5. Straining posts shall be installed at sharp changes in grade, at corners, at change of direction and where directed.

6. All corner post will have two-stay post and every tenth post will have a transverse stay post.

7. Posts shall be set in 1:2:4 plain cement concrete Blocks of minimum dimension 400 mm x 400 mm x 1000 mm deep Concrete work shall conform to relevant clause. Post shall be braced and held in plumb position and true alignment and elevation until concrete has set.

8. Fence fabric shall not be installed until concrete has cured a minimum of 7 days.

9. Bottom and top of the fence fabric shall be fixed with MS flats of 50 mm x 6mm (min).

10. Fence fabric shall be laid out with barbed edge on top, stretched tightly and shall be fastened to intermediate, post gate and straining post with 50 x 6 flats.

11. Fabric shall be secured to tension wires with tie wires at 400 mm intervals. Tie wires shall be given not less than two twists.

12. Barbed tape shall be spliced with standard wire splices.

13. Barbed tape shall be stretched to have uniform tension.

14. Barbed tape shall be attached to barbed wire arms with approved metal clips.

15. Toe wall of one Brick/Random Rubble masonry, with notches over 75 mm thick PCC (1:4:8) shall be provided below all fencing and shall be minimum 200 mm above and 200 mm below finished ground level. All exposed surfaces of brick toe wall shall be provided with 1:6 cement sand plaster and coated with two coats of colour wash with a base coat of white wash with lime. Rubble masonry toe wall shall be with raised & cut pointing and 50 mm PCC (1:2:4) band coping.

16. Proper earthing shall be done for fencing also.

Annexure-C
Technical Specification of Geotechnical Investigations

1 General

Owner requires that a detailed Geotechnical Investigations be carried out at various tower locations to provide the designer with sufficiently accurate information, both general and specific, about the sub-strata profile and relevant soil and rock parameters at site, on the basis of which the foundation of transmission line towers can be classified and designed rationally.

2 Scope

2. 1 The scope of work includes detail soil investigations and furnishing bore log data at various tower locations. The provisional quantities have been indicated in bill of quantities. However, during actual execution of work, the quantities shall be decided by the Engineer-in charge, depending upon the soil strata and terrain. Based on the bore log data/soil parameter/ soil investigation results, the contractor shall recommend the type of foundations suitable for each location and the same shall be got approved by the Owner.

2.2 This specification covers the technical requirements for a detailed Geotechnical investigation and submission of a detailed Geotechnical Report. The work shall include mobilization of all necessary tools and equipment, provision of necessary engineering supervision and technical personnel, skilled and unskilled labour etc. as required carrying out the entire field investigation as well as laboratory tests, analysis and interpretation of data collected and preparation of the Geotechnical Report. Contractor shall also collect data regarding variation of sub-soil water table along the proposed line route. The aforementioned work shall be supervised by a graduate in Civil Engineering having at least 5 years of site experience in Geotechnical investigation work.

2.3 Contractor shall make its own arrangements to establish the co-ordinate system required to position boreholes, test pits and other field test locations as per the drawings/sketches supplied by Owner. Contractor shall determine the reduced level (R.L's) at these locations with respect to benchmarks used in the detailed survey. Two reference lines shall be established based on survey data/details. Contractor shall provide at site all required survey instruments to the satisfactions of the Owner, so that the work can be carried out accurately according to specifications and drawings. Contractor shall arrange to collect the data regarding change of coarse of rivers, major natural streams and nalas etc., encountered along the transmission lines route from the best available

sources and shall furnish complete hydrological details including maximum velocity discharged, highest flood level (H.F,L), scour depth etc. of the concerned river, major streams and nalas (canals).

2.4 The field and laboratory data shall be recorded on the pro-forma recommended in relevant Indian Standards. Contractor shall submit to Owner two copies of field bore logs (one copy each to Owner's site and Corporate Office) and all the field records (countersigned by the Owner's site representative) soon after the completion of each bore-holes/test.

2.5 Whenever, contractor is unable to extract undisturbed samples, it shall immediately inform the Owner. Payment for boring charges shall be subject to Owner being satisfied that adequate effort has been made to extract undisturbed samples. Special care shall be taken for locations where marshy soils are encountered and contractor in such cases shall ensure that specified numbers of Vane Shear Tests are performed and the results correlated with other soil parameters.

2.6 One copy of all field records and laboratory test results shall be sent to Owner on fortnightly basis. Owner may observe, at the laboratory testing procedure.

2.7 The contractor shall interact with the Owner to get acquainted with the different types of structures envisaged and in assessing the load intensities on the foundation for the various types of towers and in order to enable him to make specific recommendation for the depth, founding strata, type of foundation and the allowable bearing pressure.

3 Codes and Standards for Geotechnical Investigations:

The work shall be carried out in accordance with the following Indian Standards and Codes with latest amendments:

India Standard (IS)	Title
IS:1892-1992	Code of Practice for Sub-surface Investigation for Foundation.
IS:1904-1986	Code of Practice for Design and Construction of Foundation in Soils: General Requirements.
IS:2131-1992	Method of Standard Penetration Test for Soils.
IS:2132-1992	Method of Standard Penetration Test for Soils.
IS:2720-1992	Method of Test for Soils (Relevant Parts).
IS:2809-1991	Glossary of Terms and Symbols Relating to Soil Engineering.
IS:2911-1992	Code of Practice for Design and Construction of Pile Foundations (Relevant Parts).
IS:3025	Method of Sampling and Testing (Physical and Chemical) for water used in Industry.
IS:3043-1991	Code of Practice for Earthing.
IS:4078-1990	Code of Practice for Indexing and Storage of Drilled Codes.
IS:4453-1992	Code of Practice for Exploration by Pits, Trenches, Drifts and Shafts.
IS:4464-1990	Code of Practice for Presentation of Drilling Information and Core Description in Foundation Investigation.
IS:4968 (Part-I): 1992	Method for Sub-surface Sounding for Soils, Dynamic Method using cone and Bentonite Slurry.
IS:6403-1990	Code of Practice for Determination of Allowable Bearing Pressure on Shallow Foundation.
IS:6935-1989	Method of Determination of Water Level in Bore-hole.
IS:7422-1990	Symbols and Abbreviations for use in Geological Maps, Sections and Sub-surface Exploratory Logs (Relevant Parts).
IS:8009 (Part-I): 1993	Code of Practice for Calculation of Settlement of Foundations (Shallow Foundations subjected to symmetrical Vertical Loads).
IS:9259-1992	Specification for Liquid Limit Apparatus.

4. Field Investigation for Soils:

Tentative numbers of detailed soil investigation will be given by ordering authority.

4.1 Boring:

Boreholes are required for detailed soil investigations.

5. General Requirements:

a) Boreholes shall be made to obtain information about the sub soil profile, its nature and strength and to collect soil samples for strata identification and for conducting laboratory tests. The minimum diameter of the bore-hole shall be 15Omm and boring shall be carried out in accordance with the provisions of IS: 1892 and present specification.

b) All bore-holes shall be 10 M deep for normal soil conditions. The depth of bore-holes for river crossing and special locations shall be 40m. If a strata is encountered where the Standard Penetration Test Records 'N' value greater than 100, with characteristics of rock, the bore-hole shall be advanced by coring at least by 3m further in normal locations and at least 7m further for the case of river crossing location with prior approval of the Owner. When the bore-holes are to be terminated in soil strata, an additional Standard Penetration Test shall be carried out at the termination depth. No extra payment shall be made for carrying out Standard Penetration Tests.

c) Casing pipe shall be used when collapse of a bore-hole wall is probable. The bottom of the casing pipe shall at all times be above the level of the test sample but not more than ls cm above the bore-hole bottom. In case of cohesion-less soil, the advancement of the casing pipe shall be such that it does not disturb the soil to be tested or sampled. The casing shall preferably be advanced by slowly rotating the casing pipe and not by driving.

d) In-situ tests shall be conducted and undisturbed samples shall be obtained in the bore-holes at intervals specified hereafter. Representative disturbed samples shall be preserved for conducting various identification tests in the laboratory. Water table in the bore-hole shall be carefully recorded and reported following IS: 6935. No water or drilling mud shall be used while boring above ground water table. For cohesion-less soil below water table, the water level in the bore-hole shall at all times be maintained slightly above the water table.

e) The borehole shall be cleaned using suitable tools to the depth of testing or sampling, ensuring least or minimum disturbance of the soil at the bottom of the borehole. The process of jetting through an open tube Sampler shall not be permitted. In cohesive soils, the borehole may be cleaned by using a bailer with a flap valve. Gentle circulation of drilling fluid shall be done when rotary mud circulation boring is adopted.

f) On completion of the drilling Contractor shall backfill all boreholes as directed by the Owner.

6. Auger Boring:

Auger boring may be employed in soft to stiff cohesive soils above the water table. Augers shall be of helical or post hole type and the cuttings brought up by the auger shall be carefully examined in the field and the description of all strata shall be duly recorded in the field bore log as per IS:1498. No water shall be introduced from the top while conducting auger boring.

7. Shell and Auger Boring

7.1 Shell and auger boring may be used in all types of soil, which are free from boulders. For cohesion less soil below ground water table, the water level in the borehole shall always be maintained at or above ground water level. The use of chisel bits shall be permitted in hard strata having SPT-N value greater than 100. Chisel bits may also be used to extend the borehole through local obstructions such as old construction, boulders, rocky formations, etc. The requirements in Clause 4.5.1.2 shall apply for this type of boring also.

7.2 Rotary method may be used in all types of soil below water table. In this method the boring is carried out by rotating the bit fixed at the lower end of the drill rod. Proper care shall be taken to maintain firm contact between the bit and the bottom of the borehole. Bentonite or drilling mud shall be used as drilling fluid to stabilize and protect the inside surface of the borehole. Use of percussion tools shall be permitted in hard clays and in dense sandy deposits.

8. Standard Penetration Test (SPT)

8.1 This test shall be conducted in all types of soil deposits encountered within a borehole, to find the variation in the soil stratification by correlating with the number of blows required for unit penetration of a standard penetrometer. Structure sensitive engineering properties of cohesive soils & STP values.

8.2 The test shall be concluded at depths as follows:

Location	**Depths (M)**
Normal Soils	2.0, 3.0, 5.0, 7.0
River crossing & special locations	2.0, 3.0, 5.0, 7.0, 10.0, & thereafter at the rate of 3M intervals up to 30/40M.

8.3 The spacing between the levels of standard penetration testing & next undistributed sampling shall not be less than 1.0 mm. Equipments, accessories & procedures for the conducting test & for the collection of distributed soil samples shall confirm to IS: 2131.

8.4 The test shall be carried out by driving a standard split spoon sampler in the boreholes by means of a 650N hammer having a free fall of 0.75m. The sample shall be driven using the hammer for 450mm recording the bumper of blows for 150 mm. The no of the blow for last 3OOmmdrive shall be reported as N value.

8.5 This test shall be discontinued when the blow count is equal to 100 or the penetration is less than 25mm for 50 blows. At the level, where the test is discontinued, the no of blows & the corresponding penetration shall be reported. Sufficient quantity of distributed soil samples shall be collected from the split spoon sampler for identification & laboratory testing. The sample should be visually classified & the recorded at the site as well as the property preserved without loss of moisture content & labelled.

9. Sampling

General

a) Sufficient number of soil samples shall be collected Disturbed soil samples shall be collected for soil identification and for conducting tests such as sieve analysis, index properties, specific gravity, chemical analysis etc. Undisturbed samples shall be collected to estimate the physical bearing capacity and settlement properties of the soil.
b) All accessories and sampling methods shall conform to IS: 2132 all disturbed and undisturbed samples collected in the field shall be classified at site as per IS: 1948.
c) samples shall be identified with date, borehole or test number, depth of sampling etc. the top surface of the sample in-situ shall be taken to keep the core and box samples vertical, with the mark directing upwards. The tube samples shall be properly trimmed at one end and suitably capped and sealed with molten paraffin wax. The contractor shall be responsible for packing, storing in a cool place and transporting all the samples from site to the laboratory within seven days after sampling with probe, protection against loss and damage.

9.1 Disturbed Samples

a) Disturbed soil samples shall be collected in boreholes` at regular intervals. Jar samples weighing approximately 1 kg shall be collected at 0.5m intervals starting from a depth of 0.5m below ground level and at every identifiable change of strata to supplement the boring records.

Samples shall be stored immediately in airtight jars, which shall be filled to capacity as much as possible.

b) In designated borrow areas, bulk samples, from a depth of about 0.5m below ground level shall be collected to establish the required properties for use as a fill material. Disturbed samples weighing about 25 kg shall be collected at shallow depths and immediately stored in polythene bags as per IS: 1892. The bags shall be sealed properly to preserve the natural moisture content of the sample in wooden boxes for transportation.

9.2 Undisturbed Samples

In each borehole undisturbed samples shall be collected at every change of strata and depth as follows:

Locations	Depth (M)
Normal Soils	1.0, 4.0, 7.0
Special Locations	1.0, 4.0, 7.0, 11.0 and thereafter at the rate of 3 M intervals up to 33 M.

9.2.1 The spacing between the top levels of undisturbed sampling and standard penetration testing shall not be less than 1.0 M. Undisturbed sampling shall be of 100 mm diameter and 450 mm in length. Samples shall be collected in a manner to preserve the structure and moisture content of the soil. Accessories and sampling procedures shall conform to IS: 1892 and IS: 2132.

a) Undisturbed sampling in cohesive soil:
Undisturbed samples in soft to stiff cohesive soils shall be obtained using a thin walled sampler. In order to reduce the wall friction, suitable precautions, such as oiling the surfaces shall be taken. The sampling tube shall have a smooth finish on both surfaces and a minimum effective length of 450mm. The area ratio of sampling tubes shall be less than 12.5% However, in case of very stiff soils, area up to 20% shall be permitted.

b) Undisturbed sampling in very loose, saturated, sandy and silty soils and very soft clays:
Samples shall be obtained using a piston sampler consisting of a cylinder and piston system. In soft clays and silty clays, with water standing in the casing pipe, piston sampler shall be used to collect undisturbed samples in the presence of expert supervision.
Accurate measurements of the sampling depth, dimensions of sampler, stroke and length of sample recovery shall be recorded. After the sample is pushed to the required depth, the cylinder and piston system shall be drawn up together, preventing disturbance and changes in moisture content of the sample.

c) Undisturbed sampling in cohesion less soils:
Undisturbed samples in connectionless soils shall be obtained in accordance with IS: 8763. Sampler operated by compressed air shall be used to sample cohesion less soils below ground water table.

10. Ground Water

10.1 One of the following methods shall be adopted for determining the elevation of ground water table in boreholes as per IS: 6935 and the instructions of the Owner:

a) In permeable soils, the water in the borehole shall be allowed to stabilize after depressing it adequately by bailing before recording its level. Stability of sides and bottom of the boreholes shall be ensured at all times.

b) For both permeable and impermeable soils, the following method shall be suitable. The borehole shall be filled with water and then bailed out to various depths. Observations on the rise or fall of water level shall be made at each depth. The level at which neither fall nor rise is

observed shall be considered the water table elevation and confirmed by three successive readings of water level taken at two hours interval.

10.2 If any variation of the ground water level is observed in any specific boreholes, the water level in these boreholes shall be recorded during the course of the investigation. Levels in nearby wells, streams etc., if any, shall be noted in parallel.

11. Subsoil water samples (only at special locations)

a) Subsoil water samples shall be collected for performing chemical analysis. Representative ground water samples shall be collected when first encountered in boreholes and before the addition of water to aid boring or drilling.

b) Chemical analysis of water samples shall include determination of PH value, turbidity, sulphate carbonate, nitrate and chloride contents, presence of organic matter and suspended solids. Chemical preservatives may be added to the sample for cases as specified in the test methods or in applicable Indian Standards. This shall only be done if analysis cannot be conducted within an hour of collection and shall have the prior written permission and approval of the Owner.

12 Laboratory Testing:

12.1 Essential Requirements

a) Depending on the types of substrata encountered, appropriate laboratory tests shall be conducted on soil samples collected in the field. Laboratory tests shall be scheduled and performed by qualified and experienced personnel who are thoroughly conversant with the work. Test indicated in the scheduled of items shall be performed on soil, water as per relevant IS codes. One copy of all laboratory test data records shall be submitted to Owner progressively every week Laboratory tests shall be carried out concurrently with the field investigations, as initial laboratory test results could be useful in planning the later stages of fieldwork A schedule of laboratory tests shall be established by the Contractor to the satisfaction of the Owner within one week of completion of the first bore-hole.

b) Laboratory tests shall be conducted using approved apparatus complying with the requirements and specification of Indian Standards or other approved standards for this type of work. It shall be checked that the apparatus are in good working condition before starting the laboratory tests. Calibration of all the instruments and their accessories shall be done carefully and precisely at an approved laboratory.

c) All samples, whether undisturbed or disturbed shall be extracted, prepared and examined by competent personnel properly trained and experienced in soil sampling, examination, testing and in using the apparatus in conformance with the specified standards.

d) Undisturbed soil samples retained in liners or seamless tube samplers shall be removed, without causing any disturbance to the samples, using suitably designed extruders just prior to actual testing. If the extruder is horizontal, proper support shall be provided to prevent the sample from braking. For screw tube extruders, the pushing head shall be free from the screw shaft so that no torque is applied to the soil sample in contact with the pushing head. For soft clay samples, the sample tube shall be cut by means of a high speed hacksaw to proper test length and placed over the mould before pushing the sample into it with a suitable piston.

e) While extracting a sample from a liner or a tube, care shall be taken to assure that its direction of movement is the same as that during sampling to avoid stress reversal.

