

**TECHNICAL SPECIFICATION  
FOR  
LINE & ERECTION**

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OF  
LINE & ERECTION

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## TECHNICAL SPECIFICATION FOR CONSTRUCTION OF

### 33 KV LINES AND 11KV LINES

**1.0 GENERAL:** The work covered by this Specification is for 33kV and 11 kV distribution lines as specified herein. Preliminary route alignment in respect of the proposed 33KV & 11KV transmission lines has been fixed by the Owner subject to alteration of places due to way leave or other constraints. The Right of way shall be solved by the contractor and all expenses there of shall be borne by him. However, OWNER shall render all helps in co-ordination with law and order department for solving the same. Involvement of Forest land should be restricted as far as possible.

**2.0 SURVEY (detail survey, spotting of Poles & estimating of quantities ):**

2.1 Preliminary investigations have been made. The topography of all 33 kV lines and 11kV lines of more than 5 km length are enclosed in the specification as **Annexures.**

Walk over survey, detailed survey shall have to be carried out to confirm the Route alignment by the contractor for 33 KV, 11 KV lines. If the line is passing in any Municipal/ NAC areas permission from local bodies has to be obtained prior to execution of work. Suitable distance from the side of the road has to be made towards placement of line poles.

2.2 Provisional quantities/numbers of different types of tower structures/Joist poles/PSC poles have been estimated and indicated in the BOQ Schedule given. However, final quantities for work shall be as determined by the successful bidder, on completion of the detail survey, preparation of route profile drawing and designing of the different types of tower structures/Joist poles/PSC poles as elaborated in the specification and scope of work.

2.3 The contractor shall undertake detailed survey on the basis of the tentative alignment fixed by the Owner. The said preliminary alignment may, however, change in the interest of economy to avoid forest and hazards in work. While

surveying the alternative route the following points shall be taken care by the contractor.

- (a) The line is as near as possible to the available roads in the area.
- (b) The route is straight and short as far as possible.
- (c) Good farming areas, religious places, forest, civil and defense installations, aerodromes, public and private premises, ponds, tanks, lakes, gardens, and plantations are avoided as far as practicable.
- (d) The line should be far away from telecommunication lines as reasonably possible. Parallelism with these lines shall be avoided as far as practicable.
- (e) Crossing with permanent objects are minimum but where unavoidable preferably at right angles.
- (f) Difficult and unsafe approaches are avoided.
- (g) The survey shall be conducted along the approved alignment only.
- (h) For river crossing/ Crossing of Nallas : Taking levels at 5 meter interval on bank of river and at 20 meter interval at bed of river so far as to show the true profile of the ground and river bed railway/road bridge, road The levels shall be taken at least 100 m. on either side of the crossing alignment. Both longitudinal and cross sectional shall be drawn preferably to a scale of 1:2000 at horizontal and 1:200 vertical.

After completing the detailed survey, the contractor shall submit the final profile and pole schedule (with no. of stay or strut) for final approval of the Owner. To facilitate checking of the alignment, suitable reference marks shall be provided. For this purpose, concrete pillars of suitable sizes shall be planted at all angle locations and suitable wooden/iron pegs shall be driven firmly at the intermediate points. The contractor shall quote his rate covering these involved jobs.

## **2.4 Optimization of Pole Location**

### **2.4.1 Pole Spotting**

To optimize the line length, the contractor shall spot the poles in such a way so that the line is as close as possible to the straight line drawn between the start & end point of the line.

**2.4.2 Road Crossings:-** At all road crossings, the 13mtr GI RS Joist single pole shall be used. There should absolutely no joints in the conductors in all road, power line and all other major crossing. The ground clearance from the road surfaces under maximum sag condition shall be not less than 8.5mtr over roads. In National High way the minimum height of guarding at the maximum sagging point should be less than 8.5 mts.

**2.4.3 Railway Crossings-** The railway crossing shall be carried out with underground cables in the manner as approved & prescribed by the railway authorities from time to time, preferably by HDD method using HDPE pipes .

During detailed engineering, the contractor shall prepare & submit the proposed arrangement for each railway crossing to the owner alongwith all documents drawings etc as per the requirements. The approval for crossing railway track shall be obtained by the owner from the Railway Authority.

#### **2.4.4 Power Line Crossings-**

Where the line is to cross over another line of the same voltage or lower voltage, provisions to prevent the possibility of their coming into contact with each shall be made in accordance with the Indian Electricity Rules.

#### **2.5 Details En-route**

After survey and finalization of route, the contractor shall submit detailed route map for each line. This would be including following details:

All poles on both sides of all the crossings shall be tension poles i.e. disc type insulators shall be used on these poles. At all the crossing described above the contractor shall use protective guarding as per REC Construction Standard A-1 to fulfill statutory requirements for 11 kV & 33 KV trunks & main spur line.

11kV & 33 KV branch spur line, being in the village, protective guarding shall be used wherever it will be required.

Clearance from Ground, Building, Trees etc. – Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the Indian Electricity Rules, 1956 as amended up to date. The vendor shall select the height of the poles in order to achieve the prescribed electrical clearances.

## **2.5. Final Schedule**

The final schedule including Bill of quantity indicating location of poles specifically marking locations of failure containment pole/structure, line tapping points; angle of deviation at various tension pole locations, all type of crossings and other details shall be submitted for the approval of the owner. After approval, the contractor shall submit six more sets of the approved documents along with one soft copy in CD to OWNER for record purpose.

## **3.0 CHECK SURVEY**

The contractor shall undertake the check survey during execution on the basis of the alignment profile drawing and tower schedule approved by the Owner. If during check survey necessity arises for minor change in route to eliminate way leave or other unavoidable constraints, the contractor may change the said alignment after obtaining prior approval from the Owner

## **4.0 POLE FIXTURE AND ACCESSORIES**

### **4.1 Danger Plates & Number Plates**

The vendor shall provide & install danger plates on all 33kv, 11 kV Single Pole, DP structures , 4-pole structures and towers. The dimension of the plate size: Length 250mm X Width 200mm, Thickness (without enameling) - 2mm, Thickness (With enameling) - 2.3mm. Danger plates shall conform to IS: 2551 and as per the drawing no. ODASSP/LINE/15.

### **4.2 Anti-climbing Devices**

The vendor shall provide and install anti-climbing device on all 33kv and 11 kV DP structures, 4-Pole structures, towers and at all single poles. This shall be done with G.I. Barbed wire with spikes. The barbed wire shall conform to IS-

278 (Grade A1). The barbed wires shall be given chromatin dip as per procedure laid down in IS: 1340.

#### **4.3 Fittings Common to all Line**

Pin Insulator Binding: The contractor shall use AL. Binding wire for binding shall be as per REC Construction Standards No. C-5 or better thereof.

Mid Span Compression Joint & Repair Sleeves: The contractor shall supply & install the Mid Span Compression Joint and Repair Sleeves as per IS: 2121 (Part II).

Guy/Stay wire Clamp: The contractor shall supply & install Guy/Stay wire Clamp as per REC Construction Standard G-1 or better.

Strut (Stud) will be provided in all angle points with deviation more than  $10^0$  upto  $60^0$ .

#### **4.4 Stay/Guy Sets**

**a)** The Stay/Guys shall be used at the following pole locations;

At all the tapping points & dead end poles.

At all the points as per REC construction dwg. No. A-10 ( for the diversion angle of 10-60 degree)

Both side poles at all the crossing for road, nallaha, railway crossings etc.

**b)** The arrangement and number of stay sets to be installed on different pole structures shall be as per REC Construction Standards no. A-23 to A-27, G-5 & G-8. However, this shall be decided finally during erection, as per the advice of Engineer.

**c)** The stay set to be installed complete in all respect and would broadly consist of following items:

7/10 SWG G.I. Stay wire for 11 kV lines as per REC Specification No.46/1986  
Stay Insulator type C for 11 kV line as per REC Specification No. 21/1981,  
Turn Buckle. Anchor rod and plate (Hot Dipped galvanized). Thimbles and  
Guy Grip Complete stay set shall be as per REC Construction Standards no. G-1. The stay clamp is envisaged as GS structure along with other clamps brackets etc.

#### **4.5. Erection of stay sets**

The contractor shall install the stay set complete in all respect as per REC Specification. This includes excavation of pit in all kinds of soil with PCC in the ratio 1:2:4 as specified which shall be placed in the bottom of the pit.

The rest (upper half) of the pit shall be filled with excavated soil duly compacted layer by layer. An angle between 30 to 45 degrees shall be maintained between stay wire and the pole. The stay wire shall be used with a stay insulator at a height of 5 mts. above ground level with F.I. turn buckle.

## **5.0. Stringing and Installation of Line with Conductors.**

### **5.1 General**

The scope of erection work shall include the cost of all labour, tools and plants such as tension stringing equipment and all other incidental expenses in connection with erection and stringing work. The Bidders shall indicate in the offer the sets of stringing equipment he would deploy exclusively for work under each package.

The stringing equipments shall be of sufficient capacity to string AAA conductor or ACSR conductor.

The Contractor shall be responsible for transportation to site of all the materials to be provided by the Contractor as well as proper storage, insurance etc. at his own cost, till such time the erected line is taken over by the owner.

Contractor shall set up required number of stores along the line and the exact location of such stores shall be discussed and agreed upon with the owner.

### **5.2 Insulator Fixing**

Pin insulators shall be used on all poles while strain insulators shall be used on all angle & dead end poles. Special type Pin Insulators should be used for conductors more than 100 mm<sup>2</sup>. In coastal districts of Balasore, Bhadrak, Jajpur, Kendrapara, Jagatsinghpur, Cuttack, Khurdha, Puri and Ganjam polymer insulators shall be used. Damaged insulators and fittings, if any, shall not be used. Prior to fixing, all insulators shall be cleaned in a manner that shall not spoil, injure or scratch the surface of the insulator, but in no case shall any oil be used for this purpose. Torque wrench shall be used for fixing



various line materials and components, such as suspension clamp for conductor, whenever recommended by the manufacturer of the same.

### **5.3 Running Out of the Conductors**

The contractor shall be entirely responsible for any damage to the pole or conductors during stringing. The conductors shall be run out of the drums from the top in order to avoid damage to conductor

A suitable braking device shall be provided to avoid damaging, loose running out and kinking of the conductors. Care shall be taken to ensure that the conductor does not touch and rub against the ground or objects, which could scratch or damage the strands.

The sequence of running out shall be from the top to down i.e. the top conductor shall be run out first, followed in succession by the side conductors. Unbalanced loads on poles shall be avoided as far as possible.

Wherever applicable, inner phase off-line conductors shall be strung before the stringing of the outer phases is taken up.

When lines being erected run parallel to existing energized power lines, the Contractor shall take adequate safety precautions to protect personnel from the potentially dangerous voltage build up due to electromagnetic and electrostatic coupling in the pulling wire, conductors and earth wire during stringing operations.

The Contractor shall also take adequate safety precautions to protect personnel from potentially dangerous voltage build up due to distant electrical storms or any other reason.

### **5.4 Repairs to Conductors**

The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations. Repair to conductors, if necessary, shall be carried out with repair sleeves and not more than one repair sleeve will be used in one span.

Repairing of the conductor surface shall be carried out free of cost only in case of minor damage, scuff marks, etc. The final conductor surface shall be clean,

smooth and free from projections, sharp points, cuts, abrasions etc. After compression the sharp edges must be smoothed by filing.

The Contractor shall be entirely responsible for any damage to the poles, insulators etc during stringing.

### **5.5 Stringing of Conductor**

The stringing of the conductor shall be done by the standard stringing method. The Bidder shall submit complete details of the **stringing method** for owner's approval. Conductors shall not be allowed to hang in the stringing blocks for more than 96 hours before being pulled to the specified sag.

Derricks/ scaffoldings or other equivalent methods shall be used to ensure that normal services are not interrupted and any property is not damaged during stringing operations for roads, telecommunication lines, power lines and railway lines. However, shut-down shall be obtained when working at crossings of overhead power lines. The contractor shall make specific request for the same to the owner.

### **5.6 Jointing**

When approaching the end of a drum length at least three coils shall be left in place when the stringing operations are stopped. These coils are to be removed carefully, and if another length is required to be run out, a joint shall be made as per the recommendations of the conductor manufacturer.

Conductor splices shall not crack or otherwise be susceptible to damage during stringing operation. The Contractor shall use only such equipment/methods during conductor stringing which ensures complete compliance in this regard.

All the joints on the conductor shall be of compression type, in accordance with the recommendations of the manufacturer, for which all necessary tools and equipment like compressors, dies etc., shall be arranged by the contractor. Each part of the joint shall be cleaned by wire brush till it is free of rust or dirt, etc. This shall be properly greased with anti-corrosive compound if

recommended by the manufacturer, before the final compression is carried out with the compressors.

All the joints or splices shall be made at least 30 meters away from the pole. No joints or splices shall be made in spans crossing over main roads, railway line and SmallRiver spans. Not more than one joint per conductor per span shall be allowed. The compression type fittings shall be of the self centering type or care shall be taken to mark the conductors to indicate when the fitting is centered properly.

During compression or splicing operation, the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After compressing the joint, the Aluminium sleeve shall have all corners rounded; burrs and sharp edges removed and smoothed.

To avoid any damage to the joint, the contractor shall use a suitable protector for mid span compression joints in case they are to be passed over pulley blocks/aerial rollers. The pulley groove size shall be such that the joint along with protection can be passed over it smoothly.

In case AAAC is used each press should overlap 25% of the previous press.

#### **5.7 Tensioning and Sagging Operations:**

The tensioning and sagging shall be done in accordance with the approved stringing charts or sag tables.

The sag shall be checked in the first and the last section span for sections up to eight spans and in one additional intermediate span for sections with more than eight and sagging operations shall be carried out in calm weather when rapid changes in temperature are not likely to occur.

