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GENERAL & PARTICULAR SPECIFICATIONS

SECTION – 1 : OVERHEAD EQUIPMENT:

- The contractor has to design the OHE for INCREASED SPEED POTENTIAL TO 160KMPH & suitable for 2 X 25 KV System duly following RDSO Instruction.no. INSTRUCTION No. TI/IN/0042 or latest correction slips.
- The contractor has to design the PSI for INCREASED SPEED POTENTIAL TO 160KMPH & suitable for 2 X 25 KV System duly following RDSO Instruction.no. INSTRUCTION No. TI/IN/0043 Rev.01 or latest correction slips.
- Note: The foundations and Structures shall be designed as per RDSO Instruction.no. INSTRUCTION No. TI/IN/0042 or latest correction slips considering the future requirement of 2X 25 KV system. However, regulating equipment, Dropper schedule shall be as per the existing 25 KV Conventional system unless specified particularly.

1.1: TRACK:

- a) **GAUGE AND TRACK CENTRES** -The track gauge is 1676 mm (5'-6"). In multiple track zones, the normal distance between track centers varies between 4270 mm (14'. ft) and 4420 mm (14'-6").
- b) **SPEED** - The overhead equipment which shall be of the simple polygonal type and pre-sag should be designed for a maximum speed of 160Km/h (Approx.100 miles/h) if regulated and for a maximum speed of 80 Km/h (Approx. 50 miles/h) if Tramway type, unless otherwise specified in Section-10 of this part for any particular section.
- c) **CURVES** - The minimum radius permissible is 175 mm (573 ft) i.e., a 10°curve. Inside station limits, the curvature at a 1 in 8.5 turnout is 8° i.e., of radius 219 m (716 ft).
- d) **SUPER ELEVATION** -The maximum super elevation is 165 mm (6.5"). On curves, the minimum setting of structures shall be decided on the basis of maximum super elevation (see para 2.3.10 at Section-8 of this part). For purposes of design and erection of overhead equipment, the actual super elevation as existing at site or as indicated to the contractor shall be adopted.
- e) **LOW JOINTS** -For low or loosely packed rail joints a difference of 25mm (1") in the level of opposite rails may be taken as the basis for estimating the displacement of the pantograph with respect to its normal position.
- f) **FORMATION** -Generally sections with more than one track have common formation. In certain lengths, however the formation for different tracks may be separate.
- g) **DISPLACEMENT** - The general design of overhead equipment shall permit a displacement of +100 mm of tracks without difficulty and any adjustment of the overhead equipment on this account shall be of such a nature as could be done conveniently without changing any component of the overhead equipment.

1.2: SECTIONING:

- a. **INSULATED OVERLAPS:** Insulated overlaps are provided for facility of isolation. Some of the overlaps may be provided with manually operated isolators switches. In addition, for connecting the overhead equipment to booster transformers, insulated overlaps are indicated in the sectioning diagrams.

- b. **YARD SUPPLY** - The sectioning diagram/s also indicate the tracks in stations yards and siding whose equipments is electrically independent from those of other tracks.

The overhead equipment in yards and sidings may be fed through isolator switch or interrupter in accordance with arrangement indicated in the sectioning diagram/s.

- c. **SECTION INSULATORS** - Section insulators shall be provided as indicated in the sectioning diagrams, to isolate sections of overhead equipment in yards and sidings. Section isolators may also be used to form neutral sections at special locations as indicated in the approved drawings.
- d. **Deleted**
- e. **FEEDERS & RETURN FEEDERS 25 KV ALONG TRACK FEEDERS:** 25 kV along track feeders may connect sections of overhead equipment to a switching station or an isolator switch or gantry. Such feeders will be run usually on traction structures and sometimes on independent masts. A single 'SPIDER' conductor shall be used for such feeders.
- f. **RETURN CONDUCTOR: DELETED.**
- g. **SCHEMATIC ARRANGEMENTS:** - The different arrangements of feeders, return feeders, 25 KV along track feeders and return conductors are shown in the drawing listed.
- h. **SECTIONING DIAGRAM** - The provisional sectioning diagram/s to be electrified is /are available in the office of Sr.DEE/TrD/SC and tenders can see in the office working hours.

1.3: **PANTOGRAPHS:**

- (a) The outline of the pantograph, its dimensions and its current collecting area are shown in a drawing listed.
- (b) **NUMBER AND PRESSURE** -Each locomotive will be equipped with two pantographs, but only one pantograph generally the trailing one will be in use at a time. The working pressure of the pantograph on the contact wire may vary between 5 and 15 kg.
- (c) **SPACING IN MULTIPLE HEADED TRAINS** -The distance between adjacent running pantographs in the case of multiple heading would normally be 20 meters. This distance may, however, be reduced to 7.9 meter between two pantographs in very exceptional cases.
- (d) **INSULATION CLEARANCE** -The electrical clearances for the pantograph on tangent tracks and on curves for design and erection of overhead equipment shall be based on the schedule of Dimensions 1676mm. Gauge, 1939 printed in 1973 in metric units, issued by the Ministry of Railways (Railway Board), Government of India and any other orders that may be issued by the Railway Board from time to time.

1.4: OVERHEAD EQUIPMENT:

BRIEF DESCRIPTION - Essentially the traction overhead equipment shall consist of a grooved contact wire of conventional/Tramway type.

- (a) **Catenary wire:** The catenary wire shall be Cadmium copper catenary wire having 65 sq.mm.
- (b) **CONTACT WIRE** - The contact wire shall be grooved and made of hard drawn copper having 107 sq.mm / 150 sq.mm cross section.
- (c) **JUMPERS** -- All jumpers connected to OHE conductors shall be of copper only. The in-span jumpers potential equalizer jumpers at insulated overlaps and neutral section, shall be of 50mm sq. nominal, 19/1.8mm size. Flexible jumpers of nominal section 105 sq mm., 19/7/1.06 mm size shall be used at overlaps, turnouts, crossings etc., 130 sq.mm jumper to be used for tail feeders 160 sq.mm jumpers to be used for cross feeders.
- (d) **BRIDLE WIRE:** - Bridle wire for supporting contact wire for regulated tramway equipment shall be of Cadmium copper 7/2.10 mm in size.
- (e) **ANTI THEFT JUMPER:** -Anti theft jumper of 50 mm sq. nominal, 19/1.8 mm in size shall be used in out of run wire of conventional OHE and copper cadmium anti creep wire as an anti-theft measure. The jumper connecting the aluminium Conductors to any other conductors' terminal or clamp shall be made with the aid of suitable bi-metallic clamps. All Aluminium jumpers of size 19/7/1.4 mm bare 3/4 hard shall be used to connect other Aluminium conductors such as return conductor. The tail ends of feeder wires from the strain clamps at the termination of a feeder, return feeder or return conductor may be connected directly to a terminal or clamp where feasible to avoid the use of a separate jumper wire.

1.5: TRAMWAY TYPE OF EQUIPMENT: The overhead equipment used shall normally be regulated type equipment (contact wire only).

- (a) **TRAMWAY TYPE EQUIPMENT REGULATED CONTACT WIRE ONLY:** In tramway type equipment regulated, only a contact wire is provided without a continuous catenary or droppers. The tension in the contact wire is regulated. At support, bridle wire is used for supporting the contact wire.
- (b) The section in which different types of equipment should be provided are indicated in Section-10 of this part.

1.6: PLANE OF CONTACT:

- (a) **REGULATED** -The regulated overhead equipment shall be so erected that the contact wire has the designed sag.
- (b) **TRAMWAY TYPE** -In tramway type equipment, the contact wire will have its own natural sag when erected.

- (c) **DROPPER: Dropper** charts to be used for standard span of regulated and unregulated overhead equipment would be supplied by the Purchaser. Dropper for non-standard spans, span with section insulators and special locations shall be calculated by the Contractor in accordance with the method indicated by the Purchaser and submitted to the Purchaser for approval.

1.7: TENSIONS:

- (a) **REGULATED** - (i) In regulated equipment the tension is the Copper catenary and in the Copper contact wire shall be 1,000 kgf in each conductor.

(ii) The regulated tension in the Aluminium alloy catenary shall be 1,000 kgf and 1,000 kgf in copper contact wire.

- (b) **TRAMWAY TYPE:** In regulated type tramway equipment, the tension shall be 1,250 kgf.

1.8: CLEARANCE:

- (a) **GENERAL** -The distance between live parts and parts at earth potential (for parts likely to be earthed) shall be as large as possible. In all cases the values given in Schedule of Dimensions, 2004 or its latest revision shall be observed along with any other supplementary rules that may be issued by the Railway Board time to time.

- (b) **OVER BRIDGES & TUNNELS** -The clearances which are to be made available at over bridges, signal, gantries and other over line structures shall be based on the above rules.

- (c) **PLATFORM SHEDS AND OTHER STRUCTURES** -In the course of checking the overhead equipment pegging plans, the Contractor shall prepare a list of platform sheds and other structures in the vicinity of track to be wired. The clearances to these structures shall be in accordance with those shown in the relevant drawings listed in Annexure-I at Part-N. If these clearances are not available, the Contractor shall advise the Purchaser in time to enable the later to take up necessary modifications.

1.9: HEIGHT OF CONTACT WIRE:

- (a) Normally, the minimum height of contact wire above rail level shall be 5.50 m at mid span under the worst temperature conditions. This height may be reduced under bridges and in tunnels to the extent permitted by the purchaser. The minimum height shall be 4.80 m. In electric locomotive sheds and over electric locomotive inspection pits, the minimum height shall be 5.80 m. At level, crossings the minimum height shall be 5.50 m. Any infringement restricting minimum height at level crossings will be removed by the Purchaser.

- (b) **GRADIENT OF CONTACT WIRE** -- Any change in the height of the contact wire shall be made gradually and the maximum slope shall not normally exceed 3 mm per metre on main lines and 10 mm per metre on sidings. The end span of any section with a gradient of contact wire shall have a slope not greater than half the main slope.

1.10: STAGGER: To ensure uniform wear of contact strips of pantographs, the contact wire shall normally be staggered in a manner which will be indicated by the Purchaser.

1.11: TERMINATION:

(a) **GENERAL** -- Traction overhead lines shall be terminated using components specified at Section-9 of this part. The termination may be carried forward by one or two spans if anchoring facilities so require.

(b) Terminating wires shall be electrically connected to the conductors with which they are likely to approach closely or come into contact under normal conditions.

(c) **SUPPLEMENTARY INSULATION** -If a terminating wire passes over a live conductor to which it should not be connected, i.e. in a different elementary section, the portion of the terminating wire close to the live conductor shall be separated by means of insulators. The insulators swept shall be located in such a manner as to clear the zone of the pantograph under the worst conditions and as far away as is possible from live conductors.

1.12: TYPES OF STRUCTURES:

(a) The overhead equipment of main tracks in case of multiple tracks section shall be electrically and mechanically independent of the one another by provision of independent cantilever masts to the maximum extent possible.

(b) **PORTALS**: -In cases where the tracks in a multiple track section do not permit location of independent masts and where automatic tensioning of overhead equipment is required, rigid portals may be used. Also, in the vicinity of points and crossings, portals may be used, provided it is not possible to have prescribed setting with independent cantilever masts. These structures shall be equipped with standard bracket assemblies for supporting individual equipment of different tracks. The use of such structures is to be avoided as far as possible and for this purpose, the Purchaser will arrange to slew the tracks, if practicable. A single portal shall normally not cover more than five tracks. Portal structures shall also be employed at anticreep central locations and such portals will have necessary guy arrangement.

(c) **FOUNDATIONS** -Foundations for all structures shall be designed in an economical manner by following the methods of design indicated by the Purchaser and observing the schedule furnished by him

1.13: CANTILEVER ASSEMBLY: The bracket assembly carrying overhead equipment shall be of the swiveling type. The assembly shall be such that the tubes adopted will permit easy adjustment of the whole equipment after erection to cater for displacement of the track during maintenance up to the extent of 100 mm on either side except as otherwise relaxed by the Purchaser. In special locations, pull-off arrangements may be used with the approval of the Purchaser.

1.14: OVERLAPS: Overlaps shall be provided at suitable intervals such that neither the tension length exceeds 1,500 m nor the fixed anchor to balance weight anchor exceeds 750 meters.

(a) **GENERAL** -The two contact wires at the overlapping zone shall be parallel to each other in a plane parallel to the track and run separated from each other.

(b) **INSULATED** -In the case of insulated overlaps, the separation between the two contact and the two catenary wires shall be 0.5 m.

1.15: POINTS & CROSSINGS: Arrangements of overhead equipment of different types e.g. regulated, unregulated or tramway at points and crossings shall be in accordance with the standard drawings listed.

1.16: SECTION INSULATORS:

(a) **BRIEF DESCRIPTION** -The section insulators shall provide effective electrical isolation of two elementary electrical sections of overhead equipment and permit smooth passage of the pantograph in either direction at all speeds up to 80 KM/H. The outline of a section insulator is shown in a drawing listed. The section insulators shall be of the single wire type.

(b) **SIZE AND WEIGHT** -The section insulator assembly shall be such that it should be possible to install the insulator in the overhead equipment provided the axial distance between the catenary and the contact wire with section insulator in position is not less than 450 mm. The weight of the complete assembly shall not be more than 45 kg for single wire type excluding the weight of the catenary insulator and the catenary ending clamps.

1.17: ISOLATORS: Manually operated isolators single or double pole type, with or without earth contact assembly may be required to bridge certain section insulators or insulated overlaps. In certain large yards, isolators controlling different lines may be grouped together on a gantry.

1.18: BRIDGES AND TUNNELS:

(a) **OVER BRIDGES** -The complete overhead equipment (i.e., both the catenary and the contact wires) shall normally pass under over-line structures. Additional intermediate suspension points shall be provided, if necessary, to ensure the specified minimum height of contact wire being maintained. In special cases catenary may be anchored on either side of the over line structure and the contact wire carried underneath.

(b) **SAFETY SCREENS** - On over-bridges, metallic protective screens shall be provided in order to prevent any person from coming into contact with the live overhead equipment. Such screens shall be properly earthed.

(c) **HEIGHT GAUGES AT LEVEL CROSSINGS** -Height gauges will be provided at all level crossings in accordance with the general arrangement drawings listed

1.19: BONDING AND EARTHING:

(a) Bonding and earthing shall be done in accordance with the code for bonding and earthing.

(b) **LONGITUDINAL AND TRANSVERSE BONDING** Longitudinal and transverse bonding of tracks, bonding of structures including traction structures to rails and associated earths shall be provided in accordance with the above code.

(c) **TRACTION STRUCTURE BONDING**: -Every traction mast or structure shall be bonded to a non-track circuited rail unless it is provided with a continuous earth wire or it is individually earthed by means of an earthing station. For general arrangement drawings.

(a) **DOUBLE RAIL TRACK CIRCUIT**: -.

1.20: L.T. SUPPLY TRANSFORMER STATIONS:

1.21: LIGHTNING ARRESTORS: No lightning Arrestors will be provided on the traction overhead equipment.

1.22: Bolts and nuts shall be ordered from on same supplier.

SECTION-2 : FOUNDATIONS

2.1: SCOPE: This section deals with the design of foundations and anchor blocks for traction structures carrying overhead equipment (including those on bridges), structures at switching stations, booster stations, L.T. Stations, feeding stations, sub-stations, concrete pedestal for equipments, cable trenches required for traction substation, feeding station, shunt capacitor bank and other concrete work. It also deals with the specifications for concrete.

2.2: DESIGN OF FOUNDATION:

(a) **SOIL PRESSURE**: For design of foundations for traction structures carrying overhead equipment, the Contractor shall determine the type and allowable bearing pressure of soil at suitable intervals and adopt the type and size of foundations, suitable for particular locations with the help of the approved employment schedules. In cases of particularly weak soil, the bearing pressure may have to be determined for each location where so advised by the Purchaser. Soil bearing pressure, using SPT (falling weight equipment) should be determined generally for every 5-kilometer interval or less wherever change of soil is encountered. In general, IS code of practice (IS:6403/1981 or latest for “Code of practice for determination of breaking capacity of shallow foundations”) should be followed. In addition, at every 250m the soil bearing pressure should be determined by dial gauge type penetrometers. Dial gauge type penetrometers shall also be made available by the Contractor at each foundation site so as to facilitate cross check at each individual location.

For design of foundation for masts and gantries at switching stations and traction sub-stations, the Contractor shall determine the type and allowable bearing pressure of soil at the locations of such stations and shall prepare designs for the foundations suitable for each location to suit the bearing pressure of the soil in consultation with the Purchaser.

(b) **STRUCTURES CARRYING OVER-HEAD EQUIPMENT**: Foundations for traction structures carrying overhead equipment shall be either of the side bearing, side gravity or new pure gravity type according to their location, formation of the sub-grade and bearing pressure of the soil. In new filled-up soil or cinder formation, pure gravity sand-filled core foundations,

or foundations with cast-in-situ reinforced concrete piles, or cantilever types foundation with counter-weights or guyed foundations may be adopted.

(c) **ON BRIDGE PIERS:** Complete design of foundations for traction structure on bridges to suit different locations and local conditions will be furnished by the Purchaser.

(d) **MASTS & FABRICATED STRUCTURES AT SWITCHING STATIONS and FEEDING STATIONS:** Foundations for the masts of gantries at switching stations and feeding stations shall be of the pure gravity type, the base of which shall rest on consolidated soil.

(e) **FENCING POSTS:** Foundation for fencing posts shall rest on consolidated soil if the depth of unconsolidated soil is less than 1.5 m below the datum level and shall be rectangular parallel piped in shape. If the depth of unconsolidated soil is more than 1.5 m the foundation block shall rest on reinforced concrete piles cast-in-situ or reinforced concrete foundation may be adopted as desired by the Purchaser.

(f) **TYPICAL DESIGN:** Typical design and drawings of side bearing and new pure gravity and side gravity type foundations are included in the drawings listed. Employment schedules for standard foundations for traction structures for various locations and types are also included in the drawings.

(g) **SPECIAL FOUNDATIONS:** In the case of foundations at locations not covered by the employment schedules obtained from the Purchaser, the Contractor shall prepare special designs and furnish full design calculations justifying the choice of the type of foundations for such locations. In black cotton soil specially pile foundations of under reamed type as per RDSO'S standard designs (Reference RDSO'S Drawings No.ETI/C/0062, Rev.B or latest for "Short bored pile foundation for traction mast (permissible BM and volume'')) or any other approved design may have to be cast at limited locations for trial purpose. The tenderer may furnish the technical details of alternative design, construction methods proposed to be adopted and their previous background/experience, if any. The decision of the Purchaser with regard to feasibility and suitability of adoption of the alternative design for each type of foundation will be final.

(h) **EQUIPMENT:** Pedestals for Interrupters and L.T. supply transformers where required, shall be of mass concrete with the base resting on consolidated soil. Foundations for circuit breakers supported on steel structures and for other items of equipment such as isolators, instrument transformers, **bus-bar** support insulators etc., shall be of the pure gravity type, the base of which shall rest on consolidated soil and shall be left with core holes into which the legs of supporting structures shall be suitably fixed by grouting.