13. Tests

13.1 These tests shall include but may not be limited to the following:

a) Tests of undisturbed and disturbed samples

- Visual and engineering classification.
- Sieve Analysis and Hydrometric Analysis.
- Liquid, Plastic and Shrinkage Limit.
- Specific Gravity.

- Chemical Analysis.
- Swell Pressure and Free Swell Index Determination.

b) Tests of undisturbed samples
   - Bulk Density and Moisture Content.
   - Relative Density (For sand).
   - Unconfined Compression Test.
   - Box Shear Test (For sand).
   - Tri-axial Shear Test (Depending on the type of soil and field conditions on undisturbed or re-moulded samples)
     I) Unconsolidated Undrained.
     II) Consolidated Drained.
   - Consolidation.

c) Chemical Analysis of sub soil water

14. Salient Test Requirement

a) Tri-axial Shear Test shall be conducted on undisturbed soil sample, saturated by the application of that pressure. Only the water table is at sufficient depth so that chances of its rising to the base of the footing are small or nil, the tri-axial tests shall be performed on specimens at natural moisture content. Each test shall be carried out on a set of three test specimens from one sample at cell pressures equal to 100, 200 & 300 Kpa respectively or as required depending on the soil conditions.
b) Direct shear test shall be conducted on undisturbed soil samples. The three normal vertical stresses for each test shall be 100, 200 & 300 Kpa. or as required for the soil conditions.
c) Consolidation test shall have loading stages of 10, 25, 50, 75, 100, 200, 400 & 8OO Kpa. Rebound curve shall be recorded for all samples by unloading the specimen at its in-situ stress. Additional rebound curves shall also be recorded wherever desired by the owner.
d) Chemical analysis of subsoil shaft includes determination of PH value, carbonate sulphate (both SO_3 & SO_4), chloride and nitrate contents, organic matter. Salinity and any other chemicals which to be harmful to the foundation material. Their contents in the soils shall be indicated as percentage (%).
e) Chemical analysis of subsoil water samples shall include the determination of properties such as colour, odour, turbidity, PH value and specific conductivity, the last two chlorides, nitrates, organic matter and any other chemical harmful to the foundation material. The chemical contents shall be indicated as parts per million (PPM) based on weight.

15. Geotechnical Investigation Report

15.1 General

a) Contractor shall submit a formal report containing geological information of the region, procedures adapted for geo-technical investigation, field observations, summarized test data, conclusions and recommendations. The report shall also include detailed bore-logs subsoil sections field test results, laboratory observations and test results both in tabular as well as graphical form, practical and theoretical considerations for the interpretation of test results, supporting calculations for the conclusions drawn, etc. Initially, contractor shall submit three copies of the report in draft form for Owner's review.
b) Contractor's Geotechnical Engineer shall visit Owner's **Planning & Engineering Office at 2nd floor, Vidyut Bhavan, Salt Lake**, for a detailed review based on Owner's comments in order to discuss the nature of modifications if any, to be done in the draft report. Contractor shall incorporate in the report agreed modifications and resubmit the revised draft report for approval. **6(Six) copies** of the detailed final approved report shall be submitted to Owner together with one set of reproducible of the graphs, tables etc.

c) The detailed final report based on field observations, In-situ and laboratory tests shall encompass theoretical as well as practical considerations for foundations for different structures.

15.2 Data to be furnished

The report shall also include the following:

a) A plot plant/location plan showing the locations and reduced levels of all field test e.g. boreholes, trial pits, static cone penetration tests, dynamic cone penetration tests, etc., property drawn to scale and dimensioned with reference to the established grid lines.
b) A true cross section of all individual boreholes and thickness of individual stratum, position of ground water table, various in-situ tests conducted, samples collected at different depths and the rock stratum, if encountered.
c) Observation and data regarding change of course of rivers, velocity, scour depths, slit factor, etc. and history of flood details for mid stream and river bank locations.
d) Past observations and historical data, if available, for the area or for the others with similar soil profile, or with similar structures in the surrounding areas.
e) Plot of standard Penetration Test (uncorrected and corrected N values) with depth for each test site.
f) Results of all laboratory test summarised according to table 1.0 (i) for each sample as well as (ii) for each layer, along with all the relevant charts, tables, graphs, figures, supporting calculations, conclusions and photographs of representative rock cores.
g) For all tri-axial shear tests, stress vs. strain diagrams as well as Mohr's circle envelopes shall be furnished. If back pressure is applied for saturation, the magnitude of the same shall be indicated. The value of modules of elasticity (E) shall be furnished for all tests along with relevant calculations.
h) For all consolidation tests the following curves shall be furnished
    i. e Vs. Log p.
    ii. e Vs. P.
    iii. Compression Vs. Log t or Vs. √t

    depending upon the shape of the plot, for proper determination of coefficient of consolidation.

    The point showing the initial condition (e0, p0) of the soil shall be marked on the curves.
i) The procedure adopted for calculating the compression index from the field curve and settlement of soil strata shall be clearly specified. The time required for 50% and 90% primary consolidation along with secondary settlements, if significant, shall also be calculated.

Table 1.0

SUMMARY OF RESULT OF LABORATORY TESTS ON SOIL AND WATER SAMPLES

1. **Bore hole test pit no.**
2. **Depth (M)**
3. **Type of sample**
4. **Density (kg/m^3)**
   a) Bulk
   b) Dry
5. **Water content (%)**
6. **Particle Size (%)**
   a) Gravel
   b) Sand
   c) Silt
   d) Clay
7. **Consistency properties**
   a) LL
   b) PL
   c) PI
   d) LI
8. **Soil**
   a) Classification – IS
   b) Description
   c) Specific gravity
9. **Strength Test**
   a) Type
   b) c (Cohesion)
   c) ϕ (angle of internal friction)
10. **Consolidation Test**
    a) e0
    b) P_C
    c) C_C
    d) DP
    e) M_V
    f) C_V
11. **Shrinkage limit (%)**
12. **Swell Test**
    a) S. Pr
    b) FS
13. **Relative Density (%)**
14. **Remarks**

Notations:-

I. For type of Sample:

DB – Disturbed bulk soil sample
DP – Disturbed SPT soil sample
DS – Disturbed samples from cutting edge of undisturbed soil sample.
RM – Remoulded soil sample
UB – Undisturbed block soil sample
US – Undisturbed soil sample by sampler
W – Water sample

II. For strength test:

UCC – Unconfined Compression Test
VST – Vane Shear Test
T_{UU} – Unconsolidated Undrained Tri-axial Test
Note: Replace T by D for Direct Shear Test
Tod – Consolidation Drained Tri-axial Test

III. For Others:

LL – Liquid Limit (%)
PL – Plastic Limit
Pl – Plasticity Index
LI – Liquidity Index
C – Cohesion (kpa)
θ – Angle of Internal Friction (degree)
S-Pr. – Swelling Pressure (kpa)
FS- Fully Submerged
e0 - Initial Void Ratio
P_C – Reconsolidation Pressure (kpa)
Cc – Compression Index
DP – Change in Pressure (kpa)
M_V – Coefficient of Volume Compressibility (M^2/KN)
C_V – Coefficient of Consolidation (M^2/hr)

IV. For Chemical Test :

As per specification

16. Recommendations

16.1 Recommendations shall be provided each location duly considering type of soil data. The recommendations shall provide all design parameters and considerations required for proper selection, dimensioning and future performance of tower foundations and the following:

a) The subsurface material must provide safe bearing capacity and uplift resistance by incorporating appropriate safety factors thereby avoiding rupture under ultimate loads.
b) Movement of foundation, including short and long term components under transient and permanent loading, shall be strictly controlled with regard to settlement, uplift, lateral translation and rotation.
c) Co-efficient of permeability of various sub-soil and rock strata based on in-situ permeability tests.

d) For shallow foundation the following shall be indicated with comprehensive supporting calculations:

i. Net Safe allowable bearing pressure for isolated square/ rectangular footing of sizes 1.5, 2, 2.5, 3, 3.5 up to 4.0 M at three different depths 1.2,1.5, 2.0,2.5 and 3.0 M below ground level considering both shear failure and settlement criteria giving reasons for type of shear failure adopted in the calculation.

ii. Net safe allowable bearing pressure for raft foundations of widths greater than 5 M at 1.5, 2.0 and 3.0 M below ground level considering both shear failure and settlement criteria.

iii. Rate and magnitude of settlement expected of the structure.

iv. Net safe bearing capacity for foundation sizes mentioned in para (i) above, modulus of sub-grade reaction, modulus of elasticity from plate load test results along with time settlement curves and load settlement curve in both natural and log graph, variation of modulus of sub-grade reaction with size, shape and depth of foundation.

e) The stable slopes for shallow and deep excavations, active and passive earth pressure at rest and angle of repose for sandy soils shall be furnished. The loading of the foundations shall not compromise the stability of the surrounding sub-surface materials and the stability of the foundation shall be ensured against sliding or overturning.

f) Depending on the sub-surface material, water table level and tower type, either reinforced concrete isolated pad and chimney, cast-in-situ bored pile of special foundations shall be installed at a given location.

g) Net Safe allowable bearing pressure and uplift resistance shall be provided for the various sizes of isolated square footings founded at various depths below ground level considering both shear failure and movement criteria; rate and magnitude of movement expected of the structure (settlement, uplift, rotation) shall also be given.

h) In cases where normal open cast / pile foundations appear to be impractical, special pile foundations shall be given due consideration along with the following:

   i. Type of pile foundation and reasons for recommending the same duly considering the soil characteristics.
   ii. Suitable founding strata for the pile.
   iii. Estimated length of pile for 450,500, 650,750 and up to 1000 KN capacities and bearing resistance shall be indicated separately.
   iv. Magnitude of negative skin friction or uplift forces due to soil swelling.

i) Where the sub-soil water and soil properties are found to be chemically aggressive, Contractor shall take suitable precautions during construction including any protective coating to be applied on the foundations, susceptibility of soil to termite action and remedial measures for the same shall be dealt with.

j) Suitability y of locally available soils at site for filling, back-filling and adequate compaction shall be investigated.

k) If expansive soil such as black cotton soil is encountered recommendation of removal or retaining the same shall be given in the latter case, detailed specifications of special requirements shall also be given.

l) Susceptibility of sub-soil strata to liquefaction in the event of earthquake and remedial measures, if required, shall be considered.

m) Any other information of special significance such as dewatering schemes etc. which may have a bearing on the design and construction shall be provided.

n) Recommendation n for additional soil investigations beyond the scope of the present work shall be given if Contractor considers such investigations necessary.

17. Hydrological Conditions

17.1 The maximum elevation of ground water table, amplitudes of its fluctuations and data on water aggressivity with regard to foundation structure materials shall be reported. While preparing ground water characteristics the following parameters should be specified for each aquifer:

a) bi-carbonate alkalinity mg-eq/(deg).
b) pH value.
c) Content of aggressive carbon dioxide, mg/l.
d) Content of magnesia salts, mg/l, recalculated in terms of ions Mg^{+2}.
e) Content of ammonia salts, mg/l, recalculated in terms of ions NH_4^+.
f) Content of caustic alkalis, mg/l, recalculated in terms of ions Na^+ and K^+.
g) Content of chlorides, mg/l, recalculated in terms of ions Cl^-.
h) Content of sulphates, mg/l, recalculated in terms of ions SO_4^{-2}.
i) Aggregate content of chlorides, sulphates, nitrates, carbonates and other salts, mg/l.

18. Rates and Measurements

18.1 Rates

The contractor's quoted rates shall be inclusive of making observations, establishing the ground level and co-ordinates of the location of each bore hole, test pit etc. No extra payment shall be made for conducting Standard Penetration Test, Collecting, Packing, Transporting of all samples and cores, recording and submittal of results on approved format.

19. Measurements

Certain tests have to be conducted in bore holes or test pits etc. Such bore holes, test pits etc. shall be measured only once for payment regardless of the number of test carried out.

20. Specific Requirements for Geo-Technical Investigation at River Crossings Location

20.1 The entire soil investigation work at river crossing locations (if required) shall be carried out in accordance with the relevant parts of the specifications for the geo-technical investigation modified to the extent given below.

20.2 **Requirements**

20.2.1 Bore holes shall be executed to specified depth of 40 M (*ref. Clause 5.b*). If refusal strata is reached (i.e. SPT-N value is greater than 100 continuously for 5m depth) with characteristics of rock the bore hole may be terminated at shallower depth, i.e. at 5 M in refusal strata, with prior approval of the Owner.

20.2.2 Laboratory Testing shall be conducted on all soil samples to determine grain size distribution, liquid limit and plastic of the different soil strata encountered.

20.2.3 Geo-Technical Report must furnish the following:

a) Geo-Technical Investigation Scheme.
b) Bore-logs indicating soil stratification, with IS classification, sampling details and SPT N values.
c) Soil cross- sections along various bore holes in two orthogonal directions indicating soil stratification based on field and laboratory tests.
d) Grain Size distribution curves.
e) IS Classification of soils.
f) Shear Tests (Unconfined Un-drained) to be done on saturated soil samples.
g) Bearing capacity of soil at different levels.

h) Scouring depth of river.
i) Highest Flood Level (HFL).
j) Maximum Discharge, Velocity etc. (from authenticated source such as PWD / Irrigation Department or appropriate State Authorities).
k) Recommendations s regarding type of foundation to be adopted at the location.

20.2.4 A check list for reporting results of river crossing location details, details soil investigation and river values for river crossing are to be enclosed as per direction of E.I.C.

20.3 **Soil Report (up to 40 M depth)**

- N Value
- Cohesion (C) and friction angle (ϕ).
- Dry density &Submerged density of soil.
- Soil composition including bore log data.
- Soil strata distribution details depth vise.
- R.L. of ground (soil investigation and foundation location).
- Mean grain size.
- Silt factor calculations.
- Scour depth calculations.
- Special Recommendations, if any.
- River crossing [showing the position of bore holes)
- Any other details like bundle roads bridges etc. with their R.Ls.

River Values

- Maximum discharge.
- Maximum velocity (V_{MAX}).
- H.F.L.
- Clear waterway.
- River Meaning history.
- Navigable/Non navigable.
- Location reference of above River Values for crossing details.
- River bed level (R.L.).

21.0 Statutory Regulations and Standards.

21.1 Contractor is required to follow statutory regulation stipulated in Electricity (Supply) Act, 1948, Indian Electricity Rules and other local rules and regulations.

21.2 The codes and standards referred to in this specification shall govern. In case of a conflict between such codes/standards and the specification, the provisions of the code of latest amendment shall prevail.

21.3 Other internationally acceptable standards, which ensure equivalent or better performance than those specified, shall also be acceptable.

22.0 Field Quality Plan

A standard Field Quality Plan is to be maintained by contractor in consultation with the controlling officer.

23.0 Completion Period

The work as detailed in this specification shall be completed in all respect within 45(Forty five) days from date of issuance of handing over of respective sites.

Technical Specification of Soil Resistivity Test

Method : Method used for earth resistance measurement will be Wenner four pin method or Three-pin fall of potential method

Procedure : (i) Computed average value of apparent earth resistivity in Ohm-mtr
(ii) Computed maximum value of apparent earth resistivity in Ohm-mtr

If earth resistivity can't be computed then as alternatve of (i) & (ii):

(a) Measured maximum & average earth resistance in ohm :

(b) Distance between adjacent electrodes in meter during earth resistance measurement:

(c) Depth of electrodes in meter during earth resistance measurement (minimum depth of 0.5mtr is recommended) :

(d) Length of the electrode in meter (required for three-pin method) :

(e) Diameter of the electrode in meter (required for three-pin method) :

(f) Provision of gravel filling as surface material is there or not :

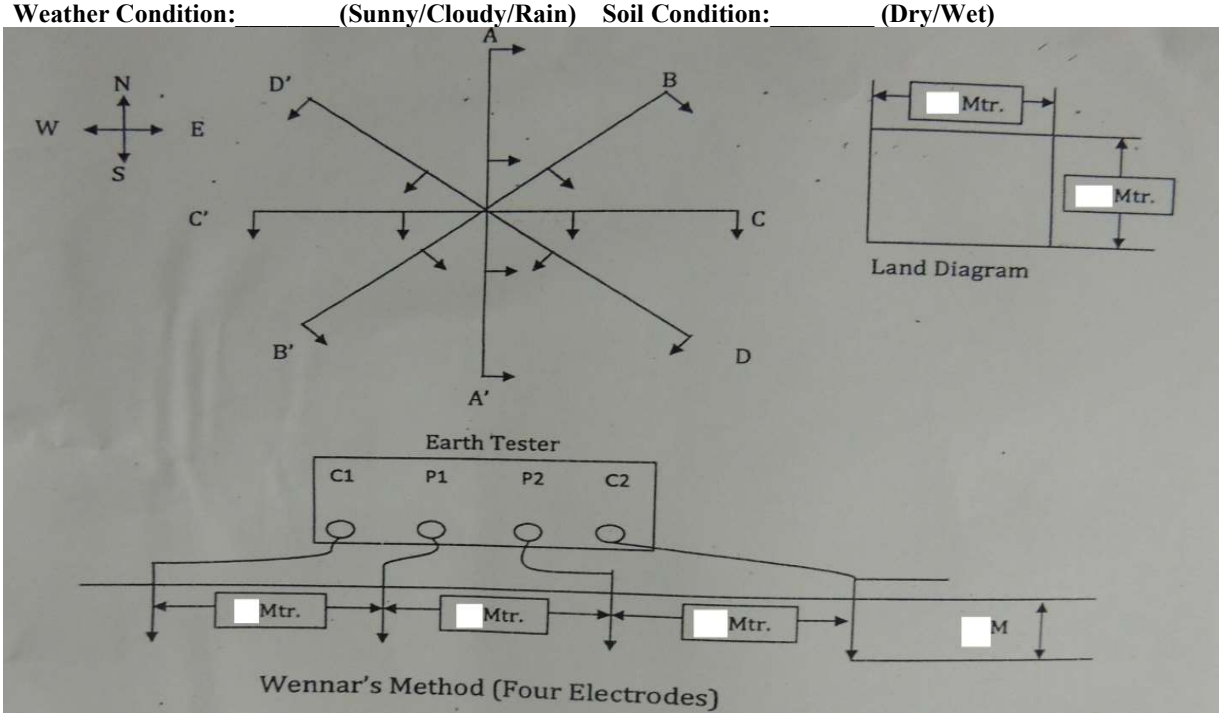
(g) Thickness of gravel filling, if provision is there :

