

**MANUAL OF STANDARDS & SPECIFICATIONS  
FOR  
RAILWAY ELECTRIFICATION PROJECTS  
UNDER  
EPC CONTRACTS**



## SECTION 1

### GENERAL

- 1.1 This Manual is applicable for Planning, Design & Construction of Rail System (“the Project”) through EPC mode. The scope of the work shall be as defined in the Agreement. This Manual shall be read harmoniously with the intent of the Agreement.
- 1.2 The Project and the project facilities shall conform to the requirements of design and specifications set out in this Manual, which are the minimum prescribed. The project report and other information provided by the Authority shall be used by the Contractor only for its own reference and for carrying out further investigations. The Contractor shall be solely responsible for undertaking all the necessary surveys, investigations and detailed designs in accordance with good industry practice and due diligence, and shall have no claim against the Authority for any loss, damage, risk, costs, liabilities or obligations arising out of or in relation to the project report and other information provided by the Authority.
- 1.3 At least 2 weeks prior to commencement of the work, the Contractor shall draw up a Quality Assurance Manual (QAM) covering the Quality System (QS), Quality Assurance Plan (QAP) and documentation for all aspects of the Project works and send three copies each to the Authority’s Engineer for review. The QAM shall conform to Applicable Laws, Good Industry Practice in vogue and the provisions of the Agreement.
- 1.4 The codes, standards and specifications applicable for design of the components of the railway electrification are listed in Section 2,3,4 and 5.
- 1.5 The latest version of the codes, standards and specifications, which have been published before the last date of bid submission shall be considered applicable.
- 1.6 The terms ‘**Inspector**’ and ‘**Engineer**’ used in codes, standards or specifications shall be deemed to be substituted by the term “**Authority’s Engineer**”, to the extent it is consistent with the provisions of the concession Agreement and this Manual. The role of the Authority’s Engineer (AE) shall be defined in the Contract Agreement.
- 1.7 In the absence of any specific provision on any particular issue in the aforesaid codes, standards or specifications read in conjunction with the Specifications and Standards contained in this Manual, the Contractor shall be at liberty to rely on any International Standard in consultation with Authority’s Engineer.

- 1.8 All items of building works shall conform to the standards specified in the National Building Code (NBC) and the relevant codes issued by BIS. For this purpose, building works shall be deemed to include station buildings, Depot and workshop, Tower Wagon Shed, Remote Control Centre, Signalling Installations, Traction Installations, buildings comprising Project Facilities, traffic integration works, landscape elements and/or any other works incidental to the building works.
- 1.9 The Contractor shall develop fire fighting system in consultation with Authority's Engineer complying with the local fire safety regulations and Good Industry Practice in vogue. Fire detection and suppression shall generally be as per NBC-2005.
- 1.10 The design of a rail system shall be fully integrated and compatible with all other sub-systems that constitute the Rail System so that the overall requirements of the Rail System are met. As far as possible, uniformity of design standards shall be maintained throughout the rail system.

**1.11 Alternative Standards and Specifications**

The requirements stated in the Manual are the minimum. The Contractor will, however, be free to adopt international practices, alternative specifications, materials and standards to bring in innovation in the design and construction provided they are better or comparable with the standards prescribed in the Manual. The specifications and techniques which are not included in the codes, standards or specifications shall be supported with authentic standards and specifications reflected in other internationally recognized codes, standards and specifications. Such a proposal shall be submitted by the Contractor to the Authority's Engineer. In case, the Authority's Engineer is of the opinion that the proposal submitted by the Contractor is not in conformity with any of the codes, standards and specifications, then he will record his reasons and convey the same to the Contractor for compliance. A record shall be kept by the Authority's Engineer, of the non-compliance by the Contractor of the minimum Specifications and Standards specified in the Manual. Adverse consequences, if any arising from any such non-compliance, shall be treated as "**Contractor Default**" and shall be dealt in accordance with the provisions of the Agreement.

**1.12 General considerations for planning, design and construction**

The Contractor shall take measures to overcome the physical and operational constraints and plan, design and construct the Project using appropriate methods, management techniques and technologies. General consideration shall, without being limited to, be as follows:

(a) The constraints

The physical constraints in the Project could be in the form of limitation of right of way, existing train services in the vicinity, inadequate approach roads and underpasses, at-grade yards & stations etc. The operation constraints arise out of the necessity or possibility of closing a portion of the road for construction and/ or diverting the traffic to temporary diversions, thereby reducing the capacity and safety of the existing network. The solutions evolved by the Contractor shall be such that these constraints are overcome through appropriate planning, design and construction method, techniques and technologies and by adopting suitable traffic management measures.

(b) Safety of design

All designs shall be safe to ensure that the Project or any part thereof (for example embankment, pavement, retaining structures, bridges, tunnels, culverts, etc.) does not collapse (global stability) nor its serviceability/performance (for example settlement, roughness, undulations, deflections, etc) deteriorates below acceptable level as recognized by Good Industrial Practice.

(c) Durability

The Project shall not only be safe but also durable. This would mean that the deteriorating effects of climate and environment (for example wetting and drying, freezing and thawing, if applicable, temperature differences, aggressive environment leading to corrosion, etc) in addition to the traffic shall be duly considered in design and construction to make the Project durable.

(d) Mitigating disruptive effects of construction

The planning, design and construction of the Project shall be such that the construction does not have adverse impact on the environment and does not disrupt the lives and business activities of the people living close to the Project.

### 1.13 **General considerations for rail systems design**

The rail systems including all the subsystems designed to be utilized by the Contractor shall be of proven technology and should have been in service in other similar systems for at least 03 years.

## 1.14 Safety during Construction and Operation & Maintenance

1.14.1 The Contractor shall develop, implement and administer a surveillance and safety program for providing a safe environment on or about the Project, and shall comply with the safety requirements set forth in the Agreement.

1.14.2 Before taking up any construction work, the Contractor shall prepare a Traffic Management Plan for each work zone and furnish it to the Authority's Engineer for comments duly incorporating the following:

- (i) Designate a Site Safety Team headed by a qualified Safety Officer.
- (ii) Traffic safety devices as per IRC:SP:55 with the following specifications:
  - (a) Signages of retro-reflective sheet of high intensity grade.
  - (b) Delineators in the form of cones/drums (300 to 500 mm dia and 1000 mm high) made of plastic/rubber having retro reflective red and white band, at a spacing of maximum 5 m along with a reflective tape (red and white band) to be tied in between the gaps of cones/drums. A bulb/flasher using solar energy is to be placed on the top of the cone/drum for night delineation.
  - (c) Barricades using iron sheet (plain) with adequate iron railing/frame painted with retro-reflective paint in alternate black and white (or yellow and black) strips. Warning lights at 5.0 m spacing shall be mounted on the barricades and kept lit in the dark hours and night.
- (iii) Sprinkling of water for dust control at work zones, haul roads and plant/camp sites.
- (iv) Noise/ Pollution suppression measures at work zones haul roads and plant/camp sites.
- (v) Mechanical, electrical and fire safety practices.
- (vi) Safety measures like PPE (Personal Protection Equipment) for workers engaged.
- (vii) First Aid and Emergency Response Arrangements i.e. First aid Box, Ambulance, paramedical staff, alarms, etc.
- (viii) Safety training/awareness programmes.
- (ix) Formats to maintain the accident records/emergency response provided during accidents.

