

SECTION – 8B
TECHNICAL SPECIFICATIONS

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SECTION – 1

GENERAL

SECTION -1**1. GENERAL****1.1 General**

- 1.1.1 These Specifications contained herein shall be read in conjunction with other tender documents.
- 1.1.2 The Work shall be carried out in accordance with the approved drawings and designs as would be submitted by the contractor and approved by the Engineer duly signed and stamped or issued to the Contractor by the Engineer duly signed and stamped by him as the case may be. The Contractor shall not take cognizance of any drawings, designs, specifications, etc. not bearing Engineer's signature and stamp. Similarly, the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Engineer in writing.
- 1.1.3 The work shall be executed and measured as per metric units given in the Schedule of Quantities, drawings etc. (FPS units where indicated are for guidance only).
- 1.1.4 Absence of terms such as providing, supplying, laying, installing, fixing etc. in the descriptions does not even remotely suggest that the Contractor is absolved of such providing, supplying etc. unless an explicit stipulation is made in this contract.
- 1.1.5 The specifications have been divided into different sections / sub-heads for convenience only. They do not restrict any cross-references. The Contractor shall take into account inter-relations between various parts of works/trades. No claim shall be entertained on the basis of compartmental interpretations.
- 1.1.6 The classification of various items of works for purposes of measurements and payments shall be as per Bills of Quantities (BOQ). Except where distinguished by BOQ, the rates apply to all heights, depths, leads, lifts, sizes, shapes and locations. They also cater for all cuts and wastes.
- 1.1.7 **DELETED.**
- 1.1.8 **DELETED.**
- 1.1.9 **Contractor to Provide:**

The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, except for the items specified in the Bill of Quantities the cost being held to be included in the Contract Rates:

1. General works such as site clearance before and on completion of works.
2. All labour, materials, plant, equipment and temporary works, overhead charges as well as general liabilities, obligations, insurance and risks arising out of GCC, required completing and maintaining the works to the satisfaction of the Engineer.
3. Adequate lighting for night works, and also at other times whenever and wherever required by the Engineer.
4. Temporary fences, barricades, guards, lights and protective work necessary for protection of workmen, supervisors, engineers, General public and any other persons permitted access to the site. Contractor shall provide proper signages as directed.

All fences, barricade shall be painted with colour shades as specified by the Engineer.

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The barricading should be of adequate height to ensure visual obstruction of work from public view.

5. All equipment, instruments, labour and materials required by the Engineer for satisfactory completion of works.
6. Design mixes and test them as per relevant clauses of specifications giving proportion of ingredients, sources of aggregates, and binder along with accompanying trial mixes. Test results to be submitted to the Engineer for his approval before adoption on works.
7. Cost of Preparation and compliance with provision of a quality assurance control program.
8. Cost of safeguarding the environment as per SCC.
9. Contractor has to provide Method statements ie detailed work procedure for all the works.

1.1.10 **Quality Assurance & Quality Control**

1. The work shall conform to high standards of design and workmanship, shall be structurally sound and aesthetically pleasing. The Contractor shall conform to the Quality standards prescribed, which shall form the backbone for the Quality Assurance and Quality Control system.
2. At the site, the Contractor shall arrange the materials, their stacking/storage in as per the standards manner to ensure the quality. The Contractor shall provide all the necessary equipment and qualified manpower to test the quality of materials, assemblies etc., as directed by the Engineer. The tests shall be conducted at specified intervals and the results of tests properly documented. The cost of all such testing shall be included in the quoted rates and nothing extra shall be paid for in this regard. In addition, the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of the surfaces.
3.
 - (a) The Engineer shall be free to carry out such tests as may be decided by him at his sole discretion, from time to time, in addition to those specified in this document as per provisions of General Conditions of Contract. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples, or for the collection of the samples.
 - (b) The test shall be conducted at the Site laboratory that may (to) be established by the Contractor at his cost or at any other Standard Laboratory selected by the Engineer.
 - (c) The Contractor shall transport the samples to the laboratory for which nothing extra shall be payable. In the event of the Contractor failing to arrange transportation of the samples in proper time the Engineer shall have them transported and recover two times the actual cost from the Contractor's bills.
 - (d) All testing shall be performed in the presence of Engineer or his authorized representative. Testing may be witnessed by the Contractor or his authorized representative if permitted by the Test House. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.
4. The Engineer shall have the right at all times to inspect all operations including the

sources of materials, procurement, its transportation, layout and storage of materials, all equipment including the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and the Engineer's approval obtained prior to starting of the particular item of work. This shall however, not relieve the Contractor of his responsibilities.

5. All materials which do not conform to these specifications shall be rejected. In the event of contractor not being able to arrange the material conforming to these specifications or in the event of failure of the contractor to get the sources approved within the agreed schedule submitted by contractor, the Engineer shall have the powers to cause the Contractors to purchase and use such materials from any particular source, as may, in the Engineer's opinion, be necessary for the proper execution of work.

1.1.11 **Dimensions**

1. Figured dimensions on drawings shall only be followed and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others. All dimensions shall be checked on site prior to execution.
2. The size, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.
3. The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

1.1.12 **Setting out of Works-DELETED**

1.1.13 **Materials**

1. **Source of Materials**
It shall be the responsibility of the contractor to procure all the materials required for construction and completion of the contract. The contractor shall indicate in writing the source of materials well in advance to the Engineer, after the award of the work and get it approved from the Engineer before commencing the work. If the material from any source is found to be unacceptable at any time, it shall be rejected by the Engineer.
2. **Quality**
All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed hereafter, or where tests are not laid down in the specifications, with the requirements of the latest issues of the relevant Indian & other Standards.
3. **Sampling and Testing**
All materials used in the works shall be subjected to inspection and test in addition to

test certificates. Samples of all materials proposed to be employed in the permanent works shall be submitted to the Engineer at least 15 days in advance for approval before they are brought to the site.

Samples provided to the Engineer for their retention are to be labeled in boxes suitable for storage.

Materials shall be tested before leaving the manufacturer's premises, quarry or source, Materials shall also be tested at site and they may be rejected if not found suitable or in accordance with the specifications, notwithstanding the results of the tests at the manufacturer's works or elsewhere or test certificates or any approval given earlier.

The contractor will bear all expenses for sampling and testing, whether at the manufacturer's premises at source, at site or at any testing laboratory or institution as directed by the Engineer subject to the provisions of No extra payment shall be made on this account.

4. **Dispatch of materials**

Materials shall not be dispatched from the manufacturer's works to the site without written authority from the Engineer.

5. **Test certificates**

All manufacturer's certificates of test, proof sheets, etc showing that the materials have been tested in accordance with the requirement of these specifications and of the appropriate Indian Standards are to be supplied free of charge to the Engineer.

6. **Rejection**

Any materials that have not been found to conform to the specifications or otherwise not acceptable to the Engineer will be rejected forthwith and shall be removed from the site by the Contractor at his own cost within three days or as instructed by the Engineer.

1.1.14 **Storing of Materials at site**

All materials used in the works shall be stored on racks, supports, in bins, silos, go-downs, under cover etc. as appropriate to prevent deterioration or damage from any cause whatsoever to the entire satisfaction of the Engineer.

The storage of materials shall be in accordance with IS 4082 "Recommendation on stacking and storage of construction materials on site" and as per IS 7969 "Safety code for handling and storage of building materials".

The materials shall be stored in a proper manner at places at site approved by the Engineer. Should the place, where material is stored by the Contractor, be required by the Employer for any other purpose, the Contractor shall forthwith remove the material from that place at his own cost and clear the place for the use of the Employer within the time as communicated by the Engineer and at no extra cost to the Employer.

1.1.15 **Water**

1. **Water from approved source:**

Potable water only shall be used for the works. Contractor shall have his own source of water duly tested and approved by Engineer. The water shall be free from any deleterious matter in solution or in suspension and be obtained from an approved source. The quality of water shall conform to IS 456.

2. **Storage:**

The Contractor shall make his own arrangements for storing water, if necessary, in drums or tanks or cisterns, to the approval of the Engineer. Care shall be exercised to see that water is not contaminated in any way.

3. **Testing:**

Before starting any concreting work and wherever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete for approval of the Engineer. No water shall be used until tested and found satisfactory. Cost of all such Tests shall be borne by the contractor.

1.1.16 **Workmanship**

1. All works shall be true to level, plumb and square and the corners, edges and rises in all cases shall be unbroken and neat.
2. Any work not to the satisfaction of the Engineer or his representative will be rejected and the same shall be rectified or removed and replaced with work of the required standard of workmanship at no extra cost.

1.1.17 **Load Testing on Completed Structures -DELETED**

1.2 **Structural Work-DELETED**

1.2.1 Supply of Monthly Progress Photographs and Album-DELETED

1.2.2 Supply of Monthly Progress Video CD's-DELETED

1.2.3 Survey Work-DELETED

1.2.4 **Barricading**

The work covers barricading for the work done along the Existing IR track, median and areas affecting road or rail traffic. Barricading for other areas like casting yard, batching plant, storage, and other working area shall be done at own cost by the contractor. The detailed scope of work is:

- a. Providing and installing the barricade of the design and type as shown in the typical sketch furnished as per the approved plan firmly to the ground and maintaining it during the progress of work.
- b. Providing adequate road and IR track safety devices. A tentative list given hereunder identifies minimum items, which may be required. However, actual numbers required shall be as per plan approved by the Engineer and clearance obtained from traffic department, Bangalore and concerned division of Railway officials. During execution of works, if any additional cost to this list is required then the contractor shall not be paid any extra cost.
- c. Dismantling of barricade, other temporary installation from the site and cleaning the site shall be as per direction of Engineer upon completion and acceptance of work.

Tentative Road or IR track Safety Devices are mentioned below or any other safety devices as per site requirement.

1. Supply of Red portable traffic cones of 750mm height with white reflective tape bands on 100mm width all around.
2. Hazard warning light flashes with rechargeable. Maintenance free battery & charging system.

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3. Safety light island post with 11 nos. parallel reflective.
4. Red reflective arrow fitted on enabled mild steel board of 360 x 220mm size.
5. Traffic Triangular Tripod made of fluorescent cloth fitted on steel frame.
6. Retro-reflective tape (I) 50mm width.
7. Fluorescent Jackets with reflective tape all around.
8. Yellow reflective cat eyes of size 115 x 11 x 22 mm made of ABS material having 19 glass beads on each side.
9. Metal Tabular Delineator of 610mm height with reflective tapes.
10. Retro-reflective arrows diversion board 450 x 900mm with crystal clear protective transparent coat to avoid damage on 14-gauge Mild Steel sheet with and without pole.
11. Retro-reflective “Men at Work” triangular board of size 900mm with crystal protective transparent coat to avoid damage on 14-gauge Mild Steel board with and without poles.
12. Retro-reflective board for “Go Slow Work in Progress” of size 1200 x 750mm with crystal clear protective transparent coat to avoid damage to the Mild Steel board with and without pole.
13. Retro-reflective advance direction signs cum Diversion Boards of size 1200 x 900mm with crystal clear protective transparent coat to avoid damage to the 14-gauge Mild Steel sheet with and without pole.
14. Retro-reflective speed limit circular sign Boards of 600mm Diameter with crystal clear protective transparent coat to avoid damage on 14-gauge sheet (without pole).
15. SORRY FOR INCONVENIENCE’ Retro-reflective Boards of size 900 x 300mm size with crystal clear protective transparent coat to avoid damage on 14-gauge Mild Steel sheet (without pole).
16. HAZARD MARKERS (Yellow & Black) must be put all over the construction sites. This Retro-reflective board is of size 300 x 900mm with crystal clear protective coat to avoid damage and the 14-gauge Mild Steel with or without pole.
17. ‘CAUTION’ tape which is normally yellow tape of special Polyether Material having 75mm width ‘CAUTION’ is written all over with Black colour is rolls of 300 meters.
18. For running trains, Retro-reflective speed limit as per IR Specifications.

1.2.1.1 Measurement-DELETED

1.2.2 Transplantation of Trees -DELETED

1.2.3 Sub-Contractor-DELETED

1.3 **Guarantees and Maintenance: - DELETED**

1.3.1 **Responsibility for Shop drawings, Samples and Mock-ups: - DELETED**

1.3.2 **Cleaning - DELETED**

1.3.3 **Expansion bolts/ fasteners: -DELETED**

1.4 **Applicable Codes, Standards & Publications for Electrical works**

The important Codes, Standards and Publications to Contract are listed here under:

Sl.no	Standard	Description
1	IS:3427	AC metal enclosed switchgear and control gear for rated voltages above 1 KV and up to and including 52 KV.

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Sl.no	Standard	Description
2	IS 12063	Classification of degrees of protection provided by enclosures of electrical equipment
3	IS 9920 (Parts 1 to 4):	High Voltage Switches.
4	IS 9921 (Parts 1 to 5):	Specification for AC disconnectors and earthing switches for voltages above 1000 V
5	IS 13118	HV AC Circuit Breakers
6	IS 12729	General requirements of switchgear and control gear for voltages exceeding 1000 V
7	IS 10601	Dimensions of terminals of HV Switchgear and Control gear.
8	IEC 1330	High voltage/Low voltage prefabricated substations
9	IEC 60694	Common clauses for MV switchgear standards.
10	IEC 6081	Monitoring and control.
11	IS 2705	Current Transformers
12	IS 3156	Voltage transformers
13	IS 8686	Specification for Static Protective Relays
14	IEC 62271-200	Standards for high voltage metal clad switchgear up to 52 KV.
15	IS 8130	Conductors for insulated electrical cables and flexible cords.
16	IS 10810(series)	Methods of tests for cables.
17	IS 10418	Drums for electric cables.
18	IS 7098 (Part 2)	Cross-linked Polyethylene insulation for Cables
19	IS 5831	Specification for PVC insulation sheath for electric cables
20	IS 7098 (Part-II) 13573,1992	Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2 \text{ kV}$) up to 30 kV ($U_m = 36 \text{ kV}$) - ALL PARTS
21	IS 3043	Code of Practice for Earthing
22	IS 398-part II	Aluminium Conductor for Overhead Transmission Purpose
23	IEC-99-4	Gapless Lightning Arrestor
24	IS 3070 P-III	Metal Oxide Surge Arrestors without gaps for AC Systems
25	IEC 99 P-III	Artificial Pollution Testing of Lightning Arrestor
26	IS 2071	Methods of H V Testing
27	IS 694	PVC Insulated cables for working voltages up to and including 1000V
28	IS 14786/2000	Specification for high voltage prefabricated Sub-station
29	IS 1180	Power Transformer
30	IS 3637	Gas Operated relays
31	IS 1347	Low Voltage Switchgear and Control gear
32	IS 1255	Code of practice for installation and maintenance of power cables up to and including 33 kV rating
33	IS 13158	Prestressed concrete circular spun poles for overhead power, traction and telecommunication lines -- specification
34	IS 785	Reinforced concrete poles for overhead power and telecommunication lines - specification

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Sl.no	Standard	Description
35	IS 4091	Code of practice for design and construction of foundations for transmission line, tower and poles
36	RDSO	All relevant RDSO drawings and specifications.

SECTION – 2

FOUNDATIONS



1. **Design of Foundations**

1.1. **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) should be followed. In addition, at every 250 m 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 booster 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.

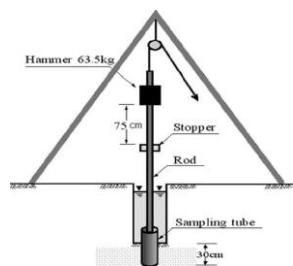


Figure 3: Standard Penetration Test (SPT)



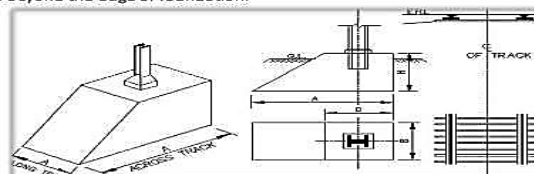
1.2. **Structures Carrying Over-Head Equipment**

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

OHE FOUNDATIONS

TYPES OF FOUNDATIONS

b) Side gravity foundations or "BG" type foundations may be used for masts where soil bearing capacity is 8000 and 11000 kgf/m², or adequate shoulder width is not available i.e. less than 300mm beyond the edge of foundation.



1.3. **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

1.4. **Masts and Fabricated Structures at Switching Stations**

Foundations for the masts of gantries at switching stations and TSS shall be of the pure gravity type, the base of

which shall rest on consolidated soil



1.5. **Fencing Post**

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-site or reinforced concrete foundation may be adopted as desired by the Purchaser.



1.6. **Typical Design**

Typical design and drawings of side bearing and new pure gravity and side gravity type foundations are included in the drawings listed in Annexure-1. Employment schedules for standard foundations for traction structures for various locations and types are also included in the drawings listed in Annexure-1, Part E.

OHE FOUNDATIONS

TYPES OF FOUNDATIONS

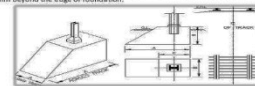
d) Pure gravity foundations or "P" type foundations - are used for portals and are designed for soil bearing capacity of 8000 and 11000 kg/m².



OHE FOUNDATIONS

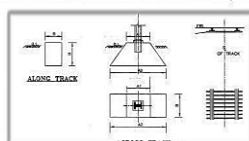
TYPES OF FOUNDATIONS

b) Side gravity foundations or "SG" type foundations may be used for masts where soil bearing capacity is 8000 and 11000 kg/m², or adequate shoulder width is not available (a less than 300mm beyond the edge of foundation).



TYPES OF FOUNDATIONS

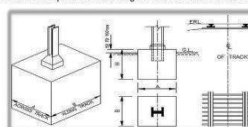
d) New pure gravity foundations or "MG" type foundations may be used for masts where soil bearing capacity is 5500, 8000 and 11000 kg/m² or where adequate shoulder width is not available. In such cases, it should be ensured that foundation is not exposed.



OHE FOUNDATIONS

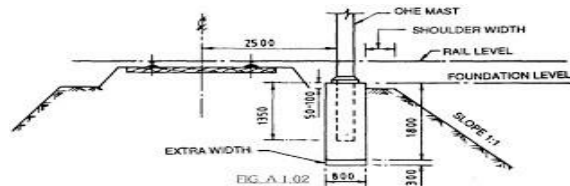
TYPES OF FOUNDATIONS

a) Side bearing foundations or "B" type foundations - are used for masts where earth is normal and fully consolidated, the soil bearing capacity is 11,000 or 21,500 kg/m² and 300mm wide shoulder is available beyond the outer edge on the foundation on banks.