FORMAT FOR MEASUREMENT OF SOIL RESISTIVITY AT PROPOSED LOCATION

AT_____

UNDER_____ **DIVISION ON**____/_____/_____

Temperature : _____^{0} c Soil Type:_____ Time:_____
Weather Condition:_____(Sunny/Cloudy/Rain) Soil Condition:_____ (Dry/Wet)



INSTRUMENT DETAILS :
MAKE: _____ SL. NO.:_____ RANGE:_____ SELECTED RANGE:_____
TEST RESULTS:
REMARKS :

DIRECTION	DISTANCE BETWEEN TWO CONSECUTIVE ELECTRODES (A)	MEASURED RESISTANCE (R) IN Ω	CALCULATED RESISTIVITY ρ = 2ΠAR Ω-m
AA'			
BB'			
CC'			
DD'			

Maximum Resistivity: _____ Minimum Resistance: _____
Average Resistivity: _____
Recommendation, if any:

WBSEDCL

"RATE CONTRACT" FOR SOIL INVESTIGATION AND SOIL RESISTIVITY WORK THROUGHOUT THE JURISDICTION OF WBSEDCL

WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED

(A GOVT. OF WEST BENGAL ENTERPRISE)

VIDYUT BHAVAN, BLOCK- DJ, SECTOR – II

BIDHANNAGAR, KOLKATA – 700091

MARCH' 2016

CIN : U40109WB2007SG113473

DISTRIBUTION HEAD QUARTERS, 1ST FLOOR, "D" BLOCK,
VIDYUT BHAVAN, BLOCK- DJ, SECTOR – II, BIDHANNAGAR, KOLKATA – 700091

OFFICE ORDER No. CED/121 Dt. 28 .03. 2016

Sub: "Rate Contract" for Soil Investigation & Soil Resistivity work throughout the jurisdiction of WBSEDCL

Soil investigation and soil resistivity test is the preliminary and fundamental work to be carried out from the very inception of any new project for designing and estimation purpose.

To facilitate the soil investigation and soil resistivity work of different locations under the jurisdiction of WBSEDCL within the scope of different project and O&M works, uniform rates of different items related for these works at different terrains in West Bengal are hereby standardised as per enclosed schedule of works for early and smooth completion of the same, as per requirement of WBSEDCL.

This "Rate Contract" is hereby in force with effect from **28.03.2016** and will remain valid till issuance of further Office Order

Schedule of work for "Rate Contract" is enclosed herewith vide **Annexure – "X"**

The work of Soil investigation and Soil resistivity test will be guided by the enclosed Technical specification vide **Annexure – "Y" and latest PW (Roads) S.O.W**

The following terms and conditions shall be observed inter-alia:-

i) The rates of different items of the Schedule of works are **firm** & inclusive of all Taxes, Duties, BOWCC Cess, Transportation but excluding Service Tax Service Tax, as applicable as per rule, will be paid extra by the WBSEDCL.

ii) 1% BOWCC Cess, Income Tax (as applicable) will be recovered while releasing payment against the bill. Drawing and Disbursing authority will issue necessary TDS certificate accordingly.

iii) The contractors enlisted under WBSETCL & other Working and Experienced contractors under WBSEDCL, having persons preparing the report with minimum qualification of Graduation degree in the respective field, may be engaged for this work. However deployment of contract by turn or rotation may be made considering past tract record and satisfactory performance of the contractor.

iv) The contractor must have PAN/TAN, PTCC, Service Tax registration, PF registration number & ESI in their own name.

v) The contractor must have own laboratory having equipments in conformity to IS provisions for soil sample testing, where WBSEDCL's representatives have full access for witnessing the tests.

vi) The contractor shall ensure compliance of statutory provisions as laid down in various Labour Laws.

vii) No sub-letting of contract will be allowed to the Contractor for execution of the work.

viii) Individual execution order shall be placed with the contractor observing usual terms and conditions as per standard Civil works policy of WBSEDCL by the Controlling Officers.

ix) The contractor, to whom execution order will be place, shall have to deposit initial Security deposit @ 10 % of the order value to the controlling officer in the form of Demand Draft from any Nationalised/ Schedule bank in favour of "West Bengal State Electricity Distribution Company Limited" payable at the area under the jurisdiction of controlling officer. This initial security deposit will be refunded after expiry of security period of 6 months from the date of successful completion of the respective job.

x) The financial power for placement of execution order shall be guided by the present **"Revised Schedule of Delegation of Power"** of WBSEDCL issued vide **O/O no. 1011, dt. 04.11.2015** of the Director (HR) and its subsequent modifications/ revisions thereof.

The has got "In Principle" approval of the Chairman and Managing Director, WBSEDCL on 03.03.2016

Enclo: Annexure- "X", "Y"

Sd/-

Chief Engineer, Distribution
W.B.S.E.D.C. L

Technical specification

Table of Contents

3.01 Scope of work:

The work to beperformed by the contractor covers manufacture, testing, supply and ex-works delivery of 8m and 9m P.C.C.poles in accordance with the enclosed drawing bearing no. PLN(D)/SS/123 and PLN(D)/SS/124 dt.09.03.2018 respectively and approved modifications as may be found required subsequently.

3.02 Work to be provided for by the contractor:

The work to be provided for by the contractor, unless otherwise specified, shall include but not be limited to the following:

- Furnish all labour, supervision, services, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, testing equipment, tools & plants, transportation, handling, incidental construction like different sheds, casting bed, curing vats etc. as required for due fulfillment of the contract.
- Furnish samples and submit results of tests of various ingredients and / or finished jobs for approval, if asked for.
- Provide all incidental items not shown or specified in particular but reasonably implied as necessary for successful completion in accordance with the drawings, specification, and schedule and as per direction of the Engineer-in-charge.
- For supply of certain materials normally manufactured by specialist Firms, the contractor may have to produce, if directed by the Engineer-in-charge, a guarantee for satisfactory performance of the material binding both the manufacturer and the contractor jointly and severally for due performance of the above items, the cost element may be considered as included in the rates.

3.03 Codes and standards:

All items of work under this contract shall, unless otherwise specified elsewhere in the contract, conform to the latest revision up to the date of bid submission and / or replacements of relevant Indian Standard specification and code of practices. The work under the contract shall comply with the relevant provisions made in the following Indian Standards or the latest versions thereof.

- IS: 1678-1998:Pre-stressed concrete poles for overhead power traction and telecommunication lines – Specification.
- IS: 2905-1989: Concrete poles for overhead power and telecommunication lines - Methods of test.
- IS: 7321-1974: Code of practice for selection, handling and erection of concrete poles for overhead power and telecommunication lines.

However, if the specifications, provisions and other requirements set out by WBSEDCL differ from that of the IS codes, then those of WBSEDCL will prevail and shall be binding on the contractor. In case any particular item is not specifically covered by Indian Standard practice & usage that should be carried out as per direction of the Engineer-in-charge.

3.04 Forms and Moulds:

Form work shall include all temporary or permanent forms or moulds of Mild Steel required for forming the concrete with all temporary / permanent constructions and installations for their support. Form work shall be of rigid construction (strong

enough to withstand the concrete and other incidental loads imposed upon it during and after casting of concrete) true to shape and dimensions to produce poles strictly as per drawing having a smooth surface. The form boxes mould (including forms for block-outs or pockets, if any) shall be fabricated in such a way that the same may be easily dismantled/taken out in sections or as required without causing any damage to the poles. It shall be made sufficiently rigid by using adequate number of ties, bracings and, if required, by providing wedges to make up any deformation before and during placement of concrete. Provision shall also be there for strictly maintaining dimensions of the poles. It shall be of sufficient number to maintain the ordered rate of supply of poles, without any interruption. Provisions shall also be there to accommodate increased/decreased production of poles if found necessary and intimated to the contractor.

Before use, all the moulds shall be thoroughly cleaned from grit or other foreign materials and individual moulds shall be fitted rigidly using suitable devices. The moulds shall be oiled properly with waste transformer oil or waste oil from vehicles or mixture of light diesel oil/crude oil and grease (by melting) in the ratio 10 litres to 500 grams of grease. The moulds shall not be oiled excessively and all care shall always be taken that wires do not come in contact with oil.

Before concreting the alignment and level of pedestal foundations and moulds shall be checked and set right, if not in order. Deformity in moulds, if any, shall also be set right before using the same for manufacture of poles. All components of individual moulds should be assembled, tightened and brought to true alignment to have correct shape. The assembled moulds shall be free from leakage of water or cement slurry.

3.05 Aggregate (coarse or fine):

Aggregate (coarse or fine) as to be used in manufacture of PCC poles should conform to IS: 383-1970. They shall be hard, strong, dense, durable, clear and free from veins and adhering coating and free from injurious amount of disintegrated pieces, alkali, vegetable matters and other deleterious substances.

As far as possible flaky, scoriaceous and elongated pieces should be avoided. All aggregates (coarse or fine) shall be within the grading limits as per relevant clauses of IS: 383-1970.

The grading of fine aggregates shall be determined as described in IS: 2386-1963 and shall be within the limit as described in IS: 383-1970. However, the grade-II fine aggregate as in IS: 383-1970 is always preferred.

All aggregates (both course and fine) shall be of tested quality as per relevant IS Codes. All aggregates shall be stored in such a way as to prevent the admixture of foreign materials. The heaps of fine aggregate and coarse aggregates shall be kept separate. When different sizes of fine and coarse aggregates are procured separately, they shall be stored in separate stock-piles, sufficiently removed from each other to prevent the materials at the edge of the stock-piles from getting intermixed.

3.06 Cement:

The cement used in the manufacture of Pre-stressed Cement Concrete Poles shall be Ordinary Portland Cement conforming to IS: 8112 or IS: 12269.

Cement shall be stored at site in well covered sheds in such a manner as to prevent deterioration due to moisture or due to intrusion of foreign matters.

3.07 H.T. Wire:

H.T. wire of diameter 4 mm. having a minimum tensile strength of 1715 N/mm^2 shall be used as per approved drawing for manufacture of the PCC poles. Test certificate for each lot of H.T. wires shall be submitted by the contractor at his own cost if desired by the Engineer-in-charge. The H.T. wire shall be continuous over the entire

length of the Tendon. It shall be free from rust, loose scales and/or other deleterious materials/coating liable to effect adversely on proper tensioning of H.T. wire or its proper bonding with concrete. The H.T. wire shall conform to IS: 6003-2010 (Indented wire for Prestressed Concrete — specification). H.T. wire shall ordinarily be stored in such a way so as to avoid distortion and to prevent deterioration and corrosion.

3.08 Water:

Water should be free from chlorides, sulphates, other salts and organic matter. Potable water will be generally suitable.

3.09 Admixtures:

Admixture, if used, should not contain calcium chloride or other chlorides and salts which are likely to promote corrosion of pre-stressing steel. However, if any admixture is used, the same should be brought to the notice of WBSEDCL.

3.10 Reinforcement and Tensioning:

Pre-stressing wires come in coils of large diameters. The same may be unwound for use and slight bends or kinks, if any, may be straightened by using a hammer. Heating of pre-stressing wire shall be avoided. The required length from Bulk Head at one end to the other in a single length after adding approximately 2 metre extra for jacking operation may be cut by using a bar cropper. The pre-stressing wires may be placed through the holes at cross beam at one of the bulk heads and drawn through the holes at the end plates of successive moulds and finally through the holes at the cross beam at the opposite bulk head. The wire should project for distances beyond the bulk heads to facilitate stretching by jacks. Initial sag in the wires shall be eliminated by stretching the same manually. The cover of the reinforcements be checked and set right, if not in order. All pre-stressing wire/reinforcements be placed in position as shown in the drawing and accurately fixed. Un-tensioned wires/reinforcement, if any as indicated in the drawings be held in position by the use of stirrups which should go round all the wires. All the wires to be pre-tensioned be accurately stretched with uniform pre-stress in each wire, individually or in a group according to convenience by the power / labour operated tensioning devices with the help of a dynamometer. The stretch in the wire shall be checked with the help of the dynamometer and from time to time tensioning may be stopped at the required stretch and be checked with the help of stress-strain chart as supplied by the wire manufacturer. All care shall be there to avoid over tensioning i.e. to avoid tensioning more than 80% of the ultimate tensile strength of the particular type ofH.T. wire. The cover to the pre-stressed wires should be checked again and set right if not in order.

Failure to observe this precaution may cause eccentricity of the pre-stressed wires which in turn cause bending of poles.

After applying the required pre-stress the pressure be released slightly and the wires be anchored permanently by tapping the wedges through the slits in the nose cone of the jack. The jack be then released and the operation is carried out in other wires or group of wires.

All precautions should be there to arrest any accident.

3.11 Designing, mixing, placing and compacting concrete:

The design of concrete Mix shall conform to the requirements laid down for controlled concrete (also called design mix concrete) in IS: 1343-1980 and IS: 456-2000 subject to the condition that minimum works cube strength at 28 days should be at least 42 N/mm^2 and the concrete strength at transfer should be at least 21 N/mm^2. The mix should contain as low a water content as is consistent with adequate workability.A cube testing register should be maintained at site.

Placing and compacting concrete shall be commenced and continued as per relevant IS Code. Concreting shall be commenced only after checking forms, Tensioned wires, covers (20 mm.) etc. and if found to be in order. All care shall be there that none of above is disturbed in any way during laying and compacting concrete.

In all cases segregation of the ingredients of concrete shall be avoided and if any segregated mass is observed the same shall be rejected and removed at the cost of the contractor. Low water cement ratio for obtaining high strength concrete requires mechanical aid for compaction since the workability of the mix is poor. Electrical vibrators having flat bottom surface are preferred for vibrating the concrete placed in the mould. It may be ensured that atleast two vibrators are fixed at a time for each mould and concrete shall be poured in the mould only when the vibrator is fixed properly and switched on. No cement mix/slurry be allowed to leak/fall during the process of pouring concrete and / or compacting. Immediately after completion of pouring concrete, the top surface of the concrete shall be finished to have a smooth surface.

During the cold weather, below 4.5°C temperature, concreting shall not be done.

During hot weather, precaution shall be taken to see that temperature of wet concrete does not exceed 38°C.

3.12 Curing of Poles:

Curing of poles shall be commenced after setting of the concrete. The poles shall be covered with well burlaps, gunny bags and kept continuously moist, until transfer of pre-stress (de-tensioning). After this the curing shall be continued by immersion of the poles in the curing vat. If steam curing is used, it must be done under careful control and special precaution.

3.13 De-tensioning and cutting of wires:

The pre-stressing wires shall be de-tensioned only after the concrete has attained the specific strength at transfer i.e. 21 N/mm^2 to grip the wires and retain pre-stress. Normally good quality concrete should develop the required strength after 72 hours of casting. The cubes of concrete taken for the purpose, from each day's concrete (working mix) be cured as far as possible, under conditions similar to those under which the poles are cured. The transfer stage shall be determined based on daily tests carried out on the above concrete cubes till the specified strength indicated above is reached. It is to be ensured that the wires are de-tensioned by a de-tensioning device before they are cut by releasing the wires slowly without imparting any shock or sudden load to the poles with control by any suitable means either mechanical (screw type) or hydraulic. The poles shall not be de-tensioned or released by cutting the pre-stressing wires using flames or bar croppers while the same are under tension. After de-tensioning, thewires be cut with the help of wire cutters or welding transformers. To start with cutting be done at the centre portion of the bed length and then other tendons are cut.

3.14 Curing of poles in vats, handling and stacking:

After de-tensioning, cutting wires & removing the moulds, the poles preferably be taken to curing vats carefully (so that no pole is damaged) for continuous curing under cold water for 25 days or so to achieve the desired strength. Separate eye-hooks shall be provided for handling, lifting and transport, one each at a distance of 0.15 time the overall length from either end of the pole. Eye-hooks shall be properly anchored and should be on the face that has the shorter dimension of the cross section. While handling the poles after taking the poles from curing vats to the stack yard or for other purposes all care shall be taken that the poles are lifted and carried with their broad faces placed vertically and in such a manner that shocks are avoided.

Stacking of poles be done in a manner that the broad sides of the poles are vertical. Each tier in the stack should be supported on timber sleepers located at 0.15 times the overall length measured from the end. The timber supports in the stack should be aligned in a vertical line.

3.15 Calibration:

The instruments/equipment required for Testing shall have valid calibration certificate issued by National Test House or equivalent Government Laboratory.
Before testing, the supplier shall produce the calibration certificate.