#### **5.8 Clipping In**

Clipping of the conductors into position shall be done in accordance with the manufacturer's recommendations. Jumpers at section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Pilot pin insulator shall be used, if found necessary, to restrict jumper swing & to ensure proper clearance to design values.

Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and sprung into position.

### **5.9 Fixing of Conductors Accessories**

Conductor accessories supplied by the Contractor shall be installed by the Contractor as per the design requirements and manufacturer's instructions. While installing the conductor accessories, proper care shall be taken to ensure that the surfaces are clean and smooth and that no damage occurs to any part of the accessories or of the conductors.

### **5.10 Replacement:**

If any replacements are to be effected after stringing and tensioning or during maintenance e.g. replacement of cross arms, the conductor shall be suitably tied to the pole at tension points or transferred to suitable roller pulleys at suspension points.

### **5.11 Normal Span length**

1. Normally the span length is to be kept 60 mtr in case of 33kV lines with 148 sqmm AAAC & 70mtr in case of 11kV lines with 100 sqmm AAAC , But where there is way leaf problem, the span length can be modified by maintaining minimum ground clearance.
2. One cut point in every 1KM in rural area & two cut points in every 1KM in Urban area shall normally be adopted. But however, this can vary as per the site requirement .

## **6.0 WAY-LEAVE AND TREE CUTTING**

Way-leave permission which may be required by the contractor shall be arranged at his cost. While submitting final-survey report for approval, proposals for way-leave right of way shall be submitted by the contractor. Owner may extend help to get the permission within a reasonable time as mutually agreed upon for which due notice shall be given by the contractor in such a way so that obtaining permission from appropriate authority do not hinder the continued and smooth progress of the work.

The Owner shall not be held responsible for any claim on account of damage done by the contractor or his personnel to trees, crops and other properties.

The contractor shall take necessary precaution to avoid damage to any ripe and partially grown crops and in the case of unavoidable damage, the Owner shall be informed and necessary compensation shall be paid by the contractor.

All the documents required for application to the statutory authorities must be prepared by the contractor & submitted to the Owner for submission of the application towards approval of Railway Crossing etc. However, the responsibilities lie with the contractor to get the clearance.

Trimming of tree branches or cutting of a few trees en-route during survey is within the scope of survey to be done by the contractor. Contractor shall arrange for necessary way-leave and compensation in this regard. During erection of the line, compensation for tree cutting, damage caused to crops, actual cutting and falling of the trees including way-leave permission for such route clearance shall be arranged by the contractor at his cost. The contractor will identify the number of trees and detail of obstructions to be removed for erection of the line and intimate the Owner well in advance in case of any help. Other related works like construction of temporary approach roads, etc. as required, shall be done by the contractor and the same will lie within the scope of contractor's work and such cost shall be considered to be included in the rates quoted by him.

#### **7.0 SUB-SOIL INVESTIGATION** (In case of river crossing locations / other locations where PILLING may be required)

To ascertain soil parameters in locations where higher tower either 220KV (UR+6) or 132 KV type tower (PC+6) of OPTCL design, will be required in order to get adequate ground clearance, the contractor shall carry out sub-soil investigation through reputed soil consultant as approved by the Owner.

#### **7.1 SCOPE OF WORK**

The scope of sub-soil investigation covers execution of complete soil exploration for the transmission line under this contract including boring, drilling, collection of undisturbed soil sample where possible, otherwise disturbed samples, conducting laboratory test of soil samples to find out the various parameters as detailed in this specification and submission of detailed reports in 6 copies along with specific

recommendation regarding suitable type of foundation for each bore-hole along with recommendation for soil improvement where necessary.

## **7.2 TEST BORING**

The boring shall be done at the major locations / crossing of special towers. However, it is desirable that all special towers in river X-ing spans, sub-soil investigation bore-hole will be required.

The test boring through different layers of all kinds of soil shall have to be carried out by the contractor through the approved soil consultant as briefed hereunder.

- (a) Method of boring, selection of sampling tubes, sampling, recording of boring, protection, handling, leveling of samples shall be done as specified in IS: 1892/1977, The contractor / consultant shall furnish in the soil report the, the equipment and method of boring adopted.
- (b) Depth of boring below ground level shall be normally 15 Mts to 25 Mts.,in river crossing locations.
- (c) Undisturbed soil samples shall be obtained for the initial 4M depths at every 1.5M interval and at change of strata. After these initial 4M depths, samples shall be obtained preferably at every 3M or where there is a change of strata, or as advised by the Owner.
- (d) In case collection of undisturbed samples becomes difficult/impossible detailed soil testing on remolded soil samples is to be considered and reported in the soil report.
- (e) Standard penetration test as per IS: 2131 with latest amendment shall have to be conducted in different strata and recorded properly.
- (f) The ground water table shall be recorded during boring operation and incorporated in the bore log. If possible, the position of the water table just after monsoon period be ascertained from local people and indicated in the report.

## **7.3 LABORATORY TESTS**

The method and procedure of testing of soil sample to be followed shall be as per relevant IS codes. Adequate volume of test samples shall be collected from site. Sample shall be properly sealed immediately after recovery as specified in relevant IS code and transported carefully to laboratory for carrying out necessary laboratory tests. Date and time of taking of the sample shall be recorded in the test report.

#### **7.4 REPORT ON SUB-SOIL INVESTIGATION**

The contractor shall make analysis of soil samples collected by him in the field and approved by the Owner. A comprehensive report shall have to be prepared by him, finally incorporating all the data collected in proper tabular forms or otherwise along with the analysis.

Three copies of report in the draft form shall be submitted for Owner's approval. 6(six) copies of final report incorporating Owner's comments, if any, shall be submitted within one week after completion of this work.

Recommendations shall include but not be limited to the following items (1) to (11)

1. Geological information of the region.
2. Past observations and historical data, if available, for the area or for other areas with similar profile or for similar structures in the nearby area.
3. Procedure of investigations employed at field as well as laboratory test results.
4. Net safe bearing capacity and settlement computation for different types of foundations for various widths and depths of tower and building.
5. Recommendations regarding stability of slopes, during excavations etc.
6. Selection of foundation types for towers, transformers and buildings etc.
7. Bore hole and trial pit logs on standard proforma showing the depths, extent of various soil strata etc.
8. A set of longitudinal and transverse profiles connecting various boreholes shall be presented in order to give a clear picture of the site, how the soil/rock strata are varying vertically and horizontally.
9. Depth of ground water table and its effect on foundation design parameters.
10. Recommendations regarding stability of slopes, during shallow excavation etc.

11. Whether piles are necessary or not. If piles are necessary, recommendation of depth, diameter and types of piles to be used.

## **8.0 CONDUCTOR**

AAA Conductors of 100 Sq mm (7/4.26) AAAC will be used in 11 KV lines and that of 148 sq mm mm (19/3.15) AAAC will be used in 33 KV lines. **The conductors shall withstand a temperature of 85<sup>0</sup> C .**

### **8.1 CLEARANCE FROM GROUND, BUILDING, TREES ETC.**

- 8.2 Clearance** from ground, buildings, trees and telephone lines shall be provided in conformity with the Indian Electricity Rules, 1956 as amended up to date. The bidder shall select the height of the poles such that all electrical clearances are maintained.

- 8.3 Guarding mesh** shall be used in all electric line / telecom line / road / drain / canal crossing and at all points as per statutory requirements. The bidder shall provide & install anti climbing devices and danger plates on all poles. Where there is no such provision in the existing line.

- 8.4 Pole accessories** like danger plates, and number plates shall be provided as per IS: 2551 Standard.

## **9.0 TOWERS / POLES**

Support Structures may be of lattice type or joist or PSC poles. The total steel structures to be inducted to the existing or as additional features should be Galvanized with minimum zinc coating of 610 gms / Sq. Mts. Any new design (approved and tested in any approved test bed) as per the required parameters is also acceptable. In case of 11KV lines the conventional PSC poles shall be used in rural areas and Joist poles in urban areas. Where 11mtr & 13mtr poles can not be transported to the site, two pieces of galvanized Joists with single joint as per the drawing no. ODSSP /LINE/11 using galvanized sections of plates of adequate size along with required size GI bolt nuts & spring washers is to be adopted. The materials must conform to



IS: 800. All the test on materials and fabrication etc will be as per the relevant Indian standards.

In different crossings the contractor shall take into consideration the prevailing regulations of the respective authorities before finalizing type and location of the towers. While carrying out survey work, the contractor has to collect all relevant data, prepare and submit drawings in requisite number for obtaining clearance from road, aviation, railways, river and forest authorities.

## **10.0 ERECTION WORK**

When the survey is approved, the contractor shall submit to the Owner a complete detail schedule of all materials to be used in the line. Size and length of conductor etc. are also to be given in the list. This schedule is very essential for finalizing the quantities of all line materials. The contractor shall furnish the same.

### **10.1 SCHEDULE OF ERECTION PROGRAMME**

After due approval of the detailed survey, the contractor shall supply & erect the poles as per the detailed project schedule.

### **10.2 DRAWINGS FOR TOWER AND FOUNDATIONS**

Indicative drawings of PSC poles, DP structures, 4-Pole structures etc with foundation have been provided by OWNER in the bid document. Other drawings as per the requirement shall be submitted by the contractor for approval by the OWNER.

### **11.0 CONSTRUCTION OF FOUNDATION FOR TOWER, G.I (RS Joist) POLES AND PSC POLES**

#### **11.1 ERECTION OF POLE, CONCRETING OF POLES AND COMPACTION OF SOIL**

Drawing for the excavation of pits, Foundation of soil is enclosed which are to be adopted.

**11.2** Following arrangement shall be adopted for proper erection of poles wherever necessary and properly compacting of the soil around the base / foot of the poles, under this package.

- (a) Excavation has to done as per the drawing to the required depth and size. After final excavation the pit should be dressed properly so that uneven portion and loose soil should be removed before PCC (**M-10**) of thickness 75 mm is laid. The base footing concrete shall be RCC (M-20) in all DP & 4-Pole structures and PCC (M-15) for all PSC pole & Joist single pole as per drawing no. ODSSP/CIVIL/1-REV-A for PSC pole, ODSSP/CIVIL/2-REV-A for Joist Pole & ODSSP/LINE/19 for tower structure.
- (b) The verticality and leveling of pole/structure should be done by the help of plumbob or with theodolite and leveling instrument.
- (c) **In case of Joist pole Base clits ( 65x65x6mm angles, 400mm long) and in case of PSC pole GI base plate (500x500x10)mm shall to be provided over the Lean concrete.**

### **11.3 CEMENT CONCRETE (PLAIN OR REINFORCED), STUB SETTING GROUNDING AND BACK FILLING etc.**

#### **A) Materials**

All materials whether to be consumed in the work or used temporarily shall conform to relevant IS specification, unless stated otherwise, and shall be of the best approved quality.

#### **B) Cement**

Cement to be used in the work under the contract shall generally conform to IS:269/455-1989. Cement bags shall be stored by the contractor in a water tight well ventilated store sheds on raised wooden platform (raised at least 150 mm above ground level) in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter. Cements to be used within three months from the date of manufacture. Sub-standard or partly set cement shall not be used and shall be removed from the site by the contractor at his cost .

**C) Coarse Aggregates** i.e Stone chips or stone ballast. For M15 & M20 concrete, the aggregate will be in the ranges from 12mm to 20mm.size.

#### **D) Pole erection**

1. **After proper alignment**, checking of verticality and leveling, the pole or structure should be properly tied before placing of base concrete of required height. Again the verticality and leveling should be checked.
2. **The RCC pedestal concrete** (M-20) is to be done by providing good quality of shutters, so that there will no leakage of cement slurry during concreting. The coping height should be **450 mm/750 mm** above the existing ground level in urban area and in cultivated lands respectively. The top portion of the coping should be made tapered.
3. **All the bolted joints** should be tightened properly by providing suitable size GI Bolt Nuts and Spring washers. After completion of erection works all the bolts should be spot welded in order to avoid theft of members.
4. **The back filling** of locations should be done by using the excavated soil only in layers (each layer should not be more than 500 mm) by putting water and ramming by using wooden rammers. In no case stone of size more than 75mm used for back filling. Back-filling has to be done 75mm above ground level or as specified
5. **Curing of concrete** should be done for 28 day continuously. Curing should not be done within 24 Hours of concreting.
6. **All the excess** excavated materials and other unused materials from the concreting site should be disposed of to a suitable site by the contractor.
  - a) Mixer (Running time-2 min.)
  - b) **In case of** hand mixing, 10% extra cement has to be provided.  
Hand mixing should be done on GI sheet platform only.
  - c) **Poking rod** may be used for compacting in locations at PSC poles only
  - d) **Use of vibrator** for compacting is mandatory.
  - e) **Clean water** (free from saline and alkaline) should be used for concreting.
  - f) **Aggregates** (both coarse and fine) used should be free from foreign materials.
  - g) **Shutters** used should not be removed before 24hrs. of casting.
  - h) **In case of** black cotton soil borrowed earth (morum soil mixed with sand is preferable) may be used for back filling.
  - i) **Sufficient qty. of water** should be sprinkled over backfilled earth and chimney kept wet by using wet gunny bags.

**11.3.1 All the persons** working on tower shall wear safety helmet, safety belt and safety shoes, Similarly all the persons working on ground shall wear safety helmet and safety shoes.

**11.3.2. If there is any LT/HT** power line near the vicinity of tower erection, necessary shutdown of the power line shall be obtained in writing from the concerned Agency in order to avoid electrical hazards caused by accidental touching of stay/Guy ropes with power line.

**11.3.3.Safety precaution** Safety shall be given utmost importance during stringing. The following need to be ensured.

**11.3.4 Safe working** conditions shall be provided at the stringing site.

**11.3.5 Full proof communication** through walky- talkie / mobile phones shall be used in order to avoid any damage to workmen or public on ground.