1.7. **Special Foundations**

In the case of foundations at locations not covered by the employment schedules furnished by 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 especially pile foundations of under reamed type as per RDSO'S standard designs (Reference RDSO'S Drawings No. ETI/C/0062 MOD-B or latest) 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.



1.7.1. **Foundation in Contact / Buried under Non-aggressive Soil/Ground Water.**

The Foundation Concrete shall be of M-15 Grade. The Core concrete shall be M-20 Grade. It shall be adopted in the areas where concrete is in contact/buried under non-aggressive soil/Ground water as per IS: 456-2000

1.7.2. **Foundation in Coastal Areas.**

The Foundation Concrete shall be of M-20 Grade. The Core concrete shall also be M-20 Grade. It shall be followed in the areas where concrete is exposed to Coastal Environment as per IS: 456-2000.

- 1.7.3. For casting the OHE foundation in Soft Rock and Hard Rock, RDSO drawing mentioned at SI. No.-123 of LIST OF STANDARD DRAWINGS AND SPECIFICATIONS (ANNEXURE - 1 of Part E) of tender Document.
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.



1.8. **Equipment Pedestal**

Pedestals for interrupters and L.T. supply transformers where required, shall be of mass concrete with the base resting on consolidated soil. Pedestal for Power transformers shall be made of mass concrete with base resting on consolidated soil. Foundation for circuit breakers supported on steel structures and for other items of equipments such as isolator, instruments 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.



1.9. 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.



1.10. Bearing Pressure

1.10.1. Guiding Information

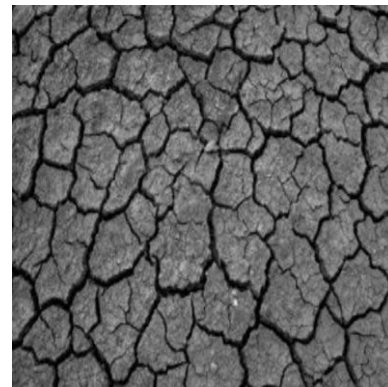
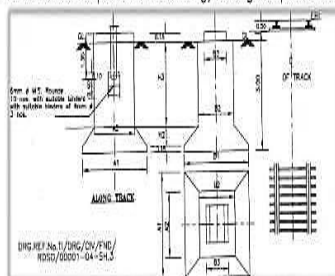
Subject to above para, the following allowable bearing pressures may generally be expected for various kinds of soil. The information is given for general guidance only.

- a) Average good soil in banks and cutting - 11,000 kg/sq.m.
- b) Moorum soil in cutting - 22,000 kg/sq.m
- c) New banks & bad soils in banks and cutting - 5,500 kg/sq.m.
- d) 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

TYPES OF FOUNDATIONS

e) WBC and NBC type of foundations are used in Black cotton soil. Primarily WBC foundations are to be adopted where swelling / shrinkage is not expected to take place at the founding level and NBC foundations have to be provided where swelling / shrinkage is expected to occur.



1.10.2. Concrete

Concrete for foundations shall be nominal mix / Ready mix of grade M 15 obtained by mixing cement, coarse aggregate, fine aggregate and water in accordance with proportions given vide Table 3 of IS:456 (Latest version as indicated in Annexure-1) reproduced below. For grouting, mulling, embedding of structures in foundations and for cable trenches at switching stations, nominal mix concrete M 20 obtained by mixing materials in proportions as indicated in Table-3 of IS:456 (Latest version as indicated in Annexure-1) shall be used. Volume batching may be adopted vide clause 9.2.2. of IS:456 (Latest version as indicated in Annexure- 1) reproduced below: IS: 456-2000 (latest version)

PROPORTIONS FOR NOMINAL MIX / READY MIX CONCRETE

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 aggregates kg max.	Proportion of fine aggregate of coarse aggregate (by mass)	Quantity of water per 50 kg of cement (max. Liters)
1	2	3	4
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	350		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.
- Minimum grade of concrete shall be not less than M - 20 in reinforced concrete work.
 - Specification for coarse and fine aggregates from natural sources for concrete (second revision).
"Volume batching may be allowed only where weigh-batching is not practical and provided accurate bulk densities of materials to be actually used in concrete have earlier been established. Allowance for bulking shall be made in accordance with IS: 2386 (Part-3) (Latest version as indicated in Annexure-1). The mass volume relationship should be checked as frequently as necessary, the frequency of the given job being determined by Engineer – In charge to ensure that the specified grading is maintained."
- 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 (Latest version as indicated in Annexure-1). The crushing strength of concrete shall not be less than the limits given below:

Specified characteristic compressive strength of 15 cm cubes at 28 days

Grade of Concrete	Compressive Strength after 28 days
M – 10	10 N/mm ²
M – 15	15 N/mm ²
M – 20	20 N/mm ²

- 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 (Latest version as indicated in Annexure-1). The sample of concrete from which test specimens are made shall be representative of the entire batch.
- Age is reckoned from the day of casting.

1.1.1. Size and Grating of Aggregates

The graded coarse aggregate 20 mm nominal size (table 2 of IS: 383 (Latest version as indicated in Annexure- 1)) shall be used for foundation. A coarse aggregate for grouting muffs and embedding shall be of 20 mm graded nominal size (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.

Size of Aggregate for different Grade of concrete		
Grade of Concrete	Mix of (Cement:Sand:Aggregate)	Size of Coarse Aggregates
M20	1:1.5:3	20 mm
M15	1:2:4	12.5 mm, 20 mm
M10	1:3:6	20 mm, 40 mm
M7.5	1:4:8	40 mm, 63 mm
M5	1:5:10	40 mm, 63 mm
Low Grade	1:6:12	40 mm, 63 mm

1.12. **Sand Cored Foundation**

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.

1.13. **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 mm high reinforced with 6 mm (1/4") dia rods spaced 150 mm apart, both longitudinally and circumferentially, the concrete shall be of grade M.20.

2. **Type of Foundation 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.

2.1. **Cement**

The cement to be used in the construction of PCC / RCC structures should be of Ordinary Portland Cement to IS:269 (Latest version as indicated in Annexure-1).

2.2. **Vibrator**

Vibrator shall be used to ensure proper compaction and avoid honeycomb in concrete

SECTION – 3

STRUCTURES

TECHNICAL SPECIFICATION FOR OHE STEEL STRUCTURES

1. Types of Steel Structures.

Structures and gantries may consist of any or more of the following types.

- a) Broad flange beams.
- b) Rolled steel joists (I section)
- c) 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. Limited quantity (approx. 700 nos.) of circular spun prestressed concrete masts may also be used at the sole discretion of the Purchaser

2. Design

2.1. For OHE 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 (Latest version as indicated in Annexure-1). The thickness of smallest steel sections used shall be 5 mm for galvanized members.

All the steel Structures and small part steel for carrying overhead equipment are to be fully galvanized after drilling and fabrication as per specification ETI/OHE/13 (4/84) (Latest version as indicated in Annexure-1) and no painted structures are to be used.

2.2. For TSS

2.2.1. General

The steel structures may be of riveted, bolted or welded construction as convenient for installation. The thickness of smallest steel section used shall not be less than 6 mm (or 1/4"). Legs of gantry structures/portals and supporting steel work and uprights or busbar supports shall generally be embedded in concrete foundation blocks and for equipment and in special cases secured by means of holding down bolts.

2.2.2. Design

All the steel structures like gantries/portals, other supporting members, small part steel work etc. shall be galvanized after fabrication with a minimum value of average mass of zinc coating being not less than 610 g/m² as per RDSO's specification No. ETI/OHE/13 (4/84) with Amendment No.1,2 & 3. All designs for special steel work shall be furnished by the Contractor, for approval of the Purchaser. 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, other relevant IS Specifications and statutory regulations. For purposes of design, all possible loads which may occur in the worst combination shall be considered.

2.2.3. Steel Structures

For calculation of wind load on structures, conductors and equipment, the basic wind pressure shall be taken as 112.5 Kg/sq.m 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 busbars and earth screen wire at 66/25 kV sub-stations shall not exceed 200 kg. at 4°C (without wind).

2.2.4. Upright and fencing Post

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

single or fabricated.

Notwithstanding the provisions contained in I.S. and other regulations above regarding permissible deflection, the following should apply.

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

The torsional rotation of the mast due to permanent loads shall not exceed 0.1 radian

2.3. Cantilever Masts

2.3.1. Loads

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).

Description	Loads to be considered
Weight of Overhead Equipment	1.60 kg/meter for each conventional and 1.32 kg/meter for each composite OHE
Weight of bracket supporting the Overhead Equipment	60 kg/normal bracket
Weight of a man	60kg
Weight of earth wire	0.32 kg/meter
Weight of the Mast	To be obtained from the Fabricator and the same shall be considered by the Contractor.
Weight of feeder, return conductor or other special equipment wherever they occur	To be calculated by the Contractor
Wind loads perpendicular and parallel to the track.	To be calculated by the Contractor
The effect of eccentricity of vertical and horizontal loads on the bracket due to variation in temperature	To be calculated by the Contractor
Radial forces on the mast, due to stagger, curvature, anchorage etc.	Radial forces on the mast, due to stagger, curvature, anchorage etc
Any other load or loads that may occur due to special location of the Structures	To be calculated by the Contractor (if any)

2.3.2. Deflection

Notwithstanding the provisions contained in IS:800 (Latest version as indicated in Annexure-1) referred to in para above regarding permissible deflection, the following shall apply. 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. The additional deflection under maximum wind pressure shall not exceed 8 cm at the level of the contact wire

2.3.3. Torsion

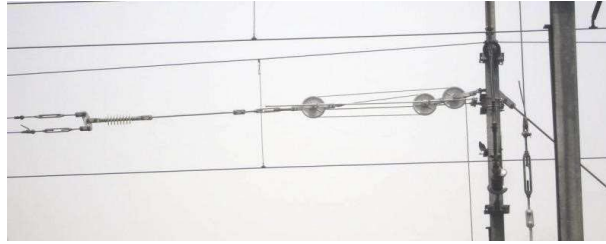
The torsional rotation of the mast due to permanent loads shall not exceed 0.1 radian.

2.3.4. Typical Design

The typical design of a traction mast is included in the set of standard drawings listed in Annexure-Employment schedules for standard masts for various locations and types are included in the standard drawings listed in Annexure-1, to enable selection of suitable type for different locations and local conditions.

2.4. Anchor Mast

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.



2.5. Dwarf Mast

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.



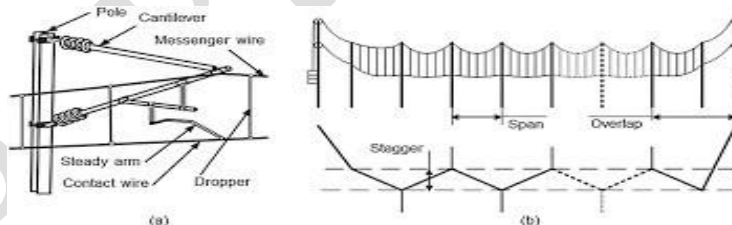
2.6. Head Spans

2.6.1. Load

The loads to be considered shall be as detailed in para above as far as applicable and at their worst combination.

2.6.2. Sag for HEAD Span Wire

The sag of the head span wire shall be approx. one-tenth ($1/10$) of the span.



2.6.3. Minimum tension in cross 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.

2.6.4. Deflection of Mast

Deflection at the top of the mast or Structure shall be limited to one-eightieth ($1/80$ th) of its height above foundation.

2.6.5. Typical Design

Typical design for head span mast carrying overhead equipment for 4 tracks will be furnished to the contractor

2.7. 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 in Annexure-1.

b) Load

The load shall be as detailed in para above as applicable.



2.8. Structures on Bridges

2.8.1.1. 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.

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

2.9. 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.

2.10. 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 and outside of curve, the standard setting shall be as per the relevant drawing included in Annexure-1. Minimum setting of structures shall be 2.8 M plus curve allowance as required. Whenever this distance can not be provided, specific approval of Purchaser shall be obtained before erection. Setting of portal upright overlap/ turn-out structures, anchoring structures and other masts carrying more than one OHE will be 3.0 m wherever possible.
- c) The value of setting of masts/structures shall be painted on each mast/ structure. The figure shall be 25mm in size in black colour with yellow colour background. In addition, the track level shall also be marked on the mast/structure by a horizontal red painted stroke.

2.11. Extra Clearances 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 in Annexure-1.

2.12. 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 center under the worst conditions of wind.

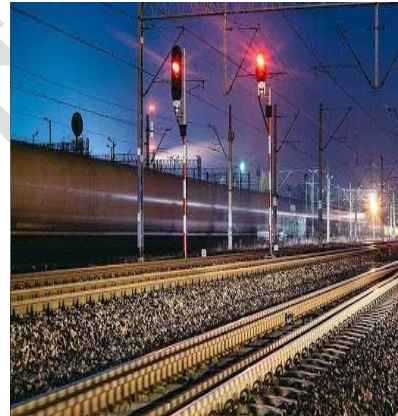
2.13. Structures on Platform

The setting of structures on platform shall be not less than 4.75 m



2.14. 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 in Annexure 1



2.15. 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/Retro-Reflective number plate shall be provided on each mast or structure as per approved designs (See Annexure-1).



2.16. Steel Work for Switching Station and Gantries

a) 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 followings:

- I) Weight of insulators, instrument transformers, isolator switches, busbars, and their accessories.

- II) Loads caused by feeders, along and across tracks, return feeders etc.
- III) Loads caused by anchorage due to guying of anchored masts (where applicable).
- IV) Pull or Push on the structures due to anchorage and radial tension (where applicable).
- V) Wind load on the different structures, conductors and equipment. The wind pressure shall be taken as indicated.
- VI) Weight of men working on the structures.
- VII) Weight of structure itself.
- VIII) Erection loads.
- IX) Any other load or loads which may occur due to special equipment wherever they occur.

b) **Tension of Conductors**

For purpose of designs, the maximum tension of different conductors, without wind load, shall normally be as under: -

- I) Maximum tension in the cross feeders at switching stations under worst conditions: -
- II) For spans less than 18 m ... 100 kgf.
- III) For spans more than 18 m ... 200 kgf.
- IV) Maximum tension in longitudinal feeders running parallel to the track at the switching stations under worst conditions. 1500 kgf.
- V) Tension in anchored overhead equipment in case of sectioning and paralleling stations 2,000 kgf.

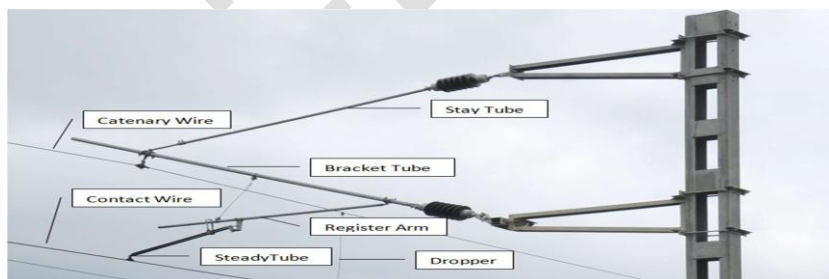
c) **Deflection of Gantry Masts**

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.

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.

d) **Chairs and Brackets**

Chairs, brackets and supporting steel work carrying potential transformers, lighting 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.



2.17. **Steel**

Steel conforming to IS: 2062 (Latest version as indicated in Annexure-1) shall be used for all fabricated steel work.

SECTION – 4
**EQUIPMENTS, COMPONENTS AND
MATERIALS**

1. **Compliance with Standard Specification**

In the technical specifications of equipments, components and materials, references are made to the following standard specifications:

- a) International Electro Technical Commission (abbreviated as IEC) publications.
- b) British Standards (abbreviated as BS)
- c) Bureau of Indian Standards (abbreviated as BIS)

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, in that case firm should submit English rendering of the text and illustrations of the national standard specifications and British or Bureau of Indian Standards in question, in the relevant Annexures. In case of doubt, the Purchaser shall decide the clause and specification applicable and the contents of the specification and standard mentioned above shall guide such decisions.

2. **Proto Type Test:**

2.1 **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 prototypes 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.

2.2 **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, in the presence of the Purchaser's representative. The contractor shall arrange to get these tests conducted at his own cost.

2.3 **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.

2.4 **Exemption from Prototype Tests**

If prototype samples of equipment, 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 equipment, components or fittings will be exempted from the tests.

Supply of bulk quantities shall, however, be affected only after the Purchaser's prior approval is obtained in writing.

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.

3. **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. **Test Certificates**

Three copies of the test certificates of successful prototype tests carried out at the manufacturer's factory on all equipments 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 for inspection

5. **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 it manufacturer may proceed after exemption from prototype tests is received from the Purchaser in writing.

6. **Inter Changeability**

All equipment, components and fittings shall be inter-changeable 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.

7. Technical Specifications

Please see at Annexure-1). List of standard RDSO drawings, RDSO specifications and IS specifications for important materials, components and equipment [As per version available as on date of opening of tender).

8. 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 galvanized tubes, bolts and nuts and/or any other fittings as may be agreed to by the Purchaser.
- b) In case of insulators, galvanized steel tubes, stainless steel wire rope and conductors, name of manufacturer shall be specified in "As Erected" drawings for identification.

9. Steel work and Protection Against Rust:

a) Galvanizing

All ferrous materials and fittings shall be hot dip galvanized according to the specification ETI/ OHE/13 (4/84). (Latest version as indicated in Annexure-1).

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 ETI/OHE/13 (4/84) (Latest version as indicated in Annexure-1) 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.

10. Bracket Assembly Components

10.1 Arrangement of Normal OHE

The arrangement of the different fittings and structural components of bracket assemblies are shown in drawings listed in Annexure-1. The employment schedule of bracket will be furnished to the Contractor.

10.2 Bracket

Bracket tubes shall be of seamless cold drawn or electric resistance weld steel complying with ETI/OHE/11 (5/89) (Latest version as indicated in Annexure-1) with an insulator near the support. The length of the tubes shall be such that their is a free length of about 200 mm beyond the catenary suspension bracket. To facilitate adjustment during track maintenance.