(i) DELETED

(j) **CABLE TRENCHES:** The cable trench shall rest on original ground if the depth of unconsolidated soil is less than 0.5 m. If the depth of the unconsolidated soil is more than 0.5 m., the cable trench shall be made of reinforced cement concrete of approved design supported at suitable intervals on concrete pillars. Cable trench details are shown in a drawing.

(k) **Gantry Structures, Mast & fabricated structure of feeding station**

Foundations for the gantry structures/portals, mast of gantries at feeding station shall be of the pure gravity type, the base of which shall rest on consolidated soil.

l) Equipment

Pedestals for power transformers shall be made of mass concrete with base resting on consolidated soil. Foundations for Circuit Breakers supported on steel structures and for other items of equipment such as isolators, instrument transformers, bus-bar support insulators etc., shall be of the pure gravity type, the base of which shall rest on consolidated soil, and shall be left with core holes into which the legs of the supporting structures shall be suitably fixed by grouting.

m) Fencing posts

Foundations for fencing posts shall rest on consolidated soil if the depth of unconsolidated soil is less than 1.5 m below the datum level and shall be rectangular parallelo-piped in shape. If the depth of the unconsolidated soil is more than 1.5 m the foundation block shall rest on reinforced concrete piles cast-in-site or reinforced concrete foundation may be adopted as desired by the Purchaser.

2.3: BEARING PRESSURE:

(a) **GUIDING INFORMATION:** Subject to Para 2.2.2(a) above, the following allowable bearing pressures may generally be expected for various kinds of soil. The information is given for general guidance only.

- i) Average good soil in banks and cutting ... 11,000 kg/sq.m.
- ii) Morum soil in cutting ... 22,000 kg/sq.m.
- iii) New banks & bad soils in banks and cuttings. ... 5,500 kg/sq.m.
- iv) Black cotton soil: Pure gravity foundation shall normally be adopted. However, under reamed pile foundations may be adopted at the option of the Purchaser in limited locations for trial purpose. In the case of dry black cotton soil, the soil should be subjected to a bearing pressure as close as possible but not exceeding 16,500 kg/sq.m. the depth of the foundation block being not less than 2.8m. In the case of wet black cotton soil, the soil should be subjected to a bearing pressure as close as possible but not exceeding 8,000 kg/sq.m.

In the case of hard rock, a hole should be blasted in the rock, or by means of any other drilling and pneumatic method and the mast sealed into it with concrete.

2.4: CONCRETE: Concrete for foundations shall be nominal mix of grade **M-10** obtained by mixing cement, coarse aggregate, fine aggregate and water in accordance with proportions given vide Table-3 of IS:456-2000 reproduced below. For grouting, muffing, embedding of structures in foundations and for cable trenches at switching stations, nominal mix concrete **M-15** obtained by mixing materials in proportions as indicated in Table -9 of IS:456-2000 shall be used. Volume batching may be adopted vide relevant clause of IS:456-2000 reproduced below: -

IS : 456-2000: TABLE - 9 : PROPORTIONS FOR NOMINAL MIX CONCRETE

(Clause 9.3 and 9.3.1)

Grade of concrete	Total quantity of dry aggregate by mass per 50 Kg of cement, to be taken as the sum of the individual masses of the fine and coarse aggregate, kg max.	Proportion of fine aggregate of coarse aggregate (By mass)	Qty. of water per 50 kg. of cement, max.
1	2	3	4
	KG		Litrs
M 5	800	Generally, 1:2 but subject to an upper limit of 1:1.5 and a lower limit of 1:2.5	60
M 7.5	625		45
M 10	480		34
M 15	330		32
M 20	250		30

NOTE: The proportions of the fine to coarse aggregates should be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger. Graded coarse aggregate shall be used.

Example: For an average grading of the fine aggregate (that is zone II of Table 4 of IS: 383-1970*) the proportions shall be 1:1 1/2, and 1:2 and 1:2 1/2 for maximum size of aggregate 10mm, 20 mm and 40 mm respectively.

* Specification for coarse and fine aggregates from natural sources for concrete (second revision).

“In case uniformity in the materials used for concrete making has been established over a period of time, the proportioning may be done by volume batching, provided periodic checks are made on mass/volume relationships of the materials, where weigh-batching is not practicable, the quantities of fine and coarse aggregate (not cement) may be determined by volume. If the fine aggregate is moist and volume batching is adopted, allowance shall be made for bulking in accordance with IS:2386 (Part-III)-1963”. *

*Method of test for aggregates for concrete-part-III specific gravity, density, voids, absorption and bulking.

In judging the acceptability of the materials, **quality of concrete and the method of work, the Purchaser will generally observe the provisions of the “Indian Standard code of Practice for Plain and Reinforced Concrete, IS:456-2000.** The crushing strength of concrete shall not be less than the limits given below: -

Crushing strength of 15cm cubes by works test.

Concrete.	At 7 days age.	At 28 days age.
(a) M- 10	70 kg/sq.cm	100 kg/sq.cm
(b) M- 15	100 kg/sq.cm	150 kg/sq.cm
(c) M- 20	140 kg/sq.cm	200 kg/sq.cm

NOTE:

- a. Test specimen of works tests shall be taken at the site of work from mixture of concrete ready for pouring into the foundation hole. All tests shall be carried out in accordance with IS: 516-1959 or its latest version. The sample of concrete from which test specimens are made shall be representative of the entire batch. The test cube shall be generally placed in the core of the foundation from where the sample is taken till it is taken for testing. Test sample shall be taken to the approved lab by the contractor. It is the responsibility of the contractor to get test cubes tested and test certificates submitted. Otherwise, alternate tests shall be carried out by contractor at his cost to satisfy that the concrete laid is having strength as per specification.
- b. Age is reckoned from the day of casting.
- c. Three cubes for 7 days testing and three cubes for 28 days testing. Reading: Average of three readings to be taken.
- d. Six (6) cubes to be taken for every 50 cu.m of foundation cast.
- e. **CURING:** Curing shall be done for 21 days such that the surface is always moist. The surface to be covered as per IS 453 of 2000 i.e., with canvass or such other materials so that the surface is wet.

Vibrator to be used for all foundations.

2.5: SIZE AND GRADING OF AGGREGATES: The graded coarse aggregate **40 mm** nominal size (table 2 of IS: 383-1970) shall be used for foundation. A coarse aggregate for grouting muffs and embedding shall be of **20 mm** graded nominal size as per Table 2 of IS: 383-1970 (specification for coarse and fine aggregate from natural sources for concrete). Fine aggregate shall be graded from 10 mm downwards. The maximum size of aggregate for under reamed pile foundation shall be 20 mm graded nominal size.

2.6: SAND CORED FOUNDATIONS: After erection of masts in sand-cored foundations, the core hole of the foundation blocks shall be filled with dried sand and covered with a layer of bitumen of 80 mm thickness below 30 mm from top level of the block. A hemispherical shaped muff shall be provided on such foundations in lieu of standard type.

2.7: SINKING OF CONCRETE SHELLS: Where the water-table is high, one or more sections of reinforced concrete shells may have to be sunk before casting concrete. The size of each of shell shall be 1,200 mm outside dia x 50 mm thick x 600 high reinforced with 6 mm (1/4") dia rods spaced 150 mm apart, both longitudinally and circumferentially, the concrete shall be of grade M-15 as per provisions.

2.8: TYPE OF FOUNDATION IN BLACK COTTON SOIL: Types of foundations in black cotton soil. The foundations in dry black cotton soil should be of type BC or NBC or any other type as approved by the Purchaser.

2.9: CEMENT: The cement to be used should be of ordinary Portland cement to IS :269-1989.

2.10 Use of crushed stone sand shall be as per SCR HQ Ir.No E.252/TrD/Genl/Vol.III /1631 dated 11-12-2017. (attached at Page No. 63-64)

SECTION-3: STRUCTURES

3.1: SCOPE: This section deals with the design of steel structures and steel work for overhead equipment, switching stations, booster transformer stations and L.T. supply transformer stations. This chapter also deals with the design of steel structures and steel work for gantry structures, supporting structures and small part including chairs, brackets and other fabricated steel work for mounting various equipments, bus-bars, cables etc., at Traction sub-stations, feeding stations and shunt capacitor banks.

3.2: TYPES: Structures and gantries may consist of any or more of the following types

- i) Broad flange beams.
- ii) Rolled steel joists (I section).
- iii) Fabricated steel Structures (welded/bolted).

Structure/uprights shall generally be embedded in concrete foundation blocks in special cases Structures may be secured by means of holding down bolts.

3.3: DESIGN:

(a) **STEEL STRUCTURES:** Designs for steel Structures shall, except where otherwise provided, comply with the Indian standard code of practice for use of structural steel in General Building Construction - IS: 800-1984. The thickness of smallest steel sections used shall not be less than 5 mm for galvanized members.

(b) All the steel Structures and small part steel for carrying overhead equipment are to be fully galvanized after drilling and fabrication as per specification No. ETI/OHE/13 (4/84, Rev.3 or latest for “Specification for Hot dip zinc galvanization of steel masts (Rolled & Fabricated), tubes and fittings used on 25kV ac OHE”) and no painted structures are to be used.

(c) All the steel structures like gantries /portals, other supporting members, small part steel work etc. shall be galvanized with a minimum value of average mass of zinc coating being not less than 610 g/sq.m as per RDSO’s specification No. ETI/OHE/13 (4/84, Rev.3 or latest for “Specification for Hot dip zinc galvanization of steel masts (Rolled & Fabricated), tubes and fittings used on 25kV a.c. OHE”).

(d) For purposes of design, all possible loads which may occur in the worst combination shall be considered.

(e) For purposes of design of gantries, the tension in the 220 KV incoming /outgoing lines shall be taken as 200 kg at 4-degree C (without wind) in each conductor and 150 Kg. at 4 C (without wind) in the earth wire. The tension in the 66 kV strung bus-bars and earth screen wire at 66/25 KV sub-stations shall not exceed 200 Kg at 4 degree C (without wind).

(f) Uprights and fencing posts.

Uprights carrying equipment such as potential transformers, current transformers, lightning arrestors, bus-bar support insulators, shall be made from standard metric steel sections viz., channels, angles or small joists, either single or fabricated.

(g) The deflection at the top of the mast or structure shall be limited to one eightieth ($1/80$) of its height above foundation.

(h) The torsional rotation of the mast due to permanent loads shall not exceed 0.1 radian.

(i) Steel conforming to IS: 2062-1992 shall be used for all fabricated steel work. Steel should be to designation ST:42-S

3.4: CANTILEVER MASTS:

(a) **LOAD:** For purposes of design the worst possible combination of all loads that may occur shall be considered. The load shall include the following (weights to be assumed for design of Structures are shown against important items).

- i) Weight of overhead equipment (1.60 kg/meter for each conventional and 0.9512 kg/meter for each Tramway OHE).
- ii) Weight of bracket supporting the overhead equipment (60 kg/normal bracket)
- iii) Weight of a man (60 kg)
- iv) Weight of an earth wire (0.32 kg/metre).
- v) Weight of feeder, return conductor or other special equipment wherever they occur.
- vi) The effect of eccentricity of vertical and horizontal loads on the bracket due to variation in temperature.
- vii) Wind loads perpendicular and parallel to the track. The wind pressure adopted shall be taken as that indicated in **Section-10 of this part.**
- viii) Radial forces on the mast, due to stagger, curvature, anchorage etc.
- ix) Weight of the mast itself.
- x) Any other load or loads that may occur due to special location of the Structures.

(b) **DEFLECTION:** Notwithstanding the provisions contained in IS:800 – 1984 Referred to in para 2.3.3 above regarding permissible deflection, the following shall apply.

i) The deflection at the top of the mast due to permanent loads shall not exceed 8 cm and the mast shall be so erected that it becomes reasonably vertical after application of permanent loads.

ii) The additional deflection under maximum wind pressure shall not exceed 8 cm at the level of the contact wire.

(c) **TORSION:** The torsional rotation of the mast due to permanent loads shall not exceed 0.1 radian.

(d) **TYPICAL DESIGN:** The typical design of a traction mast is included in the set of standard drawings listed in Annexure-1 at Part-N. Employment schedules for standard masts for various locations and types are included in the standard drawings listed in Annexure-1 at Part-N, to enable selection of suitable type for different locations and local conditions.

3.5 : ANCHOR MASTS :

(a) Masts at which overhead equipment will be anchored shall also normally be of the same type as those in other locations. Anchor masts shall normally be provided with suitable guys, but struts may be permitted in special cases.

(b) **DWARF MASTS**: At certain locations where due to local conditions it is not feasible to anchor the guy rod on a foundation block in the ground, a dwarf mast shall be used in accordance with approved designs.

3.6: HEAD SPANS :

(a) **LOAD**: The loads to be considered shall be as detailed in para 2.3.4 (a) above as far as applicable and at their worst combination.

(b) **SAG FOR HEAD SPAN WIRE**: The sag of the head span wire shall be approx. one-tenth (1/10) of the span.

(c) **MINIMUM TENSION IN CROSS SPAN & STEADY SPAN WIRES**: For purpose of design, a minimum tension of 200 kg, shall be ensured in the span wires for worst combination of temperature and wind load.

(d) **DEFLECTION OF MAST**: Deflection at the top of the mast or Structure shall be limited to one-eightieth (1/80th) of its height above foundation.

(e) **TYPICAL DESIGN**: Typical design for head span mast carrying overhead equipment for 4 tracks will be furnished to the contractor.

3.7: PORTALS :

(a) **GENERAL**: Portals shall be of fabricated steel of standard types of purchaser's designs. The most important designs are covered by Drawings listed.

(a) **LOAD**: The load shall be as detailed in Para 2.3.4 (a) above is applicable.

3.8: STRUCTURES ON BRIDGES:

(a) The structure may be either cantilever masts or portals (hinged or fixed at base) depending on the type and condition of bridge pier capping. As far as possible cantilever masts grouted in foundations blocks on pier will be used. Where this is not possible cantilever masts with holding down bolts or suitable portals (hinged or fixed at the base) may be adopted.

(b) Designs of structures on bridges to suit different locations and local conditions will be furnished to the contractor by the Purchaser.

3.9: SPECIAL STRUCTURES : In the case of structures at locations not covered by the employment schedules furnished by the Purchaser, the contractor shall furnish complete design calculations justifying the choice of the type of structures for such locations.

3.10: SETTING OF STRUCTURES:

(a) The setting is the distance from the Central line of the track, on straight or curve to the face of the mast/structure of fitting located on the mast.

(b) On straight curve:

(c) **EXTRA CLEARANCE ON CURVES** - The minimum setting of structures on curves shall be determined by adding to the above minimum figures an extra clearance indicated in the table included in the set of standard drawings listed.

(d) **STRUCTURES WITH COUNTER WEIGHTS** - In case of structures carrying counter-weight assemblies, the term “setting” shall refer to the minimum distance of the counter-weight from the track centre under the worst conditions of wind.

(e) **STRUCTURES ON PLATFORM** - The setting of structures on platform shall be not less than 4.75m.

(f) **STRUCTURES NEAR SIGNALS** - In the vicinity of signals, structures shall be located in a manner which shall ensure good visibility where necessary, the setting shall be increased as per the relevant drawing included.

(g) **SETTING OF STRUCTURES** - The value of setting of masts/structures shall be painted on each mast/structure. The figure shall be 25 mm in size in white on a red background or as approved by purchaser in writing. In addition, the track level shall also be marked on the mast/structure by a horizontal red painted stroke.

3.11: NUMBERING OF STRUCTURES CARRYING OVERHEAD EQUIPMENT:

All structures shall be numbered in accordance with the numbering given in the approved overhead equipment layout plans. Enameled number plate shall be provided on each mast or structure as per approved designs.

3.12 STEEL WORK FOR SWITCHING STATIONS, FEEDING STATIONS AND GANTRIES

(a) **TENSION OF CONDUCTORS:** For purpose of designs, the maximum tension of different conductors, without wind load, shall normally be as under: -

- i) Deleted.
- ii) Maximum tension in the cross feeders at switching stations under worst conditions: -
 - 1) For spans less than 18 m ... 100 kgf.
 - 2) For spans more than 18 m ... 200 kgf.
- iii) Maximum tension in longitudinal feeders running parallel to the track at the switching stations under worst conditions. 1,500 kgf.
- iv) Tension in anchored overhead equipment in case of sectioning and paralleling stations. 2,000 kgf.

(b) **DEFLECTION OF GANTRY MASTS:** Deflection under the permanent loads (at an average temperature of 35°C without wind) at the top of the fabricated structures of mast shall be limited to one eightieth (1/80) of its height above foundation.

(c) Masts of the gantry at which feeder or overhead equipment will be anchored at the switching stations shall normally be provided with suitable guys, but struts shall not be permitted.

1. **CHAIRS AND BRACKETS:** Chairs, brackets and supporting steel work carrying potential transformers, lightning arrestors, insulators, etc., shall be made of fabricated

steel and be mounted on the main auxiliary gantry preferably by means of clamps to avoid drilling of mast sections.

2. **UPRIGHTS AND FENCING:** Uprights carrying operating handles of isolators and fencing posts shall be made from steel sections, viz., channels, angles or small joists, either single or fabricated.

(d) HORIZONTAL MEMBERS OF GANTRY

Horizontal member of main as well as auxiliary gantry carrying isolator switches, insulators, potential transformers etc., shall be made from steel sections viz., channels, angles and small joists, single or fabricated. They shall preferably be attached to masts by means of clamps to avoid drilling of masts sections.

For purpose of design, all possible loads which may occur in the worst combination shall be considered. The loads shall include the following:

Weight of insulators, instrument transformer, isolator switches, bus-bars and their accessories.

Loads caused by feeders, along and across tracks, return feeders etc.

Loads caused by anchorage due to guying of anchored masts (where applicable).

Pull or Push on the structures due to anchorage and radial tension (where applicable).

Wind load on the different structures, conductors and equipment. The wind pressure shall be taken as that indicated in Section-10 of this part.

Weight of men working on the structures.

Weight of structure itself.

Erection loads.

Any other load or loads which may occur due to special equipment wherever they occur.

SECTION-4: EQUIPMENTS, COMPONENTS AND MATERIALS

4.1: GENERAL : This section deals with the details and specifications of the equipment components and materials to be used for traction overhead equipment, switching stations, L.T. supply transformer stations, traction sub-stations and shunt capacitor banks. This section does not cover foundations and structures. In general based on the specifications issued by various bodies, such as Indian Standard Institution, British Standard Institution etc. Specifications have been issued by the Purchaser. Such specification may be bought separately from the office of the Purchaser. All these specifications are included in the set of drawings and specifications.