**11.3.6 In case of 11 KV, 10mtr 300 kg PSC pole in rural area and 11 kV Joist pole in urban area shall be adopted. In case of 33 kV line, 11mtr Joist pole to be used.**

**11.3.7** The poles shall then be lifted to the pit with the help of wooden supports. The pole shall then be kept in the vertical position with the help of 25 mm (min.) manila ropes, which will act as the temporary anchor. The verticality of the pole shall be checked by spirit level in both longitudinal & transverse directions. The temporary anchor shall be removed only when **poles set properly in the pit for foundation concreting & backfilling with proper compacting the soil. The backfilling should be done inlayers (maxm. 0.5 mts at a time with sprinkling of water and by using wooden hammer. No stone more than 75 mm should be used during back filling.**

**11.3.8** Pin type insulators in all straight line locations and Four pair bolted type tension H/W fittings in all DP & 4-pole structures shall be used in all new 33 & 11 Kv lines with 70 KN normal B&S insulators.

## **12.0. Earthing of Support**

**12.1** Each pole shall be earthed with coil type earthing as per REC Construction Standard J-1.

**12.2** All DP & Four pole structures & the poles on both sides of railway crossing shall be earthed by providing two nos. **pipe earthing as per Drawing provided by OWNER.**

**12.3** Each tower/structures should be earthed by providing 2.5 mts. 50x6 GI flat and 50x 3000 mm heavy gauge ISI mark earthing pipe. The top of the earthing pipe should remain 600 mm below ground level. All railway X-ing locations two nos. earthing should be provided.

### **13.0 Fixing of Cross Arms**

After the erection of supports and providing guys, the cross-arms are to be mounted on the support with necessary clamps, bolts and nuts. The practice of fixing the cross arms before the pole erection should be followed.

## **14.0 INSTALLATION OF LINE MATERIALS**

**14.1 Insulator and Bindings-** These materials are to be procured from the approved vendors only after type test subsequent to the design approval of OWNER.

1. In angle locations single tension fittings to be used with 4 nos. 70 KN disc insulators for 33kV lines & 2nos. of 70KN disc insulators for 11kV lines.
3. Suitable pre formed armoured rods should be used in all suspension fittings **in case of higher size Conductors.**
4. Guarding has to be provided at all road crossings .
5. Four **pair** bolted type (**suitable for M-16 bolts**) tension fittings for AAA conductors and for River crossing locations, compression type tension fittings for AAAC conductors has to be used.
6. The “distribution tie “ meant for pin insulator binding should be of no. 6 size and that of soft annealed wire having a minimum length of 3 mtr.
7. Compression type jointing sleeves should be used for jointing of conductors only.

### **14.2 Insulator hoisting**

- a) Insulators shall be completely cleaned with soft and clean cloth.
- b) It shall be verified that there is no crack or any other damage to insulators.

- c) It is very important to ensure that 'R' clips in insulator caps are fixed properly. This is a security measure to avoid disconnection of insulator discs.
- d) Both Arcing horns (both at top & bottom) of each insulators string has to be provided.

**The pins for insulators** shall be fixed in the holes provided in the cross-arms and the pole top brackets. The insulators shall be mounted in their places over the pins and tightened. In the case of strain or angle supports, where strain fittings are provided for this purpose, one strap of the strain fittings is placed over the cross-arm before placing the bolt in the hole of cross-arms. The nut of the straps shall be so tightened that the strap can move freely in horizontal direction.

All materials, which are to be supplied by the contractor should be procured from the approved Manufactures of OWNER 's only. Procure ment from any suppliers will not permitted. All the related drawings of materials has to be approved by department. All the materials has to be tested in presence of authorized representative of department as well as officers of third party engaged by Government if any also.

## **15.0 Handling of Conductor**

All cares should be taken not to damage conductor surface during transit. Necessary tools and plants for the same has to be effectively used by the agency.

### **15.1 Running Out of the Conductors:**

The contractor shall be entirely responsible for any damage to the pole or conductors during stringing. Care shall be taken that the conductors do not touch and rub against the ground or objects, which could scratch or damage the strands.

- 15.2** The sequence of running out shall be from the top to down i.e. the top conductor shall be run out first, followed in succession by the side conductors. Unbalanced loads on poles shall be avoided as far as possible. When lines

being erected run parallel to existing energized power lines, the Contractor shall take adequate safety precautions to protect personnel from the potentially dangerous condition.

### **15.3 Monitoring of Conductors during Stringing**

- a) The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations. Repair to conductors, if necessary, shall be carried out with repair sleeves. The final conductor surface shall be clean, smooth and free from projections, sharp points, cuts, abrasions, etc. The Contractor shall be entirely responsible for any damage to the poles during stringing.
- b) Conductor shall be checked constantly as it is unwound from Conductor drum for any broken, damage or loose strand. If any major defect is noticed then the defective portion has to be removed and mid span joint provided. However if the defect is of minor nature i.e. number of damaged strands is not more than 1/6<sup>th</sup> of the total strands in outer layer, a repair sleeve shall be provided.
- c) M.S.(mid span) Joint shall be provided at least 15 meters away from line Poles/ Structures. All Mid-Span joints should be Compression type by providing suitable aluminium compression pipes. The compression joints should be continuous. In case of AAAC compression joints, minimum 25% over lapping with the previous compression should be done.
- d) There shall not be any Mid-Span joint over Rly / River / Main Road Crossing.
- e) Not more than one Mid-Span Joint shall be provided in one span for each conductor.

Rough sagged conductors of one phase shall be simultaneously tightened by which machine fixed on tower till the desired final sag is achieved.

### **16.0 STRINGING OF CONDUCTOR**

- 16.1** The works include spreading of conductors without any damage and stringing with proper tension without any kinks/ damage Jumpering at cut points by using two nos., three bolted, PG claps has to be done. **No binding of two conductors with aluminium wires will be allowed.** In each and every joints three bolted very good quality PG clamps should be used wrapping of suitable

aluminium tapes if required as per the decision of the Engineer in Charge. The ground & line clearances at road crossings along roads other crossings shall be as mentioned in this specification.( which also should not be less than the relevant clearances mentioned in I.E. rules.)

- 16.2** While transporting conductors' drums to site, precautions are to be taken so that the conductor does not get damaged. The drum shall be mounted on cable drum support. The direction of rotation of the drum shall be according to the mark in the drum so that the conductor could be drawn. While drawing the conductor, it shall not rub against surface causing damage. The conductor shall be passed over poles on rubberized or aluminum snatch block (pulley) mounted on the poles for this purpose.
- 16.3** The conductor shall be pulled through come-along clamps to string the conductor between the tension locations.
- 16.4** Conductor splices shall not crack or otherwise be susceptible to damage in the stringing operation. The Contractor shall use only such equipment / methods during conductor stringing which ensures complete compliance in this regard. All the joints including mid span joints on the conductor shall be of the compression type, in accordance with the recommendations of the manufacturer.

The contractor shall remain fully responsible for the exact alignment of the line. If after erection, any tower is found to be out of alignment, the same shall have to be dismantled and re-erected after correction by the contractor at his own cost, risk and responsibility, including installation of fresh foundation, if felt necessary by the Owner.

**NB:- 1.0 % is the non-accountable allowable wastage (for both sag &wastage) will be permitted**

## **17.0 FLEXIBLE COPPER BOND**

At suspension and tension towers, the earth wire suspension and tension clamps shall be securely bonded to the tower steelwork by means of a multi-



strand flexible copper bond wire. The copper bond shall be sufficiently flexible to allow movement of the suspension clamp under all operating conditions and terminated with compression lugs.

The flexible copper bond shall be of nominal 34 sq.mm equivalent copper area and not less than 500 mm in length. It shall consist of 259 wires of 0.417 mm dia. tinned copper conductor. It shall be laid up as seven stranded ropes, each of 37 bunched wires. The tinning shall be as per IS 9567. Two tinned copper connecting lugs shall be press jointed to either ends of the flexible copper cable. One lug shall be suitable for 12 mm, dia. bolt and the other for 16 mm dia. bolt. The complete assembly shall also include one 16 mm dia., 40 mm long mild steel bolt hot dip galvanised with nut and lock washers.

## **18.0 TAKING OVER**

Tower and tower accessories received at site stores are to be stored item-wise and mark-wise to facilitate joint inspection of the materials (with reference to packing list and detailed order).

If the materials/equipment or any part thereof is damaged or lost during the transit, the replacement of such materials shall be effected by the contractor timely so as to maintain programme of work. However, the line under erection shall be taken over by the purchaser only when the entire line is completed in all respect and made ready for commissioning at rated voltage. Partly erected line will not be taken over.

Taking over of the line shall be in no way relieve the contractor from his responsibility for satisfactory operation of the erected line in terms of the guarantee clause of the specification.

## **19.0 MATERIALS HANDLING AND INSURANCE**

The contractor shall deliver all equipment/materials against this contract to his site stores under cover of Transit Insurance to be taken in his name. Cost of such insurance is to be borne by the contractor.

Cost of transportation of all materials from contractor's store to the site of work as well as department supply items like Transformers, Breakers, CT, PT, ACDB, Isolators, Conductors, AB cables, etc shall be borne by the contractor irrespective of mode of transportation and site condition.

The contractor has to bear the cost of premiums on insurance for all materials, tower accessories and total erection cost of the line including cement, rods for foundation.

It will be the responsibility of the contractor to report to the concerned Police Station about all incidents of thefts and lodge, pursue and settle all claims with Insurance Company in case of damage/loss due to theft, pilferage, flood and fire etc. and the Owner of the work shall be kept informed promptly in writing about all such incidents. The loss, if any, on this account shall be recoverable from the contractor if the claims are not lodged and properly pursued in time or if the claims are not settled by the insurance company due to lapses on the part of the contractor. The contractor shall have to replenish promptly damaged, stolen tower members and accessories conductors, earth wire, hardware's etc. and repair/re-erect the damaged lines, free of cost to the Owner so as to maintain the programme of work. The Owner will not be responsible in any way for such loss of materials.

## **20.0 Check List**

Before the line is offered for taking over and disbursement of final payment subsequent to the materials reconciliations a comprehensive format in shape of check list as shown at schedule C-4 must be filled up and signed by the executing agency.

## **(A) TECHNICAL SPECIFICATIONS FOR GI WIRE 6 SWG & GI WIRE 8 SWG**

### **I. Qualification Criteria of Manufacturer:-**

The prospective bidder may source GI Wire from manufacturers only who must qualify all the following requirements :

a) The manufacturer must have successfully carried out Type Test of similar item from CPRI or any NABL Accredited Laboratory within the last 5 years, prior to the date of submission of the bid.

b) The manufacturer should have supplied at least 1000 Kgs. (all sizes taken together) to electricity supply utilities / PSUs. The bidder should enclose Performance Certificates from the above users issued in the name of the manufacturer as proof of successful operation in field.

### **II. SCOPE**

This specification covers manufacture, testing and supply of hot dip galvanized MS solid wire of sizes 6 SWG (5 MM) & 8 SWG (4 MM) diameter.

### **III. APPLICABLE STANDARDS**

#### **ZINC**

Zinc shall conform to grade Zen 98 specified in IS 209& IS:4826-1979 with upto date amendments.

#### **ZINC COATING**

Zinc coating shall be in accordance with IS:4826-1979 for heavily coated hard quality.

#### **GALVANISING**

Galvanizing shall be as per IS:2629-1966, IS 4826-1979 with up to date amendments.

#### **UNIFORMITY OF ZINC COATING**

Uniformity of zinc coating shall be as per IS:2633-1972 with up to date amendments.

#### **TENSILE PROPERTIES**

The tensile strength of the wire after galvanizing shall be between 55-95 Kg/sq.mm ensuring MS wire mechanical properties as per IS-28:1972 8.1 to 8.3.

## **FREEDOM FROM DEFECTS**

As per IS:2629-1966 & 4826-1979 & with up to date amendments be ensured

### **IV. MATERIAL**

The mild steel wire shall have chemical composition maximum sulphur-0.055%, phosphorous -0.055%, Carbon 0.25%.

### **V. TESTS**

During the process of manufacturer/fabrication and all tests for chemical, mechanical, galvanizing as per IS- 280-1979, IS1521-1972, IS-1755-1961, IS:6745-1972 & 4826-1979 shall be carried out. The certificate towards, chemical composition shall be submitted for each lot offered for inspection.

The following tests shall be conducted in presence of the representative of the Owner:

Visual physical inspection and measurement of specified dimension  
Coating test as per IS:1755-1961, IS 2629-1966, IS:2633-1972, IS:4826-1969  
Adhesion test as per IS:1755-1961, IS:2629-1966, IS:2633-1972, IS:4826-1969, & IS:6745-1972

Tensile strength and breaking load and elongation determined as per IS:1521-1972 with up to date amendments

### **VI. PACKING & MARKING**

Packing shall be as per IS:280-1979 and each coil shall be between 50-100 kg. marking shall be as per IS:280-1972.

## **GUARANTEED TECHNICAL PARTICULARS (GI WIRE 6 SWG & GI WIRE 8 SWG)**

(To be submitted along with offer)

<b>Sl. No.</b>	<b>GENERAL TECHNICAL PARTICULARS</b>	<b>6 SWG</b>	<b>8 SWG</b>
<b>1</b>	Nominal diameter of wire		
<b>2</b>	Tolerance in diameter		
<b>3</b>	Sectional Area (In Sq. mm.)		
<b>4</b>	Tensile strength		
<b>A</b>	Min. N/mm <sup>2</sup>		
<b>B</b>	Max. N/mm <sup>2</sup>		
<b>5</b>	Minimum breaking load (KN)		
<b>6</b>	Type of coating Heavy/Medium/Light		
<b>7</b>	Variety Hard/Soft		

<b>8</b>	Weight of Zinc coating (Gms/Sq. Mtr.) Min.		
<b>9</b>	No. of dips the coating is able to withstand as $18 \pm 20^{\circ}\text{C}$		
<b>10</b>	Adhesion Test (Wrap Test at 1 turn per second coiling while stress not exceeding % nominal tensile strength)		
<b>A</b>	Min. complete turn of wrap		
<b>B</b>	Dia of mandrel on which wrapped		
<b>11</b>	Bend Test		
<b>A</b>	Angle		
<b>B</b>	Dia round a format to be bent		
<b>12</b>	Freedom from defect		
<b>13</b>	Chemical composition the MS Wire used shall not exceed		
<b>A</b>	Sulphur 0.060%		
<b>B</b>	Phosphorous 0.065%		

## **(B) TECHNICAL SPECIFICATIONS FOR EYE BOLT FOR GUARDING**

### **GENERAL REQUIREMENTS:**

M20 eye bolts (120 mm long) shall preferably be of drop forged manufacture and shall be supplied complete with full thread and two full nuts.