10.3 Tubular Stay Arm

Steel tubes with adjustable steel rods shall be used for tubular stay arm of all bracket assemblies.



10.4 Register Arm

The register arm shall also be electrical resistance weld or cold drawn steel tubes or proper dimensions duly formed. It

shall be suspended by a dropper from the catenary suspension clamp/bracket tube. A hook and eye arrangement shall be used at the bracket end to permit free movement in every direction.

10.5 Steady Arm

Steady arm shall normally be fitted in all assemblies for overhead equipment in running. The steady arm shall be of light alloy BFB section arranged to work always in tension in accordance with **ETI/OHE/21(9/74)** (Latest version as indicated in Annexure-1). Steady arms of secondary tracks may be of solid galvanized steel rodding. The contact wire shall be fixed by a simple swivel clip without threaded parts. Steady arms shall normally be 1.0 m long but for special locations such as turnouts, diamond crossing etc. Steady arms shall be longer as indicated in the relevant drawings listed in Annexure-1.



Bent steady arms of aluminum alloy tube conforming to Spec. ETI /OHE/21 (9/74) (Latest version as indicated in Annexure-1) shall be used for neutral section overlap and in the central mast of a 4-span insulated overlap.

10.6 Bracket for Unregulated Tramway Type Equipment

Brackets provided on cantilever masts for tramway type unregulated equipment shall normally span two tracks and the contact wires carried on V-type clamps suspended from a span wire. The span wire shall be provided with a turn buckle at only one end.

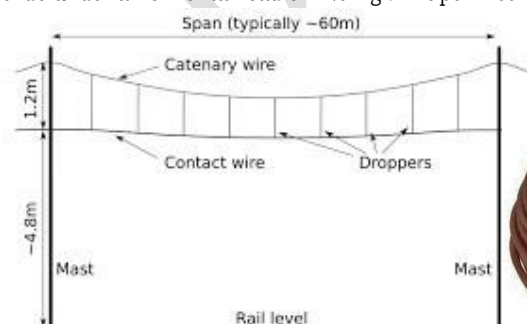
11. Droppers

11.1 General Designs

The droppers shall generally be designed as shown in standard drawings and made of copper wire about 5 mm diameter conforming to IS:282 (Latest version as indicated in Annexure-1) and shall be attached to the catenary wire by a copper dropper clip. The contact wire shall be held by a clip of aluminum bronze as shown in the standard drawings. The distribution of dropper shall be in accordance with standard designs.

11.2 Loading

The droppers shall be able to withstand a vertical load of 200 kg at the point of attachment to the contact wire and the clip shall not slide under a horizontal load of 120 Kgf. The permissible tolerance in the overall length of a dropper will be ± 5 mm.



12. Insulators

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 as desired by the Purchaser. All solid core insulators shall conform to TI/SPC/OHE/INS/0070 (Latest version as indicated in Annexure-1) or Specification No. TI/SPC/OHE/INSCOM/0991 (Latest version as indicated in Annexure-1) is for Composite Insulators wherever applicable.

(a) Interchangeability

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 galvanized malleable cast iron caps as given in standard drawings shall be adopted.

Sr. No	Insulator Type	Purpose
1	Stay arm Insulators	These insulators will be used in conjunction with. The tubular stay arm of all bracket assemblies.
2	Bracket Insulators	These will be used at the base of each bracket assembly in conjunction with bracket tubes
3	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
4	Solid Core Post Insulators	These will be used at all places for supporting isolators mechanisms, -bus-bars, -jumpers etc. of 25 kV.
5	Disc Insulators – 255mm	Clevis type 255 mm disc insulators will be used for return conductor suspension and for earth wire cut-in insulator.
6	11kV Post Insulators	These will be used at all places for supporting bus-bars, jumpers etc. In conjunction with return conductor/return feeders

- (b) The pedestal insulators for service voltage of 220/132/110 kV shall be of Solid Core type conforming to specification as indicated in Annexure-1. The pedestal insulators for service voltage of 25 kV shall be of the solid core type conforming to specification as indicated in Annexure-1.



13. End Fittings and Splices

13.1 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 **TI/SPC/OHE/Fittings/0130**) (Latest version as indicated in Annexure-1). For Aluminum Alloy/conductor, the end fittings shall be either cone type, strain clamp type or any other type as approved by the Purchaser.



13.2 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.

13.3 Restricted use of Splices

The use of splices shall generally be avoided and their use shall be restricted to the minimum necessary. Over main tracks, there shall be no splice in the contact wire on first erection. Elsewhere, not more than one splice be used in any tension

length (i.e. anchor to anchor) for which prior approval shall be taken from the Purchaser. Additional splices may, however, be provided to enable retention of conductors which are found defective during and/or after erection. Splices may also be permitted for repair of damage due to thefts or Railway accidents.



13.4 **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.

13.5 **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.

14. **Electrical Connections for OHE**

14.1 **General Designs**

All electrical connections between conductors shall be made by parallel clamps. The general arrangements of connections are shown in the standard drawings, listed in Annexure-1.

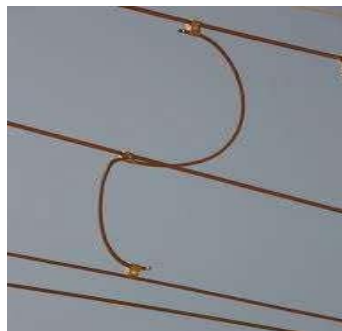


14.2 **Jumpers**

Copper jumpers shall be of any of the followings:

Large jumpers of annealed copper in accordance with specification ETI/OHE/3 (2/94) (Latest version as indicated in Annexure-1).

Small jumper of annealed copper in accordance with the specification IS:9968 (PT.2) (Latest version as indicated in Annexure-1).



14.3 **Bus Bars**

Bus-bars or rigid jumpers of copper where used shall be of 18mm dia copper rod in accordance with RE/30/OHE/5(11/60) (Latest version as indicated in Annexure-1). Aluminium bus-bars wherever used shall be of 36/28 mm tubing (See 2.4.22).

Aluminium tubular bus-bars shall be made of Al. Alloy grade 63401 (WP condition) to IS:5082 (Latest version as indicated in Annexure-1). The tolerance on diameter and thickness shall be as per class I, IS:2673 (Latest version as indicated in Annexure-1)



Note:

1. ACSR Conductors used as bus-bar or bus-bar connections shall be of ZEBRA ACSR size 61/3.18mm (28.62 mm dia) at 220 or 132 or 110/25 kV Traction Sub-station.
2. Aluminum tubes used as bus-bars or bus-bar connections shall be of dia 50X39 mm for Traction sub- station and Shunt Capacitor banks and of size 36/28 mm for Feeding Stations. Aluminum tubular bus-bars shall be made of Al. Alloy grade 63401 (WP condition) to IS:5082 and IS: 6051-1970 (Latest version as indicated in Annexure-1). The tolerance on diameter and thickness shall be as per class I, IS: 2673 (Latest version as indicated in Annexure-1).
3. Bus-bar junctions and connectors shall be made with aluminum alloy Grade 4600 M to IS: 617-1994 or equivalent. The bus-bar shall be clean, smooth mechanically sound and free from surface and other defects. No splices will be allowed in the bus-bar unless the length of bus-bar exceeds 6m. The ends of the tubular bus-bar shall be covered with suitable end caps. The joints in bus-bars where unavoidable, shall be mechanically and electrically sound so that the temperature rise under normal working conditions does not exceed 40 degrees centigrade for a max. ambient temp. of 45 degree centigrade.

(a) **Feeders**

Feeders shall be of 150 sq.mm Copper conductor

(b) **Return Conductor**

The return conductor shall be of 150 sq.mm Copper Conductor. The arrangement of return conductor carried on traction structures is shown in a drawing listed in Annexure-1, Part E.

Note:

1. The general characteristics of all wires and conductors is included in drawings listed in Annexure-1, Part E.
2. Earth wire shall be of steel reinforced Aluminium conductor 7/4.09 mm (RACCOON) conforming to **IS:398- (part-II)** (Latest version as indicated in Annexure-1).

15. **Terminal Connectors for Equipments**

Booster Transformer along with the terminal connectors suitable for taking jumpers/ bus bar as required shall be supplied by the Purchaser.

However, Power Transformer, Circuit Breaker, and L.T. supply Transformer shall be supplied by the Contractor along with the terminal connectors suitable for taking jumper/bus-bar as required including Al-Cu strips for bimetallic connections wherever required. The Al-Cu strips required for the connection of Booster Transformers shall also be provided by the Contractor if following equipment will be under the scope of Supply as per Annexure-4, otherwise Tenderer shall make its own arrangement to provide.



16. **Regulating Equipment**

(a) **General**

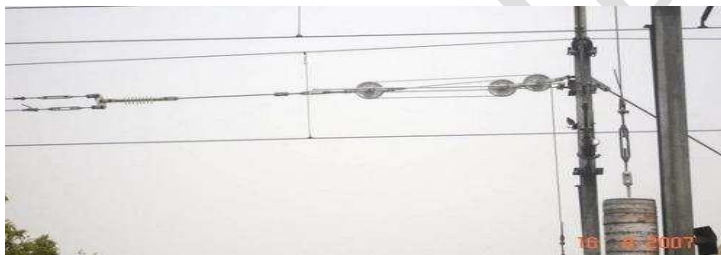
A general arrangement is shown in the standard drawings listed in Annexure-1. The regulating equipment should have a minimum adjustment range of 950 mm. Stainless steel wire rope in accordance with TI/SPC/OHE/WR/1060 (Latest version as indicated in Annexure-1) shall be used in these equipments and these shall be sufficiently flexible for the purpose.

(b) **Counter weight**

Counter weights and arrangements used shall be such that these could be accommodated within 330 mm (13 inches) measured transverse to the track under the worst conditions of wind. The vertical upward movement shall be limited with a fixed top.

(c) **Reduction Ratio**

Reduction ratio in the arrangement used shall be five for winch type and three in case of three pulley type.



17. **Headspan Construction**

(a) **Size and Factor of Safety**

All span wires used in head-span construction shall be of stranded cadmium copper conductor 65 sq. mm or 130 sq. mm cross section. All the wires shall be designed with a factor of safety of not less than 4 under the most unfavorable conditions.

(b) **Turn Buckles**

Each span wire shall be equipped with a turn buckle at each end of the span.

(c) **Additional Insulators**

Additional insulators shall be provided as necessary in head span, cross span and steady span, wires to ensure electrical independence between the equipment in different elementary electrical sections

18. **Isolators**

25kV isolators shall comply with Railway Specifications.

19. **Insulation Level**

- (a) Interrupters, Potential Transformers line indication type, 42kV Lightning Arrestors and other equipments shall be suitable for insulation levels indicated in the relevant specifications.
- (b) All equipment including insulators to be used at the traction sub-stations, feeding station and shunt capacitor banks shall be suitable for the insulation level specified below:

Sr. No	Description	SERVICE VOLTAGE				
		220 kV	132 kV	110 kV	66 kV	25 kV
1	Power frequency 1 min. wet withstand test-kV (rms)	460 kV	275 kV	230 kV	275 kV	100 kV
2	Impulse (1.2/50 microsecond) withstand test positive and negative polarity (crestvalue)-KV (peak)	1050 kV	650 kV	550 kV	650 kV	250 kV

20.

Cabling**(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 25 sq.mm aluminum two-core PVC insulated PVC sheathed and steel armoured heavy-duty cable conforming to IS:1554(part-I) (Latest version as indicated in Annexure-1).

(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) (Latest version as indicated in Annexure- 1).

The cables shall be provided as indicated in the Table below:

Purpose	Run	Circuit Voltage	Core Size and Voltage	No of Cores
FOR SWS:				
Control & indication of interrupters	From each Interrupter to terminal board	110 V/D.C.	2.5 sq.mm copper	7
Catenary indication	From each P.T. line indication type to terminal board	110 V/A.C.	2.5 sq.mm copper	2
Heater supply for interrupters control mechanism cabinet	i) From interrupter to interrupter	240 V A.C.	4.0 sq.mm Aluminium	2
	ii) From each interrupter to fuse box.	-do-	-do-	-do-
	iii) From fuse box to distribution board.	-do-	-do-	-do-
Battery Supply	1. 110V battery charger to 110V battery	110V / DC	2.5 sq.mm Copper	-do-
	2.110V battery to 15A DC fuse box	110V / DC	2.5 sq.mm Copper	-do-
	3.15A, DC fuse box to terminal board	-do-	-do-	-do-
FOR TSS:				
Control and indication of circuit breakers	From each circuit breaker to control board.	110 V DC	7x2.5	Three cables to be used.
Transformer alarm/trip circuits & tap changer control	From each transformer to control board.	110 V DC	10x2.5	Five cables to be used.
Transformer Protection (bushing transformer to current transformer connections)	From each transformer to control	110 V DC	4x4.0	One cable for each bushing CT to be used.

Purpose	Run	Circuit Voltage	Core Size and Voltage	No of Cores
Current transformer & neutral connections	From each current transformer to control board.	110 V DC	2x4.0	One cable for each core of CT/Neutral CT
Potential transformer connections	From each potential transformer to control board.	110 V DC	2x2.5	One cable to be used
110v DC Supply	1.Connection between battery chargers & DC distribution board.	110 V DC	4x4.0	One cable to be used with two core connected in parallel
	2.Connection between batteries & DC distribution board.	110 V DC	4x4.0	One cable to be used with two core connected in parallel
	3. Connection from DC distribution board to control board.	110 V DC	4x4.0	Two cables to be used with each circuit breaker and one cable for DC supply to control boards.
Control & indication of bus coupler interrupter	From interrupter to control board.	110 V DC	7x2.5	Two cables to be used.
240 V AC supply	Connection from AC distribution board to control board.	240 V AC	2x2.5	One cable to be used

(c) **Cables for heater circuits**

The 240 V AC supply to space heaters provided in control cabinets of various equipments shall be provided by means of 4 sq.mm. 2-core aluminum PVC insulated (heavy duty) cables complying with IS: 1554 (Part-I)- 1988. Three circuits shall be provided on the LT A.C. distribution board for these purposes, one for the heaters in the control cabinets of 220/132/110 KV circuit breakers, the second for the heaters in the control cabinets of 25 KV circuit breakers and bridging Interrupters and the third for heaters in marshalling box of traction transformers. Each circuit shall be provided with a fuse of approved type and suitable rating in the LT A.C. distribution Board.

(d) **Cables for battery Chargers**

240 V A.C. supply to each of the battery chargers in the Control Room shall be provided by means of 4 sq.mm. 2 core PVC insulated, PVC sheathed (heavy duty) copper cables complying with IS: 1554 (Part-I)- 1988. Two circuits each with a fuse of approved type and suitable rating in the LT A.C. distribution board shall be provided for the two battery chargers in the Control Room. The 240 V A.C. supply to Control Board from A.C. distribution board shall be provided by means of 2.5 sq.mm. 2- core PVC insulated PVC sheathed (heavy duty) copper cable complying with IS:1554(Part-I)-1988.

(e) **Cables for blower fans**

240 V A.C. supply to blower fans fixed on the traction transformer shall be provided by means of 2 core 25 sq.mm. aluminum conductor cables. The cables shall be PVC insulated, PVC sheathed and armored cables of 1100 V grade complying with IS:1554(Part-I)-1988. Separate cables shall be laid from the L.T.

A.C. distribution board in the control room to marshalling box of each traction transformer. Individual circuits from the LT A.C. distribution board shall be provided for this purpose with each circuit protected by a fuse of suitable rating.

Note:

1. 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.
2. Notwithstanding the sizes of cables given above, the Tenderer shall assure himself that various cables would suit the ratings of equipments offered by him.

(f) **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 station is shown in the relevant drawing already included in Annexure-1.

(g) **Literature for Equipment**

The Contractor shall, within six months of issue of Letter of Acceptance of Tender, supply 5 copies of booklets containing manufacturer's instructions for operation and maintenance of each of the items of equipments the supply of which is, Herded by the contract. In addition, 25 copies of detailed schedule of components, catalogues and drawing of all parts of the equipment shall also be supplied.

Bi-RIDE

SECTION – 5

DESIGN AND DRAWINGS

1. **Contractor's drawings**

(a) **General**

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 and L.T. Supply transformer stations and complete supply and erection of Traction Sub-Stations 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.

2. **Standards for Drawings**

All designs, legends note 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 RE/OHE/ 25 and ETI/PSI/31(5/76) (Latest version as indicated in Annexure-1).

3. **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, equipment's, components and fittings of traction overhead equipment, switching stations booster transformer stations and LT supply transformer stations and TSS 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. The contractor for his use and reference shall obtain copy each of such standard basic arrangement, component and fittings drawings and employment schedules from GM/Electrical/BI-RIDE office.

(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 result of his experience or other development, he shall justify his proposals with supporting explanatory notes.

4. **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. **Particular Designs& Working Drawings.**

5.1. **For OHE**

(a) **Purchaser's Pegging Plan**

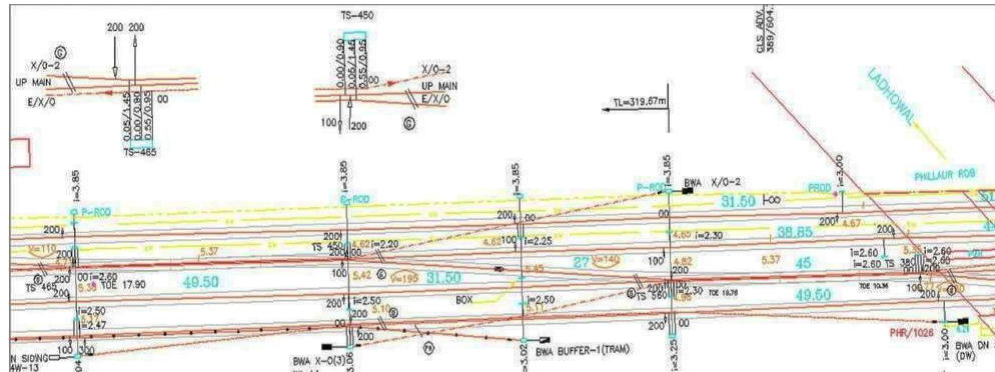
The pegging plans for sections to be equipped indicating the type of overhead equipment, locations of masts and other general particulars prepared on the basis of the latest survey will be furnished by the Purchaser. The Contractor shall verify and check these plans at site.