4.2: COMPLIANCE WITH STANDARD SPECIFICATION: In the technical specifications of equipments, components and materials, references are made to the following standard specifications:

- i) International Electro Technical Commission (abbreviated as IEC) publications.
- ii) British Standards (abbreviated as BS)
- iii) Indian Standards (abbreviated as IS)

Tenderers may, however, offer equipment in accordance with the appropriate National Standard Specifications of the country of manufacture, but such offers will be treated as deviations and will summararily be rejected.

4.3: QUALITY ASSURANCE: The provisions for quality assurance will apply, including facilities to be provided by the manufacturer

4.4 : PROTO TYPE TESTS :

(a) **FITTINGS, COMPONENTS AND MATERIALS** : All the fittings, components and materials to be supplied by the contractor, in terms of this contract, the requisite number of proto types of components shall be supplied free of cost to the Purchaser for tests and approval. The tests will be conducted in a laboratory selected by the Purchaser.

(b) **EQUIPMENTS:** This comprises inspection and tests conducted on the first equipment of a specified manufacturer, which the Purchaser considers sufficient to prove that the design is in conformity with the specification at the manufacturer's factory. The type tests shall be conducted on each equipments as indicated in the individual specifications, in the presence of the Purchaser's representative. The Contractor shall arrange to get these tests conducted at his own cost.

(c) **RESPONSIBILITY:** Any testing and approval by the Purchaser of prototype shall in no way absolve the contractor of his responsibility under the terms of the contract for the equipment supplied and erected.

(d) **EXEMPTION FROM PROTO TYPE TESTS** : If prototype samples of equipments, components or fittings of any manufacturer have already been approved in connection with the electrification of other sections of Indian Railways, on the 25 kV 50 HZ single phase A.C. system prototype samples of such equipments, components or fittings will be exempted from the tests. Supply of bulk quantities shall, however, be effected only after the Purchaser's prior approval is obtained in writing.

(e) The results of prototype tests will be communicated to the Contractor as expeditiously as possible. Any delay in this respect will be ground for extension of time for completion.

4.5: ROUTINE INSPECTION AND TESTS: These comprise inspection and tests conducted at the manufacturer's factory for ensuring quality of manufactured items as part of the quality Assurance Programme.

4.6 : TEST CERTIFICATES : Three copies of the test certificates of successful prototype tests carried out at the manufacturer's factory on all equipments/ component/ fitting shall be furnished to the Purchaser within a month after completion of the prototype tests. Three copies of the routine tests carried out on each equipment shall also be furnished, after the equipment is passed by the Purchaser's representative on inspection.

4.7 : BULK MANUFACTURE : Bulk manufacturer may be undertaken only after specific written approval of the Purchaser or his representative has been obtained indicating that tests on the prototypes are satisfactory. Where prototypes have already been approved in connection with electrification works already in progress, bulk manufacturer may proceed after exemption from prototype tests is received from the Purchaser in writing.

4.8: INTER CHANGEABILITY: All equipments, components and fittings shall be interchangeable and supplies shall be in accordance with the Purchaser's designs unless otherwise specifically approved by him. Components such as fuses, indication lamps etc., should be replaceable with substitutes available indigenously, as far as possible. Important components and fittings and their drawings.

4.9: TECHNICAL SPECIFICATIONS: The following specifications (**latest revision as on the date of opening the tender**) will govern the supply and testing of important materials, components and equipments. Special maintenance instructions issued by RDSO/Railway Board for OHE/PSI equipment form part of the specification of this tender and contractor shall procure materials and erect equipment in confirmation with latest SMI's also.

Structural Steel	IS: 2062-1975, IS:800-1984 IS:808-1964 & IS :808-PT.I-1978, (PT.II) 1978 ,(PT.III) 1979, (PT.V) 1976, (PT.VI) 1976.
Tensile Testing	IS:1731-1971 IS:2004-1978, IS:1608-1972 For steel products, etc.
Welding Disc.	IS: 816-1969, IS: 731-1971, IS: 3188-1980.
Dropper Wire	IS: 282-1982.
Annealed Copper Jumper Wire.	IS: 434 (PT.I)-1964.
Al. Jumper wire	IS: 694 (Pt.II).
All Aluminium conductor	IS: 398 (PT.I)-1976.
Material for Aluminium Tubular bus-bar.	IS: 5082-1981.
Dimensions for Aluminium Tubular Bus-bar	IS:2673-1979.
Galvanized stay strand	IS: 2141-1979.
PVC insulated cables	IS: 1554 (Part-I) 1976.
Tin bronze castings	IS: 306-1968.
Aluminium bronze castings	IS: 3091-1965.
Malleable iron castings	IS: 2108-1977.

Grey iron castings	IS: 210-1978.
Aluminium castings	IS: 617-1975.
Copper strip for formed Fittings	IS: 1897-1983.
Cadmium copper conductor for overhead Railway Traction	ETI/OHE/50(6/97) With A&C slip NO.1 of(6/97)
Contact wire	ETI/OHE/42(6/97) with A&C slip NO.1
Annealed stranded copper conductors for jumper wire	ETI/OHE/3(2/94) with A&C slip No 1. (4/95)
Copper Bus-bar	RE/30/OHE/5(11/60)
steel tubes	ETI/OHE/11(5/89)
Hot dip galvanisation of steel masts (Rolled and fabricated) tubes and fittings used on 25 KV a.c. OHE	ETI/OHE/13(4/84) with A&C slip No.1 of (5/86). 2 of (4/90) & 3 of (4/90).
Stainless steel wire ropes	TI/SPC/OHR/WR/1060 (6/2006)
25 KV solid core insulator including those for polluted zones	TI/SPC/OHE/INS/0070(4/2007)
25 KV single and double pole isolator	ETI/OHE/16 (1/94) Rev 2(3/2004)
Bolts, Nuts and Washers	ETI/OHE/18(4/84) with A&C slip No.1 to 4(10/2002).
Aluminium Alloy Section and tubes.	ETI/OHE/21 (9/74)
Standard drawings for Traction overhead equipment	RE/OHE/25 (3/66)
Section Insulator assembly	ETI/OHE/27 (8/84)with A&C slip No.1 (10/92)
Enamelled steel plates	ETI/OHE/33 (8/85)
Galvanised steel wire	ETI/OHE/36 (12/73) Rev1(5/98)
Fittings for 25 KV 50 Hz AC traction equipment	ETI/OHE/49 (9/95) with A&C slip no.1 (5/97)
7.5 KV lighting Arrestor	ETI/PSI/3(8/75) A.C. slip No. 1 of (2/91)
25 KV Interrupter	ETI/PSI/167(9/97)
25 KV Potential Transformer.	TS/SPC/PSI/PTs/0992(08/2005)
25 KV Booster Transformer (100 KVA)	ETI/PSI/92(8/93)
-do- (oil filled)	ETI/PSI/98 (8/92) with A&C slip No.1 of 9/92, 2(1/94) & 3(6/94)
25 KV Drop out fuse switch & operating pole for use with 10 KVA &100 KVA, 25 KV/230 V LT supply transformer.	ETI/PSI/14(1/86) with A&C slip No. 1 of (4/87).
25 KV/240 V, 5KVA,10KVA, 25KVA,50KVA LT Transformer	ETI/PSI/15(8/2003).
3-pulley type Regulating equipment (3:1)	ETI/OHE/48A(9/85) Rev 5(08/2005)

4.10: NOMENCLATURE AND MARKING:

(a) All components and fittings supplied by the Contractor's shall bear the respective identification number and a mark to identify the source of supply except in the case of galvanised tubes, bolts and nuts and/or any other fittings as may be agreed to by the Purchaser.

(b) In case of insulators, galvanised steel tubes, stainless steel wire rope and conductors, name of manufacturer shall be specified in "As Erected" drawings for identification.

4.11: STEEL WORK AND PROTECTION AGAINST RUST:

(a) **GALVANISING** -All ferrous materials and fittings shall be hot dip galvanised according to the specification No. ETI/OHE/13 (4/84, Rev.3 or latest for "Specification for Hot dip zinc galvanization of steel masts (Rolled & Fabricated), tubes and fittings used on 25kV ac OHE").

(b) **PAINTING** - Some components or parts may, with the approval of the Purchaser, be protected only by paint and parts so protected shall be given two coats of composite Aluminium primer and two coats of Aluminium paints. The second coat of Aluminium paint shall be applied after erection.

(c) **RECTIFICATION AT SITE** -In case of modifications, which would damage the protective coat, repairs to such damage would be allowed only in exceptional circumstances. The part damaged shall be protected in accordance with the method indicated in specification No.ETI/C/3 (2/94, Rev.1 or latest for "Technical specification for Annealed stranded copper conductors for jumper wire for Electric Traction") or any other method approved by the Purchaser. The Contractor shall in all such cases obtain prior permission from the Purchaser before carrying out repairs.

4.12: BRACKET ASSEMBLY COMPONENTS:

The bracket assembly carrying overhead equipment shall be of the swivelling type. The assembly shall be such that the tubes adopted will permit easy adjustment of the whole equipment after erection to cater for displacement of the track during maintenance up to the extent of 100 mm on either side except as otherwise relaxed by the Purchaser. In special locations, pull-off arrangements may be used with the approval of the Purchaser (refer standard drawing of the bracket assembly and components).

4.13: INSULATORS :

(a) All insulators except those on return conductors and earth wires shall be of the solid core type. Disc insulators shall be used on return conductors and earth wires or other locations desired by the Purchaser. All solid core insulators shall confirm to TI/SPC/OHE/INS/1070(04/2007, Rev.0 or latest for "Specification for solid core porcelain insulators for 25kV a.c. 50Hz single phase overhead traction lines" and composite insulator shall confirm to TI/SPC/OHE/INSCOM/1070 (01/2007, Rev.0 or latest for "Technical specification for Silicone composite insulators for 25kV ac 50Hz single phase overhead traction lines".

(b) **INTER-CHANGEABILITY**: For free inter-changeability only, the following types of insulators shall be used. While the shapes of the insulators may vary slightly from those shown

in the drawings, the essential dimension of the galvanised malleable cast iron caps as given in standard drawings shall be adopted.

- i) **9-Tonne Insulators**: - These will be used at all places for cut-in and terminal insulation including those in return conductors, but excluding those in earth wire.
- ii) **Solid core post insulators**: - These will be used at all places for supporting isolators mechanisms, bus-bars, jumpers etc., of 25 kV.
- iii) **Disc insulators 255 mm**: - Clevis type 255 mm disc insulators will be used for return conductor suspension and for earth wire cut-in insulator.

4.14 : ENDING FITTINGS AND SPLICES :

- (a) **GENERAL DESIGNS** - Terminating or ending fittings and splices on copper conductor shall be of the cone type clamping on both the inner and outer strands of conductor except for contact wire ending clamps which may be of wedge type. The arrangement shall be easy to install and also be such as would apply the clamping pressure gradually without shock (See ETI/OHE/49 (9/95, Rev.1 or latest for “Technical specification for Fittings for 25 kV a.c. OHE”). For Aluminium Alloy/conductor, the end fittings shall be either cone type, strain clamp type or any other type as approved by the Purchaser.
- (b) **LOADING** : All the parts shall be capable of withstanding without damage, a load greater than the ultimate strength of the wires to which they are fitted. In the case of thread no damage shall occur when they are subjected to a load equal to two third of the ultimate strength of the wires.
- (c) **RESTRICTED USE OF SPLICES**: [deleted]
- (d) **STRENGTH OF ASSEMBLED FITTINGS**: The strength of fittings assembled with appropriate conductors or wires shall be not less than that of the conductor or wire itself.
- (e) **ADDITIONAL TERMINATING WIRES**: Cadmium copper stranded wire of 65 sq.mm. nominal section or 37/2.1 mm (as used in head span construction) may be used as additional terminating wires for extending single and double conductors respectively, if termination at the nearest structure is not feasible .

4.15: ELECTRICAL CONNECTIONS FOR OHE:

- (a) **GENERAL DESIGNS** - All electrical connections between conductors shall be made by parallel clamps. The general arrangements of connections are shown in the standard drawings.
- (b) **JUMPERS**: Copper jumpers shall be of any of the followings:-
 - i) Large jumpers of annealed copper in accordance with specification No.ETI/C/3 (2/94, Rev.1 or latest for “Technical specification for Annealed stranded copper conductors for jumper wire for Electric Traction”).
 - ii) Small jumper of annealed copper in accordance with the specification IS:434 - Pt.I.

JUMPERS: Aluminium jumpers wherever used, shall be of all Aluminium stranded conductor 19/7/ 1.4 mm bare 3/4 H generally conforming to IS:8130.

(c) **BUS-BARS** : Bus-bars or rigid jumpers of copper where used shall be of 18 mm copper rod in accordance with RE/30/OHE/5 (11/60). Aluminium bus-bars wherever used shall be of 36/28 mm tubing (See 2.4.22 below). Aluminium tubular bus-bars shall be made of Aluminium Alloy grade 63401 (WP condition) to IS:5082-1981. The tolerance on diameter and thickness shall be as per class I, IS: 2673-1979.

(d) **FEEDERS**: Feeders shall be of all Aluminium conductor 19/3.99 mm (SPIDER).

(e) **RETURN CONDUCTOR** : DELETED

(f) The general characteristics of all wires and conductors is included in a drawings listed in Annexure-I, Part-N.

(g) Earth wire shall be of steel reinforced Aluminium conductor 7/4.09 mm (RACCOON) conforming to IS: 398 - (part-II) 1976.

4.16: TERMINAL CONNECTORS FOR EQUIPMENTS : Isolators, interrupter, potential transformer line indication type, lightning arrestor, fuse switch and L.T. supply Transformer shall be supplied by the Purchaser alongwith the terminal connectors suitable for taking jumper/bus-bar as required. However, Al-Cu strips shall be provided by the Contractor for bimetallic connections wherever required.

4.17: REGULATING EQUIPMENT : 3-pulley type regulating equipment (3:1 ratio) shall comply with the specification as indicated in para 2.4.9 of this Section.

4.18: -- Deleted

4.19: ISOLATORS : 25 KV Isolator switches shall comply with specifications as indicated in para 2.4.9 of this Section.

4.20: INSULATION LEVEL : Interrupters, Potential Transformers line indication type, 42 kV Lightning Arrestors and other equipments shall be suitable for insulation levels indicated in the relevant specifications.

All equipment including insulators to be used at the traction substations, feeding station and shunt capacitor banks shall be suitable for the insulation level specified below:

SERVICE VOLTAGE	220 kV	132 kV	110 kV	66 kV	25 kV
i) Power frequency 1 min. wet withstand test – KV (rms)	460 kV	275 kV	230 kV	275 kV	100 kV
ii) Impulse (1.2/5° microsecond) withstand test positive and negative polarity (crest value) – KV (peak).	1050 kV	650 kV	550 kV	650 kV	250 kV

4.21: BUS-BARS :

(a) No splicing will normally be allowed in the tubular bus-bars unless the length of the bus-bar exceeds 6m.

(b) GENERAL - The bus-bar shall be clean, smooth, mechanically sound and free from surface and other defects. Provision shall be made where necessary to allow for expansion and contraction of bus-bars caused by temperature variation. The open ends of bus-bars shall be covered by suitable tube caps, wherever the tubular bus-bars are required to be bent, the radius of the bend shall be not less than 200 mm.

(c) JOINTS -

i) The joints in bus-bars shall be mechanically and electrically sound so that the temperature rise under normal working condition does not exceed 40°C for an ambient temperature of 65°C.

ii) All Aluminium joints shall be thoroughly cleaned and smeared with suitable corrosion inhibiting joint compound before and after assembling the joint. Similar procedure shall be followed for connecting the equipment terminals to the Aluminium bus-bars with bi-metallic connectors.

(d) ACSR Conductors

ACSR conductors used as bus-bars or bus-bars connections shall be of ZEBRA ACSR size 61/3.18 mm (28.62 mm dia) at 132/25 kV traction sub-station.

(e) Aluminium tubes

Aluminium tubes used as bus-bars or bus-bars connections shall be of dia 50 x 39 mm for fraction sub-station and shunt capacitor banks and of size 36 mm x 28 mm for feeding stations. The aluminium tubes shall be made of alloy 63401 to IS:5082–1998 and IS:6051–1970 or its equivalent. The maximum manufacturing tolerance on diameter and thickness of the tubes shall not exceed the values specified under Class-I of IS 2673 – 1979.

(f) Bus-bar junctions and connectors.

Bus-bar junctions and connectors shall be made with aluminium alloy Grade 460 M to IS: 617 – 1994 of equivalent.

(g) TERMINAL CONNECTORS

The equipments as power transformer, circuit breakers shall be supplied by the purchaser with suitable terminal connectors of approved design and of bimetallic type wherever required.

(h) INSULATORS

The pedestal insulators for service voltage of 132 kV shall be of Solid Core type conforming to specification as indicated in Annexure-1 at Part-N. The pedestal insulators for service voltage of 25 kV shall be of the solid core type conforming to specification as indicated in Annexure-1 at Part-N.

(i) NOMENCLATURE

All components/fittings supplied by the Contractor to Railway's standard designs shall bear the standardized nomenclature and identification numbers, if any.

4.22: CABLING :

(A) Switching stations

(a) **CABLE FOR L.T. SUPPLY** : 240 V A.C. supply from L.T. supply transformer at switching stations shall be brought and terminated on the L.T. a.c. distribution board in the remote control cubicles at the switching stations by 1100 Volt 70 sq. mm aluminium two-core PVC insulated PVC sheathed and steel armored heavy duty cable conforming to IS:1554 (part-I): 1975.

(b) **CONTROL AND INDICATIONS CIRCUITS** -All other cables for control and indication at switching stations shall be 1100-V grade PVC insulated and sheathed un-armored (heavy duty) complying with IS:1554(part-I)-1975.The cables shall be provided as indicated in the Table below:-

PURPOSE	RUN	CIRCUIT VOLTAGE	CORE SIZE & MATERIAL	No. OF CORES
Control and indication of Interrupter s.	From each interrupter to terminal board	110V D.C.	2.5 sq.mm copper	7
Catenary indication	From each PT line indication type to terminal board.	100V AC	-do-	2
Heater supply for interrupter control mechanism cabinet.	i) From interrupter to interrupter.	240 V AC	2.5 Sq.mm Copper	-do-
	ii) From each interrupter to fuse box.	-do-	-do-	-do-
	iii) From fuse box to distribution board.	-do-	-do-	-do-
Battery supply	i) 110 V battery charger to 110 V Battery.	110 V DC	4.0 Sq. mm Copper	-do-
	ii) 110 V Battery to 15 A, DC fuse box.	110 V DC	-do-	-do-
	iii) 15 A DC fuse box to terminal board.	-do-	4.0 Sq. mm Copper	2

NOTE:

i) In case of feeding stations which are located within the traction sub-station premises, the cables shall be run from individual equipment and terminated inside the sub-station control room.

ii) Notwithstanding the sizes of cables given above, the Tenderer shall assure himself that various cables would suit the ratings of equipments offered by him.

(c) **SPECIFICATION** -The cables shall be resistant to decay, abrasion, acids, alkalis and other corrosive materials. All indoor wiring on walls shall be clamped neatly on teak wood battens fixed to the wall by means of wall plugs/wooden pegs. The cable run layout at a typical switching stations is shown in the relevant drawing already included.