(x) A penalty scheme for violations in provision of adequate traffic control devices and proper traffic management should be proposed by the Contractor. In case of default, the amount of penalty shall be paid by the Contractor to the Authority.

(xi) A compensation scheme including insurance cover for third party for works/road users and road side residents in case of death/injury/damage to the vehicle/property resulting from accidents on the Project, irrespective of the person at a fault should be proposed by the Contractor.

1.14.3 The Contractor shall also be responsible for ensuring compliance of all labour laws and regulations including those relating the welfare of workers engaged both directly and indirectly on the Project, besides their occupational safety and health.

1.15 The Contractor shall set up field laboratory for testing of materials and finished products as stipulated in QAM. It shall make necessary arrangements for additional/ conformity testing of any materials/products at the government accredited laboratory, for which facilities at site laboratory is not available.

#### 1.16 Environment Mitigation Measures

The Contractor shall carry out tests/monitor various parameters impacting the environment of the Project keeping in view the guidelines of the Ministry of Environment and Forests and submit proposals for mitigation of adverse environment impact including provision of noise barriers, etc. for review and comments of the Authority's Engineer, if any and undertake implementation of the proposals in consultation with the Authority's Engineer.

The Contractor shall take measures as may be necessary in accordance with the Applicable Laws and Good Industry Practice in vogue to control and mitigate the noise and vibration arising from the Rail System and their impact on the users and the neighbourhood. Noise mitigation measures shall be employed to ensure that the prescribed noise limits within the neighbourhood buildings and rail vehicles are not exceeded.

#### 1.17 Utilities

The details of the new utilities which are to be constructed or provided for along or across the Project shall be as specified in relevant schedule of the Agreement.

### **1.18 Review and comments by the Authority's Engineer**

In cases where the Contractor is required to send any drawings or documents to the Authority's Engineer for review and comments, and in the event such comments are received by the Contractor, it shall duly consider such comments in accordance with the Agreement and Good Industry Practice in vogue for taking appropriate action thereon. The correspondence between the Contractor and the Authority's Engineer shall be deemed valid only if a copy thereof endorsed to and received by the Authority.



## SECTION 2

### ELECTRICAL

#### 2.1 Introduction

This part of Tender document contains general, technical and other specifications for design and erection of complete 25 kV A.C. 50 Hz single phase Traction Overhead equipment, Switching stations, Booster Transformer stations, L.T. Supply Transformer stations, Traction Sub-Stations and associated Transmission line works, SCADA System, Electrical General Works, Signalling works, Telecom works, Civil Engineering works etc.

This part also gives typical designs relating to Overhead Equipments, Switching Stations, Booster Transformer Stations and Traction Sub-Stations along with technical specifications of materials, components, fittings etc.

The entire Railway Electrification work shall be executed as per relevant IS/ Specifications/ Drawings (latest version applicable in all cases up to the date of tender opening) and good industry practices. A list of the relevant Specifications / IS available is included in Annexure.

#### 2.2 List of Standard Specifications and IS

This Annexure contains list of documents, technical Specifications and IS referred to in various paragraphs of the Tender. The list of relevant Drawings for RE works has been included in the Schedule-I (Drawings) of RFP document.

All references to drawings, charts, schedules, specifications, IS etc. given in this Annexure or elsewhere in the tender document shall be taken to be the latest versions including all amendments up to the date of tender opening.

All other items not covered under the Drawings/Specification shall be referred to as per relevant IS and Railways practices in force.

The Drawings and RDSO specifications can be purchased from the office of CEE/CORE, Allahabad or TI Directorate of RDSO, Lucknow on payment basis.

##### 2.2.1 List of Standard RDSO's Specifications for OHE, TSS and SCADA

S.N.	TITLE OF SPECIFICATION	RDSO SPECIFICATION NO
1.	Annealed stranded copper conductor for jumper wire.	ETI/OHE/3(2/94) with A&C slip No.1of (4/95)
2.	Copper busbar	RE/30/OHE/5 (11/60)
3.	Structural Steel tubes.	ETI/OHE/11 (5/89)
4.	Hot dip zinc galvanisation of steel masts (Rolled and Fabricated) tube and fittings used on 25 KV AC OHE.	ETI/OHE/13(4/84) with A&C slip No. 1of (5/86),2 of (4/90) & 3 of (4/90)

5.	Stainless steel wire ropes	TI/SPC/OHE/WR/1060 with A&C slip No 1 of (11/06) & 2 of (05/07)
6.	Solid core porcelain insulators for 25 KV 50 Hz single phase overhead lines	TI/SPC/OHE/INS/0070 (04/2007)
7.	25 KV single and double pole isolators.	ETI/OHE/16(1/94) with A&C slip No.1 of (06/2000) & 2 of (3/2004)
8.	Steel fasteners & Stainless Steel fasteners	TI/SPC/OHE/Fasteners/0120
9.	Aluminium alloy section and tubes	ETI/OHE/21(9/74)
10.	Standard for drawings for Traction Overhead equipment	ETI/OHE/25(3/66)
11.	Light Weight Section Insulators assembly. OR Section Insulator assembly without sectioning insulator.	TI/SPC/OHE/LWTSI/0060 (8/2006) OR ETI/OHE/27(8/84) with A&C slip No.1 of (10/92)
12.	Enamelled steel plates	ETI/OHE/33(8/85)
	Retro-reflective Structure Number Plates & Caution/Warning Boards	ETI/OHE/33A(12/97) Rev-7
13.	Galvanised steel wire	ETI/OHE/36(12/73) with A&C Slip No.1 of (5/98)
14.	3 pulley Type Regulating Equipment	TI/SPC/OHE/ATD/0060 (8/2006) with A&C Slip No1 of (10/2006) & 2 of (5/2007)
15.	Fitting for 25 KV 50 HZ AC Overhead equipment	ETI/OHE/49(9/95) with A&C Slip No 1 of (3/97) and CORE's A&C slip No. 2 of (4/2000), 3 of (08/01), 4 of (03/2002) & 5 of (10/2010).
16.	Cadmium copper conductor for overhead Railway Traction	ETI/OHE/50 (6/97) with A&C slip No.1 to 3.
17.	Principles of OHE layout plans and sectioning diagrams for 25 KV AC traction	ETI/OHE/53(6/88) with A&C slip no.1 of (12/88), 2 of (8/89), 3 of (6/90), 4 of (8/92) & 5 of (11/2006)
18.	19/2.79mm All Aluminium alloy stranded catenary wire.	ETI/OHE/54(2/85) with A&C slip No. 1 of (11/89) & 2 of (10/92)
19.	Bimetallic (Al- Cu) strip	ETI/OHE/55(4/90)
20.	Short Neutral Section Assembly (Phase Break)	TI/SPC/OHE/SNS/0000 of (2/2000)
21.	Code for bonding and earthing for 25 KV, AC single phase, 50 Hz traction system.	ETI/OHE/71(11/90) with A&C slip no. 1 of (8/91) & 2 of (3/93)
22.	Insulated Cadmium copper catenary 19/2.10 mm dia for provision under	TI/SPC/OHE/INSCAT/0000 of (4/2000)