3.16 Sampling and Inspection:

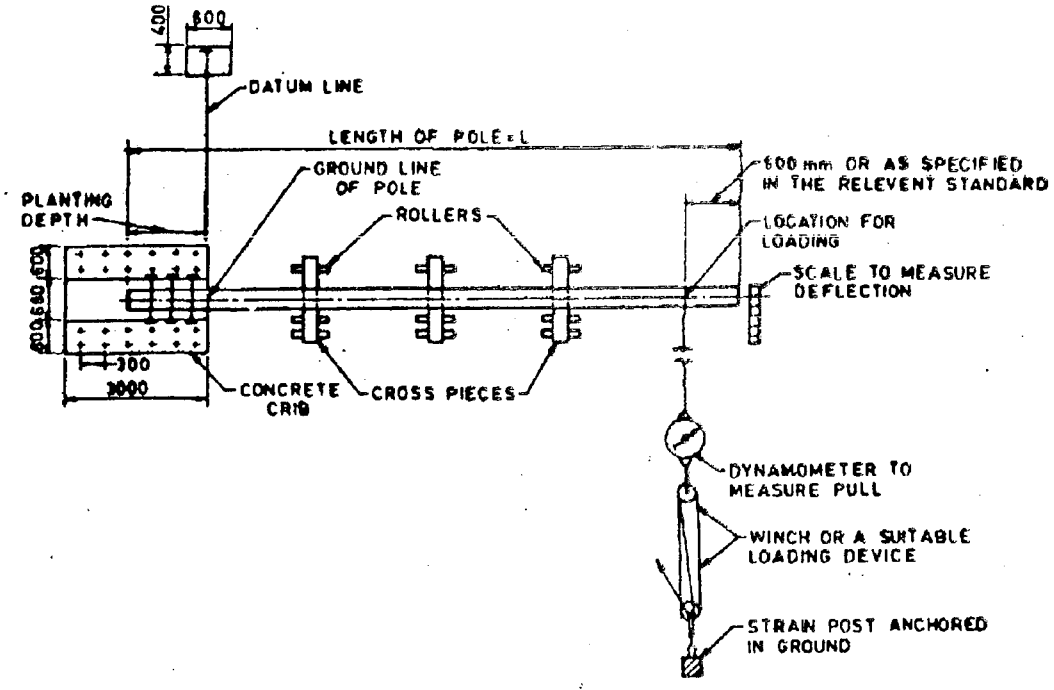
All poles of the same class and same dimensions shall be grouped together to constitute a lot. If the number of poles in a lot exceeds 100, the lots shall be divided into a suitable number of sub lots such that the number of poles in a sub lot does not exceed 100. The acceptance of a sub lot/lot shall be determined on the basis of the performance of samples selected from it. The number of poles to be selected from a lot or a sub lot shall depend upon and shall be guided by relevant clause of IS: 1678-1998.

All such selected poles shall be tested for overall length, cross section and uprightness. The tolerance shall be for overall length ± 15mm. cross-sectional dimensions ± 3 mm. and uprightness 0.5 percent. The number of poles, which doesnot satisfy the requirements of overall length cross-section and uprightness, shall not exceed 1(one) in each lot/sub lot of 100 poles. If the number of such poles exceeds the corresponding number, all the poles in the lot or sub lot shall be tested for these requirements and those not satisfying the requirement shall be rejected.

3.17 Transverse Strength Test:

After deciding acceptance of lots/sub lots as per clause 3.16, one pole from each lot/sub lot of 100 poles shall be subjected to Transverse Strength Test as per relevant clauses of IS: 1678-1998 and IS: 2905-1989 or its latest version. Unless otherwise specified this test on pole shall not be carried out earlier than 28 days after the date of manufacture of poles manufactured with Ordinary Portland Cement. The test specimens shall not have been exposed to a temperature below 4°C for 24 hours immediately preceding the test and the same shall be free from all visible moisture. The specimen shall be inspected and any specimen with visible flaws shall be discarded. If any specimen fails because of the mechanical reasons, such as failure of testing equipment or improper specimen preparation, it should be discarded and another specimen be taken.

The pole may be tested in either horizontal or vertical position. If tested in horizontal position, provisions shall be made to compensate for the overhanging weight of the pole. For this purpose, the overhanging portion of the pole may be supported on a moveable trolley or similar device. The test loads shall be applied at a point 600 mm. from the top of the pole by means of a suitable device, such as wire rope and winch placed in a direction normal to the direction of the length of the pole, so that the minimum length of the straight rope under pull (excluding the curved portion near the transmitting devices) is not less than five times the length of the pole. The pulling line shall be kept level between the winch position and the point where load is applied to the pole. The pulling line shall be secured around the pole at the load point. Load measuring device shall be placed in a way so as to accurately measure the tension in the pulling line the other end of which is attached to the loading equipment. To minimize a vertical movement at the point of load application and to reduce the stress due to dead weight of the pole, a rail support be provided near the



All dimensions in millimetres.

FIG. 1 TYPICAL ARRANGEMENT FOR TESTING OF CONCRETE POLES

point of load application or alternatively a number of frictionless supports in the form of trolleys may be provided conveniently as per direction of the testing Engineer. The pole shall be fixed in the crib longitudinally from butt to its ground line i.e. for the depth of planting and then it shall be secured firmly in place upto the satisfaction of the testing Engineer (Ref.: Fig.1). The crib shall check all longitudinal and rotational motions of the clamped portion of the pole.

The test load shall then be applied and increased steadily and gradually to the value of the transverse load at first crack. The load shall then be reduced to zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse strength as per drawing/order and again reduced to zero. This procedure shall be repeated until the load reaches the value of 80 percent of the minimum ultimate transverse strength and thereafter increased by 5% of the minimum ultimate transverse strength until failure occurs. Each time the load is applied, it shall be held for two minutes. The load applied to the pole at the point of failure shall be measured to the nearest five kilograms. The deflection of the pole at each stage of loading and the same after reduction of the load to zero at each stage shall be measured simultaneously and recorded. Number and extent of cracks appearing at each stage of loading and the same disappearing/remaining after reduction of the load to zero at each stage be noted and recorded. The test pole may be considered to have passed the test if no visible crack appears prior to application of the design transverse load at first crack (i.e. the working load of the pole) and also if no failure of the pole occurs prior to application of the design ultimate transverse load. The lot/sub lot of pole be considered to have passed the testing and may be certified to be acceptable by the testing Engineer if the test sample passed the testing as above. The pole shall be deemed not to have passed the test if visible cracks appear at a stage prior to the application of the design transverse load at first crack or if the observed ultimate transverse load at failure is less than the design ultimate transverse load. In that case another two samples of the same lot/sub lot of 100 poles are to be taken and subjected to testing following the same procedure as above. The

lot/sub lot of poles may be certified by the testing Engineer to be accepted. If one or more samples in retesting (2nd specimen or 3rd specimen) fail, the lot/sub lot represented by the corresponding samples shall be considered not to have passed the test.

3.18 The failed lot:

The failed lot pole shall be marked as "R" by red paint and removed from factory premises.

3.19 Checking of cover:

After completion of transverse strength test, the sample pole shall be taken and checked for cover. The cover of the pole shall be measured at three points, one within 1.8 metre from the butt end of the pole, the second within 0.6 metre from the top of the pole and the third at any intermediate point and the mean value compared with the specified value. The mean value of the measured cover should not differ by more than 1 mm. from the specified cover, the individual values however should not differ by more than + 3 mm. from the specified value. If these requirements are not met, the workmanship with reference to pre-stressing wires and assembly of mould should be improved to get approved by the Engineer-in-charge.

3.20 End Capping:

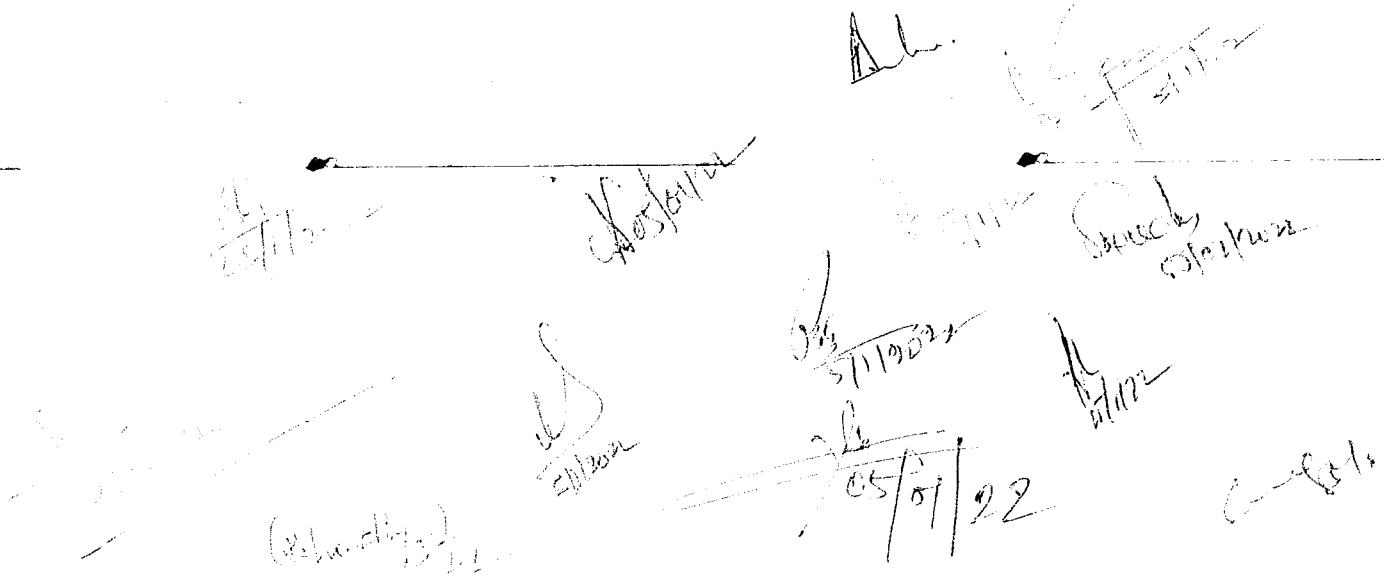
End capping at both ends of each pole shall be done by applying three coats of approved quality anticorrosive bituminous paint as per direction of the Engineer-in-charge.

3.21 Marking of Poles:

Each pole shall be clearly marked by engraving for proper identification with the following:

- Date, Month & Year of manufacture
- Maker's Serial Number and Mark.
- WBSEDCL or any other mark as prescribed in the tender.

Additionally, each pole shall be clearly marked by one green coloured peripheral band 75mm wide painted with two coats of non washable paint starting from 1500mm distance from bottom of the pole.

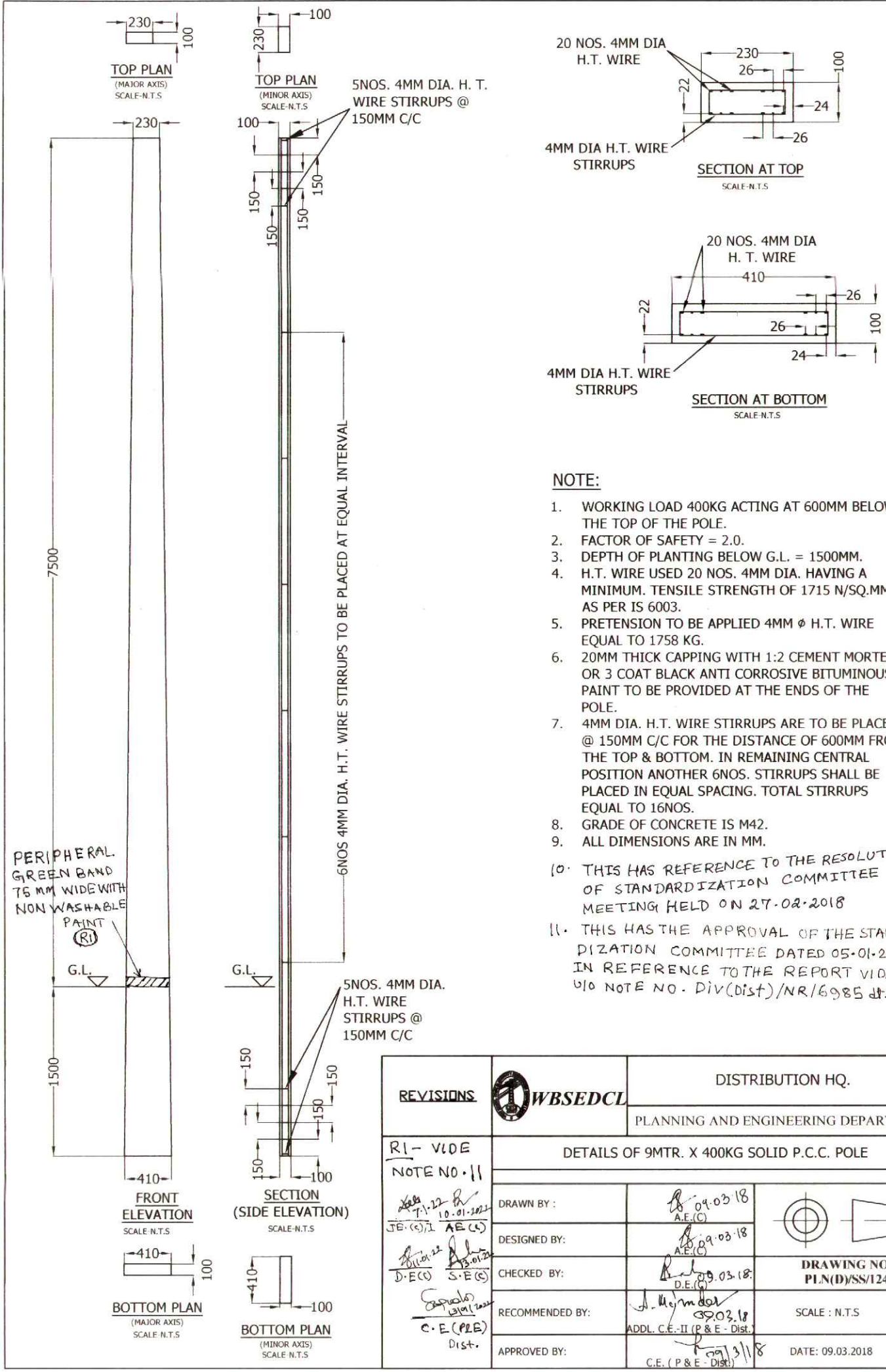


Technical Particulars for 8m/200kg Pre-stressed Cement Concrete Poles

Sl no.	Parameters	Unit	8m PCC pole	Remarks
1	Overall length of pole	m	8	**Any other detail are available in the drawing bearing no.** PLN(D)/SS/123 dt.09.03.2018
2	Working load	Kg.	200	
3	Bottom depth	mm	280	
4	Top depth	mm	150	
5	Breadth	mm	100	
6	Depth of planting	m	1.5	
7	Factor of safety	-	2.5	
8	Dia. of HT Pre-stressing wire	mm	4	
9	Minimum tensile strength of HT pre-stressing wire	N/mm^2	1715	
10	Number of HT wire	Nos.	15	
11	Concrete grade	-	M42	
12	Ultimate load	Kg	500	

Technical Particulars for 9m/400kg Pre-stressed Cement Concrete Poles

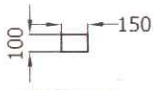
Sl no.	Parameters	Unit	9m PCC pole	Remarks
1	Overall length of pole	m	9	**Any other detail are available in the drawing bearing no.** PLN(D)/SS/124 dt.09.03.2018
2	Working load	Kg.	400	
3	Bottom depth	mm	410	
4	Top depth	mm	230	
5	Breadth	mm	100	
6	Depth of planting	m	1.5	
7	Factor of safety	-	2	
8	Dia. of HT Pre-stressing wire	mm	4	
9	Minimum tensile strength of HT pre-stressing wire	N/mm^2	1715	
10	Number of HT wire	Nos.	20	
11	Concrete grade	-	M42	
12	Ultimate load	Kg	800	



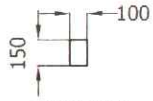
NOTE:

1. WORKING LOAD 400KG ACTING AT 600MM BELOW THE TOP OF THE POLE.
2. FACTOR OF SAFETY = 2.0.
3. DEPTH OF PLANTING BELOW G.L. = 1500MM.
4. H.T. WIRE USED 20 NOS. 4MM DIA. HAVING A MINIMUM. TENSILE STRENGTH OF 1715 N/SQ.MM AS PER IS 6003.
5. PRETENSION TO BE APPLIED 4MM ϕ H.T. WIRE EQUAL TO 1758 KG.
6. 20MM THICK CAPPING WITH 1:2 CEMENT MORTER OR 3 COAT BLACK ANTI CORROSIVE BITUMINOUS PAINT TO BE PROVIDED AT THE ENDS OF THE POLE.
7. 4MM DIA. H.T. WIRE STIRRUPS ARE TO BE PLACED @ 150MM C/C FOR THE DISTANCE OF 600MM FROM THE TOP & BOTTOM. IN REMAINING CENTRAL POSITION ANOTHER 6NOS. STIRRUPS SHALL BE PLACED IN EQUAL SPACING. TOTAL STIRRUPS EQUAL TO 16NOS.
8. GRADE OF CONCRETE IS M42.
9. ALL DIMENSIONS ARE IN MM.
10. THIS HAS REFERENCE TO THE RESOLUTION OF STANDARDIZATION COMMITTEE MEETING HELD ON 27-02-2018
11. THIS HAS THE APPROVAL OF THE STANDARDIZATION COMMITTEE DATED 05-01-2022 IN REFERENCE TO THE REPORT VIDE U/O NOTE NO. DIV(Dist)/NR/6985 dt. 08.11.21