(B) CABLES FOR SUB-STATIONS : Deleted

4.23 : LITERATURE FOR EQUIPMENT : The Contractor shall within one month of issue of Letter of Acceptance of Tender, supply six (6) copies of detailed schedule, catalogues and drawings of all parts of the equipment.

SECTION-5.0: DESIGNS AND DRAWINGS

SECTION-1

DESIGNS AND DRAWINGS FOR O.H.E, SWITCHING STATIONS AND BOOSTER TRANSFORMER STATIONS

5.1: GENERAL :

- (a) This chapter deals with the procedure for approval of designs and drawings.
- (b) The type designs shall be as few as possible to cover the largest field of application consistent with economic consideration.
- (c) In all drawings as far as possible only such symbols as are in international use, shall be used as per Indian Railway Works Manual unless otherwise specified or conveyed by purchaser.

5.2: CONTRACTOR'S DRAWINGS :

(a) The Contractor shall submit to the Purchaser for approval except where otherwise specified below, all detailed designs and drawings which are necessary to ensure correct supply of equipments, components and materials and to enable correct and complete erection of overhead equipment, switching stations, booster transformer stations, L.T. Supply transformer stations, TRACTION SUB-STATIONS AND SHUNT CAPACITOR BANKS in an expeditious and economic manner.

(b) **RESPONSIBILITY**: It is to be clearly understood that all original designs and drawings shall be based on a thorough study. General designs and dimensions shall be such that the Contractor is satisfied about the suitability of the designs for the purpose. The Purchaser's approval will be based on these considerations and notwithstanding the Purchaser's acceptance, the ultimate responsibility for the correct design and execution of the work shall rest with the Contractor in terms of the conditions of Contract.

5.3 : STANDARDS FOR DRAWINGS : All designs, legends, notes on drawings and schedules of materials shall be in English and shall be prepared in the metric system. All designs and drawings shall conform to specification No. ETI/OHE/53 (6/88) amended upto Nov.2006 or latest (Principles for OHE layout plans and sectioning diagrams for 25kV ac traction) and ETI/PSI /31(5/76) or latest (Standards for drawings for power supply installations)

5.4 : BASIC DESIGNS :

(a) **STANDARD DESIGNS**: Where the Contractor adopts designs and drawings conforming to the standard designs, drawings and specifications of the Research, Designs and Standards Organization. Manak Nagar, Lucknow-226 011 (RDSO) for basic arrangements, equipments, components and fittings of traction overhead equipment, switching stations and L.T. supply transformer stations and adopts employment schedules furnished by the Purchaser, he shall

verify such designs, drawings and employment schedules and satisfy himself that these are correct before use. Within two months of the issue of letter of Acceptance of Tender the Contractor shall indicate to the Purchaser, the list of standard basic arrangements, components and fittings drawings and employment schedules, which he will adopt for the purpose of the work.

(b) DEVIATIONS: Normally deviations from the standard drawings of the Purchaser will not be accepted. However, in exceptional cases where the Contractor desires to suggest improvements as a results of his experience or other development, he shall justify his proposals with supporting explanatory notes.

(c) STANDARD DRAWINGS:

Drawings shall be made in accordance of works manual. Some details are given as below:

Para 902: Plans for Other Departments

- a) The Engineer may, at his discretion, request sketch plans for other Departments or other Government Departments, or for private parties. Detailed plans should be prepared when there is a likelihood of the schemes proposed being sanctioned or when the charges for preparation of plans and estimates have been deposited.
- b) When preparing plans, the Engineer may obtain complete details from other departments. He should arrange for the plans to be signed by the representative of the department concerned or the private party in token of approval and acceptance the terms "tracing" includes drawings/ documents which are capable of being reproduced.

Para 903: Sizes of Drawings

- a) Sizes of the trimmed sheets of all drawings, except yard plans, should be as given in Table 9.1. All plans required to be of longer length will be in the form of a roll, keeping the width as specified. The size to be used would depend on the extent of details required; broad guidelines are indicated in Table 9.1.
 - The General power supply diagram, **Pegging** Plan, wiring plan, OHE sectioning diagram, Layout OHE plan, bonding plan, OHE profile drawing, can be in running continuous sheets of width minimum 285 mm to 350 mm with proper folding. The miniature wiring monitoring cum sectioning diagram to be made in continuous sheet of width 140mm to 160mm suitably folded. The progress of wiring done is colored as it progresses

No.	Sheet Designation	Trimmed Size (mm) (WxL)	
1.	A0	841x1189	Index Plan and Section. General arrangement and detailed drawings for road over bridges, major/important bridge works & important structures, building (steel and concrete) etc.
2.	A1	594x841	General arrangement.
3.	A2	420x594	Temporary arrangement & detailed drgs. for bridge works, steel structures, building and temporary arrangement drgs. for Sr. No .1 above.
4.	A3	297x420	Site plans for road over/road under bridges, passenger platform coverings, buildings etc. and drawings for minor detailing.
5.	A4	210x297	Plans for inclusion in Works Programme booklets for handy reference, PERT charts of works of limited activities etc.

- The track in layout plan shall be shown as double line contrary to other drawings which facilitate depiction of the stagger of contact wire.
 - The Cross-section diagram for portals shall be in A3 sheets and others shall be in A4 sheets. Substation drawing, SP and SSP drawings shall be in size A3 except substation layout plan which shall be in A2 size.
- b) Depending on the size of a yard, yard plans should be prepared in the trimmed widths of 841 mm or 420 mm or 210 mm. The length of the yard plans should not be more than 1189 mm when they are not intended to be kept as a roll. Yard plans can be in parts, if necessary, maintaining the scale for the drawing.
- c) Borders enclosed by the edges of the trimmed sheet and the frame limiting the drawing space shall be as detailed in BIS: SP - 46-1988 and shown in Annexure 9.1.
- d) A standard arrangement of drawing layout will ensure that all necessary information is included and its essential part is located easily. The title block should be plated at the bottom right hand corner. Folding marks must be made on the drawing sheet.

904 Titles and Numbering of Drawings-

- a) Title block should be of size 170 mm x 65 mm
Following basic information should be given in the title block.
- 1) NAME OF THE RAILWAY
 - 2) NAME OF DIVN/CONSTN. ORGANIZATION
 - 3) NAME OF WORK
 - 4) REFERENCE TO SANCTION PARTICULARS
 - 5) SCALE OF DRAWING AND REFERENCE TO STANDARD DRAWING, IF ANY
 - 6) DRAWING NUMBER
 - 7) COMPLETION DRAWING NUMBER

8) DATED INITIALS OF THE CONCERNED OFFICIALS
9) ALTERATIONS, IF ANY, WITH FULL PARTICULARS

- b) Multiple drawing sheets marked with the same number should be indicated by means of a sequential sheet number on the total number of sheets in the following manner
Sheet No. = n/p , where n is sheet number and p = total number of sheets
- c) If a drawing cancels a previous one, a note to this effect and the number of cancelled drawing should be recorded on the drawing. Correspondingly, the cancelled drawing should have an appropriate endorsement.
- d) In the case of land plans or plans where other Railways or Organizations are concerned, additional space should be provided for their signatures. In cases involving organizations other than the Railways, the designations should be written in full.
- e) All signatures on tracings should be in indelible ink and dated.

Para 906 Details on Drawing

- a) The following information should, when applicable, be shown
 - i. The magnetic north point and true north with magnetic variation, if known and where buildings are designed to suit a particular orientation, an indication to that effect.
 - ii. The names of the nearest junctions or terminals stations, that on the left hand being the one from which the kilometrage starts.
 - iii. The kilometrage from headquarters of the railway to the center of the station, the kilometrage of all junction points, the zero of all branch lines, the center of a station, junction point and zero of any line, when once adopted for any 'yard' or portion of the line, shall be a permanent mark for all future references and shall not vary with additions, alterations, or remodeling of yards.
 - iv. The original center line of the railway together with its chainages.
 - v. The boundaries of land according to the land plans. Where it does not unduly interfere with important details of the plan, side widths from the center line and boundary posts (and desirably their numbers) should be shown.
 - vi. Any known bench mark with the datum from which its value has been reckoned.
 - vii. The degree, radius, total angle of deflection and the tangent points of all curves on the line, both on the plan and in the longitudinal section. Beginning and end of transitions together with their lengths should also be shown.
 - viii. All gradients, together with the distance from which the level or gradient extends out of station.
 - ix. All borrow pits, rivers and pipelines, streams, sullage and sewer drains together with their direction of flow. For rivers their names and the highest known flood levels must be given.
 - x. Temples, mosques and graves, roads and footpaths with the names of towns or villages they lead to.
 - xi. The position and block numbers of buildings. Where a building consists of two or more storeys, the number of floors shall be mentioned. Where outhouses exist, these shall be marked "O.H. Lo Block No."
 - xii. In the case of foundations, the nature of the soil as determined from trial pit, and bore log details.
 - xiii. The clear length of all inspection pits, capacity of weigh-bridges in tonnes; diameter of turntables; capacity of high-level tanks and of ground tanks; diameter and depth of all wells whether for drinking or for loco use; diameter of water columns, hydrants,

- taps, main and subsidiary pipe lines; the clear lengths and sizes of drains and sewers and stormwater drains; location of septic tanks.
- xiv. The length and capacity in terms of vehicles of sidings; position of fouling marks and buffer stops; distance, centre to centre of tracks; distance of all the facing points on the main line from the centre of station; the serial numbers of the turnouts; the angles of crossings; inclination of gathering lines; the distance from the centre of station of all signals, signal cabins with their distinguishing feature, signals being shown as viewed by the Driver and with their bases at the sites they occupy; lengths of passenger and goods platforms and their heights above rail level; telegraph posts and crossings of telecommunication and power lines over head or underground.
 - xv. Road crossings with their class and location; road over bridges and under bridges;
 - xvi. Infringements of standard dimensions, if any.
- b) Drawing for a structure including building should be prepared in three parts:
- i. Site plan
 - ii. Architectural and/or General Layout drawing
 - iii. Structural and/or execution drawing.
- In case of small buildings, all these parts can be included in one sheet but-placed distinctly. The site plan can be separate or part of an existing general plan. Site plans for new quarters should include the type drawing numbers and show the north line and direction of prevailing wind. The Architectural drawing should normally include ground plan, section through the building in such directions as are necessary to exhibit the intended form and dimensions of the various parts, and elevation of one or more faces. It should invariably indicate the number of floors for which the foundation of the building is designed. It should also include roof drainage arrangement, sanitary details, layout of bathrooms and layout of kitchen. Details of finishing items and specification should also be indicated in the Architectural drawing in the form of a note. Landscaping and developmental work involved must also be shown. The structural drawing will indicate foundation plan, details of R.C.C. members and a bar bending schedule as per standard I.S. bar bending specification.
- c) The drawings for a bridge should include the site plan, plan and longitudinal section of the river or nala above and below the proposed site in the case of large bridges being rebuilt on account of insufficient waterway or being built at a new site and a sufficient number of cross sections showing highest flood level. If a correct survey of an important river does not exist, the river should be surveyed for a distance of 8 km upstream and 2 km downstream, all spill channels upstream being shown on the plan; these distances of 8 km and 2km are to be taken as measured at right angles to the centre line of the Railway and not along the course of the river. On these drawings, notes should be made of area of flood sections and hydraulic mean depths for each case, catchment area, velocity obtained by calculation and by experiments (preferably at high flood), waterway through bridge proposed to be allowed with a note on increase in velocity and probable highest flood level due to afflux, ground plan of foundations, sections through the bridge in such directions as are necessary to show the intended form and dimensions of the various parts, front and side elevation of abutments and piers, and drawings of such details as have not been standardised. The standard of loading for which the bridge is designed should be recorded in the plan and reference to the type drawing of the particular girder should also be recorded.
 - d) Plans of water supply, pumping, storage and distribution systems should show complete dimensions and details including reduced level of salient points. The lines should be drawn in thicker lines than the rest of the plan and only sufficient buildings (with their

designations) and tracks shown as are necessary to make the purpose and location of pipe-lines understood.

- e) Plans of drains and sewerage should show complete dimensions and details with sufficient features of the site including gradient and reduced level of salient points.
- f) The set of drawings should be complete so as to enable the work being executed as per the specifications and standards desired.

907 Symbols and Colors on Drawings

- a) Symbols to be used on site plans and plans of station yards should conform to BIS code SP46-1988. For other commonly accepted abbreviations and symbols, table 19.1 of BIS code SP46-1988 may be referred to.
- b) For clarification of drawings it is sometimes necessary to shade some members/parts of members for which section, are drawn in such cases, colour washing/ shading in hoard line may be done on the back of the tracing for the affected area.
- c) In regard to black and colored lines on tracings and prints, the following conventions should be observed
 - i. Existing work that is to remain should be in full line;
 - ii. Work that is to be dismantled should be in thin clotted lines;
 - iii. New additional work should be in full red lines. This does not apply to a drawing in which all the work is new;
 - iv. New additional work that is not to be done at the same time as the bulk of the work shown on the drawing should be in broken red lines. This does not apply to a drawing in which all the work is new;
 - v. Work to be relaid or rebuilt elsewhere on the same plan should be in full yellow lines.
- d) When desirable to do so, colored lines may also be used to distinguish tracks of different railways at junctions, M.G. or N.G. from B.G. tracks and buildings of different railways. If this is done, the color used should be distinctly different from those mentioned above.
- e) The following colors will print clearly on ferro-paper:

Black .. Indian ink

Red .. Vermilion red or scarlet lake

Yellow .. Chrome yellow

Green .. Emerald green

Blue . .. Prussian blue Cobalt blue mixed with a little Chinese white.

Para 908 Standard Drawings

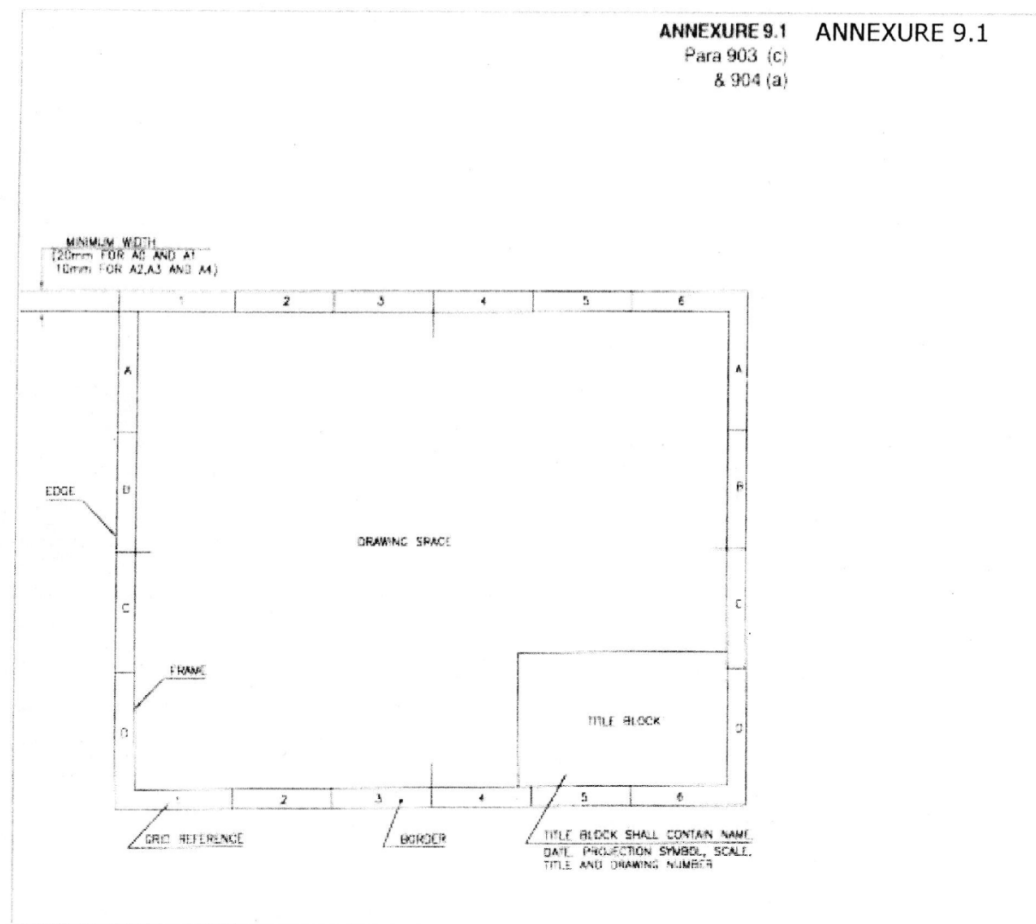
Standard drawings issued by the RDSO such as for track and bridges and the Track Manual Drawings, TI directorate of RDSO, shall not be traced. Copies as required should be obtained or Standard drawings should be carefully filed in each office separately from other drawings and a record thereof maintained.

Para 909 Plans issued by the Sr.DEE/TRD/SC's Office

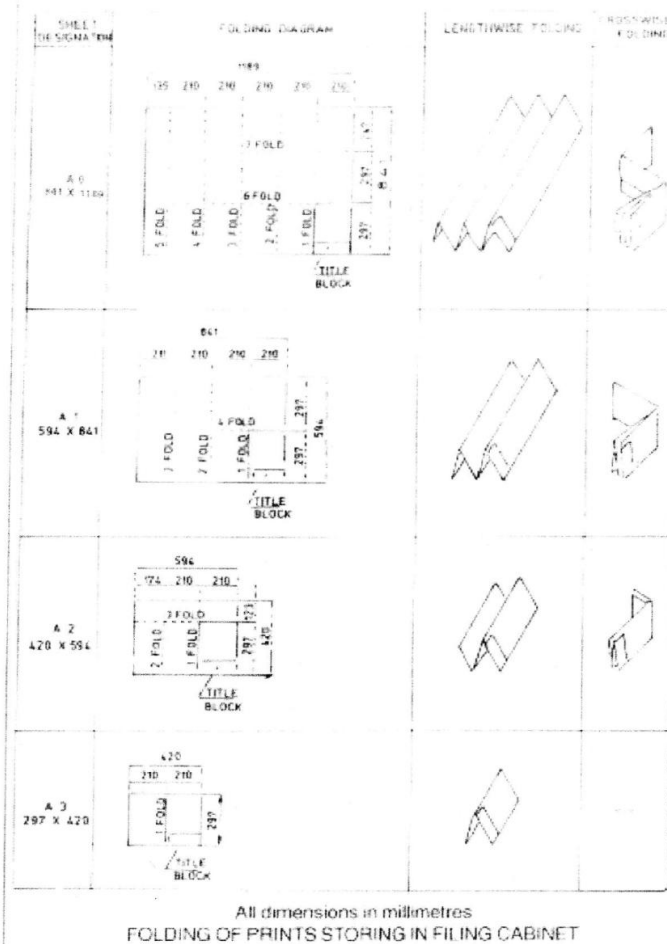
Copies/Prints of plans issued by the Sr.DEE/TRD/SC's office should be carefully maintained and recorded; copies as required may be obtained.

