

TB 369 618 003 (T L)PKG1Rev.  
No: 00

## **SECTION -2**

### **Typical Customer technical specification for Reference**



| CLAUSE NO.                                          |  | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |  |  |
|-----------------------------------------------------|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------|--|
| 11.00.00                                            |  | 220kV TRANSMISSION LINES - GENERAL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                                                                                     |  |
| 11.01.00                                            |  | SCOPE AND GENERAL INFORMATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |                                                                                     |  |
|                                                     |  | In addition to the project information and scope of work given in this specification, the following is the scope of work for overhead Transmission line work:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |                                                                                     |  |
| 11.01.01                                            |  | This specification covers detailed survey, tower spotting, optimization of tower location, soil resistivity measurements and geo-technical investigation, tower design, fabrication and supply of all types of transmission line towers including tower which are already designed and tested for equal or higher loads as specified in this specification, bolts, nuts and washers, hanger, D-shackle and all type of tower accessories like phase plate, number plate, danger plate, anti-climbing device, etc.; foundation design, selecting type of foundation for different towers and casting of foundation for towers and erection of towers, tack welding of bolts and nuts along with subsequent application of zinc coating on the welded portion, supply and application of zinc rich paint, tower earthing, fixing of insulator string, stringing of conductors, OPGW/earth wires along with all necessary line accessories and testing and commissioning of the erected transmission lines. |  |                                                                                     |  |
| 11.01.02                                            |  | Further for type tested towers bidder shall furnish design calculation for transmission line tower structures along with foundation design and drawing meeting the requirements of this technical specification.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                                                                                     |  |
| 11.01.03                                            |  | This specification includes the design and supply of insulator and their hardware conductor and earthwire, earthwire suspension and tension clamps and all the other line accessories to be incorporated in the towers during erection and stringing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                                                                                     |  |
| 11.01.04                                            |  | All the raw materials such as steel, zinc for galvanising, reinforcement steel and cement for foundation, coke and salt for earthing, bird guards, anti climbing devices, bolts, nuts, washers, D-shackles, hangers, links, danger plates, phase plate, number plate etc. required for tower manufacture and erection shall be included in the scope of supply.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |                                                                                     |  |
| 11.01.05                                            |  | The entire stringing work of conductor and earthwire shall be carried out as per standard stringing practice.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |                                                                                     |  |
| 11.01.06                                            |  | The Contractor shall carry out the detailed survey and shall submit report/results within one (1) month of date of mobilization at site. No other details except those included in tender documents shall be furnished by the Owner. Also no topographical maps shall be furnished by Owner. However, Owner's assistance may be given in obtaining these maps from Survey of India.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                                                                                     |  |
| 11.01.07                                            |  | The tree-cutting shall be responsibility of the Contractor. The Contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut. Contractor may note that Owner shall not pay any compensation for any loss or damage to the properties or for tree cutting due to Contractor's work.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                                                                     |  |
| 11.02.00                                            |  | ROUTE AND TERRAIN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                                     |  |
| 11.02.01                                            |  | The 220kv Double Circuit Transmission Line shall be connecting 220KV North Karanpura Switchyard and 220 KV Chatti Bariatu & Kerandari-A Coal Mine substation. The latitude and Longitude of the Chatti Bariatu & Kerandari-A Coal Mine substation are indicated in clause 1.15.00 fo subsection IIB Section – VI Part-A. The Bidder may carryout preliminary / detailed survey of the corridor so as to acquaint himself to the transmission line route, crossings, ground profile and levels.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                                                                                     |  |
| NORTH KARANPURA STPP<br>(3 X 660 MW)<br>EPC PACKAGE |  | TECHNICAL SPECIFICATIONS<br>SECTION VI, PART-B<br>BID DOC. NO.:CS-4410-001-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | SUB SECTION B-14<br>SWITCHYARD                                                      |  |
|                                                     |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | Page<br>59 of 102                                                                   |  |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------|--------------------------------|-------------------|
| 11.02.02                                                                                                                                                                                                                                         | Right of way and way leave clearance shall be arranged by the Owner.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                     |                                                                              |                                |                   |