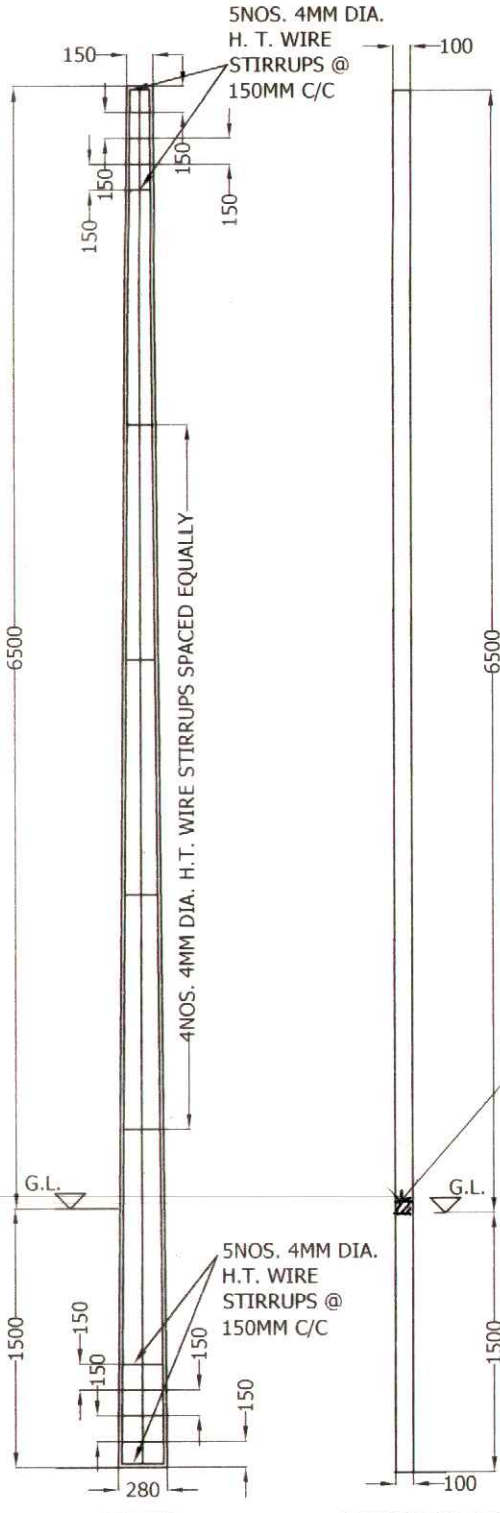
REVISIONS	WBSEDCL	DISTRIBUTION HQ.
		PLANNING AND ENGINEERING DEPARTMENT
R1- VIDE NOTE NO.11		DETAILS OF 9MTR. X 400KG SOLID P.C.C. POLE
JE(C)/I 7.1.22 AE(C) 10.01.2022	DRAWN BY :	A.E.(C) 09.03.18
D.E(C) 13.01.22 S.E(C) 13.01.22	DESIGNED BY:	A.E.(C) 09.03.18
C.E(PLE) Dist. 31/1/2022	CHECKED BY:	D.E.(C) 09.03.18 — DRAWING NO. PLN(D)/SS/124
	RECOMMENDED BY:	ADDL. C.E.-II (P & E - Dist.) 09.03.18 — SCALE : N.T.S — SHEET NO. 1 of 1
	APPROVED BY:	C.E. (P & E - Dist.) 9/3/18 — DATE: 09.03.2018 — REV NO. 0



TOP PLAN
(MAJOR AXIS)
SCALE-N.T.S



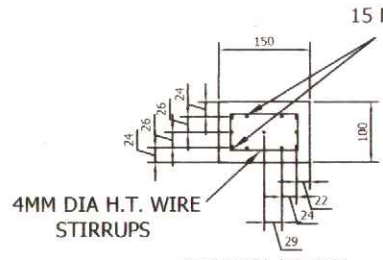
TOP PLAN
(MINOR AXIS)
SCALE-N.T.S



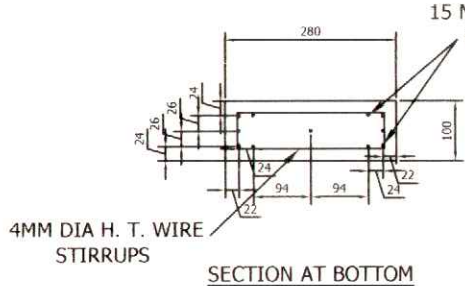
SECTION
(MAJOR AXIS)
SCALE N.T.S

PERIPHERAL GREEN BAND 75MM WIDE WITH NON WASHABLE PAINT (R1)

SIDE ELEVATION
SCALE-N.T.S



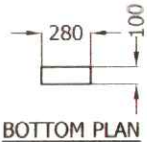
SECTION AT TOP
SCALE-N.T.S



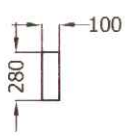
SECTION AT BOTTOM
SCALE-N.T.S

NOTE:

1. WORKING LOAD 200KG ACTING AT 600MM BELOW THE TOP OF THE POLE.
2. FACTOR OF SAFETY = 2.5
3. DEPTH OF PLANTING BELOW G.L. =1500MM.
4. H.T. WIRE USED 15 NOS. 4MM DIA. HAVING A MINIMUM. TENSILE STRENGTH OF 1715 N/SQ.MM AS PER IS 6003.
5. PRETENSION TO BE APPLIED/4MM Ø H.T. WIRE EQUAL TO 1758 KG.
6. 20MM THICK CAPPING WITH 1:2 CEMENT MORTAR OR 3 COAT BLACK ANTI CORROSIVE BITUMINOUS PAINT TO BE PROVIDED AT THE ENDS OF THE POLE.
7. 4MM DIA. H.T. WIRE STIRRUPS ARE TO BE PLACED @ 150MM C/C FOR THE DISTANCE OF 600MM FROM THE TOP & BOTTOM. IN REMAINING CENTRAL POSITION ANOTHER 4NOS. STIRRUPS SHALL BE PLACED IN EQUAL SPACING. TOTAL STIRRUPS EQUAL TO 14NOS.
8. GRADE OF CONCRETE IS M42.
9. ALL DIMENSIONS ARE IN MM.
10. THIS HAS REFERENCE TO THE RESOLUTION OF STANDARDIZATION COMMITTEE MEETING HELD ON 27.02.2018
11. THIS HAS THE APPROVAL OF THE STANDARDIZATION COMMITTEE DATED 05.01.2022. IN REFERENCE TO THE REPORT VIDE C/O NOTE NO. Div(Dist)/NR/6985 DT. 08.11.2021



BOTTOM PLAN
(MAJOR AXIS)
SCALE-N.T.S



BOTTOM PLAN
(MINOR AXIS)
SCALE-N.T.S

REVISIONS	WBSEDCL	DISTRIBUTION HQ.
		PLANNING AND ENGINEERING DEPARTMENT
R1 - VIDE NOTE NO. 11		DETAILS OF 8MTR. X 200KG SOLID P.C.C. POLE
	DRAWN BY : A.E.(C) 09.03.18	
	DESIGNED BY: A.E.(C) 09.03.18	
	CHECKED BY: D.E.(C) 09.03.18	DRAWING NO. PLN(D)/SS/123
	RECOMMENDED BY: ADDL. C.E.-II (P & E - Dist.) 09.05.18	SCALE : N.T.S
	APPROVED BY: C.E. (P & E - Dist.) 09/3/18	DATE: 09.03.2018

J.E(C)-I 7.1.22 AE(C) 10.01.2022
D.E(C) 10.01.22 S.E(C) 13.01.22
C.E (P&E) Dist 13/01/2022

SHEET NO. 1 OF 1
REV NO. 0

WBSEDCL

WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED
(A Govt. of West Bengal Enterprise)
Office of the Chief Engineer : Procurement & Contracts DepartmentVidyut Bhavan (4th Floor) : Bidhannagar : Block-DJ, Sector-II, Kolkata-700 091
Phone No. 033-2359-8397 : Fax No. 033-2359-1921 / e-mail -materialcontroller@yahoo.co.in
CIN- U40109WB2007SGC113473, website: www.wbsedcl.in

TECHNICAL SPECIFICATION FOR 33KV 400 A C.R.TYPE ISOLATOR

1.0.0 SCOPE:

1.0.1 This specification covers for design manufacture, testing at manufacturer' works, supply and delivery of outdoor type 33 KV, 3-phase, triple pole, double break, gang operated, centre rotating type Isolator with / without gang operated Earth switches, including Insulators and complete in all respects with arcing horns , bimetallic connectors, operating mechanism, indicating devices, fixing details etc., as described herein and briefly listed in ' schedule of requirements and desired delivery'.

The supporting structure for the isolators are excluded from the scope of this specification. Drawings for the details of structures for different types of isolators shall be furnished to the successful tenderers to facilitate design of mounting arrangements etc.

1.0.2 The technical specifications contained in this section are for guidance of the tenderers. Deviations if any, from the purchaser's specification proposed by the tenderer will be considered provided these are necessary either to improve the utility, performance and efficiency of the equipment or to secure overall economy.

2.0.0 STANDARDS:

2.0.1 Isolators covered by this specification shall conform to latest edition of IS: 9921(Part-I to V) & IEC Publication No. 129 (as amended up to date) unless specifically stated otherwise in this specification.

2.0.2 For the purpose of this specification all technical terms used herein shall have the meaning as defined in latest edition of IS : 9921 (1) or IEC Publication No. 129 (as amended up to date).

2.0.3 Porcelain Post Insulators for the Isolators shall confirm to IS: 2544 and/or IEC: 168 as amended up to date except to the extent of explicitly modified in this technical specification. Porcelain Post Insulators of Isolator shall be guided by relevant technical specifications of Post Insulator.

Unless otherwise specified, the rating as well as performance & testing of the isolator shall confirm to the latest revisions of all the relevant standards.

Sr.No.	Standard No.	Title
1	IS:1818	Alternating current isolators (disconnectors) and earthing switches
2	IS:9921	-do-
3	IEC:129	-do-
4	IS:2544	Insulators
5	IS 2147	Degree of protection provided by enclosures
6	IS:4691	Degree of protection provided by enclosures
7	IS:4722	Rotating Electrical Machines
8	IS:2629	Recommended practice for hot dip galvanising of iron and steel
9	IS:4759	Hop dip galvanization coating on Structural Steel.
10	IS:2633	Method of testing weight thickness and uniformity of coating on fasteners
11	IS:1573	Electro plated coating of zinc on Iron & Steel.
12	IS:3033	Spring Washers
13	IS:2016	Plain washers
14	IE Rules 1956	Indian Electricity Rules
15	IEC:168	Tests on Indoor and Outdoor post Insulator
16	IS:3961	Recommended current rating for PVC Insulated and PVC Sheeted heavy Duty Cables.
17	IS: 5561	Power Connectors
18	IS:1554	PVC Cables
19	IS:5578	Guide for marking of Insulated, conductors and arrangement for switchgear busbar main connectors & Auxiliary wirings.
20	IS:11353	Guide for Uniform system of marking and identification of conductors and apparatus terminals.

3.0.0 **TYPE:**

3.0.1 The 33 KV isolator shall be **outdoor type, three phase, double break, centre rotating type suitable for manual operation.**

All isolators as given in the schedule of requirements shall be suitable for horizontal upright mounting on structure or P.C.C. pole structures. Each pole unit of the multi-pole Isolators shall be of identical construction and mechanically linked for gang operation.

Each pole of the Isolator shall be provided with two sets of contacts to be operated in series and the moving contacts blades shall rotate in horizontal plane.

3.0.2 The design shall be such that the operating mechanism with the linkages shall be suitable for mounting on any of the outer pole ends without much difficulty and with minimum shifting of parts.

3.0.3 **Moving contacts of all isolators shall rotate through 90 degree from their "Fully Closed Position" to "fully open position"** so that the break is distinct and clearly visible from ground level.

3.0.4 The isolators offered by the tenderers shall be **designed for normal current rating of 400 Amps. and suitable for continuous service at the system voltage specified herein**. The isolators shall be suitable to carry the rated current continuously and full short circuit current for three seconds at site condition without any appreciable rise in temperature. **These shall also be suitable for operation at 110% rated (normal) voltage**. The Isolators are not required to operate under load but they **shall be suitable for isolating low capacitive/inductive current.** The limits of magnitudes of the same shall be furnished by the tenderers in schedule "A" of Guaranteed Technical Particulars.

3.0.5 The isolators and earthing switches are required to be used in electrically exposed installations and this should be taken into account while fixing the clearance between phases and between phase and earth.

4.0.0 **RATING:**

4.0.1 The isolator shall comply with the following technical requirements :-

ITEM:

i)	System frequency with ± 3 % variation (Hz)	: 50
ii)	Nominal system voltage (KV r.m.s.)	: 33
iii)	Maximum system voltage (KV r.m.s.)/ Rating Voltage	: 36
iv)	Maximum continuous current rating (Amps.)	: 400
v)	Rated short time current for 3 seconds (KA r.m.s)	: 28.8

vi) Rated peak withstand current (KA peak) : 72

vii) 1.2/50 micro-sec lightning impulse withstand voltage (KV peak)
  a) To earth and between poles : 170
  b) Across the isolating distance : 195

viii) Rated one minute power frequency withstand voltage (KV r.m.s.)
  a) To earth and between poles : 70
  b) Across the isolating distance : 80

ix) No. of poles : 3

5.0.0 **CLIMATIC CONDITIONS:**

5.0.1 The atmosphere in the area is laden with industrial and town gases and smoke with dust in suspension during the dry months and subject to tough colder months. The temperature variation between the daily minimum and maximum is large. Humidity occasionally rises upto 100%. Heavy lightning is usually in the area during the months from May to November. The area is also subjected to heavy monsoon rain, 80 to 90 % of the annual precipitation being in the month of June to October.

The climatic and isoceraunic conditions at site are given below :

a) Maximum temperature of air : 50· C

b) Minimum temperature of air : - 4· C

c) Maximum temperature of the air in sun : 60· C

d) Maximum daily average ambient temperature : 45· C

e) Maximum yearly average ambient temperature : 30· C

f) Maximum relative humidity : 100 %

g) Average No. of thunderstorm days per annum : 100

h) Average No. of dust storm days per annum : 5

i) Average No. of rainy days per annum : 80

j) Average No. of stormy rainfall days per annum (exceeding ½ " in 24 hours) : 10

k) Average rainfall per annum : 200 cm.

l) Maximum wind pressure : 150 kg / Sq. cm.

m) Average wind pressure : 71.3 kg / Sq. Cm.

n) Height above sea level : not exceeding 1000 metres.

o) Earthquake acceleration : 0.04 x 2 g.

p) Climate : Moderately hot & humid tropical climate, conductive to rust & fungus growth

6.0.0 MAIN CONTACTS :

6.0.1 All isolators shall have heavy duty, self aligning and high pressure, line type contacts made of high conductivity, corrosion resistant, hard-drawn electrolytic copper strips of proper thickness and contact area. Fixed contacts should consist of loops of above copper strips suitable for 400 Amps. rating. **The hard -drawn electrolytic copper strips should be silver plated of 20 micron thickness and fixed contacts should be backed by powerful Phosphor Bronze/Stainless Steel Springs of suitable numbers.**

6.0.2 The **isolator blades** forming the moving contacts shall **be made from tube of high conductivity hard- drawn electrolytic copper having 38 mm. Outer dia and for wall thickness 10 SWG for 400 Amps. rating**. Current density for other current carrying copper parts should not exceed 1.75 Amp/mm.sq.

6.0.3 **These fixed and moving contacts shall be able to carry the rated current continuously and the maximum fault current of 28.8 KA at 33KV for 3 seconds without any appreciable rise in temperature**. The isolator blades shall retain form and straightness under all conditions of operation including all mechanical stresses arising out of operation as well as under rated short circuit condition

6.0.4 Fixed guides shall be provided so that even when the blades are out of alignment by one inch (maximum) at the time of closing of switches, proper seating of the blades in between the contacts and adequate pressure to give enough contact surface are ensured, whenever possible, the blades shall be counter balanced by weights & springs at the end of the travel both on opening and closing of the isolator. **The springs shall be made of durable and non-rusting type alloy.**

6.0.5 The contacts shall be self cleaning by the wiping action created by the movements of the blades. The surface of the contacts shall be rendered smooth and silver-plated.

6.0.6 Isolator main switch shall be required to make or break the line charging current when no significant change in voltage occurs across the isolating distance on account of make or break.

6.0.7 **Fixed contacts shall be mounted on a block or channel welded to 10 mm thick M.S plate** with holes for fixing on insulators. Slots shall be provided for marginal adjustment of height of contacts. The contacts shall rest on a brass block and with initial tension. Suitable device shall be provided to prevent dashing.

7.0.0 EARTH SWITCH:

7.0.1 If necessary, line earth switches shall be provided.
Line earth switches shall consist of three earthing blades per Isolator which normally rest against the frame when the connected isolator is in closed position. The earthing blades for three phases shall be mechanically linked to a coupling shaft which shall be capable of being fitted on either side of the isolator. The earthing blades shall match and be similar to the main switch blades and shall

be provided at the hinge-ends with suitable flexible conductors with terminal lug for connecting to the station ground bus.

The earthing blades shall be operated by a separate mechanism but shall be mechanically interlocked with the main switch so that the earthing blades can be closed only when the main switches are in open position . The earthing blades shall be gang operated and all the three blades will operate simultaneously.

Material of the earthing blades and contacts shall be same as those of main switch. **The earthing blades shall have the same short time current rating (thermal & dynamic) as that of main switch. Earthing blades shall be capable to discharge the trapped charge of the line.**

7.0.2 **Earth switch wherever provided shall be electrically interlocked so that earth switch can be operated only when the main isolator is open or vice-versa.**

8.0.0 **FIXED AND MOVING ARCING HORNS:**

8.0.1 Suitable **Phosphor Bronze Arcing Horns** made from 6 mm. dia rod of smooth and even surface required for guiding main contacts shall be provided on the fixed and moving contacts of the isolator.