Eye bolt shall be manufactured from steel to ISO 272, 885, 888, 4759/1 and shall meet the requirements for mechanical properties detailed in ISO 272, 885, 888, 4759/1.

Where a welding process is used in manufacture, each eye bolt shall be individually proof tested by the manufacture in accordance with ISO 272, 885, 888, 4759/1 to 125% of its safe working tensile load that is to 48kN. The safe working tensile load shall be the ultimate axial tensile strength divided by the factor of safety of 2.5.

The eye shall be permanently and legibly stamped with the letter METRIC in letters not less than 3mm high. The safe working load of any eye bolt is that load which may be safely carried in an axial direction. If loaded in any other direction the safe working load is reduced and reference shall be made to the following table for safe working load of M20 eye bolts and eye nuts.

## (C) TECHNICAL SPECIFICATION FOR ALUMINIUM BINDING WIRE

### SCOPE :

Scope covers manufacture, testing and supply of 3.53 mm dia Aluminium Binding Wire as per IS 398.

### MATERIALS :

The material comprising the wire shall have the following chemical composition:

Aluminium 99.95% minimum Copper, silicon and iron 0.05% maximum

The surface of the wire shall be smooth and free from all irregularities and imperfections. Its cross sections shall closely approximate that of true circle.

### Characteristics of Aluminium Binding wire

Diameter of wire			Cross sectional area of nominal dia. Wires (mm)	Weight of wire kg/km	Breaking Load (kN)
Minimum	Nominal	Maximum			
3.15	3.53	3.55	9.787	26.45	1.57

### Inspection and Tests

The following routine checks and tests shall be carried out on 10% of the coils of aluminium binding wire. If any one sample fails to pass any one of the test nominated for that wire, then samples shall be taken from every coil in the consignment and any coil from which a sample proves defective shall be rejected. On no account shall any rejected material be presented for test again unless with the written approval of, and under conditions determined by the Owner.

### Physical properties

The surface of the finished wires shall be checked to ensure that it is smooth , free from all irregularities, imperfections and inclusions and that its cross section approximates closely that of true circle.

The wire shall be checked to ensure that its diameter and weight are within the values given I the table above characteristic of a aluminium binding wire.

### Ultimate tensile strength

When tested on a standard tensile testing machine, the value obtained for the ultimate tensile stress shall not be less than 1.57kN.

**Wrapping test**

The wire shall withstand one cycle of a wrapping test as follows:

The wire shall be closely wrapped round a wire of its own diameter form a close helix of eight turns. Six turns shall then be unwrapped and again closely rewrapped in the same direction as the first wrapping. The wire shall not break or crack when subjected to this test.

**Packing & Delivery**

The aluminium binding wire shall be delivered in 30m coils, with a permitted tolerance of +5%. Random or non standard lengths shall not be permitted.

Each coil shall be adequately guarded against damage due to transportation and handling and shall have an outer layer of tightly wound polythene tape or be contained in a suitable, transparent plastic bag.

The internal diameter of the wound coil shall not be such as to result in a permanent set in the conductor.

The coils shall be contained in non returnable wooden cases, with a gross weight not in excess of 300 kg. The number of coils contained shall be marked on the outside of each case.

**GUARANTEED TECHNICAL PARTICULARS ALUMINIUM BINDING WIRE**

<b>Item No.</b>	<b>Description</b>	<b>Bidder's Offer</b>
<b>1</b>	Manufacturer Address	
<b>2</b>	Indian Standard No. IS 398 (Part-4) 1994	
<b>3</b>	Material of Binding Wire	
<b>4</b>	Dia. Of Wire	
<b>5</b>	Maximum D.C. resistance at 20 degree centigrade	
<b>6</b>	Indivisual Aluminium Alloy Strands	
<b>a)</b>	Tensile breaking stress	
<b>b)</b>	Elongation on 200 mm length in breaking	
<b>7</b>	Particulars of Raw Materials	
<b>7.1</b>	Aluminium	
	<b>a)</b> Minimum Purity of aluminium	
<b>7.2</b>	Aluminium Alloy	
	<b>a)</b> Aluminium redraw rod conforming to	



	Elements	
	(a) Si	
	(b) Cu	
	( c) Other Element (If any)	
<b>8</b>	Linear mass of Wire	
<b>9</b>	Modulus of Elasticity	
<b>10</b>	Coefficient of Linear Expansion (per deg. Cent.)	

## **(D) TECHNICAL SPECIFICATION FOR MILD STEEL CHANNEL & ANGLE**

### **1.0 APPLICABLE STANDARD**

Materials shall conform to the latest applicable Indian standards. In case bidders offer steel section and supports conforming to any other international specifications which shall be equivalent or better than IS, the same is also acceptable.

<b>Sl.No.</b>	<b>Standard No.</b>	<b>Title</b>
1	IS: 2062 Grade 'A'	Quality Specification for M.S.Angles, M.S.Channel
2	IS: 2062	Chemical and Physical composition of material
3	IS: 1852	Rolling and Cutting Tolerances for Hot Rolled Steel products

### **2.0 GENERAL REQUIREMENTS**

#### **2.1 Raw material**

The Steel Sections shall be re-rolled from the BILLETS/INGOTS of tested quality as per latest version of IS:2830 or to any equivalent International Standard and shall be arranged by the bidder from their own sources.

The Chemical composition and Physical properties of the finished material shall be as per the equivalent standards.

Chemical Composition and Physical Properties of M.S. Angles, M.S. Channels, and M.S.Flat conforming to IS: Conforming to IS:2062/84

### **3.0 Chemical Composition**

#### **3.1 Chemical composition For Fe 410 WA Grade**

- 1 C - 0.23% MAX
- 2 Mn - 1.5% MAX
- 3 S - 0.050% MAX
- 4 P - 0.050% MAX
- 5 Si - 0.40% MAX
- 6 CE (Carbon Equivalent)- 0.42% MAX

### **4.0 Mechanical Properties**

- 1. Tensile strength Kgf/mm<sup>2</sup> - 410
- 2. Yield stress Min. for thickness/diameter
  - < 20 mm - 26 Kgf/mm<sup>2</sup> OR 250 N/ mm<sup>2</sup>
  - 20-40 mm - 24 Kgf/mm<sup>2</sup> OR 240 N/ mm<sup>2</sup>
  - > 40 mm - 23 Kgf/mm<sup>2</sup> OR 230 N/ mm<sup>2</sup>
- 3. Elongation % - 23%
- 4. Bend Test (Internal Dia) - Min-3t  
(t—is the thickness of the material).

## **5.0 Tolerance**

Variation in ordered quantity for any destination and overall ordered quantity be only to the extent of  $\pm 2\%$ .

Rolling and weight tolerances shall be as per version of IS: 1852 or to any equivalent International Standard.

## **6.0 TEST**

Steel Section shall be tested in IS approved Laboratory or Standard Laboratory the Bidder country having all facilities available for conducting all the test prescribed in relevant IS or IEC or to any equivalent International Standard or any recognized and reputable International Laboratory or Institutions.

The bidders are required to specifically indicate that;

They hold valid IS (or equivalent IEC) License.

Steel Section offered are bearing requisite IS certification or equivalent marks.

The bidders are required to submit a copy of the valid IS (or equivalent IEC) License clearly indicating size and range of product against respective ISS or any equivalent International Standards along with their offer.

## **6.0 MARKING**

It is desirable that the bidder should put his identification marks on the finished material. The mark shall be in "legible English letter" given with marking dies of minimum 18 mm size.

## **7.0 INSPECTION AND TEST CERTIFICATES**

The material to be supplied will be subject to inspection and approval by the purchaser's representative before dispatch and/or on arrival at the destination. Inspection before dispatch shall not however, relieve the bidder of his responsibility to supply the Steel Sections strictly in accordance with the specification.

The purchaser's representative shall be entitled at all reasonable time during manufacture to inspect, examine and test at the bidder's premises the materials and workmanship of the steel section to be supplied.

As soon as the steel Section are ready for testing, the bidder shall intimate the purchaser well in advance , so that action may be taken for getting the material inspected. The material shall not be dispatched unless waiver of inspection is obtained or inspected by the purchaser's authorized representative.

Test certificates shall be in accordance with latest version of the relevant Indian Standards or any equivalent International Standard.

The acceptance of any batch/lot shall in no way relieve the bidder of any of his responsibilities for meeting all the requirements of the specification and shall not prevent subsequent rejection of any item if the same is later found defective.

**Schedule C 1 - Earth Wire ( In River crossing Spans)**

<b>Description (Complete earth conductor)</b>	<b>Unit</b>	<b>GSW</b>
Appropriate Indian Standard No		398(Part-2)
Appropriate British Standard No		183
Material of earth conductor		galvanized steel
Number and diameter of wires	No./mm	7/3.15
Overall diameter of conductor	mm	9.45
Mass of conductor per kilometer	kg	428
Ultimate strength of conductor	Newton	56000
Lay length	mm	160 +/- 15
Direction of the lay of the outer layer		Right hand
Chemical composition of the steel wire	%	
Carbon		not more than 0.55
Manganese		0.4 to 0.9
Phosphorous		not more than 0.04
Sulphur		not more than 0.04
Silicon		0.15 to 0.35
Purity of Zinc for galvanizing	%	99.95
Galvanizing after stranding		
a) Minimum weight of Zinc coating per sq. m. of the uncoated wire surface	gms	240
b) Minimum no. of one minute dips that the galvanized wire can withstand in Standard Preece Test		3 and ½
Maximum length of conductor on drum #	km	4 +/- 5%
D.C. resistance at 20 °C	ohms/km	3.375

**Schedule C3 - Insulator Strings ( Tension Sets For 33 kV Lines )**

<b>Description</b>	<b>Unit</b>	<b>Single Tension Strings</b>	<b>Double Tension Strings</b>
Mechanical strength of the complete insulator string along with all hardware fittings	kN	70	2x70
Maximum voltage (in percentage ) across any disc in the complete insulator string under phase to earth voltage *	%	22	22
Number of insulator units in each string **		4	2x4
Purity of Zinc used for galvanizing	%	99.95	99.95
Minimum No. of one minute dips the ferrous parts can withstand in Standard Preece Test	No.	6	6

## **SCHEDULE C – 4**

With all Joint Measurement Certificate, the check list as detailed below is to be furnished.

### **CHECK FORMAT**

1. Excavation has been done as per approved drawing of Normal soil. **Yes/ No**
2. PCC has been done as per approved drawing. **Yes/ No**
3. RCC has been done as per approved drawing and as per required Qty. **Yes/ No**  
Rods has been provided.
4. Lapping of rods has been done as per standard (Minimum 40 D). **Yes/ No**
6. Good quality of shutters has been used. **Yes/ No**
6. Is there any honey-combs after removal of shutters observed. **Yes/ No**
7. If honey-combs observed, has been repaired by providing rich Concrete **Yes/ No**  
mixture after removal of loose ingredients.
8. Is there any deviation in alignment related to tangent tower. **Yes/ No**
9. Is there any deviation in verticality after concreting. ( If any deviation **Yes/ No**  
In verticality of pole or tower, the contractor should re-cast the  
Foundation free of cost, otherwise it will not to be accepted)
10. Is there any deviation in bi-section of angles of the Angle tower **Yes/ No**  
before taking up the concreting of pole or structure.
11. All the GI bolts-nuts of required size with required spring washer **Yes/ No**  
has been provided.
12. All the bolts-nuts has been properly tightened ( after full tight 3 Nos. **Yes/ No**  
threads will be projected out)
13. Cooping of required height ( in case of Urban area it is 30 cm, in **Yes/ No**  
Cross country it is 75cm) has been done.
14. Painting of pole or structures has been done as per specification. **Yes/ No**
15. Split pins & "I" clips has been provided in each H/W fittings & **Yes/ No**  
Insulator strings.
16. All the accessories in each locations has been fixed properly. **Yes/ No**
17. Bird guard has been provided in each tangent towers. **Yes/ No**
18. Anti climbing devices has been provided in each locations. **Yes/ No**
19. All the jumpers has been properly tightened by providing **Yes/ No**  
Required nos. of PG clamps( 2 nos. PG clamps has to be  
Provided per each side)
20. All the insulators and H/W fittings used has been free from all Defects. **Yes/ No**

- |  |                |
|--|----------------|
| 21. Equal phase to phase clearance has been maintained.  | <b>Yes/ No</b> |
| 22. Minimum ground clearance from bottom most conductor<br>(7 mts. in cross country & 9 mts. In road crossings) has been<br>maintained in each span.   | <b>Yes/ No</b> |
| 23. Curing has been done for 28 days.  | <b>Yes/ No</b> |
| 24. Proper back filling has been done as per specification.  | <b>Yes/ No</b> |
| 25. Required earthing has done in every locations.   | <b>Yes/ No</b> |
| 26. Material utilization accounts has been furnished.( In each and every<br>Bills should have material accounts of both departmental supply items<br>And contractor's supply items, except civil items, otherwise the bills<br>Will not accepted). | <b>Yes/ No</b> |
| 27. Stay   | <b>Yes/ No</b> |
| 28. Guarding at Road Crossing.   | <b>Yes/ No</b> |
| 29. Clearance with intercepting lines.   | <b>Yes/ No</b> |
| 30. Proper Jumpering.  | <b>Yes/ No</b> |



**CIVIL WORKS**  
**(Construction of Control**  
**Room-cum- Swith gear room)**

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OF  
CIVILWORK FOR SUBSTATIONS**

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## **TECHNICAL SPECIFICATION for CIVILWORK FOR SUBSTATIONS**

### **1.0 ERECTION WORK**

#### **1.1 CIVIL WORKS**

Civil works includes the following items:

The scope shall generally cover Construction of Control room-cum- Switch gear room alongwith foundations. cable trenches along with covers, cable trench crossings of road and rails, sump pits, marshalling box/control cubicle foundations, switchyard dressing and levelling, site clearance, soil investigation, roads, drains, fencing, gravel filling and, transformer foundations, firewalls, control room building, Any other items, not specifically mentioned here but required for the commissioning of substation shall be deemed to be included in the scope of this Specification. The scope shall further cover design, engineering, erection, testing and commissioning of all civil works at each substation. All civil works shall also satisfy the General Technical Clauses specified in other sections of this specification and as detailed below.