(b) Contractor's Pegging Plan

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.

(c) 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.

**(d) Provisional Layout Plans**

The Contractor shall prepare and submit overhead equipment layout plans incorporating the following in formations: -

1. The run of wires in different thickness or colour in special cases and termination.
2. The run of wires for future wiring indicated to the Contractor, in dotted lines.
3. Exact position of all cut-in-insulators, including section insulators.
4. Direction and value of stagger at each traction structure location.
5. Clearance of live conductors to Structures in the vicinity including bridges, signals gantries etc.
6. Layout of feeders.
7. Jumper connections and connection to switches and switching stations.
8. List of infringements.
9. Kilometer numbers and type of Structures. (x)
10. Location and numbers of switches.
11. Schematic sectioning diagram drawn to convenient scale showing section insulator, number of switches, elementary sections and connections to switches and switching stations.
12. Table giving references of approved profile drawings, feeder layout plans and other relevant drawings.

(e) OHE Profile Drawings

After completion of the overhead equipment layout plans, the Contractor shall prepare an overhead equipment profile drawings showing the actual height of the contact wire under each overline 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.

(f) Cross Section Drawings

While the layout plans are being finalized, the Contractor shall submit for approval, in-so-far as yards between outer most points and crossing are concerned, 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 rods 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.

In open line sections, cross-sections shall be submitted in the following proforma, separately for each Railway line for special foundation drawings with all necessary details shall be submitted to the Purchaser. In case of side bearing foundation with extra depth, formation details at such location and necessary details of anchor foundation will be submitted.

CROSS SECTION FOR THE OPEN ROUTE SECTION -----Km. ----- to -----

Sl. No.		1	2	3	4	5	6	7	8	10	11	12	13	14	15
LOCATION No.															
CHAINAGE															
DETAILS	SETTING DISTANCE IN 'm'														
	STEP DISTANCE IN 'm'														
	F.B.M. CODE														
	SOIL TYPE & PRESSURE														
	FOUNDATION TYPE AND SIZE														
	MAST SIZE & LENGTH IN 'm'														
	MAST EMBEDDED LENGTH 'M'														
	REVERSE DEFLECTION in cm														
	SUPER MAST LENGTH (m)														
	CROSS ARM LENGTH (m)														
	ANY OBSTRUCTION														

(g) **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 take into account any modifications to the locations of Structures during the process of casting of foundations.

(h) **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. In open line sections the Contractor shall submit structure erection particulars in the typical proforma as given below separately for each main line track in addition to particular details as indicated in the proforma for cross-section drawings. Modification to this proforma is found necessary will be finalized at time of structure erection drawings.

Sl.No.	1	2	3	4	5	6	7	8	9	10	11	12	13
										14	15		
LOCATION No.													
CHAINAGE													
1. ENCUMBRANCE													
2. CONTACT WIRE HEIGHT.													
3. STAGGER													
i) CATENARY													
ii) CONTACT													

4. STAY ARM i) (a) ii) CODE	
5. BRACKET i) (b) M ii) CODE	
6. REGISTER: i) C/D (M) ii) CODE	
7. STD/BENT CODE	
8. IDENTIFICATION MARK (SEE PARA 2.5.11)	
OTHER REFERENCES/CODES FOR MISC. ITEMS LIKE STEEL WORK FOR STAY/BRACKET ATTACHMENT MISC. SINGLE/DOUBLE CAT. ETC. WILL BE INDICATED ITEMS:	

Tolerances to be adopted while Erection of Bracket Assembly, conducting SED checking & Tower Wagon Checking.

Sl. No.	Item	Limits/Tolerances
(i)	Register Arm Tube Projection	150 - 200 mm in case of Push off locations. For Pull off locations, it shall project over Contact Wire Plane.
(ii)	Bracket Tube Projection	150 - 200 mm
(iii)	Dip between Register Arm Tube & Steady Arm	200-250mm on Tangent Track. (BFB Steady Arm). 250 - 320 mm on Curves. (BFB Steady Arm & Bend Tubular Steady Arm).
(iv)	Encumbrance	± 50 mm
(v)	Length of 'A' Dropper (1 st Dropper) from support	± 5 mm
(vi)	Spacing of 'A' Dropper (1st Dropper from Support)	± 30 mm
(vii)	Length of Other Droppers	± 5 mm
(viii)	Spacing of Other Droppers	± 50 mm
(ix)	Stagger of Catenary Wire	± 30 mm
(x)	Height of Catenary Wire	± 50 mm
(xi)	Stagger of Contact Wire	± 10 mm
(xii)	Position of Compensation Plate	It shall be in vertical plane.
(xiii)	Difference between mainline Contact wire and the Crossover Contact Wire at Support.	50 mm (minimum)

Note: The proforma for SED at individual locations shall be as per standard proforma already circulated and to be adopted in consultation with Purchasers.

5.2.

For TSS:

(a) Purchaser's Location Plans for Traction Sub-Station.

The location plans and schematic diagram of connections for each of the traction sub-stations will be

furnished by the Purchaser to the Contractor. These will indicate.

1. Position of incoming lines on the gantries to be erected inside the traction sub-station.
2. Location of switching station gantry showing where the 25kV outgoing feeders will be terminated.
3. Schematic diagram of connections of Transformers, Circuit breakers Isolators etc.
4. Position of the control room with respect to the traction sub-station.
5. Fencing outline with gates.

(b) **For feeding Stations**

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

1. Overhead equipment layout in the vicinity of feeding stations.
2. Location of main masts.
3. Arrangement of cross feeders and longitudinal feeders to be anchored on the gantry if any, including jumper connections to the overhead equipment.
4. Scheme of connections of interrupters.
5. Position of the remote-control cubicle with respect to the feeding stations.

(c) **Shunt Capacitor Bank**

The location plans and schematic diagram of connections for capacitor bank installation at each of the traction sub-stations will be furnished by the Purchaser to the Contractor. These will indicate.

1. Schematic diagram of connections of circuit breakers, isolators, LA's etc.
2. Position of the control room with respect of the traction sub-station.
3. Fencing outline with gates.

6. **Particular designs and working drawings for switching stations and booster stations:**

6.1. **Purchaser's Location Plan.**

The location plans and schematic diagrams of connections for all the switching stations, booster transformer stations and L.T. supply transformer stations will be furnished by the Purchaser to the Contractor. These will indicate the following as applicable:

1. Overhead equipment layout in the vicinity of switching or other stations.
2. Location of main masts.
3. Arrangement of cross feeders and longitudinal feeders to be anchored on the gantry if any, including jumper connections to the overhead equipment.
4. Scheme of connections of interrupters.
5. Position of the remote-control cubicle with respect to the switching stations.
6. 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.

6.2. **Detailed Drawings for OHE Works**

The Contractor shall submit for approval of the Purchaser the following drawings:

Cross-section drawings for each switching stations indicating the cross section of the formation transverse to the track at each location of main mast and longitudinal section parallel to the track along the center line of the interrupters. These drawings shall be prepared after an accurate survey at site and shall indicate the nature of the soil, its bearing capacity, compactness and in case of loose soil, transverse section of the parent soil. In the preparation of the drawings care shall be taken to show all obstructions to be removes, such as signal wires, rods and their correct location with reference to the track/s as well as under-ground constructions like pipes, cables etc. after collections such information from the site.

(a) **General arrangement Drawings**

General arrangement drawings for switching stations indicating the general arrangement of all equipments, run of bus bars, position of pedestal insulators, steel frame work and fencing. The drawings shall also give a schematic connection/diagram and an isometric view of busbars and connections. The drawings shall include an elevation view of the switching stations from behind a transverse cross section and plan sectional views at the level of feeder anchors insulator beams, potential transformer beams and ground. Each drawing shall have a schedule of all equipments required at the switching station along with drawing references of details of these equipments.

(b) **Structural Drawings**

Structural assembly drawing for switching stations indicating the steel frame work assembly. The drawings shall include one elevation view of the steel frame work assembly from behind, a transverse cross-section and plan views at various levels such as at the level of feeder anchors, insulator beams/and ground. In the assembly each component member shall be marked with its reference number. The drawing shall also have a schedule of component members along with drawing reference various members. The weight of the component members shall be indicated in a separate weight schedule. The drawings shall be prepared for the various structural components. An individual drawing shall be made for each component and this shall include all fixing bolts, nuts and washers whose sizes will be mentioned on the drawings. Unit isolator beams, potential transformer beams weight of the component shall also be given in the drawings.

(c) **Foundation Layout and Cross Section Drawings**

Foundation layout & cross-section drawings for each switching station indicating layout of all foundations in plan, transverse cross-section of various foundations through center line of main masts, interrupters, fencing uprights and L.T. supply transformers, if any, and longitudinal sections parallel to tracks through the center line of the cable trench. All foundations shall be marked serially on the drawing and listed in a schedule on the drawing indicating the volume of concrete for each foundation block.

(d) **Fencing Layout Drawings**

Fencing layout drawings for each switching station indicating the layout of the entire fencing and anti-climbing device in plan. Each upright, fencing panel and fixture on the upright shall be indicated on the drawing by its reference number. A schedule of components viz. Uprights, panel's fixer, and barbed wire shall be included in the drawings indicating the drawing references of components. An individual drawing shall be made for each type panel, fencing post and fixture for mounting the anti-climbing device. The drawing of each fencing post shall indicate the unit weight of the fencing post.

(e) **Earthing Layout Drawings**

Earthing layout drawing for each switching station indicating the layout of full earthing system in plan. The drawing shall show the location of earth electrodes and mark the runs of earthing strips and connections to each equipment, mast, fencing post and fencing panel. All components shall be marked with their reference numbers, for further details of the run of conductors and connections, separate drawings which may be common to all switching stations may be made and references to these drawings marked on the layout. A schedule of components shall be made out in the drawing giving drawing references of components.

(f) **Cable Run Layout**

Cable run layout of each switching station indicating inter-connection between various equipments, indoor and outdoor, along with schematic arrangements and physical disposition of equipments, colour coding or code number and the index scheme adopted for terminals. The drawings shall also indicate the cable size and grades of insulation. The quantity of various cables required shall be indicated on the drawings.

(g) **Equipment Drawings**

Equipment drawings applicable to all switching station except the ones for the equipments to be supplied by the Purchaser. Drawings should be dimensioned and should indicate: -

1. Fixing or mounting hole dimensions and arrangement;
2. Net weight of the equipment.
3. Characteristic and rating of equipment
4. Circuit diagrams;

5. Overall dimensions and other important dimensions;
6. Height and vertical and horizontal dimensions of all exposed live parts; and
7. Notes explaining the operation of the equipment

(h) **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.

(i) **Miscellaneous Drawings**

Miscellaneous drawings applicable to all switching stations. These drawings shall include drawings or sketches made for study of clearances, isolator alignment details, scheme of interlocks, number plates of various equipments and "U" bolts for cable mounting, caution or instruction boards, outriggers for busbar supports and non-standard busbar connectors.

6.3. **Detailed Design Drawings for TSS Works**

Contractor shall submit for approval the following drawings.

(a) **Cross Section Drawings.**

Cross section drawings for each traction sub-station, indicating the transverse and longitudinal cross-section of the soil along the center line of the equipments, busbar supports and cable trenches. These drawings shall be prepared after an accurate survey at site and shall indicate the nature of the soil, its bearing capacity, compactness and in case of loose soil, cross-section of the parent soil. In the preparation of the drawings, care shall be taken to show all obstructions to be removed, such as telegraph posts, underground pipes, cables etc. after collection of such information from the site.

(b) **General Arrangement Drawings**

General arrangement drawings for each traction sub-station shall indicate the general arrangement of all equipments, run of busbars, position of pedestal insulators and steel frame work. The drawings shall also give a schematic connection diagram and an isometric view of busbars and connections wherever required. The drawings shall include an elevation view of the traction sub-station, transverse cross section and plan views. The drawings shall have a schedule of all equipments required at the traction sub-station along with drawing references of the details of these equipments.

(c) **Structural Drawings.**

Structural drawings for each supporting steel frame work of pedestal. The drawing shall include one elevation view of the steel frame work assembly from behind, a transverse cross section and plan view. In the assembly each component member shall be marked with its reference number. The drawing shall also have a schedule of components members along with drawing references of various members. The weight of the component members shall also be indicated. The drawings shall be prepared for the various structural components. An individual drawing shall be made for each component and this shall include all fixing bolts, nuts and washers whose sizes will be mentioned on the drawing. Unit weight of the components shall also be given in the drawing.

(d) **Foundation layout and Cross Section Drawings.**

Foundation layout and cross section drawings for each traction sub-station indicating layout of all foundations in plan, longitudinal and transverse cross-sections of various foundations through center line of gantry/portal legs, various equipment busbar supports, fencing uprights and cable trenches. All foundations shall be marked serially on the drawing indicating the volume of concrete for each foundation block.

(e) **Earthing Layout Drawings.**

Earthing layout drawing for each traction sub-station indicating the layout of full earthing system in plan. The drawing shall show the location of earth electrodes and mark the runs of earthing leads and connections to

equipment, gantry/portal columns, fencing uprights, structural supports etc. All components shall be marked with their reference numbers. For further details of the run of conductors and connections, separate drawings which may be common to all traction sub-stations may be made and references to these drawings marked on the layout. A schedule of components shall be made out in the drawing giving drawing references of components. These drawings shall be prepared duly taking into account the actual soil resistivity of the respective traction sub-station area, measured in the presence of the Purchaser's representative in accordance with the procedure laid down in IS:3043 -1966. The necessary design calculations for the proposed earthing system of the traction sub-station shall also be submitted by the Contractor for Purchaser's approval.

(f) **Cabling and Wiring Drawings**

Cabling and wiring diagrams for each traction sub-station indicating the schematic arrangement and physical disposition of equipment, run of cables and wires for inter-connections between various equipments indoor and outdoor, colour coding and the index scheme adopted for terminals. The drawings shall also indicate the sizes of wires and grades of insulation. The quantity of various cables required shall be indicated on the drawings.

(g) **Fencing Layout Drawings.**

Fencing layout drawings for each traction sub-station indicating the layout of entire fencing and anticlimbing device in plan. Each upright, fencing panel and fixture on the upright shall be indicated on the drawing by its reference number. A schedule of components viz. uprights, gates, panels fixtures and barbed wires shall be included in the drawing indicating the drawing reference of the components. Type drawings shall be prepared for the various fencing components. An individual drawing shall be made for each type of panel, fencing post, gate and fixture for mounting the anticlimbing device. The drawing of each fencing post shall indicate the unit weight of the fencing post.

(h) **Equipment Drawings**

Equipment drawings applicable to all traction sub-stations complete with drawings of components parts except the ones for the equipment to be supplied by the Purchaser. The Contractor shall submit 6 copies for distribution to field office and one transparent print for the equipments to be supplied by Contractor. Drawings should be dimensioned and should indicate.

1. Fixing or mounting hole dimensions & arrangement.
2. Net weight of the equipment.
3. Characteristics and ratings including those of motors and resistors etc.
4. Schematic and detailed circuit diagrams.
5. Overall dimensions and other important dimensions.
6. Height and disposition of all exposed live parts, height of the bottom most point of all bushings and insulators.
7. Notes explaining the operation of the equipment.

For equipment to be supplied by the Purchaser, drawings showing the above particulars will be furnished to the Contractor to enable him to carry out the installation, wiring and commissioning of such equipment.

Note:

1. General Drawings

General drawings applicable to all traction sub-station. These drawings shall include the drawings or sketches made for study of clearances, Isolator alignment details, number plates of various equipments, caution or instruction boards, non-standard busbar connectors, clamps and U-bolts for cable mounting etc.

2. Schedule of Quantities

On receipt of approval of relevant drawings for each traction sub-station, the following schedules of quantities relating to each traction sub-station shall be submitted within a fortnight of receipt of approval.

- a. Schedule of foundations, showing volume of each type and total volume.
- b. Schedule of steel work, types, weights of each member and total weight.
- c. Schedule of quantities of various items of work.

6.4. **Detailed Design Drawings for Feeding Stations.**

Contractor shall submit for approval the following drawings

(a) **Cross Section Drawings**

Cross-section drawings for each feeding stations indicating the cross section of the formation transverse to the track at each location of main mast and longitudinal section parallel to the track along the center line of the interrupters. These drawings shall be prepared after an accurate survey at site and shall indicate the nature of the soil, its bearing capacity, compactness and in case of loose soil, transverse section of the parent soil. In the preparation of the drawings care shall be taken to show all obstructions to be removed, such as signal wires, rods and their correct location with reference to the track/s as well as under-ground constructions like pipes, cables etc. after collections such information from the site.

(b) **General Arrangement Drawings.**

General arrangement drawings for feeding stations indicating the general arrangement of all equipments, run of bus bars, position of pedestal insulators, steel frame work and fencing. The drawings shall also give a schematic connection/diagram and an isometric view of busbars and connections. The drawings shall include an elevation view of the feeding stations from behind a transverse cross section and plan sectional views at the level of feeder anchors insulator beams, potential transformer beams and ground. Each drawing shall have a schedule of all equipments required at the feeding station along with drawing references of details of these equipments.

(c) **Structural Drawings**

Structural assembly drawing for feeding stations indicating the steel frame work assembly. The drawings shall include one elevation view of the steel frame work assembly from behind, a transverse cross-section and plan views at various levels such as at the level of feeder anchors, insulator beams/and ground. In the assembly each component member shall be marked with its reference number. The drawing shall also have a schedule of component members along with drawing reference various members. The weight of the component members shall be indicated in a separate weight schedule. The drawings shall be prepared for the various structural components. An individual drawing shall be made for each component and this shall include all fixing bolts, nuts and washers whose sizes will be mentioned on the drawings. Unit insulator beams, potential transformer beams weight of the component shall also be given in the drawings.