	overline structures in the 25 KV AC Electric Traction.	
23.	Battery charger for 110 V battery, 40 AH.	ETI/PSI/1(6/81)
24.	Lightning arrester-7.5 KV	ETI/PSI/3(8/75) with A&C slip No.1 of (2/91)
25.	220 KV or 132 KV or 110 KV or 66 KV or 25 kV Potential transformers	TI/SPC/PSI/PTs/0990 with A&C slip No.1 to 5 (01/09)
26.	25 KV Dropout fuse switch & operating pole for use with 10 KVA and 100 kVA 25 kV/ 230 V L.T. Supply transformer.	ETI/PSI/14(1/86) with A&C slip no 1 of (4/87)
27.	25 kV/240 V, 5 kVA, 10 kVA, 25 kVA & 50 kVA, 50 Hz single phase oil filled Auxiliary Transformers.	ETI/PSI/15(8/03)
28.	Low maintenance Lead Acid 40AH & 200 AH cells.	RDSO/PE/SPEC/TL/0040-2003(Rev-0) with A&C slip no 1 of (9/2005)
29.	150 KVA, 25 KV, single phase, 50 Hz. Dry type Cast resin Booster Transformers	ETI/PSI/97(6/87) with A&C slip No.1 of (9/88)
30.	100 KVA & 150 KVA, 25 KV, single phase, 50 Hz, oil filled Booster Transformers	ETI/PSI/98(8/92) with A&C slip No.1 of (9/92), 2 of (1/94) & 3 of (6/94)
31	25 kV Single pole, Double Pole, Pole Mounted, Out Door Vacuum Circuit Breaker (VCB) and Vacuum Interrupter (BM)	TI/SPC/PSI/LVCBIN/0120 (December, 2013) (Revision – 0)
32	Hard drawn grooved copper Contact wire	ETI/OHE/76(6/97) with A&C slip No.1 of (4/01), 3 of (03/05), 4 of (12/06), 5 of (7/09), 6 of (5/12) & 7 of (12/13)
33	Metal Oxide Gapless type Lightning Arrester for use on 25kV side of Rly. traction sub stations & switching stations	TI/SPC/PSI/MOGTLA/0100(07/10)
34	Technical Specification for Silicon Composite Insulators for 25 kV A.C. 50 Hz single phase overhead traction lines.	TI/SPC/OHE/INSCOM/1070 (01/07) or TI/SPC/OHE/INSCOM/1071 (04/13)
35	Specification for solid core porcelain cylindrical post insulator for systems with nominal voltage of 66kV, 110kV, 132kV & 220kV.	TI/SPC/OHE/POST/0100(01/2010)

36	25kv/240V L.T. supply Transformer, 100 KVA	ETI/PSI/15 A (7/82) with A&C Slip No.1(9/89)
37	Battery charger for 110V Battery, 200 AH	ETI/PSI/24(6/81)
38	Low tension Distribution panels for Railway A.C traction sub-stations	ETI/PSI/29 (12/79)With A&C Slip No.1 ( 2/93)
39	Standard for drawings for power supply Installations.	ETI/PSI/31 (5/76)
40	Low Tension distribution panels.	ETI/PSI/63(7/82)
41	Technical specification for control and relay panel for 25kV AC TSS including specification for numerical type protection relays for traction transformer, 25kV shunt capacitor bank and transmission line for 25kV ac TSS on Indian Railways.	TI/SPC/PSI/PROTCT/6070(9/08) with A&C slip No.1
42	Technical specification for shunt capacitor & series reactor equipment for traction sub-station	TI/SPC/PSI/FC&SR/0100(01/10)
43	Technical specification for 25kV ac, 50 Hz, single phase, oil filled, current transformer with CT ratio of I -1000-500/5A (for general purpose), II-1500-750/5A (for heavy haul duties) for Railway ac traction sub-station.	ETI/PSI/90 (6/95) with A&C Slip No.1, 2, 3, 4, 5, 6, 7 (08/2007) & 8 (April 2009).
44	Technical specification for two zone static relay for distance protection for 25kV ac single phase 50 Hz traction overhead equipment.	ETI/PSI/101 (8/87) with A&C Slip No.1 (09/87)
45	Technical specification for current transformers. I. 220kV. 200-100/5A, II. 132kV. 400-200/5A, III. 110kV. 400-200/5A, IV. 66kV. 800-400/5A for Railway A.C traction substations.	ETI/PSI/117 (7/88) with A&C Slip No.1 (11/88), 2 (3/89), 3 (12/89), 4 (4/90), 5 (6/90), 6 (9/92), 7 (8/05), 8 (08/2007) & 9 (July 2008).
46	Specification for 21.6 MVA single phase, 50 Hz. i) 220/27kV ii) 132/27kV iii) 110/27kV, iv), 66/27kV traction power transformer for Railway A.C traction sub- station.	ETI/PSI/118 (10/93) with A&C Slip No.1 to 10 (08/12) or latest
47	Code of practice for earthing of power supply installations for 25kV A.C., 50 Hz, single phase traction system.	ETI/PSI/120 (2/91) with A/c Slip No1 (10/93)
48	Technical specification for i) 245 kV, (ii) 145 kV, (iii) 123 kV, (iv) 72.5 kV double pole & triple pole Isolator for	ETI/PSI/122 (3/89) with A&C Slip No.1(4/90)

	Railway traction sub stations.	
49	Specification for Metal Oxide gapless type lightning arrestors (combined) for use on 220/132/110/66 kV side of Railway A.C. traction sub-station.	ETI/PSI/137 (8/89) with A&C Slip No.1 (1/90), 2(2/91), 3(12/91), 4(8/94) 5 & 6 (9/05) & 7(07/2007)
50	Technical specification for 220 kV or 132 kV or 110 kV or 66 kV or 25 kV Potential Transformer	TI/SPC/PSI/PTS/0990 with A&C Slip No.1,2,3,4,& 5 (April 09)
51	Delta I type High resistive fault selective Relay for 25 kV AC Single phase 50 Hz traction system.	TI/SPC/PSI/PROTCT/1982 (12/2003) with A&C slip no. 1
52	Panto flashover protection relay for 25 kV A.C. single phase 50 Hz traction system.	TI/SPC/PSI/PROTCT/2983 (08/2001)
53	Technical Specification for SCADA system for 25 kV, AC Single phase Traction supply on Indian Railways	TI/SPC/RCC/SCADA/0130 (04/2014)
54	Technical Specification for Galvanised Steel Stranded Wire for Traction Masts	TI/SPC/OHE/GSSW/0090 (10/2009)
55	Technical specification for galvanized steel stranded wire for traction bonds	TI/SPC/OHE/GALSTB/0040 Rev.1
56	Setting up Earthing station at switching posts (SSP & SP) with conventional Earthing	Special Maintenance Instruction No. TI/SMI/0032 Rev-1
57	Design hand outs for Overhead equipments for running double stack containers under electrified routes (High rise OHE) with speed potential of 140 Kmph based on revised wind zones	TI/DESIGNS/OHE/2013/00001 (July'13)
58	OHE span in view of changes in wind zones in country	TI/OHE/GA/2013 dated 25/30.04.2013
59	Technical guidelines and Standard Instructions for Railway Electrification Works including OHE, TSS, Transmission line, SCADA, Electrical General Works, Signalling works, Telecom works & Civil Engineering Works	CORE/RE TENDER/EPC/2014/ STANDARD INSTRUCTIONS AND GUIDELINES