Excavation, pile drilling, dewatering, carriage of excavated earth, plain cement concrete (PCC), casting of reinforced cement concrete (RCC) foundations, super-structures for sub- station structures, equipment supports, their control cubicles, bus post supports, lighting poles and panels, brick and stone masonry, cable trenches, pipe trenches with necessary pre cast RCC removable covers, with lifting facility(In every 5 th slab) and sump pits, cable supports and their embedment in cable trenches and cable trench crossings road or rail track with backfilling complete as per drawings approved by CESU, shall be carried out by the contractor. The cable trenches inside the control room shall be provided with GI chequered plate with angle stiffeners at the bottom for mechanical strength and painting there of as per the standard practice.

The Contractor shall furnish all designs, (unless otherwise specified) drawings, labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and as per direction of the Engg In-charge .

The work shall be carried out according to the design/drawings furnished in the specifications or supplied to the contractor by the Engg In-charge . For all

buildings, structures, foundations etc. necessary layout, levels and details have been furnished by the owner keeping in view the functional requirement of the plant and facilities and providing enough space and access for operation, use and maintenance based on the input provided by the Engg In-charge . Certain requirements are indicated in this specification for guidance purposes only. However, the Bidder shall quote according to the complete requirements.

## **2.0 SOIL INVESTIGATION**

### **General**

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate general as well as specific information about the soil profile/strata and the necessary soil parameters of the site in order that the foundations of the various structures specified in the tender specification can be adopted. Foundation systems adopted by the contractor shall ensure that relative settlement shall be as per provision in IS 1904 and any latest IS and other Indian Standards.

A report to the effect will be submitted by the Contractor for the Engg In-charge specific approval giving details regarding his assumed data for Civil structures design.

Any variation in soil data shall not constitute a valid reason for any additional cost and shall not affect the terms and condition of the Contract. Nothing extra what so ever shall be paid to the Contractor on account of any variation in subsoil properties /or conditions. Tests must be conducted under all the critical locations i.e. Control room building & transformer location etc. However, some of the soil parameters for substations have to be determined and submitted to Engg In-charge .

### **2.1 EXCAVATION AND BACKFILL**

Excavation and backfill for foundations shall be in accordance with the relevant Code. Back filled materials in the pit to be levelled maximum up to a height of 200-250 mm and then to be compacted to 150mm after sprinkling of required quantity of water.

Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.

### **2.2 Rock excavation**

The rock to be excavated shall be classified under the following categories :

## **1. Ordinary rock**

Rock which does not require blasting, wedging or similar means for excavation is considered as ordinary rock.. This may be quarried or split with crowbars or pickaxes and includes lime stone, sand stone, hard laterite, hard conglomerate and reinforced cement concrete below ground level. It will also include rock which is normally hard requiring blasting when dry but can be excavated without blasting, wedging or similar means when wet. It may require light blasting for loosening materials, but this will not any way entitle the material to be classified as hard rock.

## **2. Hard Rock (Blasting prohibited)**

This shall cover any hard rock requiring blasting as described in above but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging, drilling or any other approved method.

### **2.3 Authority for classification**

The classification of excavation shall be decided by the Engg In-charge and his decision shall be final and binding on the Contractor.

#### **2.3.1 Excavations for foundations and other purposes**

Excavations shall be of the minimum sizes where not specified in the specifications, necessary for the proper construction of the works, and excavations shall not be kept open for periods longer than that reasonably required to construct the works. The Contractor shall take all precautions necessary to ensure that the bottoms of excavations are protected from deterioration and that the excavations are carried out in such a manner that adjacent foundations, pipes or such like are not undermined, damaged or weakened in any way. Any excavation taken out below the proper level without approval shall be made good at the expense of the Contractor using concrete or other material as directed.

#### **2.3.2 Support of excavations**

The Contractor shall be responsible for the stability of the sides of the excavations. Excavation surfaces shall be close timbered or sheeted, planked and strutted as and when necessary during the course of the work and shall ensure the safety of personnel working within them. If any slips occur, they shall, as soon as practicable, be made good in an approved manner at the expense of the Contractor. Shoring shall not be removed until the possibility of damaging the works by earth pressure has passed. No payment for shoring or timber left in shall be made, unless agreed in writing by the Engg In-charge .

## **2.4 Works to be in dry**

All excavations shall be kept free from water and the Contractor shall take whatever action is necessary to achieve this. Pumping, hand dewatering and

other means necessary to maintain the excavations free from water shall be at the expense of the Contractor, and carried out in an approved manner.

## **2.5 Backfill**

As soon as possible after the permanent foundation works are sufficiently hard and have been inspected and approved, backfill shall be placed where necessary and thoroughly consolidated in layers not exceeding two hundred (200) millimetres in depth.

On completion of structures, the earth surrounding them shall be accurately finished to the line and grade as shown on the drawings. Finished surfaces shall be free of irregularities and depressions.

The soil to be used for back filling purposes shall be from the excavated earth or from borrowed pits, as directed by the Engg In-charge .

## **2.6 Disposal of surplus**

Surplus excavated material not required or not approved for backfilling shall be loaded and deposited either on or off site as directed. The Contractor shall not delay disposal of surplus material after receipt of instructions from the Engg In-charge .

## **2.7 Requirement for fill material under foundations**

The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil.

Where compacted fill is required it shall consist of suitable sand, or other selective inorganic material, RRHG mixed with sand subject to approval by the Engg In-charge . The filling shall be done with locally available sand. The filled in sand shall be kept immersed in water for sufficient time to ensure compaction, if so desired by the Engg In-charge .

## **3.0 SITE LEVELLING**

### **3.1 Scope of Work**

The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the Engg In-charge .Contour survey of proposed sub-station area including the control room area has to be done by taking levels at an interval of two meters in both the ways in the presence of the Engineer-in-charge or his representative. The detail contour survey should be traced over the tracing graph paper and submitted to the Engineer-in-charge for approval.

### **3.2 General Requirement**

The material required for site surfacing/gravel filling shall be free from all types of organic materials and shall be of standard approved quality, and as directed by the Engg In-charge .

The Contractor shall furnish and install the site surfacing to the lines and grades as shown in the drawing and in accordance with the requirements and direction of the Engg In-charge . The soil of the entire switchyard area shall be levelled before placing the site surfacing/gravel fill material. After all the structures and equipment have been erected and accepted the site shall be maintained to the lines and grades indicated in the drawing and rolled or compacted with suitable water sprinkling to form a smooth and compact surface condition, which shall be matching with finished ground level of the switchyard area. After due compaction of the surface of the entire switchyard area shall be provided with plain cement concrete of 75 mm thickness (1:4:8) mix. after proper compaction. Care shall be taken for proper gradient for easy discharge of storm water.

After the PCC is applied and surface prepared to the required slope and grade a base layer of uncrushed/crushed broken gravel of 20 mm nominal size shall be spread, rolled and compacted to a thickness 100 mm. The 20 -40 mm. nominal size (for both layers) shall pass 100% through IS sieve designation 37.5 mm and nothing through 16.0 mm. IS sieve.

Engg In-charge by no means shall relieve the contractor of their contractual obligations as stipulated in General Conditions of Contract.

## **4.0 SITE DRAINAGE**

### **4.1 General**

Adequate site drainage system (By using K.B. Brick masonry using bricks having crushing strength not less than 100Kg/cm<sup>2</sup> with 1:5 cement mortar, PCC 1:3:6 & 1:2:4 ratio, Cement plastering & punning) shall be provided by the Contractor. The surfaces of the site shall be sloped to prevent the ponding of water.

The Contractor shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts, etc., to prevent erosion of material by water.

The drainage system shall be adequate without the use of cable trenches.

All manholes deeper than 1.2 m shall be provided with galvanised M.S. foot rests. Foot rests shall be of 20 mm M.S. square bars.

Invert of the drainage system shall be decided in such a way that the water can easily be discharged above the High Flood Level (HFL) outside substation boundary at suitable location and approved by Engg In-charge . Pumping of drainage water, if required, shall be provided by Contractor.

The Contractor shall locate the outfall point outside the substation vicinity and the substation storm drainage must be connected to this point.

The drainage scheme and associated drawings, if required, superseding the drawing provided in the specification, shall be subject to approval of the Engg In-charge. In such a case the payment will be made on prorata basis for different items of work.

#### **4.2 Excavation and backfill**

Trench excavations for drains shall be carried out with the minimum disturbance to adjacent ground and in such a way that existing or new work shall not be undermined. No backfill shall be placed until it has been inspected, tested and approved. Backfill shall be carefully placed by hand tools and rammed in layers not exceeding one hundred (100) millimetres thick in a manner which will not cause damage.

### **5.0 SEWAGE SYSTEM ( AT URBAN SUB-STATION)**

A sewage system shall be provided for all utility buildings including the Control room building and other auxiliary buildings.

The Contractor shall construct suitable septic tank and soak pit for the discharge of effluents.

Sewers shall be constructed as per the provision made in the price schedule (BOQ).

### **5.1 ROADS AND CULVERTS**

The approach road to the S/s and the roads inside the S/s shall be constructed in accordance to the drawing provided in the specifications and details below.

#### **A) CONCRETE ROAD:**

The concrete road shall consists of the following items.

- i. Boulder & sand packing to a depth of 500mm.
- ii. 75 mm thick consolidated WBM with stone aggregate of size 63mm to 45mm (bottom layer).
- iii. 75 mm thick consolidated WBM with stone aggregate of size 53mm to 22.4mm (top layer).
- iv. 100mm thich 1:2:4 mix concreete PCC.



**B) MOORUM ROAD:**

The approach road beyond the concrete road shall be moorum type. The following procedure shall be followed for the construction of moorum roads.

- i. 300mm thick compacted sand-moorum (30:70) admixture.
- ii. 150mm thick solling stone with filling interstics with moorum.

**6.0 TRANSFORMER FOUNDATION, RAIL TRACK**

**6.1 General**

All the transformer foundations should be designed for 12.5 MVA Power transformer in Urban areas ,for 8 MVA Power transformer sub urban areas and for 5 MVA power transformers in other areas & shall be of RCC, M20 (1:1½:3 mix) grade (as per the indicative drawing enclosed). The 60 lb rails shall be first quality manganese steel as per Indian Railway specification T-12-64.

The station transformer has to be plinth mounted as per the drawing. LA , HG Fuse, AB Switch etc. for station transformer shall be installed on the DP structure.

**Oil Recovery System**

**6.2 General**

An oil recovery system shall be provided for all transformers (containing insulating oil or any flammable or polluting liquid) in order to avoid spread of fire by the oil, and for environmental protection by providing suitable common sump pits of size 1.6 x 1.6x 2.3 metre.

**7.0 FIRE PROTECTION (BAFFLE) WALLS**

Fire protection walls shall be provided between two power Transformers.

**8.0 BOUNDARY WALL/ COMPOUND WALL:**

The boundary wall shall be as per the drawing and the quantity mentioned in trhe bid price schedule (BOQ).

In case the stability of the boundary wall as mentioned is not suitable for the soil, the bidder has to consider for putting RCC(1:1.5:3) tie beam to be rested on the RCC pillars. The size of the beam and pillar has to be carried out as per the soil condition for proper stability of the boundary walls.

**Gates:**

Gates shall be installed in locations shown on drawings. Next to the main gate, a wicket gate (1.50 m wide, single leaf) shall also be provided.

Bottom of gates shall be set approximately 40 mm above ground surface and necessary guiding mechanism (with roller on the bottom of the gate and fixed guider in the road) shall be fitted to avoid hanging of the main gate.

Flexible cooper bond has to be provided to link earthing of the sub station.

## 9.0 CABLE TRENCHES

### 9.1 General

The cable trenches should be primarily of Brick masonry supported with RCC pillars 250x250mm at an interval of 2000mm over 75 mm PCC (1:3:6) base and then 100mm RCC (1:1½:3). In each pillar, 2 nos of GI angle of 75x75x6mm of 500mm exposed length (as per the drawing) shall be suitably fixed. The cable trench wall will be of 250mm thick K.B. Brick with 16mm plasters.

The cable trenches shall take the loads of 33kV 400mm<sup>2</sup>, 11kV 300mm<sup>2</sup>/400mm<sup>2</sup>/630mm<sup>2</sup> cables and the control cables.

Cable trench covers shall be designed for (i) self weight of top slab plus concentrated load of 200 kg at centre of span on each panel and a surcharge load of 2 tonnes per sq. metre.

The top of trenches shall be kept at least 300 mm above the finished ground level (FGL). The FGL means the finish level of the soil but not the top of metalling surface. The top of cable trench shall be such that the surface rain water does not enter the trench.