(d) **Foundation Layout and Cross Section Drawings**

Foundation layout & cross-section drawings for each feeding station indicating layout of all foundations in plan, transverse cross-section of various foundations through center line of main masts, interrupters, fencing uprights and L.T. supply transformers, if any, and longitudinal sections parallel to tracks through the center line of the cable trench. All foundations shall be marked serially on the drawing and listed in a schedule on the drawing indicating the volume of concrete for each foundation block

(e) **Earthing Layout Drawings**

Earthing layout drawing for each feeding station indicating the layout of full earthing system in plan. The drawing shall show the location of earth electrodes and mark the runs of earthing strips and connections to each equipment, mast, fencing post and fencing panel. All components shall be marked with their reference numbers, for further details of the run of conductors and connections, separate drawings which may be common to all feeding stations may be made and references to these drawings marked on the layout. A schedule of components shall be made out in the drawing giving drawing references of components.

(f) **Cable Run Layout**

Cable run layout of each feeding station indicating inter-connection between various equipments, indoor and outdoor, along with schematic arrangements and physical disposition of equipment's, colour coding or code number and the index scheme adopted for terminals. The drawings shall also indicate the cable size and grades of insulation. The quantity of various cables required shall be indicated on the drawings

(g) **Equipment Drawings.**

Equipment drawings applicable to all feeding station except the ones for the equipments to be supplied by the Purchaser. Drawings should be dimensioned and should indicate: -

1. Fixing or mounting hole dimensions and arrangement

2. Net weight of the equipment.
3. Characteristic and rating of equipment
4. Circuit diagrams
5. Overall dimensions and other important dimensions
6. Height and vertical and horizontal dimensions of all exposed live parts
7. Notes explaining the operation of the equipment

(h) **Employment Schedule and Charts**

Employment schedules and charts applicable to all feeding 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.

(i) **Schedule of Quantities**

Within a fortnight of receipt of approval of relevant drawings for each feeding station, the following schedules of quantities shall be submitted.

1. Schedule of number of foundations, types, volume of different foundation and total volume. foundations will be treated as one foundation;
2. Schedule of number of masts, types, weight of different masts, and the total weight of masts of each gantry.
3. Schedule of steel work, types, weight of each member and total weight; and
4. Schedule of quantities of various items of work

(j) **Miscellaneous Drawings**

Miscellaneous drawings applicable to all feeding stations. These drawings shall include drawings or sketches made for study of clearances, isolator alignment details, scheme of interlocks, number plates of various equipments and "U" bolts for cable mounting, caution or instruction boards, outriggers for busbar supports and non-standard busbar connectors.

6.5. **Booster and LT Supply Transformer Station Drawings**

The Contractor shall submit for approval to the purchaser L.T. supply transformer stations, similar to those detailed for switching stations. The following drawings may, however, be combined together:

1. **Cross-section and foundation layout drawings;**
2. **General arrangement, structural and earthing layout drawings.**

(a) **Schedule of Quantities**

Within five months of issue of Letter of Acceptance of Tender, the Contractor shall assess the quantities of various items of work including various components and fittings as covered in Schedule 1 and submit Schedule 1 (Assess.1) along with the corresponding quantity of various fittings and components included in Schedule 3 for approval of the Purchaser. Such an assessment shall be revised at suitable intervals after the first assessment is approved till the work is completed. Such re-assessments denominated as Schedule 1 (Assess. 2) (Assess. 3) etc., shall also be submitted for approval of the purchaser. On receipt of approval of each final layout plan from the Purchaser, the followings Schedules of quantities relating to each layout plan shall be submitted within a fortnight.

- 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; and
- vi. Schedules of small parts steel work to be supplied; either by the Contractor or the Purchaser.

7. **Submission of Drawings & Schedules**

The submission of designs and drawings for approval shall be done in the manner indicated in this tender. 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 be communicated by the purchaser to the Contractor. The numbers 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 endeavor 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 taking into account the comments or modifications. Also, the Contractor shall as far as possible avoid correspondence on such comments and shall endeavor 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.

A. 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 GM/Electrical/BI-RIDE 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.

B. Special Designs

Special designs to meet the requirement of particular locations and local conditions shall be submitted in due time in duplicate for approval.

C. Purchaser's Pegging Plans

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.

D. 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.

E. 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.

F. OHE layout plans and profile drawings

Overhead equipment layout plans, provisional and final and profile drawings shall be submitted for approval in three copies.

G. 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.

H. Schedule of Quantities

Schedules of quantities for each approved layout plan/switching station shall be submitted for approval in two copies.

I. 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:

Sr. No	Document Description	No of Copies
1	Standard designs including fittings drawings)	8
2	Special designs	8
3	Final pegging plans	6
4	Structure Cross-section drawings	6
5	OHE layout plans	6
6	OHE profile drawings	6
7	Structure erection drawings	6
8	Stations Rules Diagrams	20
9	Stations working Instructions	20
10	Drawings for switching stations, booster transformer stations & LT Transformer Stations	6
11	Schedule of Quantities	3

J. Completion Drawings and Schedules

After completion of works, all drawings and designs submitted by the Contractor for OHE, TSS & SCADA works and approved by the purchaser shall be made upto date incorporation actual supply and erection particulars including the name and make of insulators, galvanized steel tubes, stainless steel wire rope, Transformers, Circuit Breakers, ATs, CTs, PTs, Interrupters, RTUs 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 shall be supplied in four sets, one of which shall be transparencies of linen or film reproduction or any other durable material approved by the purchaser. In addition, the contractor shall also supply the soft copy of approved drawings. The soft copy shall be in Auto Cad, Coral draw or any other similar format as mutually agreed between the contractor and the purchaser.

SECTION – 6

ERECTION AND INSTALLATION OF EQUIPMENT

PRINCIPLES**1. Methods of Erection**

All work shall be done in accordance with methods of erection and installation of equipment approved by the Purchaser. In the case of switching station, booster transformer stations, L.T. supply transformer stations and Traction Sub-Stations, standard methods adopted for erection and installation of electrical equipment shall be adopted.

2. Sectioning

The entire equipment shall be erected in accordance with the finally adopted sectioning diagram and in such a way so as to facilitate sectioning which may be required in future and which will be indicated by the purchaser.

3. Inspection

All erection and installation work shall be subject to inspection by the purchaser to ensure that the work is done in accordance with the specification, approved designs and drawings and is of the best quality suitable for the purpose.

4. Measurements

All measurements for location of structures and foundations shall be made with the aid of steel tapes. On curves, these measurements shall be taken on the outer rail of the middle track in the case of odd number of tracks and on the inner rail of the first outer track from the centre of the formation in the case of an even number of tracks, structures on curves shall be located in the radial offset of the location as determined.

5. Bolts, Nuts etc.

All bolts, nuts, locknuts, screws, locking plates & split cotter pins etc. shall be properly tightened and secured. Contractor shall carry out systematic inspection of this aspect of work after all adjustments to overhead equipment/installation are completed and prior to offering completed sections of equipment/Sub- Station to the purchaser for inspection and testing. No bolts may project more than 10mm beyond the nut/locknut after full tightening

6. Damage to Galvanizing Painting

In loading, transport and erection, all galvanized/ painted materials shall be handled with care to avoid damage to galvanizing/painting. If galvanizing /painting is damaged in spite of all care taken, the damaged part of component shall be put up for inspection, to obtain permission from the purchaser to carry out repairs.

7. foundations

The Contractor shall carry out soil pressure tests in accordance with methods approved by the purchaser to determine permissible bearing pressure of various representative types of soils in the presence of the purchaser's representative during the pegging out of site inspection. He shall adopt only those values as accepted by the purchaser for the design of foundations.

7.1. Locations

The location of each foundation or anchor block shall be set out correctly in accordance with approved structure cross-section drawings or foundations layout drawings, as the case may be, in the presence of the Purchaser's representative.

7.2. Method of Installation

As per provision in Clause 10.3 of IS: 456/2000, only mechanical mixers are to be used for mixing of concrete required anywhere in Electrification works including concrete for OHE foundation.

In exceptional circumstances, such as mechanical breakdown of mixer, work in remote areas or power breakdown and when the quantity of concrete work is very small, hand mixing may be done with the specific prior permission of the Engineer in writing subject to adding 10% extra cement. When hand mixing is permitted, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the concrete is uniform in colour and consistency.

He may erect traction masts or structures in the same operation as casting of foundations or erect them

subsequently in cored holes left in foundation blocks and grout them separately. In any case, the method of casting of foundation blocks and erection of masts or structures shall be subject to the approval of the purchaser.

7.3. **Excavation**

Normally, excavation of soil for foundations or anchor blocks alongside the tracks may be done upto length of 1 to 1.2 m and depth of 0.8 to 1 m without shoring, provided the excavated hole is concreted immediately and not left overnight. Shoring shall otherwise be done unless the hole is re-filled with soil and temped. In case the length of excavation is 1 to 1.2 m and depth of excavation for foundations and anchor blocks alongside the tracks is more than 0.8 to 1 m, the excavation may be undertaken only after certification by the purchaser's representative to be safe and concrete is cast on the same day. Shoring shall be done to the satisfaction of the purchaser's representative, if the excavated hole is left overnight. All water-logged locations will come under the purview of this para. In poor soil or ash banks, no excavation shall be done without adequate shoring and piling. For large foundations and water-logged locations shoring shall be done in accordance with drawings submitted by the Contractor and approved by the purchaser. Shoring/ shuttering of the pits should be provided effectively to the satisfaction of the purchaser. Core hole covers should be provided promptly on casting of foundation (within 48 hours) and their edges cemented to the foundation blocks. Prior to doing so, water should be filled in the core hole so as to assist in curing. The date of casting should be inscribed on the foundation block. In case of platform areas and Level crossings, the core holes should be filled with sand before provision of core hole covers so as to prevent any injury to rail users even if the core hole cover gets damaged or is displaced. The track ballast should be restored to its original from promptly after casting of the foundation block. The excavated earth should be removed well clear of the area so as to avoid any mixing up with the track ballast or any obstruction to the track drains. In case of cuttings, the earth should be thrown well away from the shoulders so that there is no risk of its flowing back to the drain during the rains.

7.4. **Concreting**

All concreting or grouting shall be done in accordance with above para (Foundations) with ballast graded for the purpose specified. The concrete shall be poured and temped properly in accordance with the method approved by the purchaser. The Contractor shall arrange to provide concrete testing samples for tests once every week or as and when required by the Purchaser, to determine crushing strength after 7 days or 28 days curing as required. Testing shall be arranged by the Contractor at his own cost



7.5. **Muffs**

7.5.1. **For OHE**

All anchor blocks and foundations of structures carrying overhead equipment shall be provided with concrete muffs. The top of these muffs shall be above the level of ground of the track formation and of adequate height of not less than 15 cm to afford reasonable protection during rainy weather. Muffs may be installed at the same time masts are grouted or after the mast/structure is loaded with equipment. The foundations of structures for switching stations need not, however, be provided with muffs. The top of such foundations shall be given a slope of 1 in 50 towards the edge to ensure that water does not collect at the base of the structure of the frame work of the equipment.



7.5.2. **For foundations level of TSS**

The top of all foundations and anchor blocks shall always be above the level of the ground and of adequate height, not less than 15 cm. to afford reasonable protection during rainy season. The top of foundation shall be finished to make a smooth surface sloping 1/20 outwards to drain rain water.

- a) Suitable grooves or niches shall be provided in the foundation blocks, wherever required, at the time of casting, to enable embedment of earth strips etc. to avoid the necessity of chipping of concrete.
- b) Conduits for cables should be embedded in the foundation blocks, wherever required, to avoid subsequent chipping off and breaking of the foundation blocks.
- c) All foundations will be cast in the presence of the Purchaser's representative with regard to fixed datum level.

7.6. **Masts and Structures**

7.6.1. **Erection**

In case traction masts or structures are erected in cored foundations, till such time they are grouted, they shall be properly wedged to prevent them leaning towards the track and endanger safety of moving vehicles. In case traction masts or structures are erected simultaneously with the casting of the foundations, the Contractor shall provide suitable temporary supports approved by the Purchaser. The masts/structure shall be embedded in the foundation blocks for the correct length specified in approved drawings.

Note: Mast/uprights should be grouted on the same day they are dropped in the foundations.

7.6.2. **Reverse Deflection.**

All traction masts and structures shall be erected with the correct reverse deflection so that they become reasonably vertical after they are loaded. The method of erection of masts with the correct reverse deflection shall be submitted to the Purchaser for approval

7.6.3. **Infringement to Standard Dimensions.**

In erection, care shall be taken to ensure that no part of the traction mast, structure or any fitting located on such mast or structure infringe the Schedule of Dimensions mentioned in Para - 2.1.1 (c) " Indian Railways Schedule of Dimensions".

7.6.4. **Alignment of Mast at Gantries**

The main masts of gantries shall be carefully aligned to enable easy and good assembly of fabricated steel work.

7.7. **Overhead Equipment**

A suggested method for erection of traction overhead equipment would ensure good speed and quality erection. The Contractor may, however, follow other methods which they consider would speed up and ensure good quality work, subject to the approval of the Purchaser. Any wiring method should take into consideration appreciable stretch of the catenary and contact wires in the initial days after they are strung and put under tension.

7.7.1. **Bracket Tubes**

In the erection of bracket assemblies, it shall be ensured that the free length of the bracket tube beyond the catenary suspension bracket is at least 200mm to facilitate adjustment during maintenance

7.7.2. **Stay Arms**

The choice of stay arms shall be such that their adjuster are capable of adjustments of minimum of 90 mm in either direction except as otherwise relaxed.

7.7.3. **Insulators**

Before insulators are used in bracket assemblies or dispatched to work site for erection from Contractor's Stores Depot, they shall be tested as specified for routine mechanical test. NO chipped or cracked insulators shall be installed. All insulators shall be cleaned before offering complete sections of equipment for inspection and testing. For testing of all types of Insulators, RDSO's Guidelines No. TI/MI/0011 (05/01) Rev.1 & TI/MI/ 0042 (12/2008) Rev. 0 or latest are to be followed.



7.7.4. **Stringing Catenary**

Care shall be taken to avoid kinking or bird caging of the catenary wire in stringing and subsequent operations. Soldered catenary wire should not be used. While stringing the wire shall be suspended from pulley blocks hung from the suspension clamp eye of bracket assemblies. The pulleys shall be fitted with ball bearing and shall be of the swivelling type to permit free movement in all directions to prevent damage to the strands of the wire. The design shall also be such that it will prevent slipping off of the wire during stringing operations. The designs of the pulley shall be submitted to the Purchaser for approval. After initial stringing of the catenary, it shall be maintained at the 'no load tension' for a minimum duration of 48 hours before the pulley blocks are removed and the catenary is clamped to suspension clamps of bracket assemblies. Shorter periods may, however, be allowed by the Purchaser.



7.7.5. **Stringing Contact Wire**

Care shall be taken to avoid formation of kinks, twists and damage to contact wire in stringing and subsequent operations. While stringing the contact wire, it shall be suspended from pulleys hung from droppers fitted to the catenary in their final position. In curves, the contact wire shall be run in pulleys located at traction masts or supports, corresponding to the approximate final position of the wire.

7.7.6. **Location of Droppers**

Droppers shall be correctly positioned in each span to ensure correct level of contact wire as per dropper chart applicable to the span.

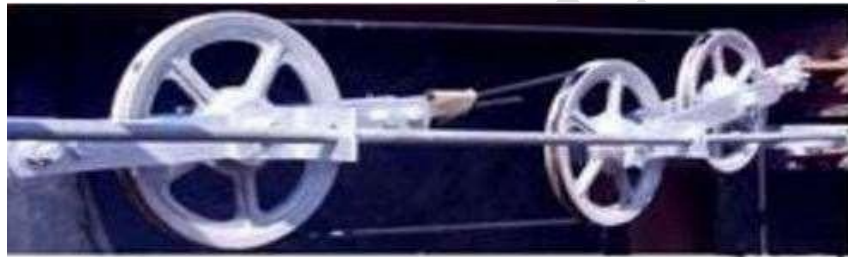


7.7.7. **Clipping droppers**

The dropper shall be clipped on the contact wire only after a minimum duration of 48 hours from the time the automatic tensioning device is brought into action. Shorter periods may, however, be allowed by the Purchaser.

7.7.8. **Auto Tensioning Device**

The auto-tensioning device shall be erected with the correct height of the counter-weight above rail level with corresponding distance between the pulleys of the device for a temperature of 35° C before it is connected to the overhead equipment and put into action. The installation of the device shall be such as to permit free, easy and unobstructed movement of counter-weight. RDSO's Guidelines No. TI/MI/0035 (09/01) Rev. 1 shall be followed at crossovers and short tension length ATDs



7.7.9. **Cut-In-Insulators**

All insulators in out of run shall be so positioned that they are away from the swept zone of the pantographs and will not foul with them. The live parts of these insulators shall also be so located that they are at least 2 m away from Structures other than those supporting traction overhead equipment.



7.7.10. **Section insulators**

All section, insulators shall be so located that they are beyond the swept zone of the pantograph running on adjacent tracks and there is no unusual sag due to the same. Where section insulators are installed, the contact plan of the runners of the insulators as well as those of overhead equipment connected to it shall be parallel to the track plane.



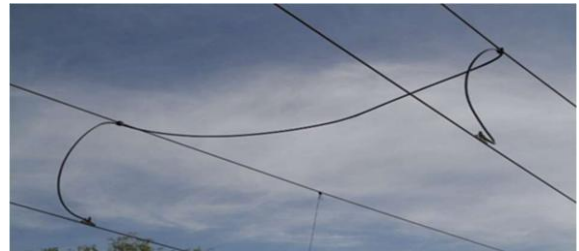
7.7.11. **Anti-Wind Clamp**

Anti-wind clamp shall be provided as shown in drawing



7.7.12. **Connection**

All jumper connections including anti-theft jumpers shall be made properly with parallel clamps and finished neatly without any loose wire or cables. The length of flexible jumpers shall be adequate to avoid any disturbance to overhead equipment or restraint in the relative movement of conductors, but the jumpers should not be excessively long. The ends of jumpers shall be tinned, including the portion inside the first parallel Clamp.



7.7.13. **Separation between OHE**

In erection, the physical separation required between overhead equipments and bracket assemblies on the same Structure at insulated overlaps shall be ensured.