## 2.2.2 List of IS Standards and Codes

IS Code No.	Descriptions
IS:2062-2006	Steel for general structural purpose
IS:808-1989	Dimensions for hot rolled steel beam, column, channel & angle sections
IS:1731-1971	Dimensions for steel flats for structural & general engineering purpose
IS:2004-1991	Carbon steel forgings for general engineering purpose
IS:1608-1995	Mechanical testing of metal- tensile testing
IS:816-1969	Welding
IS:731-1971	Porcelain Insulator for overhead power lines with a nominal voltage greater than 1000V
IS:3188-1980	Characteristics of string insulator units
IS:282-1982	Dropper Wire
IS:9968(Pt.2)-2002	Annealed Copper Jumper Wire
IS:694:1990	Al. Jumper wire
IS:398(PT.I)-1996	All Aluminium conductor
IS:5082-1998	Material for Aluminum tubular busbar.
IS:2673-2002	Dimensions for Aluminum Tubular Busbar.
IS:2141-2000	Galvanised stay strand
IS:1554(Part-I) 1988	PVC insulated cables
IS:306-1983	Tin bronze castings
IS:3091-1999	Aluminium bronze castings
IS:14329-1995	Malleable iron castings
IS:210-1993	Grey Iron castings
IS:617-1994	Aluminium castings
IS:1897-1983	Copper strip for formed fittings
IS: 2074-1992	Ready mix Paint, air drying, Red oxide, Zinc chrome
IS:398 Pt.II-1996	Al. conductor for overhead transmission purposes
IS:3043-1987	Code of practice for earthing (1 <sup>st</sup> Rev)
IS:702-1988	Specification for industrial bitumen (2 <sup>nd</sup> Rev) reaffirmed 1999
IS: 6403-1981	Code of practice for determination bearing capacity of shallow foundations (1 <sup>st</sup> Rev)
IS: 456-2000	Plain & Reinforced concrete Code of practice (3 <sup>rd</sup> Rev)
IS: 383-1970	Specification for coarse & fine aggregates from natural sources for concrete
IS: 2386 Pt.III-1963	Method of tests for aggregates for concrete Pt. III Specific gravity, density voids, absorption & buckling
IS: 516-1959	Method of tests for strength of concrete
IS: 1489 Pt. I 1991	Specification for Portland-Pozzalana cement Pt. I Fly ash based (3 <sup>rd</sup> Rev)
IS: 8130-1984	Conductor for Insulated electric cables & flexible cords (1 <sup>st</sup> Rev)

IS:335-1993	New Insulating oil (4 <sup>th</sup> Rev) Reaffirmed 2000
IS:3837-1976	Accessories for Rigid steel conduit for electrical wiring
IS:4826-1979	Specification for hot dipped for galvanised coatings on round steel wires (1 <sup>st</sup> Rev)
IS:13947 Pt. III 1993	Specification for low voltage switchgear & control gear Pt.-3, disconnectors & fuse combination unit
IS:3854-1997	Switches for domestic & similar purposes(2 <sup>nd</sup> Rev)
IS:1293-2005	Plugs & socket outlets of rated voltage up to and including 250V and rated current up to 16 Amp(3 <sup>rd</sup> Rev)
IS:371-1999	Ceiling rose spec.( 3 <sup>rd</sup> Rev)
IS:1777-1978	Industrial Luminaries with metal reflectors (1 <sup>st</sup> Rev)
IS:2312-1967	Propeller type AC ventilating fans (1 <sup>st</sup> Rev)
IS:732-1989	Code of practice for electrical wiring installation (3 <sup>rd</sup> Rev)
IS:269-1989	Specification for 33 grade ordinary Portland cement (4 <sup>th</sup> Rev)
IS:2675-1983	Enclosed distribution fuse boards ad cut-outs for voltage not exceeding 1000V AC & 1200V DC (2 <sup>nd</sup> Rev)
IS:800-1984	Code of practice for general construction in steel (2 <sup>nd</sup> Rev)
IS:9537 Pt-I-1980	Conduits for electrical installations
IS: 432 Pt.1-1982	Specification for mild steel & medium tensile steel bars and hard drawn steel wires for concrete reinforcement
IS:1786-1985	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS:1387-1993	General requirements for the supply of metals and metal products
IS:398(Part-III) 1976	Aluminium conductors galvanized steel reinforced
IS:2121-1981	Aluminium and steel cord Aluminium conductors for (Part I & II) overhead power lines.
IS: 7098 (Part-I) 1988	LT XLPE cables
IS: 7098 (Part-II) 1985	HT XLPE cables
IS : 1255 - 1983	Installation and Maintenance of Power Cables up to and including 33 kV rating.
IS: 875 (Part-3)/ 1987 (Reaffirmed)	Code of practise for design loads (other than earthquakes) for buildings and structures – Part 3: Wind loads second revision
IS:2026/ 1977	Transformer
IS: 3427 for VCB	11 KV HT vacuum circuit breaker, SF6/ 11 KV gas filled circuit breaker
IS:13118/1991 IS:13947 / 1993	ACB 11 KV
IS:11171/85 for dry type transformer	PSS/CSS with HT /LT switch gear , transformer and connected accessories
IS : 8828/96 for MCB IS:	MCCBs, MCBs, ELCBs, RCCBs, DB, ICTPN, TP, HRC