Feature of the Arcing Horns should be to "Make before and Break after" main contacts.

9.0.0 **CONNECTORS:**

9.0.1 The isolators shall be supplied complete **with high conductivity bimetallic clamping type of terminal** connectors to be made of Extruded Aluminium sheet of minimum thickness of 10 MM, suitable for connecting 200 sq mm ACSR 'PANTHER'. The support plate on which the conductor shall seat, shall be universal type i.e. rigid type connector for conductors shall have to be fitted on support plate without altering or modifying the support plate. Terminal Connectors to be fixed by 4 bolts with fixed contact with bimetallic strip. Current density for terminal connector (Aluminium) shall be 1 A/Sq mm max. The entry of conductors to the isolators along with the phase centers of the isolators i.e. the centre line of the conductors and bushings of the isolators in a phase shall be in a straight line. Suitable precautions shall be taken to inhabit bimetallic action with the aluminium conductors.

10.0.0 **OPERATING MECHANISM:**

10.0.1 The operating mechanism shall be simple & ensure quick and effective operation. Manual operating mechanism for main isolator as well as earth switch shall be through lever/hand on the operating shaft.

The design shall be such as to enable one man to operate it with nominal effort. The operating mechanism shall be suitable to hold the main switch or earth switch in closed or open position to prevent operation by gravity, wind, short circuit, seismic acceleration, vibration, shock, accidental touching.

10.0.2 The isolator blade shall be in positive continuous control throughout the entire cycles of operation. The operating rods and pipes shall be rigid enough to maintain positive control under most adverse conditions and to withstand all torsional and bending stresses arising from operation. Operation of the switches at any speed should not result in improper functioning, in displacement of parts / mechanism after final adjustment has been made. All holes in cranks, linkages etc. having moving pins shall be drilled and fitted accurately so as to prevent slackness and least motion.

10.0.3 Centre line of the operating mechanism and **operating handle shall be mounted at 1.187 meters height from the ground level**. The operating rod shall conform to IS:1239 Part - I and II (1979 / 1982). The nominal bore of the pipes shall be 40mm. (class - B medium). **The outer diameter will be 48.8mm Maxm. /47.9 mm Minm. and wall thickness of 3.25 mm**. Guide bearing shall be provided

wherever necessary, all brackets, clamps, angles or other attachments for fixing the operating mechanism to the isolating switch supporting structures , shall be supplied by the successful tenderer.

10.0.4 Provision shall be made for padlocking the operating mechanism of disconnecting and ground switches, in both open and close positions.

11.0.0 **I N S U L A T O R (IS: 2544-1973):**

The disconnecting switch shall be provided with six nos. 22 KV post Insulators of 2×22 KV Stack type per pole i.e. total 18 nos. insulators per Isolator.

11.0.2 Pertinent particulars of the insulators will be as follows:

Sl.No.	P a r t I c u l a r s	Quantity / Dimension
1	No. of Units	2 Unit of 22KV Stack type
2	Height	508 mm.
3	Cap pitch circle diameter	76 mm.
4	Base Pitch circle diameter	76 mm.
5	Diameter of Cap and Base	108 mm.

SPECIFIC TECHNICAL PARAMETERS OF 33 KV (2x22 KV) KV POST INSULATORS :

Sl No.	Description		Rating
			33 KV (2x22 KV)
1	Nominal system voltage/Working voltage	:	33 KV
2	Highest system voltage	:	36 KV
3	No. of units per Stack	:	2
4	Minimum specific Creepage distance	:	25 mm per KV
5	P.F Visible Discharge Voltage	:	27 KV rms
6	P.F. Withstand Voltage		
	a) Dry	:	95 KV rms
	b) Wet	:	75 KV rms
7	Impulse withstand voltage 1.2/50 micro second wave :		
	a) Positive b) Negative	: :	170 KVp 180 KVp
8	P.F. Minimum flash over voltage		

Sl No.	Description		Rating
			33 KV (2x22 KV)
	a) Dry	:	130 KV rms
	b) Wet	:	90 KV rms
9	Impulse flashover voltage 1.2/50 micro second wave :		
	a) Positive	:	210 KVp
	b) Negative	:	230 KVp
10	Power Frequency puncture withstand voltage on single unit	:	150 KV rms
11	Cantilever strength on stack		
	a) Upright	:	4.5 KN
	b) Inverted	:	3.4 KN
12	Tensile Strength	:	30 KN
13	Torsional Strength	:	680 Nm
14	Compression Strength	:	40 KN
15	Height	:	508 mm
16	Insulation Part Diameter	:	210 mm
17	Pitch Circle Diameter		
	a) Top	:	76 mm
	b) Bottom	:	76 mm
18	Conforming standard	:	As per IS

12.0.0 **BEARINGS:**

12.0.1 Bearing shall be ball or roller type and shall be protected from weather by means of covers and grease retainers. Bearing pressures shall be kept low to ensure long life and ease of operation . Bearing housing shall be made of die cast metal with smooth surface and suitably machined for seating the bearings. **Two nos. of bearings with adequate shaft diameter and distance between the bearings shall be provided to avoid wobbling during operations. Complete details of bearing bushes, housing, greasing etc. shall be furnished with the tender.**

12.0.2 All hinges / movable joints in current carrying parts shall be shunted with flexible copper conductor having adequate length and size to prevent breaking due to repeated bending.

13.0.0 **SYSTEM EARTHING:**

13.0.1 33 KV system will be treated as non-effectively earthed. Flexible conductor of at least 50 sq.mm and shall be tinned or suitably treated against corrosion shall be provided at the lower end of the vertical operating shaft for connection to the Station Ground Bus.

13.0.2 The frame of the isolator and earthing switch shall be provided with two reliable earthing terminals for connection to station earth bus so also clamping screw suitable for carrying specified short time current. **The diameter of clamping screw shall be at least 12 mm.** The connecting point shall be marked with earth symbol.

14.0.0 **CLEARANCES:**

14.0.1 The centre to centre distance between the insulators of adjacent phases in assembled position of the **33 KV isolator with arcing horns shall be 1370 mm.** The centre to centre distance between the insulators of adjacent poles of the same phase in the **assembled position of the 33 KV isolator shall be 457 mm.**

14.0.2 The clearance between live parts and grounded structures shall not be less than those specified in the relevant Indian standards. The length of break in full open position shall be at least 10 % in excess of the dry arcing distances of the insulators of relevant voltage class specified in relevant standards.

14.0.3 Clearance of Isolator mounting structure top/Bus height from ground level:

Sl. No	Description	Clearance from G.L	Operating Rod	Remark's
a)	Isolator suitable for mounting on P.C.C Pole Structure	Height of the top of isolator mounting channel from G.L	Length of the Rod	Bus height from G.L
	For High Level Arrangement			
b)	i) With Earth Switch	6500.0 mm.	5313 mm	Not applicable
	ii) Without Earth Switch	6387.5 mm.	5200. 5 mm	6200 mm.
c)	For Low Level Arrangement :			
	i) Without Earth Switch	5387. 5 mm.	4200. 5 mm	4500 mm.

15.0.0 **SUPPORTING STRUCTURES:**

15.0.1 The isolators shall be provided with rigid, self supporting galvanised supporting structure. Bases shall be suitable for mounting on P.C.C. Pole Structures as given above.

15.0.2 Bolt holes on the bases for fixing on the structures together with **requisite numbers of mounting bolts and nuts plus 5% spares shall be provided by the suppliers.**

16.0.0 **DESIGN, MATERIALS & WORKMANSHIP:**

16.0.1 The live parts shall be designed to eliminate sharp points, edges and similar corona producing surfaces. Where this is impracticable, adequate shields are to be provided.

16.0.2 All metal parts shall be of such material or treated in such a way so as to avoid rust corrosion and deterioration due to continuous exposure to atmosphere and rain, **all current carrying parts shall be non ferrous metals or alloys.**

16.0.3 Bolts screws and pins shall be provided with standard locking devices viz. locknuts, spring washers, keys etc. and when used with **current carrying parts, they shall be made of stainless steel or other high conductivity and wear resistant alloys**.

16.0.4 The switches should not need lubrication of any parts except at very long interval of one year minimum.

16.0.5 Each phase of isolator shall be provided with rigid base fabricated from steel sections. The base shall be suitable for mounting on support structures.

16.0.6 Down pipe :- **50 mm ID Class B pipe shall be provided for operating the isolator**. The pipe shall be terminated into a suitable swivel or universal type joint between the insulator bottom bearing and the operating mechanism.

16.0.7 **Tandom pipes shall be of at least 25 mm ID and Class B**. One pipe shall be used for phase coupling of double break isolators. Base plate of insulators for connection of tandom **pipe shall be made out of one piece of at least 10mm thick M.S. Plate. Bolt and shackle device shall be used to connect tandom pipe to the base plate**.

16.0.8 Full particulars of the following items shall be furnished with drawings and descriptions along with the tender:-

i. Contacts- material , current density etc.
ii. Design of contact pressure
iii. Contact support and fixing arrangement on insulators
iv. Bearing, housing of bearing, bushes etc.
v. Balancing of height
vi. Coupling pipes, joints, connection adjustments
vii. Base plate
viii. Down pipe , guide joints
ix. Brass bushes and bearing at various joints
x. Nuts, Bolts and fasteners
xi. Interlocking device
xii. Operating mechanism, type of gear, auxiliary switch, size and thickness of box, degree of protection, gland plate gland etc.

Offers without the above information or with incomplete information shall not be acceptable.

17.0.0 **CONTROL CABINET :**

17.0.1 The control cabinet of each operating mechanism shall be made out of 12 SWG sheet steel in the form of plate or casting. Control cabinet shall be provided with hinged doors along with padlocking

arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP55 as per IS: 2147. The cabinet shall be suitable for fixing on support structure. Details shall be provided with the offer.

18.0.0 **GLAND PLATES AND GLANDS:**

18.0.1 A removable gland plate with double compression type brass cable glands shall be provided with each operating mechanism for terminating all cables.

19.0.0 **AUXILLIARY SWITCH:**

19.0.1 Main switch operating mechanism shall be equipped with reliable auxiliary switch(4NO and 4 NC contacts) exclusively for purchaser's interlocking and protection purpose. Auxilliary switch and contacts shall be capable of carrying atleast 10 Amp. Continuously. Quick make and break (QMB) type auxiliary switch shall have snap action built in within the switch. The auxiliary switch shall be actuated by a cam or similar arrangement directly mounted on the Isolator shaft without any intermediate levers, linkages etc. to ensure fool-proof operation.

20.0.0 **TERMINAL BLOCK AND WIRING:**

20.0.1 Main switch operating mechanism shall be provided with 1100 V grade stud type terminal block. Auxilliary switch shall be wired upto the terminal block with 20% extra. All wiring shall be carried out with 1100V grade PVC insulated 2.5 sq. mm copper conductor. Maximum conductor temperature shall be as per IS 3961.

21.0.0 **PROTECTIVE COATINGS:**

21.0.1 All ferrous parts including bolt , nuts and washers of the switch assemblies shall be galvanised to withstand at least four nos. of one minute dips in copper sulphate solution of requisite strength as per IS : 2633.

21.0.2 **PAINTING, GALVANISING AND CLIMATE PROOFING:**

All interiors and exteriors of enclosures, cabinet and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, grease and other adhering foreign matter and the surfaces treated by recognised phosphating (seven tank process). After such preparation of surfaces, two coat of zinc oxide primer shall be given by suitable storing and air drying etc. before final painting. Colour of the final paint shall be of shade no. 631 of IS:5 i.e epoxy light gray. The final painted equipment shall present esthetically pleasing appearance free from any dent or uneven surface.

Paint inside the metallic housing shall be of anti condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

All ferrous parts not suitable for painting such as structural steel, pipes rods, levers, linkages, nuts and bolts used in other than current path etc. shall be hot dip galvanised. Galvanisation shall be done after completion of fabrication which shall be capable to prevent corrosion in view of the severe climatic conditions. Thickness of zinc coating shall not be less than 610 gm of zinc per sq. meter of surface. Zinc coating shall be smooth clean and of uniform thickness and free from defect. Preparation of galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material. The quality shall be established by tests as perIS 2633.

Galvanising of nuts and bolts shall be carried out by centrifugal or suitable process so that the bolts will easily fit into the tapped holes/nuts.

All components shall be given adequate treatment of climate proofing so as to withstand corrosion and severe service conditions.

Complete details of painting, galvanising and climate proofing of the equipments shall be furnished in the tender.

22.0.0 **GURANTEED TECHNICAL PARTICULARS AND OTHER DATA:**

22.0.1 Guaranteed technical particulars and other data of the isolators and earthing switches should be given in the form in 'Schedule - A '. Any other particulars considered necessary by the supplier may also be given in addition to those listed in the schedule.

22.0.2 **NAME PLATES:**

Isolator, Earth switches shall be provided with a name plate which shall contain information as per Table -I of latest version of IS : 9921 (Part-V).

23.0.0 **S P A R E S :**

23.0.1 The tenderer shall submit lists of spares recommended by him for five years' efficient operation of one isolator of each type , with their item wise price separately . Spares shall be interchangeable with identical parts of the disconnecting switches and shall be of the same materials, identical workmanship and having same characteristics. The cost of following spares shall be quoted separately.

a. Contacts
b. Moving
Blades
c. Springs
d. Bearings

In addition, list of optional spares may be enclosed.

TESTCERTIFICATES/INSPECTIONANDTESTING

1. **I S O L A T O R :**

The bidder shall submit following copies of complete type test certificates of similar Isolator of identical rating & design as well as on 33 KV (2x22 KV) Post insulators already conducted in CPRI/NABL accredited/Govt. approved test house or laboratory containg NABL logo. Type test report shall be carried out within five years from the due date of submission of tender. The bidder shall have to submit the type test report along with the tender, otherwise the offer will be rejected.

Following type test report shall have to be submitted:

a) Short Time Withstand & Peak Withstand Current Test.
b) Lightning Impulse Voltage Withstand Test.
c) PF Withstand Voltage Test (Dry & Wet)
d) Mechanical Endurance Test – On main switch as well as earth switch of each type.
e) Temperature Rise Test

In addition to that, the bidder have to submit Type Test Report on on 33 KV (2x22 KV) Post insulators as per relevant IS/IEC and technical specification of the Tender along with the Tender document.The dimensions of the Fixed & Moving Contacts of the sample Isolators, tested successfully for Type Tests in an approved Laboratory, should at least conform to the dimensions as specified in Part – A of this specification. The type of Fixed Contact should be of Reverse Loop Type.

Following Acceptance Tests shall be carried out at the works of the Manufacturer as per relevant ISS before delivery of each lot in presence of our Engineers. The contractors shall furnish 'Routine Test' reports of each unit comprising 'Millivolt Drop Test , 'Operation Test' and ' One Minute Power Frequency Voltage Withstand Test ' in six copies along with each lot offered :-

a) Temperature Rise Test
b) Millivolt Drop Test
c) One minute power frequency voltage withstand test
d) Operation Test : The tenderer shall make arrangement for operation test for the total height of the Isolators on selected samples.
e) Uniformity of silver coating on the copper contacts
f) Dimensional Check-up as per drawing and specification on selected samples.
g) Mechanical Test for Insulator as per IS-2544
f) Uniformity of zinc coating on ferrous parts (galvanization test)

This test shall be carried out at the Laboratories undertaking tests for Govt. Deptts. And in such case, reports incorporating Test Results from the respective Laboratories should be submitted in support of the contractor's Test Certificates .

Samples at random will be selected from the lot offered for above testing and if any one of the test piece fails, the lot will be rejected.

Contact pressure, Material Quality, Dimensions of the Isolator Contacts and other components shall also be verified/measured (with the approved Drawing). Quoted price should include charges for above stated Acceptance Tests and Type Tests.

Testing of materials: The purchaser reserves the right to get the metal/raw materials/silver coating/galvanizing of any component, tested at any approved laboratory at the cost of manufacturer, in case of any doubt over their quality of such metal / raw material especially for Copper and Aluminium components.

2.00 **PEDESTAL INSULATOR :**

2.01) The Pedestal Insulator to be fixed and supplied along with the Isolators will be tested both for Mechanical and Electrical characteristics as per late issue of ISS - 2544. Complete Type Test Certificates from the Manufacturer shall also to be furnished, for both Electrical and Mechanical Tests.

2.02) One or more Insulator(s) may be dismantled by the Purchaser's Representative, from Isolators offered for inspection and the Contractor shall arrange at his own cost for both Mechanical and Electrical Tests at the insulator manufacturer's Laboratory within reasonable time as per latest ISS.

2.03) The Test values in respect of ' Impulse Voltage Test ' and ' Power Frequency Voltage Withstand Test' on the complete isolators without grounding connectors, should not be less than those specified in ISS and as detailed below :

System Voltage	Impulse Withstand Voltage Positive & Negative Polarity		One Minute Power Frequency Withstand Voltage (KV r.m.s)	
	Across Isolating Distance	To Earth and Between poles	Across Isolating Distance	To Earth & Between Poles
36KV	195 KV	170 KV	80KV	70 KV

Rated Short time Current Rating is 28.8 KA (r.m.s) for 3 Sec.

3. The equipment shall be subjected to routine & acceptance tests in accordance with provisions of relevant standards.

   Routine & Acceptance tests shall have to be performed in presence of purchaser without any extra cost. The supplier/ manufacturer shall give at least 15(Fifteen) days' advance notice for conducting such tests.