7.7.14. **Gradient of Contact Wire**

The gradient of the contact wire on either side of overline Structures with restricted clearances shall be correctly adjusted and adequate clearance maintained between the overline Structure and live equipment.

7.7.15. **Adjustment at Turnouts**

Careful adjustment of equipment shall be made on equipments at Turnouts, cross overs, diamond crossings, overlaps and special Locations, for position of bracket assemblies, stay arms and height of contact wire to ensure that pantographs of electric rolling stock on the run will not foul with any parts of the bracket assemblies and changeover of the contact wire is effected smoothly.

For wiring in large Yards, the Contractor shall, prior to the execution of works, submit to the Purchaser's Engineer for the approval the sequence of stringing of catenary and contact wires to arrange for proper crossing of wires. Endeavor will be made to arrange for traffic blocks to suit approved sequence of wiring



7.7.16. **Isolators**

Isolator switches shall normally be so mounted that when the switches are operated, the operator faces the directions of the motion of trains. The operating handles and contact blades shall be correctly aligned for easy operation



7.7.17. **Bus Bars and Connections**

The busbar connections on the incoming side, shall be as tight as possible, all similar connections in adjacent bays being uniformly shaped and bent to give a good appearance. The tubular Aluminium busbars shall be supported at a uniform height throughout. Wherever tubular busbars are required to be bent, the radius of the bend shall not be less than 375 mm.

All Aluminium busbar joints shall be made carefully. The contact surfaces of the busbars and the connectors shall be cleaned vigorously either by hand with a dry coarse emery cloth or by power driven wire wheel brush. The surfaces shall be smeared with a suitable corrosion inhibiting joint compound approved by the Purchaser. The joint closed-up as soon as possible thereafter and a final light application of joint compound shall be made. Similar procedure shall be followed while connecting the equipment terminals to be busbar by means of bi-metallic connectors

7.8. **Earthing**

7.8.1. **For OHE**

The copper earth strips or MS flats used for earthing shall be bent and shaped neatly before connection to the structure or frame work of equipment. The connection of MS flats to steel work shall be made at a height not exceeding 15 cm from the datum level of a switching station. Before making earth connections the ends shall be cleaned thoroughly and tinned for copper strips. All junctions shall be properly secured to avoid loose contact. Portions of copper earth strips which remain visible above the ground level should be painted with suitable paint to make them inconspicuous.

7.8.2. **For TSS**

Typical clamping arrangement of M.S Flat inside Control Room is shown in the relevant drawing in Annexure-1. The joints on mild steel flats shall be welded type. The welds shall be treated with barium chromate before painting the welded surfaces. The connections to the various items of equipments shall be made with galvanized steel bolts (16mm dia), nuts with locknuts or spring washers as required. The earth connections to the structural members shall be made at height not exceeding 150 mm from the ground level. The steel flats shall be bent and shaped neatly before connection to the structures or frame work of equipment. The earth flats to run along the structures for connections of equipments to earth mat shall be properly supported on the structures with galvanized steel bolts (12mm dia), nuts with lock-nuts or spring washers, as required, at suitable intervals.

8. **Tolerance**

The permissible tolerance in dimensions for erections from those included in the appropriate drawings or schedules for different items are given below.

8.1. **Measurements**

- 8.1.1. The span length shall not vary more than ± 50 mm as measured along the appropriate rail
- 8.1.2. The cumulative error of measurement of all spans in a kilometer shall be not more than 1000 mm.

8.2. **Setting of Structures**

The setting of structures shall be not less than that included in the appropriate cross section drawings, especially those with the minimum setting of 2.36m. A tolerance of ± 20 mm will be permitted subject to minimum specified value, if the structure is not located in between tracks.

8.3. **Height of Contact Wire**

± 20 mm will be permitted on the height of contact wire at points of supports as shown in the relevant structure erection drawings, except under over line structures where no tolerance will be permitted.

8.4. Stagger: Generally, ± 200 mm will be permitted for stagger.

8.5. Dropper Lengths: ± 5 mm will be permitted for dropper lengths.

8.6. Dropper Locations: ± 100 mm will be permitted for dropper locations.

9. **Supplementary Instructions.**

Further working instructions will be issued if considered necessary by the Purchaser should be considered that the standard of work of the Contractor requires to be improved

10. **Equipment installations**

The installation of the equipment shall be carried out strictly in accordance with the instructions issued by the Manufacturer. The equipment shall be leveled carefully before being fixed finally in position. The bushings of insulators shall be protected adequately during erection of equipment to avoid chipping or damage to the porcelain. The following methods shall be adopted for mounting the various equipments.

S. No.	Equipment	Method of mounting.
i)	Main Power transformer	On two 90 lb/yd flat-footed rails laid on concrete foundations with a spacing of 1676 mm between the inner face of the rails
ii)	220/132/110 kV Circuit breaker	On steel supports mounted on concrete foundation with operating mechanism kiosk on concrete pedestal where necessary
iii)	25kV Circuit breakers and interrupters	On fabricated steel supports erected on concrete foundations
iv)	Isolators, potential transformers, Current transformer L.T supply transformers, 25 kV fuse Switches & Lightning arrestors.	On steel supports mounted on concrete foundations
The Circuit breakers, interrupters and Isolators shall be mounted in such a way that they can be manually operated conveniently by a person standing on the ground or on a concrete pedestal of suitable height.		
v)	Shunt capacitor bank & series reactor	On steel racks which in turn shall be mounted on a concrete plinth with suitable base frame.

11. **Cabling**

11.1. **Laying of Cables.**

All PVC cables provided out-door shall be either laid in trenches or neatly clamped to the structures as approved by the Purchaser. If it becomes necessary to take the cable connections along the steel supports for the equipment, the cables shall be laid through bent or shaped G.I. pipes embedded in concrete while the foundations are being cast. All cables in the cable trenches and along the structures shall be neatly secured with proper clamping arrangement at suitable intervals. Each cable in the cable trench/on the structure shall also be provided at suitable intervals with identification labels of durable material bearing indelible engraved or punched markings to facilitate easy identification.

11.2. **Termination of Cables**

The cables shall be terminated neatly and the cores arranged and dressed properly. Suitable terminal strips and ferrules made of PVC or other durable materials shall be provided on terminals and wire ends respectively to facilitate identification. The marking on the terminals strips and ferrules shall be either engraved or punched so as to be indelible.

11.3. **Indoor Wiring**

As far as possible all cables shall be laid in the trenches/ pipes provided for the purpose in the Control Room. Wherever necessary indoor wiring on walls shall be clamped neatly on teak wood battens/M.S flats fixed to the wall by means of rag bolts grouted in the wall. The typical clamping arrangement is shown in the relevant drawing in Annexure-1.

12. **Wiring Procedure**

The following procedure for the erection of overhead equipment has been formulated with a view to ensure that:

- 12.1. Bracket assemblies (brackets) and regulating equipment are correctly installed in their final position.
- 12.2. The conductors are correctly tensioned, and
- 12.3. The need for final adjustments of overhead equipment immediately before energization and commissioning is virtually eliminated.
- 12.4. **General**
In the case of regulated overhead equipment when the regulating equipments are in action, the tension in the conductors should remain constant, irrespective of variations in the ambient temperature. As the regulating equipments are brought into action a few days after the stringing of conductors the equipments is unregulated in the intervening period. Any of the following two procedure may be followed for tensioning and clamping of conductors of regulated overhead equipment during stringing operations, i.e. before the regulating equipments are brought into action.
 - 12.4.1. The catenary is tensioned to 1,000 kgf, the stipulated tension at the mean temperature of 35°C, whatever may be the ambient temperature during the stringing operations. In this case, at the time of clamping the catenary to the bracket, the brackets should be placed at angular positions corresponding to temperature at the time of clamping, and proportionate to their distance from the anti-creep.
 - 12.4.2. The aluminum alloy catenary is tensioned at the calculated tension to correspond to 1000 kgf, the stipulated tension at the mean temperature of 35°C whatever may be the ambient temperature during the stringing operations.
 - 12.4.3. The catenary is strained to a stringing tension corresponding to the ambient temperature for the equipment span of the tension length. In this case, the brackets are placed in the mean position, i.e. at right angles to the track, when the catenary is clamped or the regulating equipment commissioned.
 - 12.4.4. The advantage of the second method is that once the catenary is strung at the proper tension, there would be no necessity to adjust each bracket separately at the time of clamping the catenary or commissioning the regulating equipment. The erection work is, thus considerably simplified and the possibility of errors greatly reduced. This is also applicable to erection of unregulated overhead equipment.
- 12.5. **Erection of Brackets**
After the brackets are fabricated correctly in the Contractor's Depot, in accordance with the approved structure erection drawings, and provided with indelible labels or/painted marking indicating the intended locations for each bracket, they are removed to the site of work and erected on traction masts or supports. The brackets are swiveled to a position at the right angles to the track and secured in that position by means of steel wires tied to similar brackets located on the opposite side of the track or other suitable means



12.6. Anti Creep

The anti-creep of the tension length is then installed in its final positions.

12.7. Locking the regulating equipment

In the case of regulated overhead equipment, the regulating equipments are erected on the terminal masts or structures and their movement locked by suitable means in the middle position, with the distance between the pulleys of the regulating equipment corresponding to 35 degree centigrade.

12.8. Temporary Arrangement

A pulley approximately 30 cm. dia. is attached to the overhead equipment and of the regulating equipment by means of temporary accommodation fittings at both ends of the tension length to be wired. Over this pulley a flexible stranded wire is passed over. At each end of the wire two ending clamps, one for catenary and one contact wire, are attached. The wire is also clipped in the middle by 'U' clamps. The length of this temporary arrangement from the regulating equipment to the extremities of the stranded wire passing over the temporary pulley shall be a little longer than the distance between the regulating equipment and the ends of the catenary and contact wires in their final position, to permit easy clamping of terminal fittings during the final termination of the wire

12.9. Stringing of Catenary

The catenary is initially terminated in the ending clamp of the temporary arrangement at one end of the tension length. The catenary is then paid out from the wiring trolley and run-on pulley blocks hung from the suspension clamp eyes of brackets until the terminating point at the other end of the tension length is reached.

12.10. Tensioning of Catenary

The catenary is strained up to the 'Stringing tension' corresponding to the 'equivalent' span of the tension length and the ambient temperature at the time of stringing with the aid of a dynamometer, and terminated at the tension. For this purpose, the ambient temperature shall be deemed to be the temperature registered by a thermometer tied to a length of catenary wire 3 to 4 meters long, laid flat on the top platform, on one of the wagons of the wiring train. Subsequently, the tension in the wire is checked by measurement of sag with the help of leveling the attached to suspension points and to the catenary at midspan by a ladder working party. The sag shall be measured in two spans, each preferably greater than 54 meters, and situated on either side of anti-creep approximately midway between the anti-creep and the termination points. The value of sag measured by this method should be within $\pm 5\%$ of the theoretical value for the corresponding stringing tension, and the temperature at the time of this measurement. In case the discrepancy is more, the tension should be adjusted again and sag re-checked as above (see note 1). After the sag is checked the catenary is terminated at the ending fitting of the temporary arrangement at the terminating point.

In order to restrict the duration of traffic blocks to the minimum, into first block, the catenary is strained to the stringing tension with the aid of dynamometers and the catenary is terminated. In a subsequent block, the sag is checked and the tension readjusted with ladders, if necessary.

12.11. Clamping the Catenary

The catenary is clamped on the brackets placed at right angles to the track

12.12. Droppering

Droppers are fitted to the catenary at the correct locations. At the contact wire ends these droppers may be provided with small pulleys or hooks to act as temporary supports when the contact wire is strung. Hooks made of scrap contact wire, suspended from the catenary Wire, may also be used as temporary supports

12.13. Stringing Contact Wire

The contact wire is initially terminated in the contact wire ending clamp of the temporary arrangement at one end of the tension length. The wire is then paid out from the wiring trolley and supported on the pulleys hung from droppers or on hooks until the terminating point at the other end of the tension length is reached. In curves, the contact wire shall be registered on pulleys located at traction masts or supports corresponding to the approximate final position of the wire. The axes of these pulleys should be more or less vertical.

12.14. Tensioning of Contact Wire

The contact wire is strained to a tension on approximately 1.2 times the tension corresponding to the ambient

temperature and terminated in the ending clamp of the temporary arrangement.

12.15. **Regulating Equipment in action.**

The regulating equipment is put into action with the counter weight at the correct height above rail level and with distance between pulleys or the regulating equipment corresponding to a temperature of 35°C. The regulating equipment is then released and brought into action. The 'U' clamp connecting the flexible stranded wire passing round the temporary pulley is also removed

12.16. **Final Adjustment**

The entire installation is left in this condition as long as it is possible, preferably for a period not less than 15 days the temporary pulleys are removed and the conductors terminated in the permanent ending fittings, compensating plates, insulators and turn buckles. The equalizer plate is kept vertical or at a slightly inclined position (by 2 or 3 cm the contact wire being shorter than the catenary) and the position of the regulating equipment is checked in relation to, the temperature at the time. The contact wire is clipped on to the droppers (in the vertical position) and on the steady arms. Contact wire height at the bracket is adjusted as also the stagger and register arm clearance.

12.17. **Concluding Remarks**

If the above method is followed with care no further adjustment may be needed.

Note:

1. It should be ensured that sagging is done carefully and accurately. The adjustment of tension in the catenary after checking of sag, if required, would be easy if a temporary, turn buckle is inserted in the temporary termination.

The use of leveling lathes is recommended for the following reasons:

- a. The accuracy of adjustment is greater than that with a dynamometer.
 - b. No traffic block is required for this operation.
 - c. It obviates the necessity initial tensioning of the catenary accurately thus permitting a deduction in the period of traffic block required for the wiring train.
2. If feasible, without any hindrance to progress of works, the catenary may be maintained at stringing tension for a period of 48 hours before checking sag and clamping it to the brackets. This would ensure equalisation of tension in the different spans.
 3. Before clamping the catenary to the brackets, the sag should however, be checked in two spans
 4. If it is difficult to obtain a separate traffic block for stringing contact wire, the wire may be paid out at the same time, as the catenary, with the following precaution.
 - a. The contact wire is run and suspended from independent pulleys hooked on to the brackets, separately from the catenary pulleys, to avoid twisting together of the two conductors a special hook designed for this purpose.
 - b. The contact wire should not be suspended from the catenary until the latter is clamped on to the brackets.
 - c. The tension in the contact wire before termination should be about 1,500 kgf. This will ensure that sag is not excessive.
 - d. The adjustment of tension and checking of sag of the catenary wire is carried out as if the contact wire had not been strung. Only after adjustment of tension and checking of sag is completed, the contact wire is transferred to the pulleys attached to the droppers or to hooks suspended from the catenary and the tension is adjusted.
 5. When the contact wire is under tension, creep takes place which results in a increase in the length of wire and, consequently, the droppers and the equaliser plates would become oblique.

Though creep may continue for a long time, about a year, the bulk of it would occur during the days following stringing. If sufficient period of time is allowed the contact wire may be clipped to the droppers and the equaliser plates, all in the vertical position, and the necessity for any further adjustments before energisation and

commissioning of the OHE may be reduced to a great extent. If this precaution is not taken, at the time of energisation of the OHE, the droppers may not all be vertical and staff would have to be detailed for shifting the dropper clips which is attendant with risk of damage to the contact wire.

Before the temporary arrangement is removed a reference mark should be made on each conductor. After final termination of the conductors, It should be ensure that two marks are in the same relative longitudinal position as they were before the removal of the temporary arrangement.

Bi-RIDE

SECTION – 7

INSPECTIONS AND TESTING

1. **Overall performance.**

The overall performance of the overhead equipment should be such as would permit collection of current by electric rolling stock with full load at speeds, upto and including the maximum specified for the design of overhead equipment, smoothly, without mechanical shocks or prejudicial sparks and without undue heating in the case of other equipments

2. **Responsibility**

The general tests of overall performance stipulated below are only supplementary to other tests on structures, foundations, equipment, components and fittings as specified in the tender document. Any testing and acceptance by the Purchaser of overall performance shall be subject to the general terms of guarantee which shall continue to be valid as provided.

3. **Tests of OHE**

3.1 **General**

As soon as a section is ready for inspection and testing, the Contractor shall advise the Purchaser in writing. Tests to be carried out by the Purchaser will be done in the presence of the Contractor's representative and shall include the following apart from other reasonable tests that the Purchaser may like to conduct with a view to ensure, himself of the soundness of the equipments and their erection in strict compliance with the specifications.

3.2 **Insulation**

The strength of the insulation and the dielectric strength of the entire equipment as installed shall be tested with a 2500V Megger.

3.3 **Continuity**

The electrical continuity of the line and the existence of bad Contacts, if any, will be tested with a Megger.

3.4 **Electrical Independence**

The electrical independence of individual elementary sections in relation to one another shall also be tested with a Megger.

3.5 **Switches**

All isolators shall be tested for smooth and trouble-free operation.

3.6 **Tension Devices**

All automatic Tensioning devices installed shall be tested for sensitive functioning and adjustment.

3.7 **Stagger and height**

The stagger and height of contact wire over the entire section of completed overhead equipment and the clearances available shall be measured and the measurement shall be checked against approved drawings. These measurements shall be carried out at low speed with a vehicle or device to be arranged by the Purchaser, the movement of which will follow the track levels as closely as possible. Tolerance that will be permitted on the dimensions indicated in the approved drawings. The actual position of the two contact wires, relative to each other, at overlaps and turnouts shall also be checked. Special attention shall be paid to a smooth movement of Pantographs over section insulators, particularly those which are likely to be frequently traversed.

3.8 **Mechanical Behavior**

The mechanical behavior of the entire equipment shall be tested at various speeds under normal pantographs pressure without energizing the overhead equipment.

3.9 **Energizing**

If the overhead equipment, after being subjected to the above tests in an un-energised condition, is found to be satisfactory, it will be energised with the normal 25 KV A.C. supply.

Tests shall then be conducted to check if the power collection performance of the overhead equipment is satisfactory after ensuring that the contact wire is adequately clean. For this purpose, an observation car shall be attached next to the electric locomotive. The behavior of the overhead equipment will be watched at various speeds. Power

collection shall be considered unsatisfactory if a long blue flash is observed, indicating that the contact between the contact wire and the pantograph is not continuous.