| 11.02.03                                                                                                                                                                                                                                         | <p>To evaluate and tabulate the trees and bushes coming within 13.5 meters on either side of the central line alignment, the trees will be numbered and marked with quality paint serially from angle point 1 onwards and the corresponding number will be painted on the stem of trees at a height of one meter from ground level. The trees list should contain the following:</p> <p>a) Girth (circumference) measured at a height of 1 meter from ground level.</p> <p>b) Approximate height of the tree with an accuracy of + 2 meters.</p> <p>c) Name of the type of the species/tree.</p> <p>d) The bushy and under growth encountered in the 1.5 meters belt should also be evaluated with its type, height, girth and area in square meters, clearly indicating the growth in the tree/bush statement.</p>                                                             |                                                     |                                                                              |                                |                   |
| 11.02.04                                                                                                                                                                                                                                         | Payment of compensation towards the clearances, etc. will be the responsibility of the Owner.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                     |                                                                              |                                |                   |
| 11.03.00                                                                                                                                                                                                                                         | <b>DETAILED SURVEY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                     |                                                                              |                                |                   |
| 11.03.01                                                                                                                                                                                                                                         | The detailed survey shall be carried out along the Transmission Line alignment by successful bidder/contractor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                     |                                                                              |                                |                   |
| 11.3.2                                                                                                                                                                                                                                           | <b>Route Marking</b> <p>At the starting point of the commencement of route survey, an angle iron spike of 65 x 65 x 6 mm section and 1000 mm long shall be driven firmly into the ground to project only 150 mm above the ground level. A punch mark on the top section of the angle iron shall be made to indicate location of the survey instrument. Teak wood peg 50 x 50 x 650 mm size shall be driven at prominent position at intervals of not more than 750 meter along the transmission line to be surveyed upto the next angle point. Nails of 100 mm length should be fixed on the top of these pegs to show the location of instrument. The pegs shall be driven firmly into the ground to project 100 mm only above ground level. At angle position stone/concrete pillar with "NTPC" marked on them shall be put firmly on the ground for easy identification.</p> |                                                     |                                                                              |                                |                   |
| 11.03.03                                                                                                                                                                                                                                         | <b>Profile Plotting &amp; Tower Spotting</b> <p>From the field book entries the route plan with route details and level profile shall be plotted and prepared as per approved procedure. Reference levels at every 20 meters along the profile are also to be indicated on the profile besides R/Ls at undulations. Areas along the profile, which in the view of the Contractor are not suitable for tower spotting, shall also be clearly marked on the profile plots. If the difference in levels is too high, the chart may be broken up according to requirement. A 10mm overlap shall be shown on each following sheet. The chart shall progress from left to right. Sheet shall be in accordance with the IS Standard. For 'as built' profile these shall be A1 size</p>                                                                                                 |                                                     |                                                                              |                                |                   |
| 11.03.04                                                                                                                                                                                                                                         | <b>Sag Template</b> <p>Necessary data in respect of conductor, earthwire and insulator have been given in the specifications. On the basis of these, the Contractor shall prepare the sag template drawing and tower spotting data and submit the same alongwith sag tension calculations for the approval of the Owner. Sag template prepared based on the approved sag-template curve drawing shall only be used for tower spotting on the profiles. Two numbers of the approved template, prepared on rigid transparent plastic sheets, shall be provided by the Contractor to</p>                                                                                                                                                                                                                                                                                           |                                                     |                                                                              |                                |                   |
| <table><tr><td>NORTH KARANPURA STPP<br/>(3 X 660 MW)<br/>EPC PACKAGE</td><td>TECHNICAL SPECIFICATIONS<br/>SECTION VI, PART-B<br/>BID DOC. NO.:CS-4410-001-2</td><td>SUB SECTION B-14<br/>SWITCHYARD</td><td>Page<br/>60 of 102</td></tr></table> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | NORTH KARANPURA STPP<br>(3 X 660 MW)<br>EPC PACKAGE | TECHNICAL SPECIFICATIONS<br>SECTION VI, PART-B<br>BID DOC. NO.:CS-4410-001-2 | SUB SECTION B-14<br>SWITCHYARD | Page<br>60 of 102 |
| NORTH KARANPURA STPP<br>(3 X 660 MW)<br>EPC PACKAGE                                                                                                                                                                                              | TECHNICAL SPECIFICATIONS<br>SECTION VI, PART-B<br>BID DOC. NO.:CS-4410-001-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | SUB SECTION B-14<br>SWITCHYARD                      | Page<br>60 of 102                                                            |                                |                   |