All metal parts inside the trench shall be connected to the earthing system.

Cables from trench to equipments shall run in hard conduit pipes (GI pipe and necessary G.I bends and sockets)

A suitable clear gap shall be maintained between trench walls and foundations.

The vertical space between each tier and the floor shall be as per the drawing furnished. No sharp bending of cable trench is permissible, it should be done as per 20D principle.

The trench bed shall have a slope of 1/500 along the run and 1/250 perpendicular to the run.

Cable supports (all galvanised structures) shall be designed and constructed to be a single complete fabrication or assembly such that every layer of the horizontal ladder type cable supports are fixed, either bolted or welded, to a vertical steel support that is embedded in the concrete wall of the cable trough. It shall not be permitted to embed a horizontal support beam directly into the wall of the trough in order to use the concrete wall as a means of load bearing. Concrete troughs shall be provided with concrete covers of suitable load bearing strength. Where the cable troughs are run across or within 3 m of substation roads, the trough covers shall be capable of bearing an accidental wheel load of 20 kN. The drawings showing the details of fixing of cable racks in concrete cable trench walls, number of layers to be provided has to be provided in the drawing.

A running earth strip has to run all through the cable trench for proper earthing of the cable trays and stand (frame). The size of the earth strip is of 50X6mm G.I flats. Welding the GI flats to the frame to be carried out. Earthing strips to be welded with the running earth mat at 10mtrs interval.

The covers of the slab are also of RCC with ratio mixing 1:1½:3. The thickness of the slab shall be 75 mm (MS Rods to be used 8mm), The MS rods to be used shall be placed at 100 mm centre to centre both way and properly bided. The cover slab shall have provision of lifting hooks at two points for easy lifting of the slabs. Slabs having lifting hooks shall be placed at every 5<sup>th</sup> slabs, it should remain inside the top of concrete surface of the slab. The length and breath of the cable trench cover slab shall be 1900mm X 300mm.

Once the trench covers have been made they are to be stored and not laid until all trench cabling, is finished. Any covers laid before this time which become damaged shall be replaced at the Contractor's expense.

Trench covers and bridging beams for covers, except where heavy duty, shall be light enough for two men to lift.

## **10.0 FOUNDATION MATERIALS**

### **10.1 Cement**

The cement to be used shall be the best quality of its type and must not be more than 3 months old in stock.

All cement shall be sampled and tested in accordance with Indian Standards.

The Portland cement used in concrete shall confirm to IS 269.

Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the contractor.

High Alumina cement shall NOT be used.

### **10.2 Aggregate**

Coarse and fine aggregate shall conform to the requirements of IS 383-1970.

Sampling and testing of aggregates shall be in accordance with the relevant Indian Standard.

Fine and coarse aggregates shall be obtained from the same source and the Contractor shall ensure that material from the source is known to have a good service record over a long period of time.

Aggregate shall be hard and dense and free from earth, clay, loam and soft, clayey, shaley or decomposed stone, organic matter and other impurities.

### **10.3 Storage of aggregates**

Coarse and fine aggregates shall be stored on site in bins or on clean, dry, hard surfaces, and be kept free from all sources of contamination. Aggregates of different gradings shall be stored separately, and no new aggregate shall be mixed with existing stocks until tested, and approved by the Engg In-charge .

### **10.4 Water**

Water used for mixing concrete and mortar shall be clean, fresh water obtained from an approved source and free from harmful chemicals, oils, organic matter and other impurities. Normally potable water may be considered satisfactorily for mixing and curing concrete and masonry work.

### **10.5 Steel bar reinforcement**

Reinforcement shall comply with the appropriate Indian Standards.

All bar reinforcement shall be hot rolled steel except where the use of cold worked steel is specified on the drawings or otherwise approved.

The bars shall be round and free from corrosion, cracks, surface flaws, laminations, rough, jagged and imperfect edges and other defects.

The bar reinforcement shall be new, clean and of the lengths and diameters described on the Drawings and Schedules. Bars shall be transported and stored so that they remain clean, straight, undamaged and free from corrosion, rust or scale. Bars of different diameters shall be separately bundled.

### **10.6 Welding of reinforcement**

Spot or tack welding for positioning bars in heavily reinforced areas will only be allowed with the express permission of the Engg In-charge . Extension of lengths of reinforcement by welding will not be permitted.

Welding will be approved only in low stress members, and lap welding will not be approved in any circumstances.

### **10.7 Fixing of reinforcement**

Before fixing in the works bars shall be seen to be free from pitting, mud, oil, paint, loose rust or scale or other adherents harmful to the bond or strength of the reinforcement. Bars shall be fixed rigidly and accurately in position in accordance with the working drawings, unless otherwise approved by the Engg In-charge . Reinforcement at all intersections shall be securely tied together with 1.5 mm soft annealed tying wire the ends of which shall be cut and bent inwards. Cover to the reinforcement shall be in accordance permissible standard and sufficient spacers and chairs of precast concrete of approved design shall be provided to maintain the specified cover and position. No insertion of bars in previously placed concrete shall be permitted. Projecting bars shall be adequately protected from displacement. The fixing of reinforcement in the works shall be approved by the Engg In-charge before

concrete is placed. Measurement will be based on the calculated weights of steel actually used in tonnes corrected to second place of decimal.

**Concrete cover to reinforcement**

For durability the minimum concrete cover to any reinforcing bar shall be as follows:

**Concrete above ground.**

- Internal faces of slabs 25 mm
- Internal faces of beams and walls 30 mm
- Exposed faces of slabs, beams and walls 50 mm
- All faces of columns 50 mm

**Concrete below ground (including piles).**

- Faces in contact with soil including blinding concrete 75 mm
- All other faces (i.e. internal faces of basement wall) 50 mm

Only concrete or steel spacers shall be used to achieve the required minimum thickness of concrete cover to reinforcement. Concrete spacers shall have non metallic ties. Timber blocks for wedging the steel off the formwork will not be allowed.

**10.8 Formwork**

Formwork shall be constructed from timber, metal, lined as necessary for special finishes and designed with the quality and strength required to ensure rigidity throughout placing, ramming, vibration and setting of the concrete, without detrimental effect.

Formwork shall be erected true to line, level and shapes required using a minimum of approved internal ties. Faces in contact with the concrete shall be true and free from defect, jointed to prevent loss of water or fines, in panels or units which permit easy handling Ties or spaces remaining embedded shall have the minimum cover specified for reinforcement. Forms for exposed concrete beams, girder casings and columns shall provide for a twenty five millimetre chamfer on external corners.

Wedges and clamps shall be kept tight during vibration operations. Before commencement or resumption of concreting, the interior of forms shall be cleaned and free of sawdust, shavings, dust, mud or other debris and openings shall be formed to facilitate this cleaning and inspection. The inside of the forms shall be treated with a coating of an approved substance to prevent adhesion. Care shall be taken to prevent this substance being in contact with the reinforcement.

### 10.9 Grades of concrete

Concrete shall be either ordinary or controlled and in grades designated M10, M15, M20 and M25 as specified in IS: 456 (latest edition). In addition, nominal mixes of 1:3: 6 and 1: 4: 8 of nominal size 40 mm maximum, or as indicated on drawings, or any other mix without any strength requirements as per mix design shall be used where specified.

#### Ordinary concrete

Ordinary concrete shall be used for all plain cement concrete work and where shown on drawings or allowed by the Engg In-charge . Ordinary concrete shall not require preparation of trial mixes.

In proportioning concrete, the minimum quantity of cement shall be as specified in of this clause and the amount to be used shall be determined by actual weight. The quantities of fine and coarse aggregate may be determined by volume, but preferably by weight.

The water cement ratio shall not be more than those specified in IS 456.

Grade of Concrete	Minimum cement content per c.m. of finished concrete
M 10	236 kg
M 15	310 kg
M 20	400 kg

As a guide to perform the mix design properly, the relationship between water cement ratio, aggregate to cement ratio, workability and strength of concrete will be as per relevant IS.

The cement /total aggregate ratio is not to be increased beyond 1: 9.0 without specific permission of the Engg In-charge . It should be noted that such high aggregate/cement ratios will be required for concretes of very low slump and high water cement ratios which may be required to be used in mass concrete work only.

The actual cement aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used, and from trial mixes.

### 10.10 Strength requirements

The mix proportions for all grades of concrete shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than the value given below:

Grade Designation	Characteristic Compressive Strength at 28 days
M 10	10 N / sq. mm
M 15	15 N / sq. mm
M 20	20 N / sq. mm

The strength of concrete given above is the 28 days characteristic compressive strength of 15 cm cube.

The placing of concrete shall be a continuous operation with no interruption in excess of 30 minutes between the placing of continuous portions of concrete. When fresh concrete is required to be placed on previously placed and hardened concrete, special care should be taken to clean the surface of all foreign matter. For securing a good bond and water tight joint, the receiving surface should be made rough and a rich mortar placed on it unless it has been poured just before. The mortar layer should be about 15 mm thick with cement and sand proportion as that of the mix in use, and have the same water-cement ratio as the concrete to be placed.

After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men and over vibration shall not be permitted. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during placing of concrete. No concrete shall be placed in open while it rains. If there is any sign of washing of cement and sand, the concrete shall be entirely removed immediately. Slabs, beams and similar structure shall be poured in one operation normally. In special circumstances with the approval of Engg In-charge these can be poured in horizontal layers not exceeding 50 cm. in depth. When poured in layers, it must be ensured that the under layer is not hardened. Bleeding of under layer if any shall be effectively removed.

#### **10.11 Compaction of Concrete**

Compaction is necessary for production of good concrete. After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibrator to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during the vibration of the concrete. The Contractors

shall provide standby vibrators. Vibration is commonly used method of compaction of concrete, the use of mechanical vibrators complying with IS 2505, IS 2506, IS 2514 and IS 4656 for compacting concrete is recommended For all practical purposes, the vibration can be considered to be sufficient when the air bubbles cease to appear and sufficient mortar appears to close the surface and facilitate easy finishing operations. The period of vibration required for a mix depends upon the workability of the mix.

### **10.12 Curing of Concrete**

In order to achieve proper and complete strength of the concrete, the loss of water from evaporation should be prevented. Eighty to eighty five per cent of the strength is attained in the first 28 days and hence this 28-day strength is considered to be the criterion for the design and is called characteristic strength. The concrete after setting for 24 hours shall be cured by keeping the concrete wet continuously for a period of 10 days after laying.

The curing increases compressive strength, improves durability, impermeability and abrasion resistance. Failure to carry out satisfactory curing can lead to cracking in the concrete. This in turn can lead to salt attack of the reinforcement and consequential failure of the structure. If cracks occur in a structure which are severe enough to affect the structure, the Contractor shall cut out and replace the defective concrete at his own cost. The Contractor's attention is, therefore, drawn to this particular aspect of proper and adequate curing

### **10.13 Removal of formwork**

Formwork shall be kept in position fully supported, until the concrete has hardened and gained sufficient strength to carry itself and any loads likely to be imposed upon it. Stripping must be effected in such a manner and at such a time that no shock or other injury is caused to the concrete. The responsibility for safe removal rests with the Contractor but the Engg In-charge may delay the time of striking if he deems it necessary.

Minimum periods, in the absence of agreement to the contrary, between completion of concreting and removal of forms are given below but due regard must be paid to the method of curing and prevailing conditions during this period.

Removal of forms are to be done as under

- |   |        |
|---|--------|
| i) Sides of foundations, columns, beams and wall  | 2days  |
| ii) Under side of slabs up to 4.5 m span  | 7days  |
| iii) Under side of slabs above to 4.5 m span<br>and underside of beams and arches up to 6m span | 14days |
| iv) Under side of beams and arches above 6m and up to 9m span                                   | 21days |



## 11. CONTROL ROOM CUM SWITCHGEAR BUILDING

### 11.1 General

The scope includes the construction of control room building alongwith office rooms & toilets. The size of the building will be 17m X 10m. The tentative layout showing the facilities to be provided is indicated at **E21-II**. However, the size and layout of the building may be modified if the site condition does allow for it. The modification to be done with prior approval of the Engineer in Charge.

#### Specifications

Normally the building shall have the following design/construction parameters.

- i. The structure will be of framed structure with M-20 grade concrete.
- ii. The size and of specification of structural members like footings, columns, beams, lintel, slab, staircase etc. and will be as per approved structural drawings. However size of footings may be changed from site to site as per safe bearing capacity of soil at corresponding sites
- iii. Flooring – Artificial stone flooring will be provided in control room and Vitrified tile flooring in other rooms except toilets will be provided.
- iv. Bath room – Ceramic tiles in walls as well as in floors.
- v. Inside wall – Primer and plastic emulsion paint.
- vi. Outside wall – Primer with weather seal coat.
- vii. Door – 2100x2550mm size Collapsible Iron doors, 2 nos. will be provided in control room. 1070x2100mm size wooden doors in office rooms and store rooms will be provided.
- viii. Toilet doors will be of fibre reinforced plastic (FRP) type.
- ix. All windows and ventilators will be of aluminium glazed type.
- x. A service verandah has been provided in front side of building with a staircase to provide access to terrace.
- xi. A security room of 2000x2000mm size and a service portico 4000X3000 mm size adjacent to it has been provided,

The building design shall also take into consideration the layout of the panels, switchboards, switchgear and other equipment in order to allow enough area for the future extension of switchyard depending upon the availability of subEngineer in Charge area.

The building auxiliary services such as air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant sections of this Specifications to allow for easy access to equipment and maintenance of the equipment

The doors and windows of the building shall be of aluminium extruded channels, angles etc. The windows shall be provided with sliding shuttering facilities and also to be provided with aluminium make grills.

### **11.2 Dimensions**

An open space of one metre minimum shall be provided on the periphery of the rows of panels, and equipment generally, in order to allow easy operator movement and access as well as maintenance.