4. **Inspection and Testing of Switching Stations etc.**

4.1 **General.**

Equipment's from the switching stations shall be released and stored with utmost care with an intention to re-use them in the new Switching station. These equipments shall be tested for their performances as per the standard procedures and re-installed and commissioned only after ensuring all the required parameters are within the range. Released Equipments which fail in the performance tests, shall not be re-installed and they shall get repaired before re-erection. All released equipments shall be re-erected after obtaining permission from employer/Engineer.

Any equipment found faulty after release, shall be repaired by the contractor to make them in good fettle. In case, any of such equipment found irreparable, those shall be procured afresh by the contractor with prior approval of the Employer/ Engineer. There will not be any extra cost compensated to the contractor.

As soon as a switching station, booster transformer station or LT supply transformer station and Traction Sub-Station is ready for inspection and testing, the Contractor shall advise the Purchaser in writing. Testing will be carried out by the Purchaser at his cost jointly with the Contractor. These shall include the tests which the Purchaser may like to conduct with a view to assure himself of the soundness of the equipments and their erection in compliance with this specification. However, testing equipments such as those indicated below and staff required for the tests shall be provided by the Contractor free of charge.

1. Oil testing equipment.
2. 5000V/2500 V & 500 V meggers.
3. Earth megger and accessories.
4. Continuity test apparatus.
5. Avometer
6. Relay testing kit.
7. Primary injection test set.

The Contractor shall take full responsibility for these tests inter-alia his other responsibilities.

4.2 **Visual inspection**

Visual inspection which shall include check for satisfactory workmanship shall cover all connections, Painting, Plastering, Cleanliness of all insulators etc. and compliance with Indian Electricity Rules.

4.3 **Operations Test**

These tests will be conducted on every individual item of equipment such as interrupters, isolators, relays etc. to ensure that the equipment as a whole is functioning properly and is mechanically sound, i.e. in the particular case of isolators the fixed contact and knife blade have been correctly aligned and operations does not cause undue strain on the equipment. The operation tests will be carried out with the high-tension installation dis-connected from the supply, but by actuating power devices where such are provided. Continuity test of high-tension connections after setting such interrupter and isolator in their respective positions shall also be conducted as part of the operation test.

4.4 **Insulation**

The strength of insulation of the various items of equipment and of the entire installation as a whole shall be tested with a 5000V/2500 V/500 V megger, as required.

4.5 **Di-Electric Strength of Oil**

The di-electric strength of the oil of the Instrument Transformers (except if they are of sealed construction), Booster transformer Circuit Breaker & LT supply transformer, at each station shall be tested before commissioning in accordance with IS:335 (Latest version as indicated in Annexure-1) should this be found not correct, the Contractor shall arrange at his own expenses to have it rectified.

4.6 **Isolators**

All isolators will be tested for smooth and trouble-free operation. Correct functioning of interlocking device shall be checked.

- 4.7 **Interrupters**
Operation of trip and close coils for interrupters shall be tested for satisfactory performance with the respective equipment's de-energized.
- 4.8 **Instrument Transformers**
Tests shall be conducted to check the polarity of current and potential transformers.
- 4.9 **Ammeter and Voltmeter**
The Calibration of ammeters and voltmeters provided on the control board shall be checked.
- 4.10 **Protective Relays**
The Contractor, shall arrange for all protective relays to be tested and calibrated in a recognized test laboratory at his own cost, just prior to installation on the control board, and shall submit six copies of the test certificates to the Purchaser.
- 4.11 **Primary and Secondary Injection Tests**
Operation of all protective relays, auxiliary relays and trip and close coils for circuit breakers shall be tested for satisfactory performance with the respective equipment's de-energized. Correct functioning of all electrical interlocks inter- tripping etc. shall also be checked during these tests.
- 4.12 **Performance Tests**
To verify the performance of the complete capacitor bank, tests as specified in respective clause of RDSO specification No. TI/SPC/PSI/FC & SR/0100 (01/2010) shall be carried out at site after installation.
5. **Earthing.**
- 5.1 Earth wires will be checked for continuity and electrical isolation every 1000 m approx.
- 5.2 Clearances between earth wires and out-of-run wires of overhead equipment and signals shall be checked.
- 5.3 Earth resistance shall be measured separately for each earth electrode. In the case of interconnected earth electrodes, the net resistance of the inter-connected electrodes shall also be measured.
- 5.4 Earth resistance will be measured separately for each earth electrode and when they are connected together and to the equipment at each sub-station, feeding station and shunt capacitor bank.
6. **Detailed Procedure for Tests**
The detailed procedure for inspection and testing will be furnished to the contractor. The contractor shall submit the results of tests in the proforma which will be furnished by the Purchaser, in quadruplicate.

SECTION - 8

SAFETY AND SECURITY AT WORK

1. The works included in this contract are to be carried out close to the running tracks and public utilities, therefore, safety of running trains and the public is paramount. Therefore, all activities undertaken by the Contractor/his Sub-contractors shall ensure safety at all times. The contractor shall comply with the instructions issued by the Railway/ Engineer/Employer from time to time to ensure safe running of trains while carrying out works. The rates quoted by the Contractor shall be deemed to include all expenditure incurred in compliance with the same.
2. Before starting any excavation work adjacent to existing track, the contractor shall ensure that necessary permissions has been obtained and required precautions have been taken for doing such work in terms Joint Procedure Order (JPO). The penalties mentioned in the following JPO shall be levied on the contractor if such event occur. The JPO is reproduced below:

JOINT PROCEDURE ORDER FOR UNDERTAKING DIGGING WORK IN THE VICINITY OF UNDERGROUND SIGNALING, ELECTRICAL AND TELECOMMUNICATION CABLES

- 2.1 A Number of Engineering works in connection with gauge conversion/doubling/third line are in progress on various railways, which require extensive digging work near the running track, in close vicinity of the working S&T cables carrying vital safety circuits as well as electrical cables feeding the power supply to cabins. ASM room, RRI Cabin, Intermediate Block Huts (IBH) etc. Similarly, S&T organization under open line or construction units under CAO/C, are executing various Signaling and Telecom works requiring digging of earth for laying of cables or casting of foundations for the erection of signal posts etc. Rail-Tel is also executing the work of laying of quad cable and OFC on various Railways as a part of sanctioned works for exclusive use of Railways for carrying voice and data i.e. administrative and control communication, PRS, FOIS etc. or shared by RailTel Corporation of India Ltd. On certain sections, digging is also required for laying of electrical cable and casting of foundation for the erection of OHE masts by Electrical Dept. Generally, these works are executed by contractors employed by these organizations.
- 2.2 However, while carrying out these works in the vicinity of working signaling, telecommunication and electrical cables, at times, cable cuts take place due to JCB machines working along the track or during the digging work being done by contractors carrying out the Civil Engineering Works. Similarly, such cable cut are also resulting due to works undertaken by S&T or Electrical departments. Such cable faults results in the failure of vital signaling and telecommunication circuits & electrical installations.
- 2.3 Henceforth, the following joint procedure shall be followed by Engineering, Electrical and S&T (and Rail Tel organization, wherever such works are being done by them) officers of the respective divisions and by the construction organization, while carrying out any digging work near to existing signaling & telecommunication and electrical cables, so that the instances of cable cut dueto execution of works, can be controlled and minimized.
 - (a) S&T Department (and Rail Tel, where they have laid the cables) and Electrical department shall provide a detailed cable route plan showing exact location of cable at an interval of 200m or wherever there is change in alignment so that the same is located easily by the Engineering official/contractor. In addition, S&T department and Electrical department shall also provide cable markers along the alignment of the cable. These cable route plans shall be made available to the Sr.DEN/DEN or Dy. CE/C, as the case may be, by Sr. DSTE/DSTE or Sr. DEE/DEE of the divisions or Dy. CSTE/C or Dy.CEE/C within 15 days in duplicate. Sr.DEN/DEN or Dy. CE/C will send copies to their field unit i.e. AEN/SE/P. Way & Works.
 - (b) Before taking up any digging activity on a particular work by any agency, Sr. DSTE/DSTE or Sr.DEE/DEE of the section shall be approached in writing by the concerned Engg. or S&T or Electrical officer for permitting to undertake the work. Sr. DSTE/DSTE or Sr.DEE/DEE, after ensuring that the concerned executing agencies including the contractor have fully understood the S&T and Electrical cable route plan shall permit the work in writing within 7 days of the request by concerned department.
 - (c) After getting the permission from S&T or Electrical department as the case may be, the relevant portion of the cable route plan shall be attached to the letter through which permission is issued to the contractor by concerned Engg. official for commencement or work and ensuring that the contractors have fully understood the cable route plan and precautions to be taken to prevent damage to the underground cables. The contractor shall be asked to study the cable plan and follow it meticulously to ensure that the safety of the cable is not endangered. Such a provision, including any penalty for default, should form part of agreement also. It is advisable that a suitable post of SE/Sig or SE/Tele or SE/Electrical (TRD or G) shall be created chargeable to the estimates of doubling/gauge conversion, who can help Engg. agencies in the execution of the work. However basic responsibility will be of the department executing the work and the Contractor. Creation of posts is not mandatory.

- (d) The SE/P. Way or SE/Works shall pass on the information to the concerned SE/Sig SE/Tele or SE/ Electrical (TRD or G) about the works being taken up by the contractors in their sections at least 3 days in advance of the day of the work. In addition, Engineering control shall also be informed by SE/P. Way or SE/Works, who in turn shall pass on the information to the test room/network operation centre of Rail Tel/TPC/Electrical control.
- (e) On receiving the above information, SE/Sig or SE/Tele or SE/Electrical (TRD or G) shall visit the site on or before the date of taking up the work and issue permission to the contractor to commence the work after checking that adequate precautions have been taken to avoid the damage to the cables. The permission shall be granted within 3 days of submission of such requests.
- (f) The name of the contractor, his contact telephone number, the nature of the work shall be notified in the Engineering control as soon as the concerned Engineering officials issue the letter authorizing commencement of work to the contractor. Test room shall be given copies. Test room shall collect any further details from the Engineering Control and shall pass it on to S&T/Rail Tel & Electrical officials regularly. In case the supervisors of concerned departments do not turn up on the day as advised in terms of Para 4 and 5 above, the works of contractor should not be stopped on this account.
- (g) In case of works being taken up by the State Government, National Highway Authority etc., the details of the permission given i.e. the nature the work, kilometer etc. be given to the Engineering control including the contact person's number so that the work can be done in a planned manner. The permission letter shall indicate the contact numbers of Test room/network Operating Centre of Rail Tel/TPC/Elect. Control.
- (h) Where the nature of the work taken up by the Engineering department is such that the OFC or other S&T cables or Electrical cables is to be shifted and relocated, notice of minimum one week shall be given so that the Division/Rail Tel/Construction can plan the works properly for shifting. Such shifting works shall in addition, for security and integrity of the cables, be supervised by S&T supervisors/Rail Tel supervisors/Electrical Supervisors.
- (i) The concerned SE/P. Way/SE/Works/SE/Sig/SE/Tele/SE/Electrical (TRD or G) or Rail Tel supervisors supervising the work of the contractor shall ensure that the existing emergency sockets are not damaged in view of their importance in providing communication during accident/emergency.
- (j) In case of minor nature of works where shifting of cable is not required, in order to prevent damage to the cable, the Engineering contractor shall take out the S&T or optical fiber cable or Electrical cable carefully from the trench and place it properly alongside at a safe location before starting the earthwork under the supervision of SE/Sig or SE/Tele or SE/Electrical (TRD or G). The cable shall be reburied soon after completion of excavation with proper care including placement of the brick over the cable under the supervision of S&T or Electrical supervisors. However, the work will be charged to the concerned engineering works. The responsibility for ensuring availability of SE (Signal), SE (Electrical) as per Para 4 and 5 above lies with the respective department. The contractor will go ahead with the shifting of cables as per the program decided and he will not be held responsible for any cable cut.
- (k) In all the sections where major project is to be taken up/going on Rail Tel/S&T department shall deploy their official to take preventive/corrective action at site of work. As regards Electrical Department, the official may be deputed on need basis.
- (l) No new OFC or quad cable shall be laid close to existing track. It shall be laid close to the Railway boundary on one side of the Railway track to the extent possible to avoid any interference with the future works (doubling etc.). It shall be ensured in the new works of cable laying that the cable route is properly identified with electronic or concrete markers. Wherever multiple cables are laid in a trench, RFID markers may be provided for easy identification of the cable. Henceforth, wherever cable laying is planned, before undertaking the cable laying work, the cable route plan of the same shall be prepared by the Dy. CSTE/A or Dy.CEE/C and shall be got approved from the concerned Sr. DSTE/DSTE or Sr.DEE/DEE and also from the concerned Dy. CE/C for new lines and from the concerned Sr.DEN for all other projects including GC etc., to avoid possible damages in future. Such approvals shall be granted within 15 days of the submission of the request.
- (m) The works of excavating the trench and laying of the cable should proceed in quick succession, leaving a minimum time between the two activities.

- (n) In case damage caused to OFC/Quad cable or Electrical cable during execution of the work, the contractor is liable to pay a penalty for damaging the cable. Penalty shall not be levied in case of the following:
- Detailed cable route plan as per clause C-1 not provided by concerned department or cable is not protected as per laid down procedures.
 - The alignment of the cable does not tally with the information provided to the contractor.
 - The cable depth is found to be less than 800 mm from normal ground level.
 - No representative of S&T department/Rail Tel was available at site guarding the cables on the fixed pre-determined date and time.

- (o) Penalty to be imposed for damages

Cable damaged	Penalty per location
Only Quad cable or Signaling cable	Rs.1.0 Lakh
Only OFC	Rs.1.25 Lakh
Both OFC & Quad	Rs.1.5 Lakh
Electrical Cable	Rs.1.0 Lakh

Necessary debit in this regard shall be raised on the department undertaking the work who shall in turn levy the penalty on the defaulting contractor. S&T department shall raise the debits in case of damage to OFC or Quad or Signaling cable and Electrical department shall raise the debits in case of damage to Electrical cable.

- (p) Railways will not lodge FIR with RPF in case of works being executed by authorized contractors of Railways who have been duly permitted to execute the works in accordance with this JPO. Joint note by the supervisors of the concerned department shall be prepared and the responsibility of the cable cut should be decided without involving RPF. The joint note deciding the fact whether the contractor should be penalized shall be completed in a day's time from the occurrence of cable cut. In all other cases, when the cable is cut by an agency that was not permitted to execute any work, FIR should be lodged with RPF.
- (q) While giving permission for taking up the works, concerned departments may note that earthwork by engineering contractors will normally be done by machines except in a few isolated locations where the quantity of earth work is very less.
- Railways shall make necessary correction in their future contract so that this JPO can also be enforced contractually.
 - In case of damages to OFC, Rail Tel should be paid 5/6th of the penalty recovered. Rail Tel shall raise demands on the S&T department in this regard.
 - All types of signaling & OHE bonds i.e. rail bond, cross bond and structure bond shall be restored by the contractor with a view to keep rail voltage low to ensure safety of personnel.
- (r) Above joint circular shall be applicable for construction as well as open line organization of Engineering, S&T and Electrical.
- (s) S&T cable and electrical cable route plan should be prepared by the concerned S&T and Electrical officers respectively and got approved as stipulated in Para C-12 before undertaking the work. The completion cable route plan should be finalized block section by block section as soon as the work is completed.
- (t) All cable laying works shall be executed as per laid down technical specifications, such as protection measures/protective cover, compaction of refilled material etc.

3. Working Near Running Rail.

- 3.1 The contractor shall not allow any road vehicle belonging to him or his suppliers etc. to ply in railway land next to the running line. If for execution of certain works viz. earth work for parallel railway line and supply of ballast for new or existing rail line, gauge conversion etc, road vehicles are necessary to be used in railway land next to the railway line, the contractor shall apply to the Engineer for permission giving the type & no. of individual vehicles,

names & license particulars of the drivers, location, duration & timings for such work/movement. The Railways/Employer/Engineer or his authorized representative will personally counsel, examine & certify, the road vehicle drivers, contractor's flag men & supervisor and will give written permission giving names of road vehicle drivers, contractor's flag men and supervisor to be deployed on the work, location, period and timing of the work. This permission will be subject to the following obligatory conditions:

- 3.2 Road vehicles can ply along the track after suitable cordoning of track with minimum distance of 6 meters from the centre of the nearest track. For working of machinery close to the running tracks or plying of road vehicles during night hours, the contractor shall apply to the Engineer in writing for permission, duly indicating the site details in a neat sketch and safety measures proposed to be taken. Subject to the approval of concerned Railway authorities, the Engineer or his authorized representative will communicate permission to the contractor/contractor's representative. The contractor and his men shall strictly adhere to the instructions given along with such permissions.
- 3.3 Nominated vehicles and drivers shall be utilized for work in the presence of at least one flag man and one supervisor certified for such work. In order to monitor the activities during night hours, additional staff may have to be posted based on the need of the individual site.
- 3.4 The Contractor's machinery, equipment and vehicles shall normally operate 6 m clear of track. Any movement/work at less than 6m and upto a minimum of 3.5m clear of track center, shall be carried out only in the presence of a person (including any railway employee) authorized by the Engineer. No part of the road vehicle shall be allowed at less than 3.5m from track center.
- 3.5 The Contractor's machinery and equipment are required to operate close to the existing line carrying traffic. Contractor is fully responsible for operating these machineries without endangering the safety of the running line and traffic.
- 3.5.1 The "look out and whistle" caution orders shall be issued to the trains and speed restrictions imposed where considered necessary. Suitable flag men/detonators shall be provided where necessary for protection of trains.
- 3.5.2 The supervisors/workmen should be counseled about safety measures. A competency certificate to the contractor's supervisor as per proforma annexed shall be issued by Manager/Electrical which will be valid only for the work for which it has been issued.
- 3.5.3 The unloaded masts, portals, copper drums, cement/ sand bags, cut pieces of steel and other such materials after unloading along track should be kept clear off moving dimensions and stacked as per the specified heights and distance from the running track.
- 3.5.4 Supplementary site-specific instructions, wherever considered necessary, shall be issued by the Engineer.
- 3.6 The contractor shall provide at site at his own cost, all protection measures including exhibition and lighting of all Temporary Engineering Signals as per Railway rules, instructions and norms. All lights provided by the contractor shall be screened so as not to interfere with any signal light on the Railways or with any traffic or signal lights of any local or other authority.
- 3.7 **Ancillary and Temporary works**
- 3.7.1 The Contractor's proposals for erection of all ancillary and temporary works shall be in conformity with the proposals submitted along with the tender and modifications thereto as approved by the Engineer.
- 3.7.2 The Contractor shall submit drawings, supporting design calculations where called for by the Engineer and other relevant details of all such works to the Engineer for approval at least one month before he desires to commence such works. Approval by the Engineer of any such proposal shall not relieve the contractor of his responsibility for the sufficiency of such works.
- 3.7.3 The contractor shall, at his own cost, design and provide any temporary arrangements including modifications required in connection with the above said works and remove the old lines/masts/portals etc., when no longer required. These arrangements shall conform to Railway norms. The contractor shall obtain all necessary approvals and sanctions of the concerned Railway / K RIDE authorities including Commissioner of Railway Safety through the Engineer/ Employer in advance and well in time.
- 3.7.4 The contractor shall ensure and be entirely responsible for proper design, fabrication, provision and upkeep of all

temporary arrangements and all associated activities so as not to endanger safety of any assets, running track, traffic and traveling public

- 3.7.5 Notwithstanding the above, the contractor shall not, however, be relieved of his responsibility and obligation as aforesaid.
- 3.7.6 Save as provided in Para 1.5(e) above, the contractor shall bear the cost of complying with all safety requirements. No extra payment will be made for complying with the safety provisions under this chapter and the cost of all such elements to meet the safety requirements shall be deemed to be included in the price schedule.
- 3.7.7 The contractor remains fully responsible for ensuring safety. In case of any accident, the Contractor shall bear cost of all damages to his equipment and men and also damages to Railway and its passengers.