**11.03.05**

**Tower Spotting**

the Owner for the purpose of checking the tower spotting. The templates shall be on the same scale as that of the profile.

With the help of approved sag template and tower spotting data, tower locations shall be marked on the profiles. While locating the towers on the profile sheet, the following shall be borne in mind:

a) Span

The number of consecutive spans between the section points shall not exceed 15 spans. Section point shall comprise of tension point with B type, C type or D Type towers as applicable. For all crossing spans such as major road crossings, railway crossings, power line crossings etc. the span shall not exceed 80% of design span.

b) Extension

An individual span shall be as near to the normal design span as far as possible. In case an individual span becomes too short with normal supports on account of undulations in ground profile, one or both the supports of the span may be extended by inserting standard body extension designed for the purpose according to technical specification.

c) Road Crossing

At all important road crossings, the towers shall be fitted with double tension insulator strings depending on the type of towers but the ground clearance at the roads under maximum temperature and in still air shall be such that even with conductor broken in adjacent span, ground clearance of the conductor from the road surfaces shall be in line with IE rules. At all national highway crossings, tensions towers shall be used.

d) Railways Crossings

At the time of detail survey all the railway crossings coming enroute the transmission line shall be finalised as per the regulation laid down by the Railway Authorities. The following are the important features of the prevailing regulations (revised in 1987):

- i) The crossing shall be supported on D type tower on either side of railway line with double tension insulator strings.
- ii) The crossing shall normally be at right angle to the railway track.
- iii) The crossing span shall be limited to 80% of design span.
- iv) The minimum distance of the crossing tower shall be at least equal to the height of the tower plus 6 meters away measured from the centre of the nearest railway track.:
- v) No crossing shall be located over a booster transformer, traction switching station, traction sub-station or a track cabin location in an electrified area.
- vi) Minimum ground clearance above rail level of the lowest portion of any conductor under condition of maximum sag shall be maintained as per IE rules.

The approval for crossing railway track shall be obtained by the Owner from the Railway Authority. However, six copies of profile and plan, tower and foundation design and

| CLAUSE NO.                                          | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                                                     | <p>drawings, required for the approval from the Railway Authority shall supplied by the Contractor to the Owner.</p> <p>e) River Crossings</p> <p>In case of major river crossing, towers shall be of suspension type and the anchor towers on either side of the main river crossing shall be C type tower. Clearance required by navigation authority shall be provided. For non navigable river, clearance shall be reckoned with respect to highest flood level (HFL).</p> <p>f) Power Line Crossing</p> <p>Where this line is to cross over another line of the same voltage or lower voltage, towers with suitable extension shall be used. Provisions to prevent the possibility of its coming into contact with other overhead lines shall be made in accordance with the Indian Electricity Rules, 1956. The Contractor may be required to under-cross higher voltage lines by erecting gantries/suitable Rail Pole structures.</p> <p>g) Telecommunication Line Crossing</p> <p>The angle of crossing shall be as near 90 degree as possible. However, deviation to the extent of 30 degree may be permitted under exceptionally difficult situations. When the angle of crossing has to be below 60 degree, the matter will be referred to the authority incharge of the telecommunication system. On a request from the Contractor, the permission of the telecommunication authority may be obtained by the Owner. Also, in the crossing span power line support will be as near the telecommunication line as possible, to obtain increased vertical clearance between the wires.</p> <p>h) Details Enroute</p> <p>All topographical details, permanent features, such as trees, building etc. 13.5m on either side of the alignment shall be detailed on the profile plan.</p> <p>Ash Pipe Line (If applicable)</p> <p>Adequate clearances shall be maintained from ash pipe line and adjacent road.</p> <p>i) <b>Clearance from Ground, Building, Trees, etc.</b></p> <p>Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the Indian Electricity Rules, 1956 as amended upto date.</p> |                                                                                     |
| 11.04.00                                            | <b>PRELIMINARY LINE SCHEDULE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                     |
|                                                     | <p>The profile sheets, duly spotted, alongwith preliminary schedules indicating type of towers, wind span, weight span, angle of deviation, river, power line, railway or road crossing and other details shall be submitted for the approval of the Owner. After approval, the Contractor shall submit six more sets of the approved reports along with two sets in soft copy of final profile drawings to the Owner for record purpose.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                     |
| 11.05.00                                            | <b>CHECK SURVEY OF TOWER LOCATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |
| 11.05.01                                            | <p>The detailed survey shall be conducted to locate and peg mark the tower positions on ground conforming to the approved profile and tower schedule. In the process, it is necessary to have the pit centers marked according to the excavation marking charts. The levels, up or</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |
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# TECHNICAL REQUIREMENTS



down of each pit center with respect to the center of the tower locations shall be noted and recorded for determining the amount of earthwork required to meet the approved design parameters.

11.05.02

Changes, if required, after detailed survey in the preliminary tower schedule shall be carried out by the Contractor and he shall thereafter submit a final tower schedule for the approval of Owner. The tower schedule shall show position of all towers, type of towers, span length, type of foundation for each tower and the deviation at all angles as set out with other details.