   Purchaser shall have the right to select any number on random sampling basis for testing from the equipment ordered for inspection and in the event of failure in such test, the purchaser shall have the right to reject the whole lot.

   Six (6) copies of routine & acceptance reports shall have to be furnished to the purchaser for approval before dispatch of the offered equipment.

4. TYPE TEST AFTER ISSUANCE OF ORDER:

   Besides submission of Type Test Report, carried out within five years as per Tender Specification, Type Test at the discretion of Ordering authority, shall have to be arranged by the successful contractor or WBSEDCL on his own may conduct the same from any lot delivered to site, as per the relevant ISS from any NABL accredited/Government recognized Test House or Laboratory in presence of WBSEDCL'S representative. In case of failure of the materials after type test, the WBSEDCL will have the right to reject the total supplied lot of the said materials and the party have to replace the complete lot of materials at his own cost
   including transportation of materials at site.

24.0.0 DRAWINGSDATA ANDMANUALS:

24.0.1 The following drawings & details in respect of the isolating and earth switches shall be furnished in triplicate with the tender :

i) G.A. drawings describing dimension, Constructional feature & technical arrangement with list of parts .
ii) Drawing showing details of main contacts (fixed and moving), arcing horns,post isolators, terminal pads & connectors.
iii) Drawings showing the mechanical interlock between earth and isolating switches. iv) Drawings showing the manual operation device.
v) Manual for installation, operation and maintenance procedure.
vi) Technical leaflets of individual component describing design and constructional features. vii) Test Reports, literatures, phamplets of the bought out items and raw material.
viii) Schematic Drawing

24.0.2 The tenderer shall submit the following information alongwith offer:

a. List of raw material and bought out item and the name of sub-supplier.
b. Type test report of the raw material and bought out items.
c. Quality Assurancce Plan with hold points for purchaser's inspection.
d. The successful tenderer shall submit routine test certificates of bought out items at the time of routine testing of the fully assembled Isolator.

24.0.3 Six copies of above mentioned drawings, data and manuals of offered equipment shall have to be submitted for approval and final distribution afterwards along with soft copies of documents in MS OFFICE and drawings in AUTO CAD format only.

24.0.4 In addition to above, each crate containing mentioned equipment shall also accompany, in water proof folder, a set of approved drawings ,data and manuals as mentioned above.25.0.5 Before starting manufacture of the equipment , the supplier shall have to take approval of the design drawings from the purchaser.

25.0.0 **QUALITY ASSURANCE PLAN:**

25.0.1 The tenderer shall invariably furnish following information for each type of Isolator alongwith his offer, failing which his offer shall be liable for rejection:-

i. Statement giving list of important raw material, including but not limited to

a. Copper
b. Steel
c. Spring
d. Bearings
e. Nuts and Bolts
f. Operating Mechanism and its components

ii. Name of sub-suppliers for raw materials, list of standards according to which raw materials are tested, copies of test certificates.

iii. List of manufacturing facilities available.

iv. Level of automation available.

v. List of areas in manufacturing process where stage inspection are normally carried out.

vi. Special features provided in the equipment to make it maintenance free.

vii. List of testing equipment available.

26.0.0 **PACKING AND DESPATCH :**

26.0.1 The materials shall be packed by wooden planks of suitable thickness to protect against damage in transit and in such a way that individual units can be despatched at a time complete in all respect so that erection is not held up for want of any equipment.

27.0.0 **P R I C E S :**

27.0.1 The tenderer shall furnish the prices for the equipment in price schedule of this specification . Price should be firm.

28.0.0 **PERFORMANCE CERTIFICATES:**

28.0.1 Copies of performance certificates of similar equipment supplied to various organization shall have to be furnished in triplicate along with the tender as Pre-requisites.

28.02 **CREDENTIALS :**

Tenderer shall furnish document in support of supply & delivery of similar equipment to WBSEB/WBSEDCL/Other Power Utilities/Other Govt. Deptt. in earlier occasions indicating thereon names of the organization, quantity ordered , quantity supplied along with the tender as Pre-requisites. Copies of Purchase Orders and copies of Inspection Offer Letter, Copies of Despatch Instruction, copies of signed challan in support of execution of order(s) are to be submitted in support of Credential.

29.0.0 **VALIDITY PERIOD:**

Validity Period of the offer shall be reckoned from the next date of opening of the tender provided of receipt of complete information and will be valid for a minimum period of 120 days from thereon. However, WBSEDCL may
,on the merit of the case, request extension of validity of offer for a further suitable period without any change in terms & conditions of the offer.

30.0.0 **DEVIATIONS FROM SPECIFICATION :**

Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility of equipment must be mentioned in the Deviation Schedule with reasons duly supported by documentary evidence. Such deviations suggested may or may not be accepted by the WBSEDCL. Deviations not mentioned in Deviation schedule will not be considered.

31.0.0 **SCHEDULE OF REQUIREMENTS AND DESIRED DELIVERY:**

31.0.1 The quantity mentioned in this schedule are provisional and are subject to change by ± 25% at the time of ordering.

GUARANTEE:

In the event of any defect in the equipment arising out of faulty design, materials, workmanship within a period of 5 (five) years from the date of last despatch of any integral part of the equipment/cable, the supplier shall guarantee to replace or repair the same to the satisfaction of the purchaser.

If the supplier fails to do so within one month of receipt of intimation, WBSEDCL reserves the right to effect repair or replacement by any other agency and recover charges for repair or replacement from the supplier.

32.0.0 **DOCUMENTS TO BE SUBMITTED AT THE TIME OF PHYSICAL DELIVERY TO THE CONSIGNEE STORES**

The following documents to be submitted by the Vendors to the Consignee Stores at the time of physical delivery :-

a) Copy of Purchase Order.
b) Copy of Despatch Instruction.
c) Inspection Test Certificate.
d) Guarantee Certificate.
e) Proforma Invoice.
f) Seal list and packing list.
g) Challan in triplicate.
h) Way bill, if applicable.

Enclo : Schedule "A"

SCHEDULE- A

(To be filled in and signed by the tenderer)

SCHEDULE OF GUARANTEED DATA AND OTHER TECHNICAL PARAMETERS FOR 33 KV CR TYPE ISOLATOR

1. Maker's Name and address :

2. Type :

3. Model :

4. Rated Voltage :

5. Maximum permissible continuous s :
6. Maximum continuous current rating :

7. No. of Poles :

8.a)Short time current rating:
i. For 1 second :
ii. For 3 second :

b) Short circuit making current :
for earth switch, if any

9. Current density at the minimum
cross section of switch blade :

10. Temperature rise corresponding to:
a) Maximum continuous current rating :
at 40 degree C ambient temperature

b) Derating factor for higher ambient temperature

c) Short time current rating:
i. For one second :
ii. For three second :

11.a) Maximum charging current that can
be safely interrupted by the switch :
b) Maximum capacitive current that can
be safely interrupted by the switch :
c) Maximum Transformer off load
breaking capacity :
d) Maximum line charging breaking capacity :

12.Torque required to open the switch :

13. Clearance (Minimum) :
a) Between live parts and ground :
b) Between phase/poles :
c) Between fixed contact and blade in open position :

14. Particulars of switch contacts:-
a)Material :
b)Type :

c)Contact area :
d) Contact pressure :
e) Whether silver plated or not? :
15. Location and type of bearing :

16. Millivolt drop of Isolator with 100A.(DC):- a) Before operation of Isolators:
i. Across terminal :
ii. Across contact :
b) After carrying out mutually agreed No. of operations :
i. Across Terminal :
ii. Across contact :

17. Size of connecting bolts and nuts :

18. Whether connector provided & if so indicate the type and materials used . :

19. Type of interlocking to be provided for Isolator with earth switch :

20. No. of operations that switch can withstand without deterioration of contact :

21. No. of times the switch can be operated without any need for inspection :

22. Type of mounting :

23. Net weight of one complete 3 pole Isolating switch :

24. Actual dimension of the Isolating switch per phase :

25. Shipping dimension of the largest packages :
26. Support Insulator :

1.	**Particulars of Insulators:**	
	a) Type of Insulators :	
	b) Name of Manufacturer of Insulators:	
	c) Height of the Insulators:	
	d)Diameter of the largest	
	Shed: e)No of units per stack:	
2	**ELECTRICAL CHARACTERISTICS (FOR ONE INSULATOR)**	
2.1	FLASH OVER VOLTAGE	
i)	Dry Power frequency voltage(KVrms):	
ii)	Wet Power frequency voltage(KVrms):	
iii)	Impulse voltage of 1.2/50 micro sec.(+ve)(KVpeak):	
iv)	Impulse voltage of 1.2/50 micro sec.(-ve) (KVpeak) :	
2.2	WITHSTAND VOLTAGE	
i)	Dry Power frequency voltage(KVrms):	
ii)	Wet Power frequency voltage(KVrms):	
iii)	Impulse voltage of 1.2/50 micro sec.(+ve)(KVpeak):	
iv)	Impulse voltage of 1.2/50 micro sec.(-ve) (KVpeak) :	
2.3	VISIBLE DISCHARGE VOLTAGE(KVrms):	
2.4	POWER FREQUENCY PUNCTURE WITH STAND VOLTAGE OF UNIT :	
2.5	MECHANICAL CHARACTERISTICS	
a)	Cantilever strength upright(KN) :	
b)	Cantilever strength under hung (Inverted)(KN) :	
c)	Torsional strength(Nm) :	
d)	Tensile strength(KN) :	
e)	Compression strength(KN) :	
2.6	GENERAL CHARACTERISTICS	
a)	Minimum Creepage distance(mm):	
b)	Weight of complete unit(kg) :	
c)	Weight of nonferrous Parts(total)(kg) :	
d)	Weight of ferrous Parts(total)(Kg) :	
2.7	STANDARD TO WHICH INSULATOR CONFORMS:	

Signature

WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED
(A Govt. of West Bengal Enterprise)

Office of the Chief Engineer,
Procurement & Contracts Department
Vidyut Bhavan, 4th. floor,
Bidhannagar, Kolkata – 700091

Technical Specification

for

1.1 KV Copper Control Cable

TENDER NO. P-13/2016-17/PC-III

TECHNICAL SPECIFICATION FOR 1.1 KV GRADE COPPER CONTROL CABLE

1.00	SCOPE :			
	The specification cover the design, manufacture, at manufacturer's works, supply and delivery of 1.1 KV grade PVC insulated armoured stranded Copper Control Cables for use in different 33/11 KV Sub-Stations of West Bengal State Electricity Distribution Company Limited in the State of west Bengal .			
2.00	GENERAL INFORMATIONS :			
	The Control Cables are required for the control, protection, instrumentation, auxiliary Power Supply.			
	Each tender must be accompanied by full information required in the bidding schedule together with pertinent manufacturer's literatures, drawings, instruction manuals to enable the purchaser to make an appraisal of the quality and suitability of the materials offered. Failure to comply with the provision may be sufficient reasons to reject the bid.			
3.00	STANDARDS AND REGULATIONS :			
	All materials shall comply by this specification shall comply with the applicable provisions of the latest edition of Indian Standards, Indian Electricity Rules, Indian Electricity Act and other applicable statutory provisions, rules and regulations.			
	The following standards with latest amendment would apply to the specification.			
	1. IS-1554 (Part-I) – PVC insulated (heavy duty) electric cables.			
	2. IS-8130-Conductors for insulated electric Cables and flexible cord.			
	3. IS-3961 (Part-II)- Recommended current ratings for PVC insulated and PVC sheathed heavy duty Cables.			
	4. IS-5831-PVC insulated and sheath of Electric Cable.			
	5. IS:3975-Mild steel wires, formed wires and tapes for armoring of cables. 6. IS: 10810- Methods of test for cables . 7. IS: 10418- Cable drums for electric cables.			
4.00	CLIMATIC AND ISOCERAUNIC CONDITIONS :			
4.10	The climatic conditions at site under which the material shall operate satisfactory are as follows :			
	a)	Maximum ambient temperature (^{0}C)	:	50
	b)	Minimum ambient temperature (^{0}C)	:	4
	c)	Maximum Yearly average ambient temperature (^{0}C)	:	32
	d)	Maximum relative humidity (%)	:	100
	e)	Average number of thunderstorm days per annum	:	100
	f)	Average annual rainfall (Cm)	:	200
	g)	Maximum wind pressure (Kg/M^2)	:	150
	h)	Earthquake acceleration (g)	:	0.04 x 2 g
	i)	Height above Sea Level (m)	:	Not exceeding 1000
4.20	The material offered shall be suitable for continuous operation at the full rated capacity under the above conditions.			
5.00	DESIGN CRITERIA / Technical Requirements :			
	The Cables will be used for control protection and instrumentation, auxiliary Power Supply connections of the various equipment and various applications in substation etc. All such purposes PVC insulated armoured control cable of minimum 2.5 sq.mm with stranded copper conductor shall be used .			
5.10	The Cable will be laid in ground or on ladder type trays or drawn in conduit in a hot, humid and tropical atmosphere. The trays may be over head, suspended or run in concrete trenches with removable covers. The tenderer shall indicate clearly the de rating factor for the above conditions.			
5.11	The maximum conductor temperature for various classes and type of cables shall be limited to safe value as per applicable I.S. Cables shall be marked with ISI Certification Mark, if any.			
5.12	The material of PVC insulated copper conductor shall be made from high conductivity copper rods complying IS: 613-1964 and its amendments. The conductors shall consist of Stranded Electrolyte annealed bare Copper Confirming to Class-2 of IS:8130-1984 & its amendments			
5.13	Wire before stranding shall be approximately circular in cross-section. Smooth, uniform in quality and free from scale, spills and other defects.			

5.14	Cores shall be identified as per IS:1554(Part-I) for the cable up to 5C and cable with more than 5C, the identification of cores shall be by printing legible Hindu Arabic Numerals on all cores as per clause no .10.3 of IS:1554(Part-I) and its amendments.
5.15	The Normal Current rating of all PVC insulated cables shall be as per IS: 3961 and its amendments.
5.16	Cable shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.
5.17	The 1100V grade control cable shall be FRLS Type ST-2 Category C-2 conforming to IS: 1554(Part-I) and its amendments.
5.18	Progressive sequential embossing of the length of cable in metre at every one metre shall be provided on the outer sheath of all cable with marking “WBSEDCL”.
5.19	Repaired cables shall not be accepted.
5.20	ARMOURING
5.20	Armouring shall be applied over the insulation over the inner sheath for the multi core cables. The armouring shall be galvanized round steel wires and its nominal diameter shall conform to clause no. 13.3 of IS: 1554(Part-I) and its amendment.
5.30	Insulation:
	The Insulation of sheath shall consists of a compound based on Polyvinyl Chloride (PVC).
5.40	Outer Sheath :
	The Outer sheath shall be applied by extrusion. The Outer sheath shall be FRLS Type ST-2 Category C-2 conforming to IS: 5831 and its latest amenment.
5.41	Outer sheath shall be fire Retardant Low Smoke (FRLS) type, FRLS Type ST-2 Category C-2 to IS: 1554(Part-I) and its amendments.
5.42	Minimum thickness of PVC outer sheath ,standard colour and tolerance on thickness of armoured cables shall be as per clause no.14.4.2 of IS: 1554(Part-I) and its amendments.
5.43	The cable shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250deg. Centigrate with smoke density 40% and halogen density 20%.
5.44	All cables shall pass fire resistance /heat resistance test as per IS: 1554(Part-I).

5.50	INNER SHEATH : For multi core armoured cables,the inner sheath shall be extruded PVC. The filler and inner sheath for common covering shall be non-hygroscopic, fire retardant (FR) material and shall be softer than insulation. The thickness of inner sheath shall be as per clause no. 12.3 of IS: 1554 (Part-I) and its amendments and suitable for operating temperature of cables.

6.00	SPECIFIC DESIGN REQUIREMENTS :

6.10	1100 Volts Grade Heat Resisting (HR) Copper Cables suitable for use where the combination of ambient temperature and temperature rise due to load results in conductor temperature not exceeding 85 deg.C under normal continuous operation and 160 deg.C under short-circuit condition with stranded annealed copper conductor, HR PVC insulated, HR extruded PVC inner sheathed, round galvanized steel wire armoured (for multicore cable only) and overall sheath shall be FRLS Type ST-2 Category C-2 generally conform to latest revision of IS:1554 (Part-I) and its latest amendments. The cores shall be colour coded as per I.S. for easy identification.
6.11	CURRENT RATING :
	The Cables will have current rating derating factors for an ambient temperature of 45 deg.C and ground cable is required to be taken into consideration. The current ratings shall be based on the maximum temperature 85 deg.C for continuous operation at the rated current.