The building design shall also take into consideration the layout of the panels, switchboards, switchgear and other equipment in order to allow enough area for the future extension of switchyard depending upon the availability of substation area.

The building auxiliary services such as air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant sections of this Specifications to allow for easy access to equipment and maintenance of the equipment

The doors and windows of the building shall be of aluminium extruded channels, angles etc. The windows shall be provided with sliding shuttering facilities and also to be provided with aluminium make grills.

In Urban area of traditional 33/11 Kv S/S the Control Room area is 15x8 Mts.

In rural area of traditional 33/11 Kv S/S the Control Room area is 10x8 Mts.

### **11.3 Submission of data for approval**

The following information shall be submitted for review and approval to the Engg In-charge :

- Design criteria for structural steel and reinforced concrete design. The criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors and maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.
- Structural design calculations and drawings including those for construction and fabrication for all reinforced concrete and structural steel structures.
- Fully dimensioned floor plans, cross sections, longitudinal sections and elevations of each building. These drawings shall be drawn at a scale not less than 1:50 and shall identify the major building components.

- Fully dimensioned drawings showing details and sections, drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.
  - Product information of building components and materials, including walls, partitions, flooring, ceilings, roofing, doors and windows and building finishes.
  - A detailed schedule of building finishes including colour schemes.
  - A door and window schedule showing door types and locations, door lock sets and latch sets and other door hardware.
  - Anti Termite treatment of Control Room to be done by the contractor.
- Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable.

#### **11.4 Flooring (52 mm Thick)**

Flooring shall be done as per provision made in the price schedule (BOQ).

#### **11.5 Walls**

Walls shall be constructed with K.B. Bricks with C.M. (1:6) as per provision made in the drawing and price schedule (BOQ).

#### **11.6 Plastering**

All internal walls shall have minimum 16mm thick 1:6 cement sand plaster. The ceiling shall have 6mm thick 1:4 cement sand plaster.

#### **11.7 External Finish**

All external surfaces shall have painted with weather proof synthetic paints over 12mm thick cement sand plaster in two layers. Under layer 12mm thick cement plaster 1:6 (1 cement:6 coarse sand) and a top layer 6mm thick cement plaster 1:3 (1 cement:3 coarse sand) finished rough with sponge.

All ceilings shall be white based plastic emulsion paints and the internal walls are also to be provided with plastic emulsion synthetic paints. The outer of the building shall be provided with weather seal coats of synthetic paints.

#### **11.8 Roof**

Roof of the building shall consist of cast in situ R.C.C. slabs (M-20) grade. Extra heavy water proofing treatment of approved standard shall be done.

#### **11.9 Plumbing And Sanitation**

All plumbing and sanitation work shall be executed to comply with the requirements of the appropriate bye laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.

An overhead water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided.

Galvanised MS pipe of medium class conforming to IS : 1239 shall be used for internal piping works for portable water supply.

Sand C I pipes with lead joints conforming to IS:1729 shall be used for sanitary works above ground level.

A list of toilet fittings will be approved by the Engg In-charge , before procurement by the contractor and same will be inspected by the Engg In-charge before installation. Sufficient nos of toilets and bath rooms including separate urinal provision shall be provided at both ground and first floors. Required nos of wash basins (stand type) with good quality mirrors and other accessories as required are also to be provided at both ground and first floor of control room building. Same procedure for colony quarters also.

## **12.0 EARTHING :**

Earth Grid should not be more than TWO meters square. This should be done by using 75x10 mm GI flats. Earth risers should be 50x6 mm GI flats. All equipments & metal parts of the Sub-Station should be connected with main earth grid by using 50x6 GI flats at two different places. The main earth grid should be laid not less than 600 mm below the finished ground level. The lap welding should not less than 100 mm. The welding of joints should be done after removal of Zinc by using Blow lamps. Welding should be done in all four sides and should be double layer continuous. Before taking up the second layer welding the deposited flux should be removed. During welding the two flats should be tightened properly by using ' C ' clamps. Immediately after welding two layers of anti-corrosive paints should be painted over the welded portion along with two coats of Black bituminous paints. Before back filling of earth trenches the welded portion should be covered by wrapping with bituminous tape properly and also jointing portion should be covered with PCC (1:2:4) mix. The backfilling of earth pits and trenches should be done with powered loam soil mixed with Bentonate powder (10:1) mix.

All equipments, steel structures etc should be connected with Main earth mat at two rows separately. All LAs, PTs , Columns having spikes should individually connected with individual Pipe electrodes and again should be connected with main earth grid at two separate places. The Neutral of Power Transformer should be connected with two separate pipe electrodes and again connected with main earth electrodes at two separate places. The separation distance between each pipe electrodes should not be less than 2 mts. The

back filling of pipe electrodes should be done in layer of Charcoal, Salt & loam soil mixed with Bentonate power.

There should be a closely spaced earth grid ( 1.5 mts square having .5 mts spacing) below the mechanism boxes of each Isolators & AB switches. In Sub-station the diameter of pipe electrode should not be less than 50 mm. The Flange( 50x6) mm GI flat should be welded in all sides with Pipe electrode. In each face of Flange there should be two nos 17.5 mm hole to accommodate 16 mm GI Bolt nut with 1 no spring washer.

There should be one 50x6 mm earth flat run over the cable rack and should be connected with main earth grid at an interval of 5 mts The jointing portion of earth flats over the ground should be painted with two coats of Anti-corrosive paints and two coats of good quality of Aluminium paints (Berger/Asian paints).

### **12.01 (A) G.I. Flat (75x 10 mm) & G.I.Flat (50 x 6 mm)**

The specification covers manufacture, testing and supply of Galvanized Steel flat for Earthing arrangements.

#### **I. APPLICABLE STANDARDS:**

Materials shall conform to the latest applicable Indian standards. In case bidders offer steel section and supports conforming to any other international specifications which shall be equivalent or better than IS, the same is also acceptable.

<b>Sl. No.</b>	<b>Standard No.</b>	<b>Title</b>
1	IS:2062 Grade 'A' Quality	Specification for M.S. Channel and M.S. Flat
2	IS:2062	Chemical and Physical Composition of material
3	IS:1852	Rolling and Cutting Tolerances for Hot Rolled Steel products

#### **II. RAW MATERIAL :**

The steel section shall be re-rolled from the BILLETS/INGOTS of tested quality from SAIL/TATA/RINL as per latest version of IS: 2830. The chemical composition and physical properties of the finished materials shall be as per the relevant standards.

### III. TEST

Steel sections shall be tested in IS approved laboratory or standard laboratory of the Bidder country having all facilities available for conducting all the tests as prescribed in relevant IS or IEC or to any equivalent International laboratory or Institutions.

### IV. PHYSICAL & CHEMICAL PROPERTIES

#### Length

The GS Flat to be supplied shall be in 5.5 meters to 13 meters lengths.

#### Weighment

The weighment of GS Flat shall be witnessed by the consignee at the time of taking delivery. The weight recorded in the material receipt certificate issued by the consignees shall be final.

Chemical composition and physical properties of M.S.Channels and M.S.Flat conforming to IS: 2062/84L composition.

Chemical Composition		For Fe 410 WA Grade
1	C -	0.23% MAX.
2	Mn -	1.5% MAX.
3	S -	0.050% MAX.
4	P -	0.050% MAX.
5	SI -	0.40% MAX.
6	CE -	0.42% MAX.
(Carbon Equivalent)		

### V. Mechanical Properties

1. Tensile strength Kgf/mm<sup>2</sup> - 410
2. Yield stress Min. for thickness/diameter  
    <20 m - 26 Kgf/mm<sup>2</sup>  
    20-40 mm - 24Kgf/mm<sup>2</sup>  
    40 mm - 23Kgf/mm
3. Elongation % - 23%
4. Bend Test (Internal Dia) Min-3t (this the thickness of the material)

## VI. MARKING

It is desirable that the Bidders should put his identification marks on the finished materials. The mark shall be in "legible English letters"

## VII. METHOD OF GALVANISING:

Sl. No.	Tests	For GI Flat
1	Dip test	6 dips of 1 min each
2	Mass of Zinc coating	610 gram/sq.m minimum

Pre dispatch inspection shall be performed to witness following tests:

Freedom from defects,

Verification of dimensions

Galvanization tests

Mechanical tests

Chemical composition tests

These tests are to be performed and certified at Govt. recognized laboratory.

MS flat shall conform to IS 2062 & its latest amendments for steel & Galvanization as per IS 4759 & its Latest amendments.

The flat shall be coated with Zn 98 Zinc grade.

The minimum Zinc coating shall be 610 gm/sqm for thickness more than 5 mm and 460 gm/sqm for item thickness less than 5 mm.

For use in construction at coastal areas as well as other areas it shall be required for galvanizing the Cross arms and Pole top brackets as following :

All galvanizing shall be carried out by the hot dip process, in accordance with Specification IS 2629. However, high tensile steel nuts, bolts and spring washer shall be electro galvanized to Service Condition 4. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spot and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the galvanic bath which could have a detrimental effect on the durability of the zinc coating.

Before picking, all welding, drilling, cutting, grinding and other finishing operations must be completed and all grease, paints, varnish, oil, welding slag and other foreign matter completely removed. All protuberances which would affect the life of galvanizing shall also be removed.

**The weight of zinc deposited shall be in accordance with that stated in Standard IS 2629 and shall not less than 0.61kg/m<sup>2</sup> with a minimum thickness of 86 microns for items of thickness more than 5mm, 0.46kg/m<sup>2</sup> (64 microns) for items of thickness between 2mm and 5mm and 0.33kg/m<sup>2</sup> (47 microns) for items less than 2mm thick.**

Parts shall not be galvanized if their shapes are such that the pickling solutions cannot be removed with certainty or if galvanizing would be unsatisfactory or if their mechanical strength would be reduced. Surfaces in contact with oil shall not be galvanized unless they are subsequently coated with an oil resistant varnish or paint.

In the event of damage to the galvanizing the method used for repair shall be subject to the approval of the Engineer in Charge or that of his representative. Repair of galvanizing on site will generally not be permitted.

The threads of all galvanized bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specifically approved by the Project Manager. All nuts shall be galvanized. The threads of nuts shall be cleaned with a tap and the threads oiled.

Partial immersion of the work shall not be permitted and the galvanizing tank must therefore be sufficiently large to permit galvanizing to be carried out by one immersion.

After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. To avoid the formation of white rust galvanized materials shall be stacked during transport and stored in such a manner as to permit adequate ventilation. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel shall be subjected to test as per IS-2633.

The galvanization tests are to be conducted as per IS: 2633/72 & IS: 6745/72 & its latest amendments.



### **12.1. (B) Earth Electrode (50 NB 3.0 Mtr Length)**

Metal parts of all equipment other than those forming part of an electrical circuit shall be connected directly to the main earth system via two separate conductors of adequate capacity at two different points.

All main members of structural steelworks shall be earthed by galvanised iron flat connections bonded by welding or bolting to the steelworks.

Connections to apparatus and structures shall be made clear of ground level, preferably to a vertical face and protected as appropriate against electrolytic corrosion. They shall be made between clean surfaces and of sufficient size and pressure to carry the rated short circuit current without damage.

Earth bars installed directly into the ground should normally be laid bare and the trench back-filled with a fine top soil. Where the soil is of a hostile nature, special precautions must be taken to protect the earth bar. Wherever required to achieve the required resistance bentonite powder to be mixed in lom/ black cotton crushed soil in 1: 6 proportion is permissible, the method used being subject to the agreement of the Engg. Incharge . In the event of bentonite powder being adopted, water supply through conduit to the area must be supplemented and regulated to keep the surface / mat moisture absorbent.

Joints in earth bars+ shall be welded and then coated with a suitable anti-corrosion protection treatment.

Facilities shall be provided on the earth bar run between equipment and the base of structures, comprising a looped strip, so as to permit the attachment of portable earth connections for maintenance purposes.

The cross sectional area of the earth bar and connections shall be such that the current density is not greater than  $100 \text{ A/mm}^2$  for a 3 second fault duration.

## **13.0 WIRING, CABLING AND CABLE INSTALLATION**

### **13.1 Cubicle wiring**

Panels shall be complete with interconnecting wiring between all electrical devices in the panels. External connections shall be achieved through terminal blocks. Where panels are required to be located adjacent to each other all inter panel wiring and connections between the panels shall be carried out internally. The Contractor shall furnish a detailed drawing of such inter panel wiring. The Contractor shall ensure the completeness and correctness of the internal wiring and the proper functioning of the connected equipment.

All wiring shall be carried out with **1.1 kV** grade, **PVC** insulated, single core, stranded copper wires. The PVC shall have oxygen index not less than '**29**' and Temperature index not less than **250C**. The wires shall have annealed copper conductors of adequate size comprise not less than three strands.

The minimum cross sectional area of the stranded copper conductor used for internal wiring shall be as follows :

- a) All circuits excepting CT circuits and energy metering circuit of VT 2.5 sq.mm
- b) All CT circuits and metering circuit of VT 2.5 sq. mm

All internal wiring shall be supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.

Cubicle connections shall be insulated with PVC to IEC 227. Wires shall not be jointed or teed between terminal points.

Bus wires shall be fully insulated and run separately from one another. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panel suite. Longitudinal troughs extending throughout the full length of panel shall be preferred for inter panel wiring.

All inter connecting wires between adjacent panels shall be brought to a separate set of terminal blocks located near the slots of holes meant for the passage of the interconnecting wires. Interconnection of adjacent panels on site shall be straightforward and simple. The bus wires for this purposes shall be bunched properly inside each panel.

Wire termination shall be made with solderless crimping type and tinned copper lugs which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. Numbers 6 and 9 shall not be included for ferrules purposes unless the ferrules have numbers underscored to enable differentiation. (i.e. 6 and 9 ).

Fuses and links shall be provided to enable all circuits in a cubicle, except a lighting circuit, to be isolated from the bus wires.