11.06.00

## ELECTRICAL SYSTEM DATA

- |                                            |              |
|--------------------------------------------|--------------|
| a) Nominal voltage                         | 220 kV       |
| b) Maximum system voltage                  | 245 kV       |
| c) BIL (Impulse)                           | 1050kVp      |
| d) Power frequency withstand voltage (wet) | 460 kV (rms) |

11.07.00

## LIST OF STANDARDS (LATEST EDITION OF STANDARDS SHALL BE FOLLOWED)

Unless specified otherwise analysis & design of various components and systems of transmission line shall be in accordance with latest editions, latest amendments, of the relevant Indian & other international standards.(except for those references where the year of publication is specifically mentioned)

### Indian Standards    Title

### International & Internationally recognised standards

- |    |                        |                                                                                         |                                              |
|----|------------------------|-----------------------------------------------------------------------------------------|----------------------------------------------|
| 1. | IS:209                 | Specification for Zinc                                                                  | ISO/R/752-1968<br>AST, B6                    |
| 2. | IS:2062                | Structural Steel (Standard Quality)                                                     | ISO/R/6F30-1967<br>CAN/CSA G40.21<br>BS 4360 |
| 3. | IS:269                 | Ordinary rapid hardening & low heat Portland Cement.                                    | ISO/R/597-1967                               |
| 4. | IS:278                 | Specification for barbed wire                                                           | ASTM A 121                                   |
| 5. | IS:383                 | Coarse and fine aggregates from natural sources for concrete.                           | CSA A 23.1/A 23.2                            |
| 6. | IS:398                 | Alum. Condr. galvanised steel reinforced                                                |                                              |
| 7. | IS:406                 | Methods of Chemical Analysis of Slab Zinc                                               |                                              |
| 8. | IS:432<br>(Part 1 & 2) | Mild steel and medium tensile bars and hard drawn steel wire for concrete reinforcement | CSA-G-30                                     |
| 9. | IS:456-1978            | Code of practice for plan and reinforced concrete                                       |                                              |

TOWER-A, III FLOOR, ADVANTAGE BUSINESS PARK



TOWER-A, III FLOOR, ADVANTAGE BUSINESS PARK

## TECHNICAL REQUIREMENTS

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|                                                                                                                                                                                                                                                  | <p>The foundation shall be designed for the actual soil parameters based on the soil investigation carried out by the bidder and approved by the owner. For design purposes:</p> <p>(a) The angle of repose shall be considered as two-third (2/3) of the value as obtained from the soil investigation</p> <p>(b) Water table shall be considered up to the ground level.</p> <p>(c) The weight of soil shall be considered as 1440 Kg/m<sup>3</sup> under dry condition and 940 Kg/m<sup>3</sup> under wet condition.</p> <p>Well foundation or pile foundation shall be provided by the bidder wherever necessitated.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                     |                                                                              |                                |                   |
| 13.02.00                                                                                                                                                                                                                                         | <b>SOIL INVESTIGATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                     |                                                                              |                                |                   |
| 13.02.01                                                                                                                                                                                                                                         | The Contractor is required to carry out detailed soil investigation at various tower locations along the corridor, one borehole at centre of the tower, angle points, crossings, etc. and also where soil strata is different from the other locations investigated. In addition the soil investigation may be required to be carried at other locations at the discretion of the Engineer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                     |                                                                              |                                |                   |
| 13.02.02                                                                                                                                                                                                                                         | The investigation comprises of field and laboratory testing. Field investigation includes boreholes, Standard Penetration Test (SPT), Static Cone Penetration Test (SCPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), collection of water samples, etc. Laboratory tests shall include, Physical, chemical and engineering properties of soil/rock.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                     |                                                                              |                                |                   |
| 13.02.03                                                                                                                                                                                                                                         | This specification covers technical requirements for geotechnical investigation and preparation of a detailed geotechnical report. It shall include mobilization of necessary equipment, providing necessary engineering supervision and technical personnel, carrying out field investigation and tests, laboratory tests, analysis and interpretation of data and results, collecting data regarding change of course of rivers from local sources, velocity, scour, etc., giving flood details of the area (past history), safe bearing capacity for different sizes of foundations, different founding strata for the various locations along the transmission lines and preparation of geotechnical report.                                                                                                                                                                                                                                                                                                                                                           |                                                     |                                                                              |                                |                   |
| 13.02.04                                                                                                                                                                                                                                         | <p>The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. Depth of bore holes at river/bridge crossings shall be 40m, at angle points depth shall be 15.0m and at the centre of tower along the corridor depth of BH shall be 10.0m. Boring shall be terminated at the above specified depth or 3.0m continuous in rock with RQD&gt;25% for river crossings and for balance areas 3.0m in refusal whichever is earlier. Refusal means SPT 'N' value greater than 100.</p> <p>SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. At refusal penetration shall be measured and the same shall be reported in Borelog. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50. The diameter of UDS sampler shall be 100 mm minimum.</p> |                                                     |                                                                              |                                |                   |
| 13.02.05                                                                                                                                                                                                                                         | Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                     |                                                                              |                                |                   |
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| NORTH KARANPURA STPP<br>(3 X 660 MW)<br>EPC PACKAGE                                                                                                                                                                                              | TECHNICAL SPECIFICATIONS<br>SECTION VI, PART-B<br>BID DOC. NO.:CS-4410-001-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | SUB SECTION B-14<br>SWITCHYARD                      | Page<br>81 of 102                                                            |                                |                   |