13947 (Part-1&5/SecI)/93 for MCCB IS: 12640(Part-I)/2000 for RCCB IS: 13703 (Part-2/SecI)/93 for HRC fuse IS: 13947 (Part-3)/93 for SFU	fuse, Changing over switch, Switch fuse unit.
IS:7098(Part-2)/1985	XLPE 11/33 KV
IS:694/ 1990 for PVC cables IS:1554 Part-1/1988 for heavy duty PVC cable IS:7098 Part-1 /1988 for XLPE cable	PVC/ XLPE power cable upto 1.1KV grade
IS: 1248 for Analog Instruments	Instrument Voltmeter, Ammeter, PF meter
IS:13573/ 1992	11KV cable end termination and jointing kits
IS: 3231/65	Relays
IS: 9974 (Part-1)/83 for HPSV IS: 10322 (Part-5), 10322 (Part 2&3)/84 for Luminaries IS: 15111 for CFL	Luminaries, MH, HPSV, T-5 fittings, CFL & related accessories.
IS:694/1990 for PVC cable	PVC insulated Elect. Wire sheathed /Unsheathed, PVC, flexible LT cable, multicore, single core, Flat cable for submersible cable
IS: 2705 (Part 3)/92	Current Transformer
IS: 13314/92 for Inverter IS: 11260/85 for voltage Stabilizer	On line UPS, Servo Stabilizer, Inverter, CVT
IS:374/79 for ceiling fan IS:2312/63 for exhaust fan	Exhaust fan/ Air circulator/ Bracket & Pedestal fans/ ceiling fan
High mast IS: 875 Part 3, BSTN-10025/1993, CPE II TRT/1996 of ILE UK. Octagonal Pole S355JO Galvanization IS:2629 BSEN ISO-1461	Galvanized High Mast Tower/ Tubular pole/ Octagonal pole for general purpose lighting
IS: 13779/1999 IEC:62053-21	Electronic Energy meter
IS:8148 for Package type, IS:1391 for Room air conditioners	Central Air Conditioning Plants & Package type plant
IS: 13340/93 IS: 13341/92	Capacitors – PF correction for Electrical General Services.



IS: 13364(Part-1)/92 for Alternator IS: 1001/91 for Diesel Engine.	DG Sets – Portable
IS:13364	DG Engine
IS:4722/2001 IS:4728/1975	Alternator for DG set
IS: 235/96 IS:12615/2004	Induction motor
IS:13947 (Part1)/1993 IS:13947 (Part4)/1993	LT Switchgear & control gears-Contactors & motor starters, Energy Efficient Soft Starter panel/Earthing Switch, Single phase preventer
IS:8034/2002 for submersible pumpsets IS:9283/1995 for motor of submersible pumpsets IS:14220/1994 for open well submersible pumpsets	Pumps- Submersible
IS:3854/88 for switches IS:1293/88 for plugs & sockets IS:371/79 for ceiling rose IS: 1258/79 for lamp holder bakelite	Electrical accessories (Piano switch, Plugs & sockets, ceiling rose, Angle holder, holders)
IS:2268/1988 or latest	Bell Buzzer
IS:11037/1984	Electronic fan regulator
IS:1239 (Part-1)/90	GI/MS Pipe
IS:2026 IS:3895	Battery charger for other than battery room for train lighting
As per RDSO spec having re-generation facilities	Battery charger for battery room
IS: 9537/93 for PVC Conduit wiring IS: 14927 for Casing Caping wiring	PVC Conduit pipe & Casing capping for electrical wiring
IS:4571/1977	Aluminium Ladders
As per relevant IEC	LT panels

## **SECTION 3**

### **SIGNALLING**

- 3.1 The following general instructions may be followed in respect of all signalling works.
- 3.1.1 Any signalling circuit in the vicinity of 25 KV AC Traction lines is liable to be affected by induced voltages and surges. Such circuits therefore, cannot be retained on overhead line wires and shall be transferred into underground cables. All precautions shall be taken to protect circuits, equipments and persons operating the equipments from the effects of 25 KVAC traction. All precautions shall also be taken to protect circuits and equipments in such manner so as to prevent unsafe conditions for train operation. The system design must ensure fail safe principle.
  - 3.1.2 Trenching and cable laying shall be in conformity with guidelines on signal cable laying issued by RDSO vide RDSO/SI/G/2010 Version: 1.1 with latest amendment.
  - 3.1.3 IPS (Integrated Power Supply) system shall be supplied and installed in conformity to RDSO specifications No. RDSO/SPN/165/2012 with latest amendments.
  - 3.1.4 Data logger shall be supplied and installed in conformity to IRS specification No. IRS-S-99/2006 with latest amendments.
  - 3.1.5 The EI (SSI) system shall be supplied and installed in conformity to RDSO specifications No. RDSO/SPN/192/2005 and TANs (Technical Advisory Notes) with latest amendments having hot standby system configuration.
  - 3.1.6 SSDAC shall be installed in conformity with the provisions of specifications number RDSO/SPN/177/2012 (version-3.0) with latest amendments and manufacturers installation procedure.
  - 3.1.7 MSDAC shall be installed in conformity to the provisions of specifications number RDSO/SPN/176/2013 (version-3.0) with latest amendments and manufacturers installation procedure.

- 3.1.8 The BPAC using UFSBI system shall be supplied and installed in conformity with RDSO specifications No.IRS:S-105/2012(Ver.0) with latest amendments and manufacturers installation procedure.

### **3.2.1 Earthing**

- 3.2.1 Equipments with solid state components which are more susceptible to damage due to surges, transients and over voltages being encountered in the system due to lightning, sub-station switching such as Electronic Interlocking, Integrated Power supply equipment, Digital Axle counter, Data logger etc. shall be provided with earthing as per Code of practice for earthing and bonding system for signalling equipments laid down in RDSO/SPN/197/2008. Value of earth resistance shall not be more than 1 ohm.
- 3.2.2 For conventional signaling equipments the earth resistance shall not be more than 10 ohms.
- 3.2.3 In order to ensure that equipment is properly installed and commissioned by adhering to pre-commissioning check-list and procedure as defined by OEM in its installation manual, it is necessary that electronic signalling systems, such as EI (SSI), SSDAC/MSDAC, UFSBI/BPAC, AFTC, IPS and Data Logger, are installed and commissioned by RDSO approved vendor and a certificate is issued to Railways in the prescribed format.

### **3.3 List of specifications**

The materials shall be in conformity with these specifications along with latest amendments issued.

1. PVC Insulated armoured unscreened underground power Cable as per specification No. IRS-S-63/2007 Amend.3 with latest amendments except for the Aluminium conductor which shall be as per IS-1554 (Part-I) with latest amendments.
2. PVC Insulated Railway signalling Indoor Single/multi core cable as per Specification No. IRS-S-76/89 (Amed.3) with latest amendments.
3. PVC insulated armored unscreened underground Railway signalling cable as per specification No. IRS: S-63/2007 Amend.3 with latest amendments.