Para 910 Plans in Divisions, Assistant Electrical Engineer's and Section Engineer's offices:

- a) The Divisional/Executive I- Engineers and Assistant Engineers should be in possession of a set of each of the Standard Drawings, type plans, and station yard plans, land plan", plans and longitudinal sections of the line, track diagrams, plans of bridges and other structures and plans of water supply and drainage as pertain to their jurisdiction. Plans in their custody should be carefully stored. They shall ensure that the Section Engineer of Permanent Way, Works & Bridge, OHE, PSI are in possession of necessary plans as pertain to their jurisdiction and to works.
- b) Plans need revision as and when renewals are carried out and additions or alterations are made. Every endeavor should be made to keep the track diagrams and plans, particularly of station yards and colonies, up-to date and the Chief Engineer's office kept advised with details. When alterations are extensive and cannot be shown on an existing plan, a fresh plan should be prepared.



ANNEXURE 9.2



Para 907 ABBREVIATIONS

1. Scope - This section covers such of the abbreviations which are recommended for use in general engineering drawings. Abbreviations already covered in specific subjects, such as units and quantities, tolerancing, gears, fluid power, electrical and electronics are not dealt in this section.
2. Enclosed Table lists some of the common abbreviations recommended. Abbreviations are the same both for singular and plural usage. Only capital letters are used for abbreviations to ensure maintenance of legibility bearing in mind reproduction and reduction process. Abbreviations which have already been standardized nationally/internationally using lower case letters should, however, be written according to the corresponding standard.
3. When using abbreviations and symbols in engineering drawings, the following points are to be borne in mind.
 - a) They should be used sparingly only when space saving in a drawing is essential.
 - b) Short words such as 'day', 'unit', 'time', etc., should preferably be written in full, even when an abbreviation has been standardized.
 - c) Periods (full stop symbol) are not to be used except where the abbreviation marks a work (for example, No; FIG.)

- d) For hyphenated words, abbreviations are to be with the hyphen.
- e) Sometimes one and the small letter symbol may represent more than one term or quantity. Hence it is advisable not to use such symbols to mean two different terms in one and the same drawing. If it becomes unavoidable, the symbols may be provided with suitable sub script.

RECOMMENDED ABBREVIATIONS

Term	Abbreviations	Term	Abbreviations	Term	Abbreviations
Across corners	A/C	Across flats	A/F	Alteration	ALT
Approved	APPD	Approximate	APPRO	Auxiliary	AUX
Arrangement	ARRGTX	Assembly	ASSY	Bearing	BRG
Bureau of Indian Std.	BIS	Cast Iron	CI	Centre Line	CL
Centre of gravity	CC	Centre to Centre	C/C	Centres	CRS
Chamfered	C H MED	Checked	CHKD	Cheese head	CHHD
Constant	CONST	Continued	CONTD	Counterbore	C'BORF
Countersunk head	CSK HD	Countersunk	CSK	Cylinder/Cylindrical	CYL
Diameter	DIA	Dimension	DIM	Drawing	DRG
East	E	Etcetera	Etc	External	EXT
Figure	FIG.	General	GEN	Ground Level	GL
Haxagon/Hexagonal	HEX	Head	HD	Horizontal	HORZ
Hydraulic	HYD	Inspection/ed	INSP	Inside diameter	ID
Insulation	INSUL	Internal	INT	Left Hand	LH
Long	LG	Material	MATL	Machine/Machinery	M/C
Manufacture/ing	MFG	Maximum	MAX	Mechanical	MECH
Minimum	MIN	Miscellaneous	MISC	Modification	MOD
Nominal	NOM	North	N	Number	NO
Outside	OD	Pilch circle diameter	PCD	Quantity	QTY
Radius	RAD	Required	REQD.	Right Hand	RH
Round	RD	Reference	REF	Screw/Screwed	SCR
Serial Number	SL. NO.	Sheet	SH	South	S
Sketch	SK.	Specification	SPEC	Sketch	
Standard	STD	Spotface	SF	Symmetrical	SYM
Temperature	TEMP	Thick	THK	Thread	THD
Through	THRU	Tolerance	TOL	Typical	TYP
Undercut	U/C	Weight	WT	West	W

5.5: SPECIAL DESIGNS :

(a) In cases where standard designs, drawings or employment schedules do not cover requirement of special locations or site conditions, the Contractor shall submit his own designs or drawings along with supporting calculations and notes for scrutiny and approval of the Purchaser.

(b) Such special designs shall generally be in conformity with basic designs furnished by the Purchaser and in accordance with the specifications. If the Contractor wishes to adopt special designs which do not conform to the general basic designs of the Purchaser, he shall submit alternative designs and drawings justifying his proposals.

5.6: PARTICULAR DESIGNS & WORKING DRAWINGS FOR O.H.E.:

5.1.1 PURCHASER'S PEGGING PLANS:

The pegging plans for sections to be equipped indicating the type of overhead equipment, locations of masts and other general particulars prepared on the basis of the latest survey will be furnished by the Purchaser. The Contractor shall verify and check these plans at site.

5.6.2: CONTRACTOR'S PEGGING PLANS:

If the Contractor is called upon to carryout survey and prepare overhead equipment pegging plans, he shall submit such plans for approval after checking their feasibility at site.

(i) The detailed scope of work required to be carried out by contractor are broadly categorized here under.

- (a) Collection of Instructions and relevant documents if any from Sr.DEE/TRD/SC in respect of the section.
- (b) Preparation of Pegging plans in AutoCAD duly showing the details of existing electrified line, L.T. Supply Transformer stations including associated modifications to the existing OHE and Switching Stations if any.
- (c) Preparation of sectioning diagram in auto cad duly covering existing Elementary sections.
- (d) Preparation of other design drawings, if any.
- (e) The proposed new BG line to be provided with conventional OHE by using **65 Sq.mm catenary wire and 107 Sq.mm HDG copper contact wire.**
- (f) Site marking / inspection of OHE Pegging plans (jointly with purchaser's representative if required).
- (g) Incorporating corrections in the tracings and soft copy of Pegging plans, if found necessary, during site marking / inspection, to evolve pegging plans and submission of three prints thereof for comments / approval.
- (h) Preparation of quantity assessments in the standard format adopted by TRD construction organization in respect of overhead equipment and power supply equipment. The quantity assessment shall be made for each section covered under one plan.
- (i) All types steel structures required in the Pegging Plan shall be tabulated and furnished on the Pegging Plans. Length of conductors (Catenary and Contact wires) required for each tension length and anti-creep wire shall be shown on the final Pegging Plan in a tabulated form. List of ROB, FOB, Tunnels, Level crossings with Nos. etc., should be submitted. For FOB & ROB chainage, height from Rail level to bottom mast structure also should be furnished.
- (j) Preparation of OHE profile drawings including calculations and other data for over-line structure / Bridges [ROB/ RUBs], if any for adopting special design.
- (k) Preparation copies in auto cad for the standard RDSO/CORE design drawings such as dropper schedule employment schedules, IOL / UIOL drawings etc. by using **65 Sq.mm catenary wire and 107 Sq.mm HDG copper contact wire** duly adopting complete guidelines, laying down the standards / specifications / principles etc.
- (l) All available plans of the section, bench marks, reports of earlier studies, basic rules for preparation of designs, details of proposed work along with route, typical designs of loco sheds, substations etc., will be made available to the contractor on request during course of execution of the work.
- (m) In case where lines to be electrified are not in their final position, the purchaser shall furnish the remodeling plans and / or peg out the altered position of tracks. Based on the pegged-out location of tracks and the information available in this remodeling plans the contractor shall prepare the survey plans and finalize the Pegging Plans.
- (n) Slewing of tracks, if required for location for OHE structure will be indicated by the purchaser, which contractor will record on the Pegging Plans.

- (o) The pegging plans shall also indicate details of removal of infringements such as diversion of drains, pipes, signal wire, rods or other installations, details of which shall be jointly finalized with the purchaser.
- (p) The stretches of the section where return conductor and Booster transformers are to be located shall be intimated to the contractor.

(ii) The following information shall be collected while carrying out the field survey of the section, in respect of the tracks required to be wired and also all the tracks in their vicinity, to enable preparation OHE Pegging Plans.

- (a) Track center distance at every 30M in case of double and multiple tracks, in stations and yards, commencing from the kilometer post. Chainage of the existing gradient posts and details of the gradient indicated thereof e.g. 1:100 (R) and 1:200 (F) etc.,
- (b) Chainage of the existing curve pillars and the particulars as furnished thereof in respect of the curvatures e.g. degree of curvature; radius of curvature, length of curve, deflection angle, chainage of transition, turning point and of the turning points as well as super elevation will be measured if available at site.
- (c) Versine in every span length for each individual track through-out the section.
- (d) Cross section of the formation at a regular interval of 200m, commencing at the kilometer posts, to indicate the ground profile. The ground profile will cover a distance of about 4/5m from the center line of the track and will be measured with a string and survey rod.
- (e) Type of soil: - One statement indicating the type of soil has to be submitted in duplicate to purchaser based on observations, along with each Pegging Plan.
- (f) The chainages of both the edges, the width, number and class of the level crossing, dimensions relating to the position of gate lodge and the level crossing barrier with reference to the track.
- (g) The chainage of the center line of all the existing trolley refuges. The number of bridge/culvert, the chainages of both the abutments, centre line and with/shape of the piers. Wherever structures are to be located on a bridge or inside of a tunnel, sufficient details will be given on the location where structures will be located.
- (h) In case of structures locating on piers, and inside tunnel dimensions of space available, a cross section giving details of bridge member and in case of suspension from top or vertical members of bridge/tunnel, the cross section at the suspension/fixing points will be shown, giving all relevant details with dimensions. The design of supporting arrangement will not, however, form part of the contract.
- (i) The chainages of the both the edges, width and clear headroom available for each of the wired tracks under the over line structures e.g., Road Over Bridge, Foot Over Bridge, Flyover Bridge, through girder bridges etc. In respect of overhead electrical high tension (11kV & above) crossings chainages and clear head room has to be shown. In case of LT/P&T crossings only center line chainage will be provided.
- (j) Chainage at both the edges of the tunnel and cross-sectional details at every 10m interval apart from one end of the tunnel to the other end, indicating the tunnel cross section profile along with details of space available for locating OHE structure.
- (k) All the underground obstructions, which may infringe with the casting of OHE foundations like watering arrangements, underground cables and pipes will be shown on the Pegging Plans. The details may be ascertained from the local

Railway staff. Necessary assistance in this respect will be provided by the purchaser if required.

- (l) The chainage of the actual toe of the switch, the nose and the fouling board for every turn out will be indicated. The chainage of the center line of the diamond crossing, the number of slips and chainage of the actual toes of the switches.
- (m) The chainage, implantation, number and position of existing signals, with reference to adjacent tracks. The distance of extreme edges of a group of point rods requiring adjustments / special arrangements in locating OHE structures over/near them, from the center of the adjacent track/s at regular interval of 25m throughout the length of the run of point rods. Position details/chainage of signal location boxes.
- (n) Chainage/Position details with reference to adjacent track/s in respect of all the building structures e.g., station building, cabins, cable huts, goods and parcel sheds, tea and other vendor stalls on platforms etc.,
- (o) Chainage/position details of carriage watering arrangements, water columns and ash pits. Chainage of the edges of platforms ends and ends of ramps, height of the platforms and width in respect of island platform chainage of extreme edges of platform sheds is also to be mentioned.
- (p) The distance of the near and far edges of pucca drains (requiring adjustment/special arrangements for location of OHE structures near/over them) at a regular interval of 25m throughout the length of the run of drain from the center of adjacent track/s.
- (q) Position/Chainages of edges of sub-ways and their outlets on platforms. Relevant details of any other existing feature/s and obstruction/s, which will affect location of OHE, structure over/near the same i.e. 10m on either side of the track. The existing OHE location position to be indicated in the Pegging Plan.

(iii) The pegging plans should be prepared on the basis of the parameters prescribed in the principles of Overhead Equipment Layout issued by RDSO/Lucknow; latest directive of CORE/Allahabad and Railway Board on this subject. The following standards/conventions will be observed for preparation of Pegging Plans:

- (a) Standard width of the tracing shall be 297 mm or multiple thereof.
- (b) A scale of 1:1000 for open section and 1:500 for station / yard shall be used. The station / open section shall commence at the Km. post immediately in advance of the first turnout from the main line and shall end at the Km post immediately after the last turn out from the main line.
- (c) An arrow at the end of the plan will be provided to indicate the direction and name of the adjacent/extreme station in the section. The track shall be represented by single line in open section and by double line in station section.
- (d) Track shall be designated as UP/DN Up Loop / Dn. Loop Third BG line etc., according to the standard convention. The progressive direction of plotting shall be as per requirement of the purchaser.
- (e) For structures in the vicinity of signals as per standard RDSO drawing setting will be adopted to cater for both existing semaphore and proposed CLS. The locations of proposed CLS signals will be indicated by the purchaser.
- (f) Normally the plotting shall begin at the Km post and end of the Km post. The length covered will not be more than 3Km in one plan. Only one single plan shall be prepared to cover the entire length of station section from Km post at one end to another Km post at the other end. However, in case of every big yards, convenient subdivision shall be made and key plan showing the subdivision shall be prepared based on the relevant wiring plan.

- (g) Two prints of pegging plans will be supplied to purchaser as soon as tracings are ready for reference and record. Comments of the purchaser, if any, received will be utilized for incorporating necessary corrections at the time of preparing Pegging Plans.
- (h) All the observations and corrections made during site inspection after pegging plan will then be incorporated. The plan will then be thoroughly scrutinized to eliminate all design / field errors / omissions and Two prints of pegging plans and CD to be submitted for scrutiny and comments.
- (i) On receipt of approval for the Pegging Plan on original tracing, distribution copies as given in Para 2.5.10[m] along with the soft copy to be submitted to purchaser.

5.6.3: PRINCIPLES OF LAYOUT:

The Contractor shall in all cases ensure that the final pegging plans are in conformity with the latest 'Principles of preparation and checking of OHE layout plans and sectioning diagram issued by RDSO. (Spec. No. ETI/OHE/53(6/88) AND 3(6/90) with latest corrections.

5.6.4: PROVISIONAL LAYOUT PLANS:

The Contractor shall prepare and submit overhead equipment layout plans incorporating the following information:

- i) The run of wires in different thickness or color in special cases and termination.
- ii) The run of wires for future wiring indicated to the Contractor, in dotted lines.
- iii) Exact position of all cut-in-insulators, including section insulators.
- iv) Direction and value of stagger at each traction structure location.
- v) Clearance of live conductors to Structures in the vicinity including bridges, signals gantries etc.
- vi) Layout of feeders.
- vii) Jumper connections and connection to switches and switching stations.
- viii) List of infringements.
- ix) Kilometer numbers and type of Structures.
- x) Location and numbers of switches.
- xi) Schematic sectioning diagram drawn to convenient scale showing section insulator, number of switches, elementary sections and connections to switches and switching stations.
- xii) Table giving references of approved profile drawings, feeder layout plans and other relevant drawings.

5.6.5: O.H.E. PROFILE DRAWINGS:

After completion of the overhead equipment layout plans, the Contractor shall prepare an overhead equipment profile drawing showing the actual height of the contact wire under each over line Structure the gradient and height of the contact wire on either side of the Structure and the encumbrances at Structures until normal height of contact wire and encumbrances are restored.

5.6.6: CROSS SECTION DRAWINGS:

While the layout plans are being finalized, the Contractor shall submit for approval, cross-section drawings for each Structure showing guy rods, if any, indicating the cross-section of the formation, height and nature of soil, type of foundation block, structure proposed,

reverse deflection of the Structure and all necessary particulars for erection of the foundation and the Structures. In the preparation of drawings, care shall be taken to show all obstructions such as signal wires, points rod and their correct location in references to track/tracks as well as underground obstructions like pipes cables, etc. after collecting such information from the site.

5.6.7: FINAL LAYOUT PLANS:

After all the cross-section drawings in a section covered by the layout plan are finalized and foundations are cast, the Contractor shall revise the layout plans to consider any modifications to the locations of Structures during the process of casting of foundations.

5.6.8: STRUCTURE ERECTION DRAWINGS:

The Contractors shall then submit Structure erection drawings for each structure incorporating all the details included in the cross section drawing for the structure and as erected at site and the details of the bracket assembly, mast extensions, isolator mounting frame and anchorage of overhead equipment, feeder or return conductors proposed for each structure together with all particulars necessary for the correct erection of overhead equipment at the structure. For structure with isolators, the details of electrical connections shall also be incorporated. Styles of stay, bracket and register arm tube shall be mentioned. Displacement in case of curve locations to be shown on SED drawing. Maximum of two locations to be used per sheet.

Makes of contact wire, catenary wire, insulators, ss wire rope, splices if used etc. shall be mentioned on the SED sheet.

Other References/Codes for Misc. Items Like Steel Work for Stay/ Bracket Attachment Misc. Single/Double Cat. Etc. Will Be Indicated Items.

5.7: PARTICULAR DESIGNS AND WORKING DRAWINGS FOR SWITCHING STATIONS AND BOOSTER STATIONS:

a. PURCHASER'S LOCATION PLAN ETC:

The existing location plans and schematic diagrams of connections for all the switching stations will be furnished by the Purchaser to the Contractor. These will indicate the following as applicable: -

- i. Overhead equipment layout in the vicinity of switching or other stations.
- ii. Location of main masts.
- iii. Arrangement of cross feeders and longitudinal feeders to be anchored on the gantry if any, including jumper connections to the overhead equipment.
- iv. Scheme of connections of interrupters.
- v. Position of the remote-control cubicle with respect to the switching stations.
- vi. Fencing outline at the switching stations.

The Contractor shall satisfy himself about the correctness and applicability of the location plans given by the Purchaser before adopting them for detailed designs.

b. DETAILED DRAWINGS:

The Contractor shall submit for approval of the Purchaser the following drawings after incorporating all the details for providing addl. interrupters and other connected equipment.

(i) **EMPLOYMENT SCHEDULES AND CHARTS:** Employment schedules and charts applicable to all switching stations. These will include:

1. Employment schedule for pure gravity type of foundations for main masts for various direct loads and bending moments;
2. Employment schedule for all other foundations for various depths of parent soil from the datum level.
3. Sag tension charts for cross feeders for various spans and tensions.

5.8: BOOSTER TRANSFORMER STATIONS DRAWINGS:

The Contractor shall submit for approval to the purchaser drawings for booster transformer stations, similar to those detailed for switching stations in 5.7(b). The following drawings may, however, be combined together: -

- i) Cross-section and foundation layout drawings;
- ii) General arrangement, structural and earthing layout drawings.