CLAUSE NO.

# TECHNICAL REQUIREMENTS



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## a) Laboratory Tests on Soil Samples

Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement/ steel.

## b) Laboratory Tests on Rock Samples

Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.

13.02.06 The laboratory tests shall be carried out progressively during the field work after sufficient numbers of samples have reached the laboratory in order that the test results of the initial boreholes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests. All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel and the tests shall be carried out as per the procedures laid out in the latest editions of the relevant IS codes. Soil shall be classified as per the provisions of Indian standards.

13.02.07 On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc.

13.02.08 The Geotechnical report shall include, but not limited to the following:

- a) Borelogs: A true cross section of all individual boreholes with reduced levels and coordinates, showing the classification and thickness of individual stratum, position of ground water table, details of various in-situ tests conducted and samples collected at different depths and the rock stratum, wherever met with.
- b) Results of all laboratory tests summarized for each Borehole along with a consolidated table giving the layer wise soil and rock properties. All the relevant charts, tables, graphs, figures, supporting calculations, conditions and photographs of representative rock cores shall be furnished.
- c) Recommendations : The report should contain specific recommendations on type of foundations to be adopted for various structures, duly considering the sub soil characteristics, water table, total/ differential settlement permissible for structures and equipments, minimum depth and width of foundation. The observation/recommendations shall include but not limited to the following:
  - i) Geological information of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc.

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- ii) Net safe allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlements characteristics of soil with supporting calculations for the recommendations.
- iii) Based on the chemical nature of soil and ground water and exposure condition, recommendations for protective measures on concrete and steel shall be mentioned.
- iv) If expansive soil is met with, recommendation and removal or retainment of the same under structures/ roads etc. shall be given. In the later case detailed specification of any special treatment required including specifications for materials to be used, construction method, equipments to be deployed, etc. shall be furnished.
- iv) Additional investigation other then specified above, if any, the same shall be carried out by the bidder at no extra cost to owner.

**13.02.09 Indian Standard References**

- IS:1498 Classification and Identification of Soils for general Engineering Purposes.
- IS:1892 Code of practice for Subsurface Investigation for Foundation.
- IS:1904 Code of practice for design and construction of foundations in Soils: General Requirements.
- IS:2131 Method of Standard Penetration Test for Soils.
- IS:2132 Code of practice for Thin walled Tube Sampling of Soils.
- IS:2470 Code of practice for design and construction of Septic (Part-I) Tanks.
- IS:2720 Method of Test for Soils (Relevant Parts).
- IS:5313 Guide for Core Drilling Observations.
- IS:4968 Method for subsurface Sounding for Soils - Dynamic (Part-II) method using Cone and Bentonite slurry.
- IS:4968 Method for subsurface Sounding for Soils- Static Cone (Part-III) Penetration Test.

**13.03.00 LOADS ON FOUNDATIONS**

- 13.03.01 The foundations shall be designed to withstand the specific loads of the superstructure and for the full footings reactions obtained from the structural stress analysis in conformity with the relevant over load factors. The over load factor for foundation design shall be 1.10 for all loads except dead loads.
- 13.03.02 The reactions on the footings shall be composed of the following type of loads for which these shall be required to be checked:
  - a) Max. tension or uplift along the leg slope.
  - b) Max. compression or down-thrust along the leg slope.
  - c) Max. horizontal shear or side thrust.
- 13.03.03 The base slab of the foundation shall be designed for additional moments developing due to eccentricity of the loads.
- 13.03.04 The additional weight of concrete in the footing below ground level over the earth weight and the full weight of concrete above the ground level in the footing and embedded steel parts will also be taken into account adding to the down thrust.