4. 6 Quad cables as per specification IRS-TC-30-05(Amd.1 to 4) with latest amendment for axle Counter.
5. RCC Pipe 150 mm dia 2 meter long with collars to IS Specn. No. 458/1971.
6. Double walled corrugated HDP duct for signaling cable as per RDSO specification No. RDSO/SPN/204/2011(Ver.1.1) or latest.
7. Earth Leakage detector Multi channel suitable to work on 110 Voltage 50 Hz single phase AC as per RDSO Specification No. 256 /2002 complete with electromagnetic counter.
8. Signal Colour Light Multi Unit type 2,3&4 aspect without sidelight, signal transformers, lamps and lenses as per IRS S:26/64 and RDSO Drg. No. SA-23003 A/M (Adv), SA-23002 A/M (Adv) & SA-23001 A/M (Adv.) respectively with latest amendment. The mounting socket should be provided for 140 mm dia to RDSO Drg. No. S-23005 M (Adv) with latest amendments.
9. Colour Light Signalling Tubular post 5.6 M, 4.6 M & 3.6 M long, conforming to IRS specn. No. IRS: S-6 with latest amendments.
10. Signal Shunt Position Light 2 Positions as per RDSO Drg. No. SA 23840. (Adv.) latest.
11. Route Indicator Direction type 5 Unit Arm 1, 2 &3 way as per IRS Spec No. IRS: S-66/84 Amd. I and RDSO Drg. No. SA 23401(Adv.), SA 23402 (Adv.) & SA 23403 (Adv.) respectively with latest Amendment, complete with fittings but without lamps, lenses and signal transformer along with mounting sockets 140 mm dia to RDSO Drg. No. S-23005/M (Adv.) latest. (Suitable arrangement should be provided to fix the arms as per Unit combination 'a' and 'b' indicated on the drg.)
12. Ladder for colour light Signal Multi Unit Type 5.5, 4.5 & 3.5 Meters as per RDSO Drg. No. SA 23156 (Adv), SA 23153 (Adv) & SA 23150 (Adv.) Alt. 1 respectively with Latest Amendment.
13. Signal Base for 140 mm dia post as IRS (S) Drg. No. S-2011/M latest.
14. Signal Bracket Colour Position Light for 140 mm outside dia post as per RDSO Drg. No. SA 23080 (Adv.) latest.
15. Offset bracket for CLS for 140 mm outside dia post procured through Signal Workshop. RDSO Drg. is not available.

16. Circuit Controller 2, 4, 6 & 8 Way (modified design) lever type as per RDSO Drg. No. SA 20245 (Advance), SA 20266 (Advance), No. SA 20276(Advance). & SA 20286 (Advance) respectively
17. Block Section/Shunting Limit Board as per RDSO Drg. No. SA 2373 (Adv.) latest.
18. Terminal Block (M6 Terminals) as per IRS Specification No. IRS: S-75/2006 with latest amendment and IRS Drg. No. SA 23741A (Alt. 4).
19. Fuse Link cartridge cylindrical head (2A, 4A and so on) non-deteriorating type, non-indication type as per IRS Specification No. IRS: S-78/92 with latest amendment.
20. Indication type of low voltage (0.4A, 0.6A and 1.6 Amp.) Non-deteriorating Fuse links for signalling circuit as per RDSO Specification No. IRS: S-78/92 with latest amendment.
21. Fuse Block as per IRS(S) Drg. No. SA 23748 (Alt. 4)
22. Block instrument SGE type tokenless double line without 3 position polarized relay, rated voltage of instrument 12 V DC, hand micro telephone without dial for using the instrument in AC electrified traction area as per specification no. IRS: S-22/91.
23. Block proving by Axle counter(BPAC) using UFSBI(For double line & Single line) as per IRS: S 105/2012 (Ver. 0)
24. Signal colour light transformer 110/12V AC as per IRS specification No. IRS: S-59/77(Amed-2) with latest amendments & RDSO drawing SA-23014/M with latest amendments.
25. High Voltage Signal Transformer as per IRS Specification No. IRS: S-92/9388 with latest amendments.
26. Transformer 230 V AC/110V AC as per IRS Specification No. IRS: S-72/88 (Amend-2) with latest amendments.
27. Indication supply transformer 230 V AC/24 V AC with tapping at 12 V AC as per IRS Specification No. IRS: S-83-92 with latest amendments.
28. Lock key 'E' type as per IRS Drg. No. SA 3376/M latest amendments.

29. Battery chargers as per IRS Specn. No. IRS-S-86/2000(Amnd-4) with latest amendments.
30. Voltage Stabilizer Ferro Resonant Type as per Specn. No. IRS: S-74/89 (Amnd-6) with latest amendments.
31. Inverter (Ferro resonant version) for Railway Signalling Installations for 'On Line' applications as per IRS Specification No. IRS: S-82/92 (Amnd-2) with latest amendments.
32. DG sets 10 KVA single phase with wall mounting type controlled panel, subsidiary control panel for remote operation and battery charging dynamo arrangement as per RDSO specification No. RDSO/SPN/193/2005 with latest amendments.
33. Relay universal plugging type AC lamp proving relay (M to C) contact for LED signal lamp As per BRS-941A,STS /E/Relays/AC Lit LED Signal/09-2002, Amdt.I.
34. Relay Plugging type tractive armature AC lamp proving relay (Metal to Carbon Contact) Signal lamp (ON, OFF, Route, Shunt ECR) as per BRS 941A and 942.
35. Relay –“ Q “series neutral line(ACI & Non ACI) as per BRS 930 & BRS 931A
36. Relay Plugging type, Track relay 9 ohm & 4 ohms (ACI & Non ACI) as per BRS-938A, 939A, 966 and appendix F2.
37. Relay Special type Metal to Carbon as per BRS-930, 931A, 932A, 933A, 934A, 935A, 937A, 943, 960, & RDSO spec. No. RDSO/SPN/84/88 and firm's spec.
38. Relay ECRs metal to metal contact (ON/OFF, Route and Shunt aspect as per IRS:S 46 & Firm's spec.
39. Relay 3-position DC polarized as per IRS S 31/80 (Amdt.I).
40. Relay Special type (Metal to Metal) as per IRS S 46 & Firm's Spec.
41. Relay Metal to Metal 110 V AC LED ECR for LED signal lamp as per STS/E/Relay/AC Lit LED signal 09-2002 with Amdt.I.
42. Relay Point Contactor Unit As per IRS S 46 & firm spec
43. Relay Contacts-Sig-(For Q-series plugging type relay only) as per IRS S 67/85 (Amdt. 2)