5.9: SCHEDULE OF QUANTITIES:

- a) Within a month of the issue of Letter of Acceptance of Tender, the Contractor shall submit a schedule showing the phased requirement of raw copper for manufacture of wires, and conductors, separately for contact wire, catenary wire and other wires and conductors, for the purchaser to arrange raw copper. The assessment may be based on the quantum of work included in the Letter of Acceptance of Tender. (applicable if these items are supplied by Railways)

On receipt of approval of each layout plan from the purchaser, the followings Schedules of quantities relating to each layout plan shall be submitted within 3 (three) days of approval of layout plan along with blue print/ AutoCAD copies of the plans.

- i. Schedules of number of masts, types, weight of different masts and total weight of masts;
- ii. Schedules of number of foundations, types, volume of different foundations and total volume;
- iii. Schedule of quantities of various items of work other than masts and foundation
- iv. Schedule of net tension lengths of contact, catenary and feeder wires and lengths required to be ordered;
- v. Schedule of lengths of other wires and conductors required to be ordered;
- vi. Schedules of small parts steel work.

b) SWITCHING / BOOSTER STATIONS:

Within 3 (three) days of receipt of approval of relevant drawings for each switching/booster station, the following schedules of quantities shall be submitted.

- i. Schedule of number of foundations, types, volume of different foundation and total volume.
- ii. Overlapping foundations will be treated as one foundation;
- iii. Schedule of number of masts, types, weight of different masts, and the total weight of masts of each gantry;
- iv. Schedule of steel work types, weight of each member and total weight; and
- v. Schedule of quantities of various items of work of schedule 1 not included in Item (i), (ii) and (iii) above.

5.10: SUBMISSION OF DRAWING AND SCHEDULE:

- (a) The submission of designs and drawings for approval shall be done. In case Contractor wish to deviate from standard drawings he should submit to the purchaser revised drawings with full details of deviation sought explaining the necessity of deviation, calculations and other supporting documents. The purchaser, if satisfy about the necessity and adequacy of deviations, shall refer the matter to RDSO for necessary approval. In case of deviations on working drawings, decision shall communicate by the purchaser to the Contractor. The number of copies of drawings which shall be submitted are indicated in the following sub-paras. The purchaser will return one copy of the drawings either with approval subject to modification where necessary or with comments. The purchaser shall Endeavour to return this copy within a period of fifteen days from the date of receipt and shall normally return the copy within a month. Where drawings are returned with comments or approval subject to modifications, the Contractor shall submit to the purchaser within fifteen days of receipt of such advice revised drawings for approval considering the comments or modifications. Also, the Contractor shall as far as possible avoid correspondence on such comments and shall Endeavour to settle any difference of opinion on the comments by discussions with the purchaser's Engineers. No drawings shall be resubmitted without incorporating the modifications required by the comments of the purchaser, unless the purchaser has agreed to the deletion of such comments.
- (b) **DEVIATION FROM STANDARD DESIGN:** In case of deviation from standard designs and drawings, copies of correspondence and drawings shall be sent in duplicate to the Chief Electrical Engineer or his successor/nominee (whose address will be intimated in due course). In the particular case of deviations in the design of fittings the drawings submitted by the Contractor shall be actual manufacturing drawings complete with tolerances and full specifications of the materials used. In addition, four samples of the modified fittings shall also be submitted after the drawings are approved.
- (c) **SPECIAL DESIGNS:** Special designs to meet the requirement of particular locations and local conditions shall be submitted in due time in duplicate for approval.
- (d) **PURCHASER'S PEGGING PLANS:** deleted
Two copies of the purchaser's pegging plans shall be sent back after verification if found correct. If modifications are required, fresh pegging plans incorporating the modifications shall be submitted in two copies for approval.
- (e) **CONTRACTOR'S PEGGING PLANS:** When the Contractor is called upon to survey and prepare pegging plans; he shall send three copies of such plans, while submitting them for approval.
- (f) **CROSS-SECTION DRAWINGS:** Cross-section drawings shall be submitted for approval in two copies for a convenient section at a time separately for sections within station limits and section outside station limits. Such drawings shall be submitted progressively and as far as possible without gaps.
- (g) **O.H.E. LAYOUT PLANS AND PROFILE DRAWINGS:** Overhead equipment layout plans, provisional and final and profile drawings shall be submitted for approval in three copies.

- (h) **STRUCTURE ERECTION DRAWINGS:** Structure erection drawings shall be submitted for approval in two copies for a section at a time separately for sections within station limits and sections outside station limits, progressively and without gaps.
- (i) Deleted
- (j) **SCHEDULE OF QUANTITIES:** Schedules of quantities for each approved layout plan/ switching station shall be submitted for approval in two copies.
- (k) **SUB-SECTION FEEDER DRAWINGS** - Deleted.
- (l) All drawings for switching stations, booster transformer stations and L. T. supply transformer stations shall be submitted for approval in three copies.
- (m) **DISTRIBUTION COPIES:** On receipt of purchaser's unqualified approval to the Contractor's drawings, Schedule of quantities, the Contractor shall submit original tracings of those drawings and schedules for the signature of the purchaser in token of approval within seven days of the receipt of approval and the purchaser shall as far as possible return the same to the Contractor within 7 working days thereafter. On receipt of these tracings from the purchaser, the Contractor shall submit copies for distribution to field officers and other departments as indicated below within 7 days of receipt of approved tracings:

i)	Standard designs including fittings drawings as per para 5.10(b) of this section	8 copies
ii)	Special designs, if any	8 copies
iii)	Final pegging plans, if any	8 copies
iv)	OHE layout plans at CSD stage	6 copies
v)	Cross-section drawings (CSD's)	6 copies
vi)	OHE layout plans at SED stage	10 copies
vii)	OHE layout plans at EIG application stage	5 copies
Viii)	OHE layout plans at CRS application stage	5 copies
ix)	OHE profile drawings including EIG & CRS application stage	10 copies
x)	Structure erection drawings including EIG & CRS application stage	12 copies
xi)	Schedule of quantities	6 copies
xii)	Drawings for switching Stations, booster transformer Stations & L.T transformer Stations. including EIG & CRS application stage	12 copies

In all the above cases, the contractor has to supply one copy on transparent paper print and in case of designs done on computer, one soft copy in **.pdf format and also .dwg format** to be submitted.

Drawings approved by the Purchaser shall not be modified without prior consent in writing from the Purchaser. Drawings incorporating approved modifications shall be re-submitted for formal approval of the Purchaser in the same manner as original drawings.

5.11: COMPLETION DRAWINGS & SCHEDULES:

After completion of works, all drawings and designs submitted by the Contractor and approved by the purchaser shall be made up to date incorporation actual supply and erection particulars including the name and make of insulators, galvanized steel tubes, stainless steel wire rope etc. The mark of conductors shall be specified in the "As erected" OHE layout plans, SED and

other relevant drawings for identification. Such drawings and schedules shall then be verified and corrected, if necessary, by the Contractor jointly with the purchaser's representatives. The verified and corrected drawings (as erected LOP's, SED's, profile drawings, SSP/SP/AT/BT FP, TSS, SHUNT CAPACITOR BANK drawings) shall be supplied in **10 (ten) sets**, one of which shall be transparencies of linen or any other durable material approved by the Purchaser. **Soft copy of each drawing (in .pdf format and also .dwg format) in CD is also to be submitted. Contractor shall also submit six CDs/DVDs of soft copies of each drawing in the above formats.**

LIST OF STANDARD DRAWINGS AND SPECIFICATIONS

*This Annexure contains reference to drawing numbers, charts, Schedules, specifications and other data referred to in various paragraphs of this Tender Paper. All references to drawings, charts, schedules or specifications given in this Annexure **shall be taken to be the latest version available as on date of issue of LOA** of such drawings, charts and schedules of specifications as issued by the Purchaser.*

(A) LIST OF STANDARD DRAWINGS FOR CONVENTIONAL TYPE OHE (REGULATED)

Sl. No.	Brief Description	Drawing Series	Number	Mod .
1.	Extra allowance for settings of structures on curves (1676mm Broad gauge).	ETI/OHE/G	00111 Sh-1	C
2	Standard setting of structures in the vicinity of signals (broad gauge)	ETI/OHE/G	00112	D
3	Typical design of side bearing foundation.	ETI/OHE/G	00131	
4	-Deleted-			
5	Typical design cantilever mast.	R/E/33/G	00141 Sh.3	
6	Standard drilling schedule of OHE masts 9.5m long RSJ and BFB respectively.	ETI/OHE/G	00144 Sh.3	C
7	Span and stagger chart for (conventional OHE, Cd.Cu catenary & Cu.cont.wire) for wind pressure 75,112.5&150kgf/sq.m.	ETI/OHE/G	00202	
8	Employment schedule for Cantilever Mast Regulated OHE Cat. 65/ Cu and Cont 107/Cu, WP 112. 5kgf.sq.m without EW& without RC.	ETI/OHE/G	00153 Sh.1	E
10	Employment schedule for Cantilever Mast Regulated OHE Cat. 65/Cu and Cont 107/ Cu, WP 112. 5kgf.sq.m with EW & with RC	ETI/OHE/G	00153 Sh.3	
11	Employment schedule for Cantilever Mast Regulated OHE Cat. 65/Cu and Cont 107/ Cu, WP 112. 5kgf.sq.m with EW & with RC	ETI/OHE/G	00153 Sh.4	
12	Employment schedule for Cantilever Mast unregulated OHE Cat.65/Cu and Cont 107/Cu, WP 112. 5kgf.sq.m at 35xC& with 28 kgf/sq.m at 4xC without (EW&RC)	ETI/OHE/G	00154	
13	Employment schedule of bracket tubes regulated Conventional OHE (Cd Catenary & Cu contact wire 1000kgf tension Each)	ETI/OHE/G	00153 sh-1 to sh-3	
14	Dropper schedule for – uninsulated Overlap spans.	ETI/OHE/G	00169	A

Sl. No.	Brief Description	Drawing Series	Number	Mod .
15	Dropper schedule for insulated Overlap spans.	ETI/OHE/G	00170	A
16	Dropper schedule for conventional regulated OHE with zero presage (1400/1400)	ETI/OHE/G	00177	A
17	Adjustment chart of regulating equipment 3-Pulley type 3:1 ratio.	ETI/OHE/G	00195	A
18	Schematic arrangement of regulated OHE.	ETI/OHE/G	02101	A
19	Schematic arrangement of uninsulated overlaps (3&4 span overlaps).	ETI/OHE/G	02121 Sh.4	A
20	Schematic arrangement of insulated overlap.	ETI/OHE/G	02131 Sh.3	A
21	Termination arrangement of Tramway OHE with 3 pulley type regulating equipment (3:1 ratio).	ETI/OHE/G	04212	B
22	General distribution of droppers.	ETI/OHE/G	00161	-
23	Outline of Pantograph (Broad gauge and meter gauge).	R/E/33/G	00181	A
24	General formation of single-track Embankments and cutting (Broad gauge).	R/E/33/G	01101-sh-1	A
25	General formation of double track Embankments and cutting (Broad gauge).	R/E/33/G	01102 Sh.1	A
26	General formation of multiple tracks (1675mm gauge).	R/E/33/G	01103 Sh.1	A
27	Standard anchor arrangement.	R/E/33/G	01401 Sh-1	E
28	Anchor arrangement with dwarf mast.	ETI/OHE/G	01402	B
29	Schedule of anchor block for B.G. track.	ETI/OHE/G	01403 Sh.1	D
30	Double guy rod arrangement with anchor block for B.G. track.	ETI/OHE/G	01403 Sh.2	C
31	Schedule of anchor block for B.G. track (Black cotton soil)	ETI/OHE/G	01403 Sh.3	B
32	Standard guide tube arrangement on a mast and structures.	ETI/OHE/G	01505	-
33	Trapezoidal counter weight arrangement on OHE structures.	ETI/OHE/G	01502	-
34	Arrangement of 3KV & 25KV Pedestal insulator supports on OHE masts and portals.	ETI/OHE/G	01601	
35	Standard arrangements for mounting of number plate on OHE Structures.	ETI/OHE/G	01701	A
36	Schematic arrangement of regulated overhead equipment.	ETI/OHE/G	02101	A
37	Typical arrangement of OHE on cantilever masts for double track section.	ETI/OHE/G	2102	-
38	Typical arrangement for fixing of bracket assembly on 9.5m mast and structure to suit raising of tracks in future.	ETI/OHE/G	02102 Sh.3	-

Sl. No.	Brief Description	Drawing Series	Number	Mod .
39	Mast on platforms (1676mm gauge).	ETI/OHE/G	02104 Sh.1	A
40	Details of bracket arrangement on tangent and curved tracks.	ETI/OHE/G	02106 Sh.1	A
41	Details of bracket arrangement for OHE (High Speed).	ETI/OHE/G	02106 Sh.3	C
42	Single bracket assembly on Structures and dropped arms.	R/E/33/G	02107	D
43	Box type cantilever Arrangement.	ETI/OHE/G	02108	A
44	Arrangement at anti creep.	ETI/OHE/G	02111	A
45	Standard cantilever arrangement for boom anchor anti creep location.	ETI/OHE/G	02113	-
46	Schematic arrangement of uninsulated over Lap (type-I) 3&4 Span overlaps.	R/E/33/G	02121 Sh.1	F
47	Schematic arrangement of insulated overlap.	ETI/OHE/G	02131 Sh.1	
48	General arrangement of regulated OHE at turn-outs (overlap& crossed type).	ETI/OHE/G	02141	C
49	General arrangement of regulated OHE at cross over (overlap &crossed type).	ETI/OHE/G	02151	
50	Arrangement of neutral section.	ETI/OHE/G	02161 Sh.1 of 2	C
51	Arrangement of neutral section assembly (PTFE Type) at SWS.	ETI/OHE/G	02162	-
53	Schematic arrangement of unregulated overhead equipment.	ETI/OHE/G	03101	-
54	Standard termination of OHE (Regulated & un-regulated).	ETI/OHE/G	03121	E
55	General arrangement of Unregulated OHE at turnouts (crossed & overlap type).	ETI/OHE/G	03151	-
56	General arrangement of unregulated OHE crossovers and diamond crossings (overlap and crossed type).	ETI/OHE/G	03152 Sh.1	-
57	General arrangement of unregulated OHE at diamond crossing.	ETI/OHE/G	03152 Sh.2	-
58	General arrangement of head span.	ETI/OHE/G	03201	A
59	General arrangement of pull off.	ETI/OHE/G	03301	-
60	In span jumper connection between catenary& contact wire.	ETI/OHE/G	05101	-
61	Continuity jumper connection at uninsulated overlap.	ETI/OHE/G	05102	C
62	Arrangement of anti-theft jumper.	ETI/OHE/G	05107	A
63	Connection at turnouts.	ETI/OHE/G	05103	B
64	Potential equalizer connection at insulated overlap and neutral section.	ETI/OHE/G	05104	-
65	Connections at diamond crossing.	ETI/OHE/G	05106	A
66	General arrangement of connections to OHE by copper cross feeder (150)	ETI/OHE/G	05121 Sh.1	C

Sl. No.	Brief Description	Drawing Series	Number	Mod .
67	General arrangement of connections at switching station on double track section by copper cross feeder (150.	ETI/OHE/G	05122 Sh.1	C
68	General arrangement of connections at switching station on multiple track section by copper cross feeder (150.	ETI/OHE/G	05123 Sh.1	C
69	Suspension of 25kV feeder (Spider) on OHE masts.	ETI/OHE/G	05143	B
70	Termination of feeder, return conductor & return feeder (copper & aluminum).	70 RE/33/G	05145	A
71	Arrangement of suspension of double spider 25KV feeder and return feeder between sub-station and feeding station.	70 RE/33/G	05152	C
72	Assembly of section insulators.		05181	C
73	General arrangement of earth wire on OHE mast.	ETI/OHE/G	05201	A
74	General arrangement of earth wire on OHE mast.	ETI/OHE/G	05201-1	
75	Arrangement of transverse bonds.	ETI/OHE/G	05251	A
76	Connection of return conductor to track.	ETI/OHE/G	05306	F
77	Suspension arrangement of aluminum return conductor (spider) on traction Structures.	ETI/OHE/G	05307	B
78	Suspension of return conductor (spider) from boom of Structures (with clevis type disc insulators).	ETI/OHE/G	05312	A
79	Connections between OHE and aluminum return conductor at booster stations.	ETI/OHE/G	05413	B
80	Mounting of 25KV Isolators on OHE Structures (General arrangement).	ETI/OHE/G	05513 Sh.1	A
81	Details of small part steel work for supporting 25KV Isolator on new T.T.C. boom.	ETI/OHE/G	05513 Sh.2	A
82	Connection from isolator to OHE.	ETI/OHE/G	05516	A
83	Characteristics of conductors/bus-bar for 25KV AC traction.	ETI/OHE/G	05600	A
84	Arrangement of mounting 25KV/240, 10 KVA LT supply transformer.	ETI/OHE/G	05522	-
85	Employment Schedule for Cantilever Mast regulated OHE Caty 65 Cu, Cont.107/Cu (WP 75 kgf/sq.m.)	ETI/C	0702 sh-1 to 5	B
86	Employment Schedule for Tramway type regulated OHE (WP 75 kgf/sq.m.)	ETI/C	0704	B
87	Employment Schedule for 8"x8"x35 lbs BFB (9.5M. long) (WP 112.5 kgf/sq.mm Cat.65/Cu&Cont.107/Cu.	ETI/C	0708	B

Sl. No.	Brief Description	Drawing Series	Number	Mod .
88	Employment schedule for OHE mast overlap central location with 3.0m implantation. at.65/Cu&Cont.107/Cu.WP 75kgf/sq.m.	ETI/C	0709	A
89	Employment schedule for OHE mast overlap central location with 3.0m implantation. at.65/Cu&Cont.107/Cu.WP 112.5 kgf/sq.m.	ETI/C	0710	A
90	Employment schedule for OHE mast (9.5) overlap center location with 3.0m implantation. at.65/Cu&Cont.107/Cu.WP 75 kgf/sq.m.	ETI/C	0711	A
91	Employment schedule for OHE mast overlap inter location with 3.0M implantation. at.65/Cu&Cont.107/Cu.WP 112.5 kgf/sq.m.	ETI/C	0712	A
92	Employment Schedule for (9.5m) long 200x200x49.9kg mast - Caty. 65/Cu & Cont.107/Cu.WP 75 kgf/sq.m.	ETI/C	0713	B
93	Employment schedule for 9.5m long 200x200x49.9kg mast Cat.65/Cu and Cont.107/Cu WP 112.5 Kgf/sq.m.	ETI/C	0714	A
94	Employment schedule for OHE for 9.5 m mast overlap anchor location with 3.0M implantation. at.65/Cu&Cont.107/Cu.WP 75 kgf/sq.m.	ETI/C	0715	A
95	Employment schedule for OHE for 9.5 m mast overlap anchor location with 3.0M implantation. at.65/Cu&Cont.107/Cu.WP 112.5kgf/sq.m.	ETI/C	0716	A
96	Employment Schedule for regulated OHE mast (9.5m) wind pressure 75kgf/sq.m for composite OHE (1000<<1000) kgf tension.	ETI/C	0721 sh-1 to 4	
97	Employment Schedule for regulated OHE mast (9.5m) wind pressure 75kgf/sq.m. for composite OHE with extra setting distance. Overlap Anchor location.	ETI/C	0722	-
98	Employment Schedule for regulated OHE mast (9.5m) wind pressure 75kgf/sq.m. for composite OHE with extra setting distance. Overlap center location.	ETI/C	0723	-
99	Employment Schedule for regulated OHE mast (9.5m) wind pressure 75kgf/sq.m. for composite OHE with extra setting distance. Overlap inter location.	ETI/C	0724	-
100	Employment schedule for pre-stressed concrete mast (PC 42) 9.5m long, for	ETI/C	0725	A