The DC trip and AC voltage supplies and wiring to main protective gear shall be segregated from those for back-up protection and also from protective apparatus for special purposes. Each such group shall be fed through separate fuses from the bus wires. There shall not be more than one set of supplies to the apparatus comprising each group. All wires associated with the tripping circuits shall be provided with red ferrules marked “**Trip**”.

It shall be possible to work on small wiring for maintenance or test purposes without making a switchboard dead.

The insulation material shall be suitably coloured in order to distinguish between the relevant phases of the circuit.

When connections rated at 380 volt and above are taken through junction boxes they shall be adequately screened and “**DANGER**” notices shall be affixed to the outsides of junction boxes or marshalling kiosk.

Where connections to other equipment and supervisory equipment are required the connections shall be grouped together.

### **13.2 LV power cabling**

**LVAC** cable terminals shall be provided with adequately sized, hot pressed, cast or crimp type lugs. Where sweating sockets are provided they shall be without additional clamping or pinch bolts. Where crimp type lugs are provided they shall be applied with the correct tool and the crimping tool shall be checked regularly for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary.

Terminals shall be marked with the phase colour in a clear and permanent manner.

A removable gland plate shall be provided by the Contractor. The Contractor shall be responsible for drilling the cable gland plate.

Armoured cables shall be provided with suitable glands for terminating the cable armour and shall be provided with an earthing ring and lug to facilitate connection of the gland to the earth bar.

### **13.2 Multi-core cables and conduit wiring**

External multi-core cabling between items of main and ancillary equipment shall form part of the Contract Works and shall consist of un-armoured multi-core cable with stranded copper conductors PVC insulated and PVC over sheathed complying with the requirements of IEC 227 and 228 as applicable.

Multi-core cable for instrumentation and control purposes shall be supplied with 2.5 mm<sup>2</sup> stranded copper cores. Multi-core cables for CT and VT circuits shall be supplied with two by 2.5 mm<sup>2</sup> stranded copper cores and the cores shall be identified by the phase colour.

Where conduit is used the runs shall be laid with suitable falls and the lowest parts of the run shall be external to the equipment. All conduit runs shall be adequately drained and ventilated. Conduits shall not be run at or below ground level.

Multi-core cable tails shall be so bound that each wire may be traced to its cable without difficulty. All multi-core cables shall be provided with 20 % spare cores and the spare cores shall be numbered and terminated at a terminal block in the cubicle. Where cables are terminated in a junction box and the connections to a relay or control cubicle are continued in conduit, the spare cores shall be taken through the conduit and terminated in the cubicle. The dc trip and ac voltage circuits shall be segregated from each other as shall the circuits to main protective gear be segregated from those for back-up protection.

The screens of screened pairs of multi-core cables shall be earthed at one end of the cable only. The position of the earthing connections shall be shown clearly on the diagram.

All wires on panels and all multi-core cable cores shall be crimped with the correct size of crimp and crimping tool and will have ferrules which bear the same number at both ends. At those points of interconnection between the wiring carried out by separate contractors where a change of number cannot be avoided double ferrules shall be provided on each wire. The change of numbering shall be shown on the appropriate diagram of the equipment. The same ferrule number shall not be used on wires in different circuits on the same panels.

The Contractor shall provide a two (2) metre loop of spare cable at both ends of all multi-core cable runs and shall leave sufficient lengths of tails at each end of the multi-core cables to connect up to the terminal boards. The Contractor shall also strip, insulate, ring through and tag the tails and shall also seal the cable boxes. The Contractor shall be responsible for re-checking the individual cores and for the final connecting up and fitting of numbered ferrules within all equipment provided on this contract.

The drilling of gland plates, supply and fitting of compression glands and connecting up of power cables included in the Contract scope of work shall be carried out under this contract.

## **14.0 Laying and installing of cables**

### **14.1 General**

For cable laying the following shall apply:

- |                    |  |
|--------------------|--|
| a) Switchyard area | In concrete cable troughs (cable trench having cable racks with ladder type cable trays) |
| b) Control Room    | On cable racks consisting of slotted type and ladder type cable trays                    |
| c) Buildings       | Conduits   |

Directly buried cables shall be used wherever necessary with the approval of Engg. Incharge .

### **14.2 Laying of cable**

Cables shall be laid in concrete troughs provided under this contract or drawn into pipes or ducts or on cable racks or directly buried as may be required by the Engg. Incharge . All cable supports shall be earthed in accordance with IS 3043.

The cable support system shall be designed and constructed to carry the required cables without undue crowding of the supports and without overloading the supports. The maximum number of layers of cable that shall be permitted on a single cable support shall be three. The width of the cable supports shall be selected to ensure that the supports are not crowded, the cable supports are not overloaded and that sufficient space is provided in the cable trough to allow for personnel access during and after cable installation.

Where cables pass under roadways they shall be laid in pipes at a depth not less than 800 mm below the surface.

The Contractor shall be responsible for the excavation of trenches which shall include all pumping and baling required and the provision of all necessary labour, plant, tools, water, additional soil, fuel or motor power for such purposes.

Cables in trenches will be inspected by the Engg. Incharge before the trenches are backfilled.

The running of communications and power cables along the same route shall be avoided as far as possible. Where this is not possible they shall be segregated, the one group from the other. Power and communication cables shall be laid in separate tiers. For other than directly buried cables the order of laying of various cables shall be as follows:

- a) Power cables on top tiers.
- b) Control/ instrumentation and other service cables in bottom tiers.

### **14.3 Cable tags and markers**

Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

The tag shall be of aluminum with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS 280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

Location of cables laid directly in the ground shall be clearly indicated with cable marker made of galvanised iron plate.

Location of buried cable joints shall be indicated with a cable marker having an additional inscription "**Cable joint**".

Cable markers shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct, conduit entry and at every twenty meters (20 m) in cable tray/trench runs. Cable tags shall be provided inside switchgear, motor control centres, control and relay panels etc. and wherever required for cable identification when a number of cables enter together through a gland plate.

The price of cable tags and markers shall be included in the installation rates for cables/conduits quoted by the Bidder.

### **14.4 Cable supports and cable tray mounting arrangements in control room**

The control room will normally be provided with embedded steel inserts on concrete floors/walls for the purpose of cabling in the control room. The supports shall be secured by welding to these inserts or available building steel structures. However, in cases where no such embedded steel inserts are

available, the same shall have to secure to the supports on walls or floors by suitable anchoring.

#### **14.5 Cable support structure in switchyard cable trenches**

The contractor shall fabricate and install cable support structures in cable trenches. These supports shall be provided at 750 mm spacing along the run of cable trenches.

Cable supports and cable racks shall be fabricated from standard structural steel members, channels, angles and flats of required size. The fabrication, welding and erection of these structures shall conform to the relevant clauses of this Specification, in addition to the specification given herein.

#### **14.6 Termination of cables and wires**

Where cables leave the apparatus in an upward direction the cable boxes shall be provided with a barrier joint to prevent leakage of cable oil or compound into the apparatus. Where cable cores are liable to contact with oil or oil vapour the insulation shall be unaffected by oil.

PVC sheathed cables shall be terminated by compression glands complying with BS 6121 (or equivalent).

Auxiliary PVC insulated cables shall be terminated with compression type glands, clamps or armour clamps complete with all the necessary fittings.

Colours shall be marked on the cable box, cable tail ends and single core cables at all connecting points and/or any positions the Engg. Incharge may determine. Cable boxes shall be provided with suitable labels indicating the purpose of the supply where such supply is not obvious or where the Engg. Incharge may determine.

All cables shall be identified and shall have phase colours marked at their termination.

All incoming and outgoing connections shall be terminated at a terminal block. Direct termination into auxiliary switches will not be accepted.

## 15.0 SUPPLY VOLTAGE

The auxiliary supply voltages on site shall be as follows:

Nominal Voltage V	Variation	Frequency Hz or DC	Phase	Wires	Neutral Connection
430	±10%	50±5%	3	4	Solidly earthed
230	±10%	50±5%	1	2	Solidly earthed
24		DC	DC	2	

## 16.0 ERECTION CONDITIONS

### 16.1 General

The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work on this Contract to be performed at Site.

### 17.0 Contractor's field operation

#### 17.1 General

The Contractor shall inform the Engg. Incharge in advance of field activity plans and schedules for carrying-out each part of the works. Any review of such plans or schedules or methods of work by the Engg. Incharge shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall not be considered as an assumption of any risk or liability by the Employer or any of his representatives, and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

#### 17.2 Facilities to be provided by the contractor

#### 17.3 Unloading

Contractor shall make his own arrangement for unloading the equipment at site.

#### 17.4 Tools, tackle and scaffoldings

The Contractor shall provide all the construction equipment tools, tackle and scaffoldings required for offloading, storage, pre-assembly, erection, testing and commissioning of the equipment covered under the Contract. He shall submit a list of all such materials to the Engg. Incharge before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Engg. Incharge .



The Contractor shall maintain an accurate and exhaustive record detailing all equipment received by him for the purpose of erection and keep such record open for the inspection of the Engg. Incharge .

All equipment shall be handled carefully to prevent any damage or loss. All equipment stored shall be properly protected to prevent damage. Equipment from the store shall be moved to the actual location at an appropriate time so as to avoid damage of such equipment at Site.

All the materials stored in the open or dusty location shall be covered with suitable weather-proof and flameproof covering material.

The Contractor shall be responsible for making suitable indoor facilities for the storage of all equipment which requires to be kept indoors.

## **18.0 SITE CLEARANCE**

### **18.1 Clearing and uprooting of tree**

The work shall also consist of numbering of trees, removing and disposing of all materials such as trees, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, foreign materials, etc., which in the opinion of the Engg In-charge are unsuitable for incorporation in the works, from within the limits and such other areas as may be specified on the drawings or directed by the Engg In-charge . Clearing and uprooting of tree shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications and taking prior permission from forest department. During clearing and grubbing, the contractor shall take all adequate precautions against soil erosion, water pollution etc., and where required undertake additional works to that effect.

#### **Provision of plantation and developing a garden inside the sub-station.**

At least, 100 nos. flowers bearing plants as per the advice of Engineer-in-charge to be planted along the road side and in and around the control room building after making surface treatment. Provision of water taps facilities at different locations for watering the plants and as well as to the peripheral earth pits.

### **18.2 Programme**

The Contractor shall construct the works in compliance with the outline programme appended to the Bidding Document, and shall submit for the approval of the Engg In-charge a detailed programme in accordance with the requirements of this Specification.

### **18.3 Inclement weather**

As per relevant Code, during hot weather, precautions shall be taken to avoid premature stiffening of the fresh concrete mix and to reduce water absorption

and evaporation losses. During hot weather (atmospheric temperature above 40 degree C) or cold weather (atmospheric temperature at or below 5deg.C) concreting shall be done as per the procedure set out in IS 7861.

#### **18.4 STANDARDS**

All Civil works shall be carried out as per applicable Indian Laws, latest revision of International Standards and Codes. All materials shall be of best quality confirming to relevant Indian Standards and Codes.

Civil works shall be designed to the required service conditions and /or loads as specified elsewhere in this Specification or implied as per National and International Standards.

#### **19.0 MATERIALS AND WORKMANSHIP**

##### **19.1 General**

All materials used in the works shall be new and of the best quality of their respective kinds. They shall comply with the requirements of the latest edition of any relevant Indian Standard or Code of Practice where such exist, and current at the date of tendering.

All workmanship shall be of the highest standard, and shall be executed by competent men skilled in their respective trades.

##### **19.2 Samples**

In addition to the special provisions made in this specification for sampling and testing of materials by particular methods, samples of any materials and workmanship proposed to be used in the Works may be called for at any time during the Contract by the Engg In-charge and shall be furnished by the Contractor without delay and at the expense of the Contractor. Samples when approved, shall be regarded as the acceptable standard, and any material or workmanship subsequently not complying with that standard shall be rejected and replaced by those of acceptable standard at the expense of the Contractor. Sample storage boxes shall be provided by the Contractor free of cost if requested by the Engg In-charge .

##### **19.3 Tests**

Whenever considered desirable by the Engg In-charge , Inspectors may be sent to manufacturer's or subcontractors' premises to test materials or supervise their manufacture.

Where specified or requested the Contractor shall obtain from the manufacturer and send to the Engg In-charge certificates of test, proof sheets, mill sheets, etc., showing that materials have been tested in accordance with this Specification or the relevant Indian Standard.

Notwithstanding any tests which may be directed to be carried out at a manufacturer's and/or subcontractor's works, the Engg In-charge may carry

out any tests or further tests he considers necessary or desirable after delivery of materials to the Site.

The Contractor shall provide all labour, equipment and facilities necessary for carrying out the tests both in works and on site.

The cost of routine tests required by IS and this Specification shall be borne by the Contractor. The cost of other tests shall be borne in accordance with the Conditions of Contract.

#### **19.4 Names of suppliers and copies of orders**

If so required, and before ordering material of any description, the Contractor shall submit for approval the names of makers or suppliers proposed. Copies of orders shall also be submitted if so required. The Engg In-charge may at any time withdraw his previously given approval to obtaining materials from any maker or supplier should such maker or supplier fail to supply materials of the specified quality or quantity in the requisite time.

#### **19.5 Rejection of materials and workmanship**

The Engg In-charge shall at any time have power to reject materials and workmanship not complying with this Specification or with the approved Drawings. Materials so rejected shall be immediately removed from site and replaced by materials of an approved standard at the expense of the Contractor. Rejected workmanship shall be broken out and replaced by work of an acceptable standard including the supply of new materials by the Contractor, at the expense of the Contractor, and without delay.

#### **19.6 Cube Testing**

150mmX 150mm x 150mm cube from each concrete batch shall be prepared and cure as per relevant IS and then shall be subject to laboratory test to determine its strength in accordance to the Indian Standard.