninterrupted data communication.

3.5 Router shall be capable of handling VPN based security by assuming a fixed IP issued by the Multi-AN VPN Concentrator at the SCADA end.

- 3.6 Device shall have the capability of data encryption with 3DES to ensure secured communication network over GPRS (3G/4G), Broadband or latest.
- 3.7 Device shall have capability to decide and act according to the best available link in redundant mode configuration with automatic switchover.
- 3.8 QoS (Quality of Service) and Bandwidth management for optimal bandwidth usage.
- 3.9 Centralized Monitoring at Control Centre shall be available.

SCHEDULE-VI

(see regulation 20)

STANDARDS FOR VSAT (Very Small Aperture Terminal) COMMUNICATION**1. GENERAL REQUIREMENT**

- 1.1 VSAT communication shall not be used for primary protection function of power system and can be used for SCADA control functions of power system equipment as Geo-Stationery Satellite hop delay is 240 ms.
- 1.2 VSAT communication shall be preferably used for remote locations.
- 1.3 VSAT 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.
- 1.4 VSAT terminal shall work either on KU or C-band or extended C band or any other band for interruption free continuous operation in extremely rainy (more than 10mm/hour intensity) and cloudy conditions.
- 1.5 VSAT communication shall be adopted after ensuring required level of signal level and link availability (99.9 percent) for interruption free operation of the communication system. NMS shall have facility of maintaining link status along with signal strength of the nodes.
- 1.6 VSAT communication shall not be connected to the National wideband network.
- 1.7 All regulatory clearance from regulatory bodies shall be taken to operate the VSAT communication.
- 1.8 All regulatory guidelines including size of the antenna shall be followed.
- 1.9 Redundant configuration shall be enabled in NMS.
- 1.10 Pool Band width feature shall be adopted for the VSAT Network.

2. STANDARDS AND CODES OF PRACTICE

Equipment shall conform to latest revision of ITU-R recommendation S.580-6.

3. FUNCTIONAL REQUIREMENT

- 3.1 Uplink and down link configuration shall be redundant (1 + 1).
- 3.2 Network shall be designed based on FTDMA / MFTDMA / SCPC DAMA technology or any other proven future technology with configurable data rate as per data communication requirement.
- 3.3 Bit error rate shall be lesser than 1×10^{-7} (data) to 1×10^{-4} (Voice).
- 3.4 Shall support Broadcast, Unicast, Multicast, TCP spoofing.
- 3.5 Shall support IP RJ-45 (IP or E&M).
- 3.6 Receiving device shall support IEC - 60870 -5-104 protocols for interfacing data as well as to IPv4, IPv6, RIP v1, v2, ARP/VLAN, ICMP, TCP, UDP, Telnet, IGMP, v1, v2, SNMP for networking Utilities.
- 3.7 Shall be designed for 230 V +/- 30% AC power supply at 50 Hz.

- 3.8 Shall be designed for trouble free operation at temperature range -10 deg. C to 55 deg. C and humidity up to 95% non-condensing, and wind speed of minimum 80 kmph.
- 3.9 Shall be able to deliver bidirectional composite data traffic.
- 3.10 Round trip delay shall be less than 600 ms.
- 3.11 VSAT IDU (for remote sites) shall support TCP/IP without the need of an external router.
- 3.12 VSAT terminal 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.
- 3.13 VSAT terminals 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.

SCHEDULE-VII

(see regulation 20)

STANDARDS FOR RF (RADIO FREQUENCY) COMMUNICATION**1. GENERAL REQUIREMENT**

- 1.1 RF communication shall be used below 132kV / 110kV system for low speed data acquisition system and shall not be used for protection of power system equipment.
- 1.2 RF communication shall be adopted after ensuring required level of signal level with clear line of sight and link availability (99.5 percent) for interruption free operation of the communication system.
- 1.3 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% noncondensing.
- 1.4 RF communication shall not be connected to the National wideband network.
- 1.5 Utilization of radio spectrum shall be subject to regulatory clearance. All regulatory guidelines shall be followed.
- 1.6 RF communication shall be capable of delivering data, voice and video conferencing, and latency shall be less than 5 msec.

2. FUNCTIONAL REQUIREMENT

- 2.1 Communication equipment shall comply with IP 65 rating.
- 2.2 Communication system shall support concurrent use of IP, VoIP and Video.
- 2.3 Capable of channel bandwidth selection with 5 MHz steps.
- 2.4 Capable to capture both side (local and remote) spectrum view. Equipment shall have site and link management facility for configuration.
- 2.5 Support SNMP, MIB II, Bridge MIB.
- 2.6 Comply to IPv4 and IPv6 network protocols with backward compatibility feature.
- 2.7 Facility to upgrade software over the air from remote.
- 2.8 Gateway device shall have 10BASE-T/100BASE-TX Ethernet port to connect to any network.
- 2.9 NMS shall be provided to monitor the performance from the Control Centre. NMS shall be capable to provide bandwidth utilization, latency, link health and signal strength of the network.
- 2.10 Communication network shall support multiple communication protocols to provide flexibility.
- 2.11 Provide scalability, interoperability and future proofing.

[F. No. Comm_Std./PCD/CEA/]

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