Sl. No.	Brief Description	Drawing Series	Number	Mod .
	conventional OHE, Normal Location (WP 150,112.5 & 75kgf/sq.m.			
101	Standard portal (N.O, P, R, G & Double BFB type).	ETI/C	0064	-
102	Volume chart and equivalent chart of foundation.	ETI/C	0058 Sh.1	E
103	-do-new pure gravity.	ETI/C	0058 Sh.2A	D
104	-d0- Dry black cotton soil (NBC type)	ETI/C	0058 Sh.3A	B
105	-do- New pure gravity (500m, exposed)	ETI/C	0058 Sh.4	B
106	-d0- Dry black cotton soil (NBC type) 2.5m depth.	ETI/C	0058 Sh.5	B
107	-do- (For a direct load of 4000Kg)	ETI/C	0058 Sh.6	B
108	Special BFB portal for 5 tracks (General arrangement)	ETI/C	0026 Sh.1	C
109	Protective screen at foot-over bridge and road over-bridge.	ETI/C	0068	G
110	Chart for portal foundation.	ETI/C	0005/68	
111	Muff for OHE Structures.	ETI/C	0007/68	E
112	Structures muff for sand core foundations.	ETI/C	0012/69	E
113	9.5m standard traction mast (fabricated 'K' series).	ETI/C	0018-2	D
114	Remote Control Cubicle at switching station, foundation, RCC slab Building plan & steel door.	ETI/C	0067	B
115	9.5m standard traction mast (fabricated with bottom plates 'B' series)	ETI/C	0071	E
116	Details of OHE foundation in soft rock (bearing capacity 45,000 Kgf/sq.m).	ETI/C	0059	B
117	Details of foundation for fencing upright.	ETI/C	0032	B
118	Employment schedule for switching and booster station main masts.	ETI/C	0185	B
119	Drilling schedule for S-1 mast	ETI/C	0030	F
120	-do- S-2 mast.	ETI/C	0031	D
121	-do- S-3 mast (length 11.4m)	ETI/C	0180	C
122	Drilling schedule for 8" x 6"x35 lbs.RSJ mast 8.0m long for booster transformer station Type S-4.	ETI/C	0036	E
123	Drilling Schedule for S-5 mast (11.4m long)	ETI/C	0042	E
124	-do- S-6 mast (length 12.4m)	ETI/C	0181	C
125	-do- S-7 -do-	ETI/C	0182	C
126	-d- S-8 -d0-	ETI/C	0183	C
127	-do- S-9 mast (length 9.4m)	ETI/C	0184	C
128	General arrangement & details of fencing panels & gate for switching station.	ETI/C	0186 Sh.1	E
129	Details of fencing upright and anti-climbing device for switching station.	ETI/C	0186 Sh.2	E

Sl. No.	Brief Description	Drawing Series	Number	Mod .
130	S-100 fabricated mast for mounting LT supply transformer and drop out fuse switch at switching station.	ETI/C	0043	B
131	S-101 details of mast for supporting isolator inside switching station.	ETI/C	0044	A
132	Details of anchor beam or SP, SSP, &FP	ETI/C	0033	D
133	Details of small part steel for switching station.	ETI/C	0034 Sh.1	K
134	Details of bracing for switching & B.T. masts.	ETI/C	0034 Sh.2	B
135	Details of small parts steel of our rigger for switching stations and booster transformer stations.	ETI/C	0037	C
136	Details of small parts steel for booster transformer stations.	ETI/C	0040	E
137	Details pre-cast cable trench for switching station.	ETI/C	0038	E
138	Standard 'R' type portal (rod laced) general arrangement.	ETI/C	0011/69Sh.1	C
139	Standard 'G' type portal special upright and end piece.	ETI/C	0056	C
140	Short bored pile foundation for traction mast (permissible BM & volume)	ETI/C	0062	B
141	Chart for portal foundations in dry black cotton soil safe bearing capacity 16500 Kg/sq.m.	ETI/C	0063	B
142	Dwarf mast foundation on wet dry black cotton soil.	RE/ALD/OH E/SK/C	02	-
143	Typical design of new pure gravity foundation.	ETI/SK/C	131	A
144	Typical design of side gravity foundation.	ETI/SK/C	142	A
145	Rock Anchor for B.G. Track.	ETI/SK/C	208	-
146	Bracket fitting for PSC Masts capacity-4.200kgm.	ETI/SK/C	214 Sh.1	E
147	SPS details for Earth wire clamp on PSC mast.	ETI/SK/C	214 Sh.2 of 2	A
148	Special arrangement of OHE under overline structure.	ETI/OHE/SK	529	D
149	Earthing and bonding of PSC mast.	ETI/OHE/SK	537 Sh.1 of 2	D
150	Typical earthing arrangement in SPUN PSC Mast with 18mm dia rod.	ETI/OHE/SK	537 Sh.2	B
151	Arrangement of antitheft jumper at overlap.	ETI/OHE/SK	566	-
152	Catenary dropper assembly	ETI/OHE/P	1190	B
153	Parallel clamp (20/20)	ETI/OHE/P	1550	E
154	Standard guide tube assembly.	ETI/OHE/P	5060-2	C
155	Standard anti-wind clamp	ETI/OHE/P	2550-1/2	L

Sl. No.	Brief Description	Drawing Series	Number	Mod .
156	Multiple cantilever cross arm assembly	RE/33/P	3120	H
157	Anchor fitting assembly on rolled sections	ETI/OHE/P	3230	C
158	Anchor fitting assembly on 'K' series, TCC masts and 'P' type portal upright.	ETI/OHE/P	3240	D
159	Anchor assembly on 'N' and 'O' type portal upright	ETI/OHE/P	3250	D
160	Structure bonds	ETI/OHE/P	7000	E
161	Earthing stations	ETI/OHE/P	7020	B
162	Longitudinal rail bond	ETI/OHE/P	7030	F
163	Short super mast assembly	ETI/C/P	8010	G
164	Long super mast assembly	ETI/C/P	8020	C
165	Bracket attachment assembly on portal upright (N,O,R,P,G&BFB Type)	ETI/C/P	8030	B
166	Super mast assembly on portals	ETI/C/P	8050	C
167	Medium super mast assembly	ETI/OHE/P	8060	C
168	Compensating plate	ETI/OHE/P	5191-1/2	D
169	Suspension clamp	RE/33/P	1160	J
170	Double suspension clamp	RE/33/P	1170	K
171	Double suspension lock plate	RE/33/P	1172	C
172	Catenary splice (65)	ETI/OHE/P	1090	
173	Typical location & schematic connection diagram for a three-interrupter switching station.	ETI/PSI	003	C
174	Typical general arrangement of a three-interrupter switching station.	ETI/PSI	004	F
175	Typical location plan & general arrangement for sectioning & paralleling station.	ETI/PSI	005	F
176	Typical location plan and arrangement for a feeding station	ETI/PSI	006	E
177	Typical general arrangement at a Booster transformer station (with 4 cross feeder) type III	ETI/PSI	013	B
178	Typical general arrangement of 280 KVA Booster Transformer station (with 4 cross feeder) Type III	ETI/PSI	018	A
179	Typical general arrangement at a booster transformer station (without cross feeder) Type-I	ETI/PSI	011	C
180	Typical number plate for auxiliary transformer	ETI/PSI/P	7525	-
181	Typical fencing and anti-climbing arrangement at switching station	ETI/PSI	104	F
182	Typical earthing layout of sub-sectioning and paralleling station	ETI/PSI	201	B
183	Typical earthing layout of a sectioning and paralleling station.	ETI/PSI	202	B

Sl. No.	Brief Description	Drawing Series	Number	Mod .
184	Typical earthing layout of a feeding station.	ETI/PSI	203	B
185	Earthing details for interrupter L.T. supply transformer 25KV lightning arrestors P.T. Type-I (S-100 masts, S-101mast, fencing upright and main mast)	ETI/PSI	204	C
186	Typical earthing layout at a booster transformer stations (without cross feeder for Type-I and II	ETI/PSI	211-1	A
187	Typical cable run layout of a sub-sectioning & paralleling station.	ETI/PSI	301	C
188	Typical cable run layout of a sectioning and paralleling station	ETI/PSI	302	C
189	Typical cable run layout of a feeding station	ETI/PSI	303	B
190	Typical earthing layout at a booster transformer station (with 4 cross feeders for Type III, IV & V	ETI/PSI	212	B
191	Typical drawing for a terminal board	ETI/PSI	501	C
192	36mm Aluminum Bus terminal	ETI/PSI/P	6480	C
193	-do- splices	ETI/PSI/P	6490	B
194	-do- Tee connector	ETI/PSI/P	6500	C
195	36mm aluminum tee terminal	ETI/PSI/P	6510	D
196	36/15 Tap connector	ETI/PSI/P	6520	B
197	36mm Aluminum flexible bus splice	ETI/PSI/P	6550	B
198	36mm Aluminum bus splice cum tee connector	ETI/PSI/P	6560	B
199	Typical number plate for interrupter and double pole isolator	ETI/PSI/P	7520	B
200	Typical number plate for potential transformer Type	ETI/PSI/P	7521	B
201	Typical number plate for booster transformer	ETI/PSI/P	7522	B
202	Standard plan Remote Control cubicle at switching station	RE/Civil/BS-115/95		-
203	Typical details of pressed steel door, window and ventilator	RE/Civil/S-115/95	R1	
204	Bolted base connection for portals located in drains	ETI/C	0010	C
205	Details of base plate for mast on drains in station yards	ETI/C	0002/68	A
	(B) LIST OF STANDARD DRAWINGS FOR TRAMWAY TYPE O.H.E. (REGULATED)			
206	Span and stagger chart for Tramway type OHE (Regulated)	ETI/OHE/G	04201	-

Sl. No.	Brief Description	Drawing Series	Number	Mod .
207	Drilling schedule of OHE mast 8.5m&9m ling RSJ and BFB for tramway OHE	ETI/OHE/G	04202 Sh.1 Sh.2	C
208	Schematic arrangement of (regulated) tramway type OHE.	ETI/OHE/G	04203	C
209	Arrangement of bracket assembly for Tramway Type OHE (regulated)	ETI/OHE/G	04204	B
210	Arrangement of anti-creep for Tramway Type OHE (regulated)	ETI/OHE/G	04205	B
211	Arrangement of anti-creep for Tramway Type OHE (Regulated alternative arrangement)	ETI/OHE/G	04206	B
212	Arrangement of section Insulator for Tramway Type OHE (Regulated)	ETI/OHE/G	04207 Sh.1	B
213	Small parts steel for supporting section insulator assembly for regulated Tramway Type OHE.	ETI/OHE/G	04207 Sh.2	B
214	General arrangement of turnouts for Tramway type OHE (Regulated)	ETI/OHE/G	04208	-
215	Adjustment chart for Tramway type OHE (Regulated)	ETI/OHE/G	04209	-
216	Bridle wire clamp (6mm) with two bolts	ETI/OHE/P	1070-1	B
217	Large suspension clamp 20mm (with armour rod)	ETI/OHE/P	1580 Sh.2	
218	Hook Bracket	ETI/OHE/P	2380	C
219	BFB Steady arm assembly for Tramway OHE (Regulated)	ETI/OHE/P	2540-1	
220	Anti-wind clamp for tramway OHE (Regulated)	ETI/OHE/P	2550-3	E
221	Counter weight assembly (light)	ETI/OHE/P	5090-3	F
222	Counter weight assembly with pulley type regulating equipment (3:1 ratio)	ETI/OHE/P	5090-1	B
223	Employment schedule for tramway type regulated OHE without R.C. and E.W.(W.P.112.5 kgf/sq.m)	ETI/C	0705	B
224	Protective screen at FOB/ROBs	ETI/C	0068	G
225	Proposed height gauges at level crossings upto 7.3m spans.	RE/Civil/92-84	R2	-
	(C) LIST OF STANDARD DRAWINGS FOR COMPOSITE OHE (REGULATED)			
226	DELETED			

Sl. No.	Brief Description	Drawing Series	Number	Mod .
227	Employment Schedule of bracket tube regulated conventional OHE (Cd-Cu catenary and Cu-contact wire (1000kgf tension each) for wind pressure 150kgf/m ² at 10 deg C.	ETI/OHE/G	00158 Sh.3	-
228	Employment schedule of bracket tubes unregulated conventional OHE (Cd.Cu-catenary) and Cu-contact wire.	ETI/OHE/G	00159 Sh.3	-
229	Schematic arrangement of uninsulated overlap (A1.Alloy Catenary and copper contact wire.	ETI/OHE/G	02121 Sh.3	-
230	Schematic arrangement of insulated overlap (A1.Alloy Catenary and copper contact wire.	ETI/OHE/G	02131 Sh.2	A
231	General arrangement of regulated composite OHE at turnouts (overlap and crossed type)	ETI/OHE/G	02141 Sh.2	-
232	Standard terminations of Regulated composite OHE.	ETI/OHE/G	03121 Sh.2	B
233	In span jumper connection between Aluminum Alloy catenary & copper contact wire.	ETI/OHE/G	05101 Sh.2	B
234	Continuity jumper connection at un-insulated overlap (A1.Alloy catenary and copper contact wire)	ETI/OHE/G	05102 Sh.2	B
235	Connections at turnouts for composite OHE	ETI/OHE/G	05103 Sh.2	B
236	Potential equalizer connection at insulated overlap & neutral section (A1.Alloy catenary & copper contact wire)	ETI/OHE/G	05104 Sh.2	B
237	Connection at diamond crossing for composite OHE.	ETI/OHE/G	05106 Sh.2	C
238	General arrangement of connection to composite OHE by cross feeder (SPIDER)	ETI/OHE/G	05124 Sh.2	C
239	General arrangement of connection at switching station on double track section for composite OHE.	ETI/OHE/G	05125 Sh.2	C
240	General arrangement of connection at switching station on multiple track section (with composite OHE and spider cross feeder)	ETI/OHE/G	05126 Sh.2	C
241	Assembly of section insulator (with A1.alloy catenary and copper contact wire)	ETI/OHE/G	05181 Sh.2	B
242	Standard arrangement of supporting cantilevers on the BOOM of portals and TTC (to avoid Bird's nesting).	ETI/C	0076	C

Sl. No.	Brief Description	Drawing Series	Number	Mod .
Employment schedule for OHE mast (9.5m) wind pressure 112.5kgf/sq.m for composite OHE (1000+1000) kgf Tension.				
243	OHE only	ETI/C	0717 Sh.1	A
244	-do- OHE + EW		0717 Sh.2	-A
245	-do- OHE + RC	ETI/C	0717 Sh.3	-A
246	-do- OHE + EW + RC		0717 Sh.4	-A
Employment schedule for OHE mast (9.5m) wind pressure 112.5kgf/sq.m for composite OHE (1000+1000) kgf Tension.				
247	-do- Overlap anchor location	ETI/C	0718	-
248	-do- Overlap Central location	ETI/C	0719	-
249	-do- Overlap Inter location	ETI/C	0720	-
250	Employment schedule for OHE mast (9.5m) wind pressure 150 kgf/m2 Copper OHE	ETI/C	0726 Sh.1	-
251	Employment schedule for OHE mast (9.5m) wind pressure 150 kgf/m2 Copper OHE&EW	ETI/C	0726 Sh.2	-
252	Employment schedule for OHE mast (9.5m) wind pressure 150 kgf/m2 Copper OHE&RC	ETI/C	0726 Sh.3	-
253	Employment schedule for OHE mast (9.5m) wind pressure 150 kgf/m2 Copper OHE RC,&EW	ETI/C	0726 Sh.4	-
254	Employment schedule for OHE mast (9.5m) wind pressure 150 kgf/m2 Copper OHE, with higher implantation overlap anchor location.	ETI/C	0727	-
255	Employment schedule for OHE mast (9.5m) wind pressure 150 kgf/m2 Copper OHE, with higher implantation overlap central location.	ETI/C	0728	-
256	Employment schedule for OHE mast (9.5m) wind pressure 150 kgf/m2 Copper OHE, with higher implantation overlap inter location	ETI/C	0729	-
257	Implantation Schedule for Tramway type regulated OHE WP 150kgf/m2 without RC&EW	ETI/C	0706	B
258	Aluminum alloy catenary suspension clamp (MCI)	ETI/OHE/SK	176	D
259	Double suspensions lock plate. (galvanized MCI)	ETI/OHE/SK	205	B
260	Parallel grove clamp (14/9)	ETI/OHE/SK	123	D
261	Parallel grove clamp (18/14)	ETI/OHE/SK	231	D

Sl. No.	Brief Description	Drawing Series	Number	Mod .
262	Catenary dropper clip assembly with bimetallic washer.	ETI/OHE/SK	333	D
263	Envelope type end fitting assembly for all A1. Alloy standard Catenary wire (size 19/2.79mm)	ETI/OHE/SK	436	c
264	Crimp type repair sleeve for AAA stranded catenary wire.	ETI/OHE/SK	285	C
265	Catenary splice (cone type) AL. Alloy catenary.	ETI/OHE/SK	134	D
266	Aluminum catenary suspension clamp assembly (MCI).	ETI/OHE/SK	468	A
267	Double suspension clamp assembly (MCI for AL. Alloy catenary).	ETI/OHE/SK	469	A
268	Span and stagger chart for composite OHE.	ETI/OHE/SK	375	A
269	Double suspension clamp body for Aluminum alloy catenary.	ETI/OHE/P	1171-1	A

[D] Design drawings of 25kV single phase conventional OHE by using 65 sqmm. cadmium copper catenary wire and 150sq.mm HDGC contact wire