3.8 **Precautions to be taken when working under 25kV Overhead Supply.**

- 3.8.1 No work shall be done above or with in a distance of 2 meters from the live OHE without a "Permit to Work".
- 3.8.2 Inductive effects occur on large metallic structures such as fencings, structural steel of platforms running parallel to the track. They will have to be earthed suitably to afford safety.
- 3.8.3 Each working party shall be protected by at least two independent earths, one on each side of a working party.
- 3.8.4 If the distance between the working parties exceeds 100 meters, intermediate earth shall be provided in such a manner as to ensure that the distance between earths does not exceed 100 meters.
- 3.8.5 Men shall be posted on both sides of the site of work to warn the working party of any approaching train on the same track and adjacent track.
- 3.8.6 For providing earth on the OHE, fix the earthing clamp securely to a mast at least one span away after making sure that the mast to earth rail bond of this mast is intact.
- 3.8.7 Earthing clamps should always be fixed to the traction rail or mast first and then the top clamp should be hooked to the OHE to be earthed.
- 3.8.8 For removing the earthing, first remove the hook on the OHE and then the clamp fixed to the rail or mast
- 3.8.9 Two sections of conductors or ends of conductors which may have snapped should be separately earthed at two points after switching off supply to both parts of the OHE. This precaution should also be observed when working or in the vicinity of a sectioning point and cut in insulators.
- 3.8.10 Neutral sections should be treated as live equipment and earthed separately at two points on either side of the work party before commencing work.
- 3.8.11 When work is to be carried out on an isolator, both sides of the isolator should be earthed at two points.
- 3.8.12 No fallen wires shall be touched unless power is switched off and the wire suitably earthed.
- 3.8.13 In electrified track, steel tape or metallic tape or tape with woven metal reinforcement should not be used.
- 3.8.14 Ropes, come along clamps, tirfor should be tested once in a month in the presence of K- Ride/Representative
- 3.8.15 All the staff should wear helmets to protect their heads against any tools or equipment which may drop down accidentally.
- 3.8.16 Staff should protect themselves against an inadvertent fall by wearing a safety belt for supporting themselves by a rope sling.
- 3.8.17 Ropes used with ladders should be cotton or jute. Use of metallic ropes is prohibited. A ladder should be held by one person on the ground to prevent slipping, while the top end should be tied to the supporting structure or conductor to keep it in position and prevent it sliding away.
- 3.8.18 Ladders should never be allowed to fall on or rest against the contact wire.
- 3.8.19 More than one person shall not normally be allowed on a ladder as far as possible.
- 3.8.20 Climbing on a ladder with wet or slippery foot wear is forbidden.
- 3.8.21 A rope should be used to pass tools or any equipment to the men working on a ladder.
- 3.8.22 No one should stand directly below a work spot under a ladder.
- 3.8.23 The strength of the anchoring rope should not be less than of the cable to be anchored.
- 3.8.24 It is important that staff who ask for power block should know the correct method of identifying and describing any section of OHE where shutdown is required.
- 3.8.25 Whenever there is a doubt in the description, the person asking for power block shall state clearly the track and OHE structure numbers between which work is to be done.
- 3.8.26 All messages relating to shut down and restoration of power supply, permits to work, etc. issued over the telephone shall invariably be supported by exchange of private numbers and repeated twice.
- 3.8.27 Do not tie the rope on rail without taking traffic block.
- 3.8.28 It is necessary to take traffic block while working on tunnel or bridge.

3.9 Safety Rules for 25kV, 50Hz, Overhead Equipment

3.9.1 Staff Should neither sit nor stand under the ATD Balance weight.



3.9.2 Ropes, Pulleys, Pull-Lifts, come along clamps 'D' shakels and tirsfors etc. should be tested once in six months and keep record.



3.9.3 No fallen wires shall be touched unless power is switched off and the wire suitably earthed



3.9.4 Do not wear loose cloths such as kurta pazama, lungi, safi etc. while working.



- 3.9.5 Do not stand on bracket tube insulator, while maintenance of OHE



3.9.6 **The following rules are supplementary to the General and Subsidiary Rules.**

- 3.9.6.1 Printed boards containing instructions regarding treatment of persons suffering from electric shock should be exhibited in every OHE maintenance depot, equipment room, switching station, cabin, OHE Inspection Car shed, loco shed, OHE Inspection Car and wiring train and also in offices of SM, ASM, CYM, AYM and HTXR.
- 3.9.6.2 First Aid Boxes should be kept at every switching station, maintenance depot, in OHE Inspection Car, breakdown vehicle and wiring train.
- 3.9.6.3 Ropes, come-along clamps, Tirfor etc. should be tested once in six months at least, in the presence of an Bi-RIDE representative, and record of such tests maintained in each depot

3.9.7 **Permit to Work**

Before commencing work on any part of the dead OHE or within 2m of live OHE, a permit-to-work shall be obtained from TPC or other authorized person.

3.9.8 **Protection of Staff against Traffic Movements and Protection of Trains**

- 3.9.8.1 The supervisory official in-charge of work on OHE shall observe relevant provisions of GR and SR for protection of trains before work on OHE is commenced and for the whole time the work is in progress.
- 3.9.8.2 Measures shall be observed by all concerned to prevent accidental energization of the section under power block on account of electric train movements.

3.9.9 **Earthing before commencement of Work.**

- 3.9.9.1 All metallic parts within reach (either directly or through tools etc.) shall be earthed, after they are made dead.
- 3.9.9.2 Each working party shall be protected by at least two independent earths, one on each side of a working party.
- 3.9.9.3 If the distance between the working parties exceeds 1000m intermediate earths shall be provided in such a manner as to ensure that the distance between earths does not exceed 1000m.
- 3.9.9.4 Even when earthing is provided by isolator switches with earthing heels, additional temporary earths as above shall also be provided.

3.9.10 **Procedure for Providing Temporary Earths**

The following sequence of operations shall be carried out while providing temporary earths on OHE.

- 3.9.10.1 Men shall be posted on both sides of the site of work to warn the working party of any approaching train on the same track and adjacent track(s).
- 3.9.10.2 The permit-to-work shall be obtained prior to commencing work to make sure that power supply has been switched off.



First fix earthing clamp of discharge rod to rail / mast

- 3.9.10.3 For providing temporary earth on the OHE or other equipment after it has been made dead, only discharge/ earthing pole assembly specially designed for this purpose alone should be used. The cable shall be flexible and should have adequate cross-section (40 sq.mm) to be able to withstand short circuit currents.
- 3.9.10.4 Fix the earthing-clamp securely to a mast at least one span away on one side of the work site after making sure that the mast-to-earth rail bond of this mast is intact. Alternatively, the clamp may be fixed to the bottom flange of one of the traction rails, taking the cable under the rails.
 - A) In single-rail track-circuited sections, the earthing clamp should be fixed to the traction rail i.e. non- track-circuit rail; on double-rail track-circuited sections the earthing clamp should be fixed to the mast.
 - B) The mast-end or rail-end clamp of the discharge /earthing pole assembly should be checked for tightness just before connecting the top clamp on to the OHE as the earthing clamp fixed to the rail or mast in advance could have worked loose.
- 3.9.10.5 Hook securely with a snap action the top clamp of discharge/ earthing pole assembly to the OHE conductor close to the mast/structure and tie the earthing pole to the mast/structure. Never hook on the top hook of the earthing cable to the OHE, till the other end has been first connected to earth.
- 3.9.10.6 The earthing clamps should always be fixed to the traction rail or mast / structure first and then the top clamp should be hooked to the OHE to be earthed.
- 3.9.10.7 Repeat operations 4 and 5 for the second temporary earth on the other side of the working party.
- 3.9.10.8 After temporary earths have been fixed on the OHE on both sides of the work site, staff may proceed with the maintenance work.
- 3.9.10.9 After work is completed and men, materials and tools have been removed and the OHE is clear, the above earthing rods may be removed in the reverse order i.e., first remove the hook on the OHE and then the clamp fixed to the rail or mast/ structure. After warning all staff that supply will be restored and that they should keep away from live equipment, the permit-to-work may be returned and supply restored
- 3.9.11 **Precautions in Regard to Discharge/ Earthing Pole Assembly**
 - 3.9.11.1 The continuity of the cable connection between the top clamp and the earthing clamp should be checked once a fortnight.
 - 3.9.11.2 Cable should be renewed if more than 20% strands are broken. During use, cable should be continually examined for fraying and breakage of strands.
 - 3.9.11.3 Discharge/Earthing pole assembly should be inspected by Bi-RIDE/representative once a month.
 - 3.9.11.4 During accidents when slewing the OHE and in similar circumstances, the discharge/ earthing pole assembly should be provided at a location where it is not likely to be interfered with during crane working or due to work on the permanent way.
- 3.9.12 **Work on OHE or any Conductor having a Sectioning Point**
When work is to be carried out on OHE or conductors, which are not electrically bonded, following additional precautions are required.

- The two sections of conductors or ends of conductor which may have snapped may be at different potentials. Each end should, therefore, be separately earthed at two points after switching off supply to both parts of the OHE or conductor.
- This precaution should also be observed when working on or in the vicinity of a sectioning point and cut-in insulators.
- Neutral Sections should be treated as live equipment and earthed separately at two points on either side of the work party before commencing work.
- When work is to be carried out on an isolator, both sides of the isolator should be earthed at two points or more conveniently, isolator jumpered temporarily.

Even when earthing is provided by isolator switches with earthing heels, additional temporary earths shall also be provided on both side of the isolator



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3.9.13 Protective Helmets

- At the work-site, staff are advised to wear helmets to protect their heads from falling objects or accidental fall from a height.
- Wear helmet not only while working above ground level, but wear helmet while working at ground level as well.



3.9.14 Safety Belt:

Staff working on structures or a ladder are advised to protect themselves against an inadvertent fall by wearing a safety belt for supporting themselves by a rope sling.

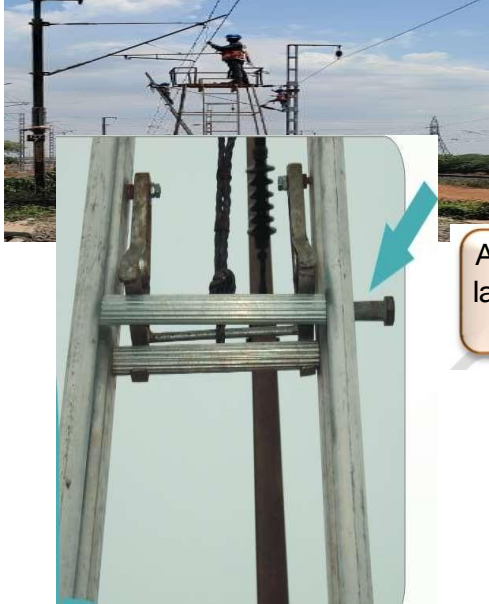


3.9.15 Rules for Use of Ladders

- 3.9.15.1 It shall be the responsibility of the supervisor to ensure that ladders are stored in a protected enclosure, properly maintained and reconditioned as often as required.
- 3.9.15.2 A ladder should never be in such a position so as to likely to fall on a live part.
- 3.9.15.3 Ladder should be held by one person on the ground, while the top end should be tied with the supporting structure/

rope.

- 3.9.15.4 Ropes used with ladders should be of cotton or jute. Use of metallic ropes is prohibited. A ladder should be held by one person on the ground to prevent slipping, while the top end should be tied to the supporting structure or conductor to keep it in position and prevent it sliding away
- 3.9.15.5 Ladders should never be allowed to fall on or rest against the contact wire



Always provide 20/16 dia G.I. bolt in step of ladder which is used for pull lift and extension step.

- 3.9.15.6 If the nature of the work involves risk of the conductor breaking into two parts (due to opening out of sleeves or splices) the ladder shall not be rested against the conductor. Trolley ladders shall be used in such cases.
- 3.9.15.7 More than one person shall not normally be allowed on a ladder as far as possible.
- 3.9.15.8 Climbing on a ladder with wet or slippery foot-wear is forbidden
- 3.9.15.9 Ladders should not be used for transporting materials.
- 3.9.15.10 A rope should be used to pass tools or any equipment to the men working on a ladder.
- 3.9.15.11 No one should stand directly below a work spot under a ladder.

3.9.16 Other Important Precautions to be Taken While Carrying out Works on OHE

- 3.9.16.1 The useful cross section of a conductor shall not be reduced while making joints.
- 3.9.16.2 Any contact with conductors, which are not specifically earthed, is forbidden.
- 3.9.16.3 The strength of the anchoring rope should be not less than that of the cable to be anchored.
- 3.9.16.4 Temporary anchoring of conductors should only be done by using stranded flexible steel cable at least of the same tensile strength as the cable to be anchored.
- 3.9.16.5 Use of two cables of different strengths joined together is prohibited. Use of cotton, jute or other non-metallic ropes for anchoring is forbidden.
- 3.9.16.6 Structure bonds and cable connections of the structure to earth shall be maintained in proper condition. No heavy materials should be stacked on the rail bonds; transverse bonds between two rails of the same track as well as rails of different tracks shall also be maintained in proper condition.
- 3.9.16.7 Where rails to which structures are connected are replaced, the structure shall be connected to the new rail immediately after it has been laid.

3.9.17 Procedure for Effecting Shut-Down for Work on Auxiliary transformers

Power supply to auxiliary transformers is effected through fuse-switches on the 25 kV side and the LT Side is controlled through fuses or double-pole iron-clad switch-fuses. Isolating fuse switches should be opened out and fuses removed both on the HT and LT sides and the transformer earthed before starting work.

3.9.18 Work on Overhead Lines Running Parallel to Electrified Tracks

No work on any span of any overhead line (LT power line or other line) running parallel to an electrified track where the minimum distance between the nearest conductor of the overhead line and the centre-line of the nearest electrified track is less than 8m, should be done without switching off power from the 25 kV traction line. (In addition to making dead and earthing the overhead line on which work is to be carried out in the normal manner).

Except for the following specific items for work:

1. Replacement of lamps, if below line.
2. Painting of structures / poles upto a distance of 2m from the live wires of the power line.
3. Reinforcement of foundations where such reinforcement does not involve any prior weakening of the foundation at any time during the work.
4. Replacement of aerial fuses.

3.9.19 Isolation of Booster Transformers

To isolate a booster transformer for maintenance or other work, the following sequence of operations should be carried out

1. Where no isolator is provided a permit-to-work should be obtained for both the elementary sections, the BT should be disconnected from the OHE and the OHE made through by jumpering.
2. When an isolator is provided to disconnect the BT primary winding from 25 kV lines, power must be switched off from both the elementary sections to which the BT is connected after which the isolator should be opened to disconnect the BT from the OHE and to make the OHE through.
3. The secondary winding of the BT should be disconnected from the return conductor and the return conductor made through by jumpering.
4. The return conductor should be earthed at the location where the BT has been disconnected; and the midpoint rail links on both sides of the BT should be opened so that booster cells on either side will extend over a longer section temporarily.
5. With the OHE and return conductors made through, 25 kV power supply may be restored

It should be noted that during the period when a BT has been disconnected from service, the interference on adjacent communication circuits will be enhanced. In view of this the defective BT should be replaced with a good BT with the least possible delay

3.9.20 Isolators

Isolating Switches on the 25 kV system shall not be opened or closed when current is passing through them. Normally, isolators should only be opened or closed, after power supply to the section has been switched off by opening the appropriate interrupter

3.9.21 Petroleum Sidings

The following arrangements/precautions would be necessary:

Arrangements

1. An equipotential link between the petroleum sidings installation earth and the track via a switch II). Setting up of neutral zones (insulating joints) in the track to avoid any risk of propagating stray current. III). Setting up of neutral zones/sections in the contact wire similar to loco inspection pits.
2. The tracks must be provided with longitudinal bonds on both the rails as well as transverse bond (30 m intervals). All masts and metallic structures in the vicinity of the track/ sidings should be provided with structure bonds. Copper rivets should be used for bonding.
3. 10-ohm earths must be connected to the petroleum siding on each side at the insulated joint.

3.9.22 Precautions

1. No oil tanker is permitted to stable under live OHE for inspection purpose.
2. Fueling to be done by side filling arrangement only.
3. Pipe lines in the vicinity of the track should be properly earthed
4. Minimum 2 m electrical clearance from live OHE of the adjacent track or only other structure nearby must be maintained.
5. During filling/loading and unloading of petroleum products the isolators at the neutral section of OHE should be kept open to ensure that the OHE is dead and earthed