44. Relay, Fail safe Electronics Time Delay mounted on 'Q' series relay base & covered with fixed timing of 120 seconds, confirming to IRS: S-61/81, IRS: S-34 & IRS: S-23. The interlocking code for this unit shall be AFGKY.
45. Nylon insulated Rail joint (Four channel Type) with all accessories as per IRS S 40/84 with Amdt.I and Drg No. SA 22101(Alt.6) for 52 Kg, SA 22171(Alt.2) for 60 Kg, SA 22181(Alt.2) for 60 Kg, (UIC), SA 22191(Alt.2) for 90 R.
46. Wire Insulator as per IRS Specification No. IRS: S-47/74 with latest amendments.
47. Track lead Jn. Box as per RDSO Drg. No. SA-20101/M Complete with 450 mm long 25 mm dia pipe.
48. Choke Type 'B' having annealed enamelled copper wire, as per IRS Specn. No. IRS: S-65/83(Amd-3) with latest amendments.
49. Channel Pin single Groove 7 mm dia (for 4 mm dia Bond wire) as per Drg. No. S-69/M with latest amendments
50. Bond wire clip (52 kg. - 90R Rails) as per RDSO Drg. No. S-22167 (Adv.) latest.
51. Wire GI soft. 4 mm (8 SWG) as per IS specn. No.IS-280.
52. Magneto Telephone Desk Type to IRS TC 36 – 97(Amnd.1) with latest amendments.
53. Electric lever lock and circuit controller combine 200mm stroke & (DW) 40 mm stroke as per drg. No. SA 21201/M (adv.) & Drg No. SA 22701(Adv) or latest.
54. Electric point operating machine type Bsg to operate on 110V DC, hauling internal locking non-trailable design (Siemens Type). As per Siemens specification and Drg. A.C immunity level & throwing force as per IRS-S-24-2002(Amend.1) with latest amendments.
55. Tag Block 200&160 way conforming to specification No. IRS-S-77/2006(Rev.1) & SA-24752 with latest amendment with Drg. No. SA-24751.
56. Low maintenance lead acid stationary secondary cell as per IRS specification No. IRS-S-88/2004 Nominal voltage 2V, each of 80/40 AH with transparent container for use of Railway signalling and telecommunication applications.
57. Dual bank battery charger 12V to 36V DC 1 Amp capacity complete with two banks of 9 Nos. each of twin cells of 4V 12 AH capacity of 100 hrs. rate low maintenance lead acid batteries as per IRS- specification No. IRS-S-85/92 (Amend. 3) with latest amendments.

58. Transformer 230V AC / 110V AC 1KVA as per IRS- specification No. IRS-S-72/88(Amnd.2) with latest amendments.
59. SMPS based integrated power supply system (IPS) as per RDSO specifications No. RDSO/SPN/165/2012 with latest amendments.
60. LED signal lighting unit as per RDSO specifications No. RDSO/SPN/153/2011 ver. 4.1 with latest amendments.
61. Specifications for Data logger as per RDSO specifications No. IRS:S-99/2006 (Amdt.) with latest amendments.
62. T.F. Battery. Charger to work on 110 V AC for charging 1or 2 or 3 or 4 lead acid cell of 80AH (10Amps) used in track circuit as per IRS specification no TRS: S 89/2013(Ver. I.0) including latest amendments.
63. Universal plug in type tractive armature AC lamp proving relay (Metal to Carbon) for 110v AC LED signal Lamp as per RDSO specification No. STS/E/Relay/AC/LED Signal/09/2002 with latest amendments.
64. Electronic Interlocking for Big Yard as per RDSO specification No. RDSO/SPN/203/2011(Ver. 01) with latest amendments.
65. Electric lifting barrier as per RDSO specification (Draft) No. RDSO/SPN/208/2012(Ver.2) with latest amendments.
66. Fuse auto change over system as per RDSO specification No. RDSO/SPN/209/2012 Rev.1 with latest amendments
67. Terminal Block, Fuse Terminal Blocks and Miniature Fuse Links of International Standard for Railway Signalling as per RDSO/SPN/189/2004 with latest amendments
68. Lightning and surge protection devices for electronic signalling equipments as per RDSO specification RDSO/SPN/146/2006 with latest amendments
69. PPTC fuses to UL thermistor standard in parallel with NDT fuses for outdoor signalling installations in location Boxes.
70. Any other new specifications issued by RDSO for new signalling equipments.



## SECTION 4

### TELECOMMUNICATIONS

- 4.1 All telecommunication equipment should adhere to the following instructions:
- 4.1.1 Any Telecommunication circuit in the vicinity of 25 KV AC Traction are liable to be affected by AC induced voltage. Such circuit cannot, therefore, be retained on overhead line wires and must be transferred on underground cable. All precautions are to be taken to protect equipments as well as persons operating the equipment from the effect of 25KV AC Traction.
  - 4.1.2 Planning and system design, location of optic fibre equipment room, building layout, layout of equipment, preliminary survey of optic fibre cable route, preparation of cable route plan and tapping diagrams, detailed survey and finalization of the route plan of fibre optic cable, laying of duct in trenches and clowing/ pulling of cables in duct, protection of optic fibre cable route and back filling of trenches, jointing and termination of optic fibre cable and testing of optic fibre cable shall be in conformity with provision contained in Chapter XIII of Indian Railway Telecom manual and RDSO's drawings given therein.
  - 4.1.3 Test & measurement for installation and commissioning of OFC cable and OFC equipments on OFC LINK should be performed as per Report No. STT - 23 (may 2000) with latest amendments.
  - 4.1.4 Procedure for under taking digging work in the vicinity of Signalling, Electrical and Telecommunication cable should also be in conformity with Telecom circular No. 17/2013 circulated vide Railway Board letter No.2003/Tele/RCIL/1 Pt IX dated 24.06.2013 or latest guide lines issued by Railway Board on the subject.
  - 4.1.5 Quad cables are required to be laid as per RDSO's drawings referred in Chapter XIII of Telecom manual.
  - 4.1.6 Thermoshrink Jointing Kits for Underground telecom cables to be installed, commissioned and acceptance test conducted as per RDSO approved manufacturer's instructions and provisions given in specifications issued by RDSO. Precautions for Thermo shrink joints of quad cable should be followed as contained in Report No.STT-44 (March 2013) issued by RDSO.
  - 4.1.7 Control equipment shall be installed, tested and commissioned as per RDSO specification No.RDSO/SPN/TC/66/2007 (Amd-2) with latest amendments. The wiring for these control equipments shall be as per standard practice.

## 4.2 Earthing:

All the equipments shall be protected against the insurgence of surge voltage and lightning etc. by providing Gas discharge tubes before they are connected to main / derivation cables. All the GD tubes should be suitably connected to proper earth. The earthing arrangement should be provided with GI Pipe earth as per RDSO Drg No.TCA/565. All earthing should be as per RDSO's drawings and provisions given therein including follows;

- 4.2.1. The CCITT report on “Earthing of Telecommunication installations 1976” with latest amendments.
- 4.2.2. The CCITT report on “The Protection of Telecommunication Lines and equipment against lightning discharges”. (Chapter 6, 7 & 8) 1978 with latest amendments
- 4.2.3 IRS/TC/39/86 with latest amendments “Code of Practice for the protection of Radio Relay stations against lightning.”
- 4.2.4 RDSO specification No. RDSO/SPN/TC/98/2011 Rev 0 with latest amendments for “Surge protective devices for telecommunication equipment.”