Sl. No.	Description	Drawing No.
270	Employment schedule for cantilever mast regulated OHE (150 sq.mm. contact wire) without EW and without RC (wind pressure 150 kgf/sq.m).	ETI/OHE/G/00120 Sh-1 (Rev 'B' or latest)
271	Employment schedule for cantilever mast regulated OHE (150 sq.mm. contact wire) without EW and without RC (wind pressure 110 kgf/sq.m).	ETI/OHE/G/00121 Sh-1 (Rev 'B' or latest)
272	Employment schedule for cantilever mast regulated OHE (150 sq.mm. contact wire) without EW and without RC (wind pressure 75 kgf/sq.m).	ETI/OHE/G/00122 Sh-1 (Rev 'A' or latest)
273	Employment schedule for cantilever mast regulated OHE (150 sq.mm. contact wire) for 31.5m and 27.0m spans.	ETI/OHE/G/00123 (Rev 'A' or latest)
274	Schematic arrangement of un-insulated overlap (Three span and four span) for higher section of OHE.	ETI/OHE/SK/607
275	Schematic arrangement of insulated overlap (Three span and four span) for higher section of OHE.	ETI/OHE/SK/608
276	Sag and tension chart (higher section of OHE).	ETI/OHE/SK/605
277	Dropper schedule of regulated OHE (for higher section of OHE).	ETI/OHE/SK/606
278	Span and stagger chart.	ETI/OHE/SK/124
279	Dropper schedule for insulated overlap span (for higher section of OHE).	ETI/OHE/SK/148

280	Dropper schedule for un-insulated overlap span (for higher section of OHE).	ETI/OHE/SK/149
281	Contact wire ending clamp (107/150).	ETI/OHE/P/1110-2
282	Contact wire dropper clip (107/150).	RE/33/P/1180
283	BFB steady arm assembly.	ETI/OHE/P/2390
284	BFB steady arm swivel.	ETI/OHE/P/2392
285	Catenary ending clamp (65).	ETI/OHE/P/1120
286	Catenary ending clamp (65) wedge type.	ETI/OHE/P/1120-1
287	Equalizing plate assembly.	ETI/OHE/P/5192-1/2
288	Compensating plate.	ETI/OHE/P/5191-1/2

E) LIST OF STANDARD SPECIFICATIONS. (OHE, SSP, SP, FP)

Sl.No.	TITLE OF SPECIFICATION	SPECIFICATION No.	Rev.
1	Annealed copper stranded jumper wire conductor for jumper wire.	ETI/OHE/3(2/94)	1
2	Copper bus-bar	RE/30/OHE/5(11/60) and IS-613-2000	-
3	Steel tubes.	ETI/OHE/11 (5/89)	-
4	Hot dip zinc galvanization of steel mast (Rolled and Fabricated) tube and fittings used on 25 KV ac OHE.	ETI/OHE/13 (4/84) with A & C slip No. 1, 2 & 3	3
5	Indian Railway standard specification for sparing zinc coating on the OHE mast.	ETI/C/3(5/93), May.83	-
6	Stainless steel wire ropes	ETI/OHE/14(9/94)	5
7	25 CV Solid core porcelain insulators for 25 kV ac, 50 Hz. single phase Overhead Traction lines.	ETI/OHE/15(9/91)	6
8	25 KV single pole and double pole isolators for Railway Electrification	ETI/OHE/16(1/94)	2
9	Steel and Stainless-steel Bolts nuts and washers	ETI/OHE/18(4/84) with A&C correction slip No.1, 2 and 3.	4
10	Aluminum alloy and section tubes for 25 kV Traction Overhead Equipment	ETI/OHE/21(9/74) IS-733-1983, IS- 1285-2002	
11	Standard for drawings for Traction Overhead equipment.	RE/OHE/25(3/66)	
12	Section Insulators assembly without sectioning insulator.	ETI/OHE/27(8/84) with A & C slip No. 1 of 10/92.	1
13	Enameled steel plates	ETI/OHE/33(7/88)	
14	Galvanized steel wire rope.	ETI/OHE/36(12/73)	1
15	Hard drawn joint less grooved copper contact wire for AC traction	ETI/OHE/76(6/97) with A & C slips 1 to 3	
16	Fitting for 25 KV 50 HZ AC Overhead Traction equipment.	ETI/OHE/49(9/95) with A&C correction slip No.1, 2, 3 and 4	1
17	Cadmium copper conductor for Overhead Rly. Traction.	ETI/OHE/50(6/97) with A&C correction slip No.1,2,3,4& 5.	1
18	Principles for OHE layout plans and sectioning diagrams for 25 KV AC traction.	ETI/OHE/53(6/88) Aug. 92.	4

Sl.No.	TITLE OF SPECIFICATION	SPECIFICATION No.	Rev.
19	Code of bonding and earthing for 25 KV AC 50 Hz single phase traction system.	ETI/OHE/71(11/90) Mar. 93	2
20	Technical specification for galvanized steel stranded wire for traction bonds for 25 KV AC electric traction system.	TI/SPC/OHE/GALSTB/0040, Aug.05	1
21	Control & relay board for railway traction sub-station.	ETI/PSI/27(6/87) Sep.89	4
22	Control & distribution panel for colour light signaling supply in 25 KV AC traction system	TI/SPC/PSI/CLS/0021, Aug,03	-
23	Standards for electrical distribution system in stations & yards where 25 KV Ac traction is to be introduced.	ETI/PSI/44(12/73), Dec. 73	-
24	25 KV Dropout fuse switch & operating pole for use with 10 KVA and 100 KVA,25,KV/230 V LT. supply transformer.	ETI/PSI/14(1/86) with A&C slip NO.1 of 4/87.	1
25	25KV/240V Auxiliary Transformer (5 kVA, 10 KVA)	ETI/PSI/15 (08/2003) with A & C slip No.2 of 10/92	-
26	Regulating Equipment for 25 kV ac Traction 3 pulley Type (3:1)	ETI/PSI/48 A(9/85) with A&C slip No.1 of 11/87.	
27	Control and relay panel incorporating static type relays for 25 KV AC traction sub station on Indian Railways.	ETI/PSI/65 (1/97), April, 02	2
28	7.5 KV Lightning arrestors with A&C slip No.1 of (2/91).	ETI/PSI/3(8/75)	
29	25 KV Potential transformers.	ETI/PSI/8(10/92)Amend 2(9/93)	
30	25 KV Booster transformers. Oil filled type (100 kVA and 150 kVA (single phase, 50 Hz.)	ETI/PSI/92(8/93) ETI/PSI/98(8/92)Amend.2 (1/94)	
31	Control and Relay Panel incorporating static type relay for 25 kV ac Traction Sub-station and Switch stations.	ETI/PSI/65 (1/97)	2
32	110V, 40AH Lead Acid batteries.	ETI/PSI/21(6/81) with A&C slip No.1 of 7/81.	
33	Battery charger for 110 V battery 40 AH	ETI/PSI/1(6/81)	
34	25 KV dropout fuse switch.	ETI/PSI/14(01/86), Aug. 03	1
35	25 KV single pole, out door SF-6 Gas Interrupters.	ETI/PSI/160(12/94)	
36	25 KV single pole out door Vacuum interrupter	ETI/PSI/161(12/94)	
37	Out door circuit breaker for 25 KV AC traction sub station.	TI/SPC/PSI/CB/002, Jul. 03	-
38	Code of practice for earthing of power supply installation for 25 KV AC 50 Hz single phase traction system.	ETI/PSI/120(2/91), Oct.93	1
39	25KV Composite Type Bracket Insulator	TI/SPC/OHE/INSCOM/0991	-

Sl.No.	TITLE OF SPECIFICATION	SPECIFICATION No.	Rev.
	(Standard) with silicone rubber as base material		
40	25KV Composite Type Stay Insulator (Standard) with silicone rubber as base material	TI/SPC/OHE/INSCOM/0991	-
41	25KV Composite Type 9 Tone Insulator (Standard) with silicone rubber as base material	TI/SPC/OHE/INSCOM/0991	-

NOTE: -

1. Please refer ACTM-Vol.II (Part-II) Chapter –II -Section-III for list of “Standard Drawings of Overhead equipment”.
2. The above mentioned drawings are not exhaustive, if any drawings other than above mentioned (However those shall be approved by CEE/CORE/RDSO) may be used while design, drawing, erection and commissioning of Over head equipment and PSI.
3. Above drawings can be purchased from the office of CEE/CORE/ALD on payment of their costs.
4. Any amendment in specification and drawings subsequent to LOA, if required to be carried out shall need approval of Sr.DEE/TRD/SC duly considering the financial implication of the same either in upward or downward direction.
5. Drawings with latest revision to be adopted.

ANNEXURE-X**UNIT QUANTITIES OF FINISHED WIRES AND CONDUCTORS FOR VARIOUS WORKS**

S.NO	Wire/ Conductor	Applicable linear density Kg/m	No. Sch-1	Bare unit requirement per unit of work (m.)	Allowance for erection per unit of work returnable as scrap (m.)	Total requirement per unit of work (col.4&5)
	1	2	3	4	5	6
1	Contact wire (107 sq.mm)	0.9512	6(a) 6(b) 6(c) 6(d) 10 12(a) 31(g) 12(c)	1005.0 1005.0 1005.0 1005.0 0.5 4.0 3.0 4.0	5 5 5 5 - - - -	1010.0 1010.0 1010.0 1010.0 0.5 4.0 3.0 4.0
2	Cadmium copper catenary wire (65 sq.mm)	0.5973	5(a)(ii) 6(a) 10 12(C) 15(a) * 31(g)	1.0 1005.0 0.5 0.65 0.5 3.0	- 5 - - - -	1.0 1010.0 0.5 0.65 0.5 3.0
3	19/7/1.25 (160 sq.mm) copper CONDUCTOR (large jumper)	1.504	15(d)	As required	-	As required
4	37/2.25 mm (150 sq.mm) copper conductor (feeder wire)	1.3335	7(e)	1010	10	1020.0
5	Cadmium copper wire (130) (tail feeder/large span)	1.1692	4(b)(iv) 5(a)(ii) * 6(a)* 6(d) 6(a)(v)	4.5 1.0 As required As required As required	- - - -	4.5 As required As required As required As required
6	All aluminum conductor (spider)	0.6520	7(a) 7(b)	1010.0 2020.0	10 20	1020.0 2040.0
7	Large Jumper (105) (Conventional /Tramway) Large Jumper 105 sq.mm)	0.982	10 15(a)(i) *	4.0/1.25 6.0	- -	4.0/1.25 6.0
8	Cadmium copper bridle wire	0.2187	6(c)	8.5	-	8.5 per bracket
9	Small jumper (50 sq.mm)	0.4352	4(b)(i)	4.5 4.5	- -	4.5 4.5

S.NO	Wire/ Conductor	Applicable linear density Kg/m	No. Sch-1	Bare unit requirement per unit of work (m.)	Allowance for erection per unit of work returnable as scrap (m.)	Total requirement per unit of work (col.4&5)
	1	2	3	4	5	6
			4(b)(ii) (iii)&(iv) 6(a) 10 +15(a)	6.0 1.6 1.6	- - -	6.0 1.6 1.6
10	Dropper wire (5mm)	0.1746	5(b) 5(c) 6(a)&(d)12 (a)&(d) 12(b) 31(a) 31(g) 6(c)	1.5 1.5 180.0 5.0 6.0 10.0 10.0 As required	- - 20 - - 2 2	1.5 1.5 200.0 5.0 6.0 12.0 12.0
11	Dropper wire (7mm)	0.341	4(a)(I) 4(a)(v) 12(c)	1.8 1.8 0.80	0.2 0.2 -	2.0 2.0 0.80
12	19/2.1(65 sq.mm) PVC catenary wire	-	15(c) 15(e)	AS required	-	As required
13	19/2.29mm al alloy catenary	0.320	6(d)	1005	10	1015

* see note 4

NOTE:

1. Col.4 of the above table indicates the bare unit requirement of the various types of wire and conductors for various items of schedule-1. This concludes allowance for sag wherever required.
2. Col.5 of the above table indicates the permissible allowance for the erection which should be left over with the contractor and should be returned to the purchaser in the form of scrap on completion of work incase these items are supplied by the purchaser. Such working allowance has been indicated on the assumption that all wire and conductors shall be made available in tailor made lengths as shall be indicated by the contractor to suit individual employment and, further, that the actual supplies shall be made in the serial order as will be indicated by the contractor. Should the purchaser be unable to supply the conductor as per above on account of which drums of a length longer than the ones desired by the contractor shall have to be erected, then such, extra length as shall result from the difference of the length of the drums actually employed and length of the drums ordered by the contractor shall be considered over and above the quantities admitted as allowances for section under column 5. Such extra length shall, in addition, be considered and shall be returned to the purchaser in the form of scrap.
3. Col.6 of the above table indicates the total quantities of wires and conductors to be supplied to the contractor by the purchaser, free of cost incase these items are made railway supply

(annexure IV). Such quantities do not consider extra quantities which may be used on account of note 2 above and quantities damaged which shall be allowed for over and above the quantities indicated in Cl.6.

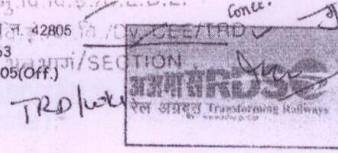
4. Whenever cadmium copper wire (130) is required against 5(a) (ii), the quantity of cadmium copper wire (65) against this will be correspondingly reduced whether the jumper wire is supplied by the purchaser or the contractor.
5. When copper wire (130) is required against 6(a), the quantities of cadmium copper wire (65) and contact wire (107) against this will be correspondingly reduced whether the jumper wire is supplied by the purchaser or the contractor.
6. Whenever antitheft jumper is provided against 15(a), the length of jumper used shall be calculated depending on the setting distance of the anchor structure.
7. Whenever large jumper (105) is employed against 15(a), the requirement of cadmium copper wire (65) shown against this will not be permissible and vice-versa.
8. Whenever anti-creep is of the boom anchor type, catenary (cadmium copper) wire against 15(a) shall be 2 meters instead of 0.5 meters.
9. The above unit requirement of quantities is for preparing utilization statement of Non-SOR (Schedule-B) items payment to the extent of quantity used in SORs (Schedule-A) as erection.



सत्यमेव जयते

भारतसरकाररेलमंत्रालय
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Research Designs & Standards
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NO.TI/OHE/GA/2013

Dated, the 7th August 2013

✓ To,

The Chief Electrical Engineer,
South central Railway,
Railnilayam ,
Secunderabad-500371.

Sub: OHE Span in view of Changes in Wind Zones in Country.

- Ref: (i) CEDE, South Central Railway's letter No.
E.252/TRD/56/RVNL/850 dated 16.07.2013
(ii) This office letter No. TI/OHE/GA/2013 dated
25/30.04.2013
(iii) Railway Board's letter No. 2013/RE/161/3 (FTS-69861)
dated 22.02.2013

OHE Span for 1200/1200 kgf tension for 65/150 Sq. mm OHE and 1000/1000 kgf tension for 65/107 sq. mm OHE & in view of the variation in wind pressure as per the latest Indian Standard IS:875 (Part-3)-1987, Reaffirmed-1997, has been found out.

2. For new Electrification works as per letter referred (i) above, Basic Wind Speed, Designed Wind Pressure and OHE Span for 65/107 OHE & 65/150 OHE are given at Table - I & II (enclosed hereby), for 800 mm 'Contact Wire Position Limit'. A factor of margin of 5% has been considered while advising the new OHE spans as per Railway Board's letter referred (iii) above.

3. CORE/RVNL may adopt this advised Span for existing 65/107 Sq. mm OHE having 1000/1000 kgf tension following Table - I.

This is for kind information & adoption in future Railway Electrification Project.

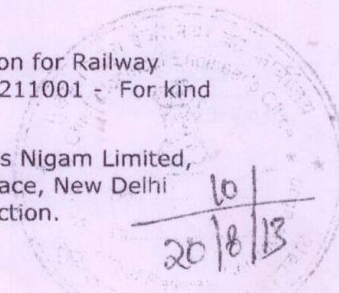
(J. N. Lal)
7.8.2013

Sr.Executive Director-OHE(TI)
For Director General(TI)

Encl: As stated above.

Copy to:

1. The Chief Electrical Engineer, Central Organisation for Railway Electrification, 1, Nawab Yusuf Road, Allahabad- 211001 - For kind information & necessary action.
2. The Executive Director (Electrical), M/s Rail Vikas Nigam Limited, 1st Floor, Agast Kranti Bhavan, Bhikaji Cama Palace, New Delhi - 110 066 - For kind information & necessary action.



Research Designs & Standards Organization
(Traction Installation Directorate)

Table-I

OHE SPAN CHART
OHE: 65/107 Sq. mm, Tension: 1000/1000 kgf, Permitted
Contact Wire Position Limit: 800 mm
(Calculated based on M/s RITES Manual, Volume-IV, Chapter - 1)

Sl. No.	Section	Basic Wind Speed	Designed Wind Pressure	Maximum permissible Span for 65/107 OHE (metres)
		(m/Sec)	(kg/m ²)	1000/1000 kgf Tension
1.	Nallapadu -Guntakal	50/44	178/136	54/58.5
2.	Wadi-Guntakal	39	105	67.5
3.	Gooty-Dharmavaram	39/33	105/73	67.5/72
4.	Guntur-Tenali doubling	50	178	54
5.	Vijayawada-Machilipatnam-Gudivada-Bhimavaram-Narsapur-Nidadavolu	50 50 50 50 50	178 178 178 178 178	54
6.	Guntakal-Bellary	39/33	105/73	67.5/72
7.	MMTS Phase II-HYB suburban section.	44	136	58.5
8.	Guntakal-Kalluru (under M.M.)	39	105	67.5
9.	Kazipet-Vijayawada Patch tripling	44/50	136/178	58.5/54
10.	Paddampet-Mancheri Patch tripling (Major section: KZJ - BPQ)	44	136	58.5

Note : (i) Displacement of OHE caused by mast deflection due to wind:0
as reverse deflection of mast provided initially during erection.
(ii) Depression of track due to low joints :0

Q. n. l.
7.8.2013

Research Designs & Standards Organization
(Traction Installation Directorate)

Table-II

OHE SPAN CHART OHE: 65/150 Sq. mm, Tension: 1200/1200 kgf, Permitted
Contact Wire Position Limit: 800 mm

(Calculated based on M/s RITES Manual, Volume-IV, Chapter - 1)

Sl. No.	Section	Basic Wind Speed	Designed Wind Pressure	Maximum permissible Span for 65/150 OHE (metres)
		(m/Sec)	(kg/m ²)	1200/1200 kgf Tension
1.	Nallapadu -Guntakal	50/44	178/136	54/63
2.	Wadi-Guntakal	39	105	67.5
3.	Gooty-Dharmavaram	39/33	105/73	67.5/72
4.	Guntur-Tenali doubling	50	178	54
5.	Vijayawada-Machilipatnam-Gudivada-Bhimavaram-Narsapur-Nidadavolu	50 50 50 50 50	178 178 178 178 178	54
6.	Guntakal-Bellary	39/33	105/73	67.5/72
7.	MMTS Phase II-HYB suburban section.	44	136	63
8.	Guntakal-Kalluru (under M.M.)	39	105	67.5
9.	Kazipet-Vijayawada Patch tripling	44/50	136/178	63/54
10.	Paddampet-Mancheria Patch tripling (Major section: KZJ - BPQ)	44	136	63

Note : (i) Displacement of OHE caused by mast deflection due to wind: 0 as reverse deflection of mast provided initially during erection.
(ii) Depression of track due to low joints : 0

Qul
7.8.2013