6.12	OPERATION :
	Cables shall be capable of satisfactory operation under Power Supply System frequency variation of ± 5% and voltage variation of ± 10%.
7.00	PACKING AND MARKING :
7.10	The Cables shall be wound on a drum (Ref. IS : 10418-1972 and its amendments) of suitable size and packed . The ends of cable shall be sealed by means of non-hygroscopic sealing material. The Cables shall be packed in non-returnable wooden drums. The wooden drums should be bearing distinguishing number with following information duly stenciled on the outer side of one flange.
	1. Name of the Manufacturer. 2. Reference Indian Standard of Cable. 3. Normal sectional area of the Conductor of the Cable. 4. Number of Cores. 5. Type of Cable & Voltage for which it is suitable. 6. Length of Cable in this drum. 7. Number of lengths on drum(if more than one) 8. Direction of rotation of Drum (by means of arrow). 9. Gross Weight. 10. Colour code (in case of single core cable). 11. Purchase Order No. & Date. 12. Year of Manufacture. 13. Property of WBSEDCL. 14. Date of Delivery.
8.00	DRUM AND DRUM LENGTH OF CABLES :
8.10	Drums shall be proofed against attack by white ant and termite, Conforming to IS -10418-1982. A layer of water proof paper shall be applied to the surface of drum and over the outer most cable layer.
8.11	The Cables shall be supplied in Drum lengths of 500 Mtr. which shall be subject to tolerance of not more than (+/-)5%.WBSEDCL HAVE THE OPTION OF REJECTING CABLES DRUMS WITH SHORTER LENGTH. However, the total quantity of cables after taking in to consideration of all cable drums of each size shall be within the tolerance of (+/-) 2%. The no. of drums and the drum length shall be finalized by the purchaser at time of placement of order.
8.12	Embossing on the outer sheath of the Cable with marking “WBSEDCL” and length of the Cable in meters at suitable intermittent distance , preferably 1 Mtr. should be done.
9.00	DRAWING DATA & MANUAL:
	The following information shall be furnished in triplicate along with the tenders :
	(a) Manufacturer’s leaflets giving construction details, dimensions and characteristics of different Cables.
	(b) Current rating of cables including derating factor due to grouping, ambient temperature and Type of various installations.
	(c) Write up sketch illustrating the manufacturer’s recommendation for spliting, jointing and termination of different type of cables.
	d) List of customers to whom the cable for similar rating have been supplied.
10.00	TESTS :
10.10	Routine Tests in accordance with the provision of relevant standard specification shall be carried out for each drum of finished cable lengths.
	Type tests and acceptance tests on the samples taken on random basis from the lot of cables offered for inspection shall have to be carried out as per relevant Indian Standard Specification to prove the general qualities and design of a given type of cable and for the purpose of acceptance of the lot.

10.11	TYPE TEST REPORTS for the type tests conducted in accordance with IS:1554 (Part-I) with latest amendment for similar type of Cables (as per Tender Specification) : Type Test Report for the type tests conducted in accordance with IS:1554 (Part-I) with latest amendment and other relevant IS/IEC with latest amendment within last 5 years from the due date of Opening of Tender on identical Cables having same voltage grade, same design, same conductor material & size (as per Tender Specification) from CPRI/ NABL accredited Test House or Laboratory are to be submitted along with the tender otherwise tender may be rejected. The Certificates of the NABL accredited Test House or Laboratory should bear the Logo of NABL accreditation.
10.12	WITNESSING OF TESTS :
	The tabulation for each test result shall contain corresponding I.S. specified limiting figures to facilitate checking of test Results. Six (6) copies of type tests certificate lot-wise for each type of cables should be sent to the purchaser for acceptance. Type Test Certificate for each lot and routine test certificate for each drum of cables shall be submitted to the Purchaser for approval before despatch of cables from the Works. The test certificates shall be completed with all results.
11.00	TECHNICAL GUARANTEED PARTICULARS :
11.10	Technical characteristics shall be guaranteed by the bidder. Technical guaranteed particulars shall be furnished in triplicate as per format annexed herewith along with other relevant particulars with the tenders. In case of failure of materials to meet the guarantee, WBSEDCL shall have right to reject the material.
12.00	List of testing equipment/instruments made available at the manufacturer's premises is to be submitted along with tender paper.

GUARANTEED TECHNICAL PARTICULARS FOR 1.1 KV COPPER CONTROL CABLE

Detailed GTP in tabular form as per spec.

NAME OF MANUFACTURER		M/s. ----------		
Cable Size:		4 Core 2.5 sq. mm.	8 Core 2.5 sq. mm.	12 Core 2.5 sq. mm.
1	Rated Voltage	1.1K V		
2	Standard Referred	IS: 1554 (Part-I)/1988 up to latest amendment		
3	Conductor			
	i) Material	Stranded Electrolyte annealed bare Copper Confirming to Class-2 of IS:8130-1984 & its amendments		
	ii) Nominal Area of Cross-section (sq. mm)	2.5		
	iii) Total no. of Conductor/ Core	7		
	iv) Shape of conductor	Circular		
4	Insulation			
	i) Material	HR PVC Type C as per IS: 5831-1984 & its amendments		
	ii) Nom. Thickness (mm)	As per IS: 1554 (Part-I) :1984 and its amendments		
	iii) Suitable by with regard to temperature, moisture, acid, oil and alkaline surrounding	Yes		
5	Inner sheath			
	i) Material	FR PVC Category C-1 PVC Type ST-2, as per IS:5831-1988 & its latest amendments		
	ii) Minimum thickness of sheath (mm)	0.30 mm		
6	Armouring			
	a) Material & Type	Galvanized Steel rounded Wire		
	b) Nom. dia of armour wires in mm	1.40	1.40	1.6
7	Outer sheath			
	i) Material	FRLS Black Type ST-2		
	ii) Minimum thickness of sheath (mm)	1.24	1.40	1.40
8	Approx. overall dia of cable(in mm)	16.00	20.00	22.50
9	Method of core identification	4C - Red, Yellow, Blue, Black 8C & 12C – All Grey with numbering		
10	Electrical Properties :-			
	i) Maximum D.C. resistance of conductor at 20° C (Ohm/Km)	7.41 as per IS:8130 (Part-I): 1984 to comply with FRLS property		
	ii) Maximum permissible conductor temperature(°C) under full load	85		
	iii) Rated voltage (KV)	1.1		
	iv) Maximum operating voltage	10% Higher than the Rated Voltage		
	v) Permissible voltage variation	±10%		
	vi) Rated frequency	50Hz		
	vii) Permitted frequency variation	±5%		
	viii) Minimum voltage resistivity at 27°C/ 85 °C (Ohm/Cm)	1×10^{13} /1×10^{1}° ohm.cm		

TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATION FOR 30 V, 100 AH STATIONARY BATTERIES

1(i). Scope : The specification covers the design, manufacture, testing at the Manufacturer's works, delivery by road transport to different sites of West Bengal State Electricity Distribution Company Limited of Lead Acid Battery set suitable for Auto and Manual Float cum Boost Battery Charger with 30 V DC Output. Supervision and erection/commissioning of devices shall have to be undertaken by mutual acceptance of terms and conditions for the same, if required.

APPLICATION:

The system requires a reliable and uninterrupted D.C. supply for supplying D.C. Power to emergency lights, closing and tripping coils of circuit breakers, relays, semaphores etc.

1(ii). Service conditions:

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Maximum ambient temperature (Degree C)	50
Maximum temperature in shade (Degree C)	45
Minimum Temperature (Degree C)	3
Relative Humidity (percent)	95
Maximum Annual rain fall (mm)	1450
Maximum wind pressure (kg/sq. m)	150
Maximum altitude above mean sea level (Meter)	1500
Isoceraunic level (days per year)	50
Seismic Level	The sites fall within seismic zone-III and IV as classified in the IS:1983
Moderately hot and humid tropical climate conductive to rust and fungus growth	

1(iii). Standards:

Unless otherwise specified, the equipment shall conform to latest applicable Indian standard of equivalent IEC, British or USA standard and in particular to the following standard (or equivalent IEC British, USA standard):

The tenderer shall clearly state the standard to which the equipment offered by him conforms.

IS: 1652/ 1991	**Specification for stationary lead acid Plante Cell battery**

TECHNICAL SPECIFICATION FOR LEAD ACID BATTERIES (30 V, 100 AH)

1.1 Low maintenance type of Lead Acid stationary Batteries incorporating of pure Lead Lamellar type with "Plante" formation positive plates assembled in 2 Volt containers with a capacity of 100 Ampere–hour at 10 hour rate of discharge to an end voltage of 1.85 V per Cell having Electrical performance as per IS: 1652/1991 or its latest version amended upto date.

1.2 The terminals of the battery shall be suitable for receiving cable lugs. 15 Nos. of 2 volts 100 AH Cell connected in series shall form one set of 30 volts 100 AH.

2.0 Application : The device shall be installed in indoor location within the battery Room of Substations to provide auxiliary DC Power Supply for following applications:

a) Emergency lighting
b) Circuit breaker/switchgear/protective relay operations
c) Equipment supervision indication

d) Audio visual annunciation

Under normal conditions, auxiliary DC Power Supply for continuous load will be met from Battery Charger and storage batteries should be kept under float or boost charging condition.

But in case of Circuit Breaker/Switchgear/Protective Relay operation and/or in the event of failure of incoming power supply to Battery Charger, required auxiliary DC Power supply shall be met from Storage Batteries.

3.0 STANDARD RATING: The standard ratings of batteries shall be 30 Volts DC, 100 AH at 27 Deg C. Duty cycle is to be mentioned.

4.0 Cell Voltage : The nominal voltage of a single cell shall not be less than 2 volts at the beginning of Charging.
The trickle charging voltage per cell shall be within 2.25 volts to 2.3 volts.
The boost charging voltage per cell shall be upto 2.75 volts.
At the end of the charging, cell shall be floated easily around 2.25 volts without causing adverse corrosion or loss of water.

5.0 Charging Current:

Trickle charging current shall be between 80 mA to 240 mA.

Boost charging current shall be within following limits:-

a) Starting Rate : 14 Amp

b) Finishing Rate : 7 Amp.

6.0 The expected life span of the batteries shall be minimum 10 years.

7.0 Constructional Feature:

7.1 Type: The storage batteries shall consist of 15 nos. Plante type Lead Acid Cells of Voltage not less than 2 volts per cell at the beginning of initial charging.

7.2 Main Components of each cell

7.2.1 Positive Plates

The positive plates of cell shall be constructed from pure lead consisting of laminations.

7.2.2 Negative Plates

The negative plates shall be pasted type consisting of sturdy lead alloy grid filled with active material.

7.2.3 Plate Connections

The plug of the plates of like polarity shall be connected to terminal post for external connections. Suitable plastic buffer, moulded bottom plate support shall be used for holding plates in proper position.

7.2.4 Separator

The separators shall be constructed from highly micro-porous and rigid material of appropriate shape. Separators shall be inert chemically and shall prevent internal short circuit and shall ensure minimum internal resistance.

7.2.5 Terminal Posts

The positive and negative terminal posts shall be clearly and indelibly marked for easy identification. The terminal posts shall be sealed properly with the lid by rubber grommets or other suitable device. The terminal posts shall have provision for inter-cell/outgoing cable connections.

7.2.6 Container

Transparent styrene acryl nitrile (SAN) container for each cell shall be made of sturdy construction having proven excellent clarity, outstanding chemical resistant property, rigidity with high insulating quality. The container shall provide permanent transparency to enable visual inspection of electrolyte level and internal condition of cell. Recommended electrolyte level shall be clearly and indelibly marked.

7.2.7 Cell Lid

Cell lid for covering cell container shall be made from high quality non-corrosive plastic materials and shall have provision for easy removal.

7.2.8 Vent Plug

A vent plug of suitable design shall be provided on each cell lid. The vent plug shall have a micro-porous plastic alloy/ceramic filter which will prevent escape of acid fume/spreading of acid fume but will allow free exit of oxygen and hydrogen generated in the process of charging.

7.2.9 Electrolyte

The electrolyte for the cell shall be battery grade sulphuric acid conforming to IS:266-1977 or its latest version amended upto date and diluted with distilled water to specific gravity 1.2 at 27 Deg C. The lead acid cell batteries shall be supplied in dry and uncharged condition. Diluted sulphuric acid of approved quality and required quantity shall be supplied in separate non-returnable porcelain or any other acid and corrosive proof jars. 10% extra electrolyte shall have to be supplied.

7.3 Other components of Battery

7.3.1 Cell pillars and connectors :

Cell Pillars and connectors shall be made from highly conductive material of lead allow having generous cross section ideally suited for high current duties.

Bolts, nuts, washers etc. for connecting the cells and connectors shall be coated with anti-corrosive highly conductive material.

7.3.2 Battery Stand

The stand for supporting battery cells shall be provided. The stand for battery cell shall be of Mild Steel finished with at least three coats of anti-sulphuric paints of approved shade. The racks shall be free standing type. Suitable porcelain/plastic insulators shall be provided between the stand and the battery room floor. Number

plate to designate each cell of battery shall be provided and shall be attached on the rack. Provision shall be made for clamping outgoing cable on the rack. The cell shall be supported on the rack in suitable row and tier formation with adequate clearance between adjacent cells.

7.3.3 Polarity Marking

The polarity marking of the terminals shall be marked for identification. The positive terminal may be identified by **"P"** or **(+)** sign or **red** colour mark and the negative terminal may be identified by **"N"** or **(-)** or **blue** colour. Terminal marking shall be permanent and non-deteriorating.

7.3.4 Life

The Bidder shall quote in his offer the guaranteed life of the battery when operating under the conditions specified in the specification.

7.3.5 Battery shall be transported in dry, uncharged condition. The electrolyte shall be supplied separately in non-returnable container of acid resistant material. Each battery set shall be supplied with operation / commissioning manual.

7.3.6 The following characteristics have to be satisfied by the batteries offered:

i) Loss of capacity on storage of a fully charged battery for 28 days shall not be more than 3%.

ii) Ampere hour efficiency shall not be less than 97 %.

iii) Distilled water addition once in 6 months should be sufficient to maintain the electrolyte level.

iv) The battery should withstand conditions of under-floating and over-floating.

v) The battery should be capable of being maintained at a higher Electrolyte specific gravity of 1.230 +/- 0.005 without deterioration to Grid corrosion.

vi) The Bidder should furnish sufficient evidence of his capability to

manufacture the low maintenance batteries.

7.3.7 Test on Battery:

All tests shall be carried as per the relevant standard. Test shall comprise of Routine tests and Acceptance Tests.

7.3.8 Routine Test :

These are to be performed at manufacture's works and shall include the following test:-

i) Verification of constructional requirement.
ii) Verification of marking.
iii) Verification of dimensions.
iv) Test for capacity.
v) Test for voltage during discharge.
vi) Ampere hour and watt – hour efficiency test.
vii) Test for loss of capacity on storage.
viii) Endurance test.

7.3.9 Acceptance Test:

These tests shall be performed in presence of purchaser's representative from the sample selected from the lot offered for supply.

i) Verification of constructional requirement.
ii) Verification of marking.
iii) Verification of dimensions.
iv) Test for capacity.
v) Test for voltage during discharge.
vi) Ampere hour and watt – hour efficiency test.

7.3.10 Important design criteria

Plate connectors and paste shall be designed to contribute maximum effective surface area, maximum electrical conductivity and superior voltage characteristics throughout service life. The plates shall be designed for maximum performance durability and shall not buckle during different service condition i.e. high rate of discharge and rapid

fluctuation of load. The container should have provision to avoid short-circuit of plates due to deposition at the bottom.

7.3.11 Accessories

Following accessories in addition to battery shall have to be supplied in each set of equipment:

Sl. No.	**Item Description**	**Qty**
01	Syringe type Hydrometer set complete in all respect and capable of indicating specific gravity reading in steps of 0.005 for Plante type Lead Acid Cell Battery	1 no.
02	Cell Testing Voltmeter (Range: 3-0-3 volts having scale conforming to IS)/ Digital Multimeter	1 no.
03	Mercury Glass Thermometer Range: 0-100 Deg C having suitable scale representing 1Deg C temperature rise.	1 no.
04	Wall mounting Plastic holder for holding 1 no. Hydrometer and 1 no. Thermometer.	1 no.
05	Plastic syringe: 10 Oz(ounce)	1 set
06	Plastic Funnel : 150 mm dia.	1 no.
07	Acid resistant plastic Jug: 2 ltrs. Capacity	1 no.
08	Rubber Siphon: 12.7 mm dia 2 mtr long	1 no.
09	Rubber apron	2 nos.
10	Rubber gloves	2 Pairs
11	Rubber boots: Knee height	2 Pairs
12	Special tools	AS required
13	Battery Stand of Mild Steel	1 no.
14	Inter battery connector of lead plated copper of cross section not less than 50 sq. mm.	14 Nos. +2 extra
15	Lead plated set containing 2 nuts,1 bolt and 2 washers	30 sets+4 extra
16	Sulphuric Acid (10% extra) of 1.190 Specific Gravity at 27°C sufficient for first filling of the Battery	1 Lot

8.0 Testing Facilities :

The Bidder must clearly indicate what testing facilities are available in the works of manufacturer and whether the facilities are adequate to carry out all Routine, Acceptance Tests. These facilities should be available to WBSEDCL's Engineers, if deputed to carry out or witness the tests in the manufacturer's works. If any of the tests can not be carried out in the manufacturer's works, Bidder shall have to arrange for such testing at any NABL Accredited/Govt. Test house or Laboratory at his own cost.

9.0 Inspection :

All tests and inspection shall be made at the place of manufacturer unless otherwise specially agreed upon by the manufacturer and the WBSEDCL. The manufacturer shall provide the WBSEDCL all reasonable facilities, without charge to satisfy him that the material is being supplied in accordance with this specification.

10.0 Tests:-

General: The equipment including all components and accessories shall be subjected to all type of tests including Routine and acceptance tests in accordance with provision contained in relevant standard.

10.1 Type Test: The Bidder shall have to submit along with their Tender documents , as pre-requisites, the complete type Test Reports as stipulated in the relevant IS/IEC, carried out within 5 years from the due date of Tender, from CPRI/NABL accredited/Govt. recognised Test House or Laboratory on the offered Item, failing which their offer may not be technically acceptable.

10.2 Routine and acceptance Tests: Routine &acceptance tests shall have to be carried out in compliance with provision contained in the relevant standard and / or to ascertain satisfactory performance of the offered device at the works of the Manufacturer.

The acceptance tests shall have to be conducted in the presence of authorised representative of the purchaser before effecting delivery.