## 4.3 Earth Resistance values

Maximum values of earth resistances specified for earthing of telecommunication equipments are as under:-

- |    |  |  |
|----|--|--|
| 1. | Earths for surge arrestors / lightning dischargers for Conventional equipment. | should not be more than 10(ten)ohms.   |
| 2. | Equipment earth for optical fibre cable huts.                                  | should not be more than 1(one)ohms.    |
| 3. | Telephone exchange earths.   | should not be more than 5 (five)ohms.  |
| 4  | Screened/Armour Aluminium sheathed Telecom cable                               | should not be more than 1 (one)ohms.   |
| 5. | Equipment earth in VF Repeater Station, cable hut & way station                | should not be more than 5 (five) ohms. |

- 4.4 All the equipment, cables and outdoor/ indoor installation shall be protected from induced current, voltage as per CCITT regulations against 25 KVcatenary carrying 1000 Amp current. Protection should be provided against all surge / transient voltage.
- 4.5 All SDH Add/Drop MUX (STM-1) for main stream short haul and SDH Add/Drop MUX (STM-1) for back up stream long haul with Ethernet card should be procured as per TEC specification No. TEC/GR/TX/SDH-004/04 JAN 2011 with latest amendments. To be installed and commissioned as per TEC approved manufacturer's instructions and provisions given in specifications issued by TEC. Acceptance test for equipments of OFC link system should be conducted as per RDSO Report No. STT - 23 (may 2000) with latest amendments.
- 4.6 All 2MB programmable primary digital drop insert Multiplexer with conference facility should be procured as per RDSO specification No. IRS:TC-68-2012 with latest amendments and installed, commissioned as per RDSO approved manufacturer's instructions and provisions given in specifications issued by RDSO. Acceptance test for equipments of OFC link system should be conducted as per CCITT recommendation & RDSO Report No. STT - 23 (may 2000) with latest amendments.
- 4.7 All the arrangement of OFC equipment should be in conformity with provision contained in Chapter XIV of Indian Railway Telecom Manual.
- 4.8 List of specifications

The materials shall be in conformity with these along with latest amendments issued.

1. Cable optic fibre armoured (24 fibre) to Specn. No. IRS TC-55-2006 Rev-1 amendment 2 including latest amendments.
2. Optic Fibre Cable Termination Box as per RDSO Specn. No. IRS: TC 81-2000(Part-B) with latest amendments.
3. Optic Fibre Distribution Frame as per RDSO Specn. No. IRS : TC 81-2000 (Part-D)with latest amendment
4. Optical fibre Telephone set as per G/OPT-01/03 May'99 with latest amendments with clip on device
5. Optic Fibre joint closure as per RDSO Specn. No. RDSO/SPN/TC/68-2007 Rev 0 amendment -1 with latest amendments
6. Fibre Distribution Management System as per Specn. no. RDSO/SPN/TC/37-2000 (Ver.3) amendment -1 including latest amendments.

7. Optical Fibre Patch cord & Pigtail as per RDSO Specn. no. RDSO/SPN/TC/69-2007 Rev 0 including latest amendments
8. Optical Fibre Jumper cable/Pigtail with FC/PC connector as per TEC spec. No.TEC/GR/TX /OFJ-01/05 NOV 2009 with Latest amendments.
9. SDH Add/Drop MUX (STM-1) as per TEC specification No.TEC/GR/Tx/SDH-004/04 JAN 2011 including latest amendments.
10. Primary digital Multiplexing equipment to IRS-TC-68-2012 including latest amendments.
11. Automatic radio patching system for control circuit using DTMF Signalling in Optic Fibre Communication to IRS-TC-59-93 including latest amendments.
12. Cable U/G Jelly Filled 6 quad for special purposes in RE areas to Specn.No.IRS:TC-30-/2005 (ver-1) amendment - 1 to 4 including latest amendments.
13. Thermo Shrink jointing kit for jointing underground Quad cable as per specification no. IRS: TC 77-2012 (Rev. 3) amendment -1 including latest amendments.
14. Thermo Shrink jointing kit for jointing underground PIJF cables as per specification no. RDSO/SPN/TC/57/2006 amendment -1 including latest amendments
15. Cable polythene insulated polythene sheathed jelly filled telephone cable with poly-Al moisture barrier to Specn. No. IRS:TC-41-97 with ammendment - 2 including latest amendments.
16. Telecommunication tip cables as per IRS-TC-24-91 with Latest amendments.
17. Wire PVC Twin Core Flexible 16/0.2 mm dia to Specn. No. IS-694:1990 with latest amendments.
18. Cable PVC Screened 0.6mm Twin core to ITD-Spc. No. S/WS-117 (B) with Latest amendments.
19. Switch Board Cable to ITD spec. no. S/WS-113B with Latest amendments.
20. Jumper Wire PVC. Spec No. G/WIR-10/03 Sept '06 including Latest amendments.
21. Cable Termination Boxes (Indoor) of sizes as per Specn.No.IRS:TC-18-75 with latest amendments

22. Emergency Control Room Equipment as per Specn. No. IRS:TC 61-93 amendment -1 including latest amendments.
23. Emergency socket box as per RDSO's Drg. No.TCA-20060 (Adv.) with latest amendments and DRG No. RE/S&T/ALD/SK/186/81A with latest amendments.
24. Six Pin Emergency Plug and socket to Specn. No. IRS-TC 42/87 amendment -2 including latest amendments.
25. Control communication Equipment for OFC using 2 wire Telephone as per RDSO Specn. No. RDSO/SPN/TC/66/2007 amendment-2 including latest amendments
26. Four wire/ Two wire combined light weight portable control Telephone as per Specn. No. IRS:TC-78/2000 amendment-1 including latest amendments.
27. Magneto Telephone Electronic desk Type as per Specn. No. IRS:TC 79-2000 amendment-2 including latest amendments.
28. 2T / 3T V.F. Transformer assembly for Quad cable to Specn. No. IRS:TC 76-2000 amendment-1 including latest amendments.
29. V.F. Isolation Transformers used for Derivation & termination of U/G Telecommunication cable circuits to Specn. No. IRS: TC 22-76 with latest amendments.
30. Maintenance free lead Acid Cells of different capacity to IRS-S-93/96 (Part A) amendment -1 including latest amendments.
31. Low Maintenance lead Acid Cells of different capacity to IRS-S-88/2004 with Latest amendments
32. Battery charger for Maintenance free lead Acid Cells of different capacity to IRS-S-93/96 (Part B) amendment -1 including latest amendments
33. SMPS based power supply equipments as per RDSO Specification No. RDSO/SPN/TL/23/99 (VER-4.0) including latest amendments
34. G.I.Pipe to Specn. No. IS-1239(Part-I):1990 including latest amendments.
35. R.C.C. pipe / split R.C.C. pipes to Specn. No. IS:458:1998 with latest amendments.
36. Permanently Lubricated HDPE Telecom Ducts to RDSO Specn. no. RDSO/SPN/TC/45-2013 Rev -2 including latest amendments

37. KRONE Module with 10/20 Pr. DP to Sepcn. No.G/CTN-10/03. June 2005 including latest amendments.
38. KRONE Terminal Block to Specn. No. G/CTN-03/02 Mar 99 with latest amendments.
39. Single Pair Protector Module for use on MDFs of Tel.Xge to Specn. No. GR/CTN-01/04.May.05 amendment-1 including latest amendments
40. 10 pair Protector Magazine KRONE for 2/3 Pin GD Tubes to Specn. No. G/PTN-11/01 Dec 92 with latest amendments.

## **Section 5: Civil Engineering Works**

The civil engineering works associated with railway electrification will be according to the “Standards and Specifications for EPC Projects’ issued by Railway Board vide letter no:\*\*.