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SECTION-1

SECTION -1

1.0.0 INTRODUCTION

- 1.1.0 The intent of this specification is to specify all details required by a Transmission Line Survey and Geo-Technical Investigation for:
- 1.1.1 Conducting transmission line route survey, tower spotting/optimization of tower location, soil resistivity measurements and geotechnical investigation, required for construction of 220kV transmission line project being executed by BHEL on turnkey basis for NTPC.
- 1.1.2 Quoting his most competitive rate for items indicated in Annexure I of this specification.

2.0.0 SCOPE

- 2.1.0 The detailed scope of work shall be as per following:
- 2.1.1 Carrying out preliminary/walkover survey using GPS and Topo sheets for three alternative routes, suggesting best optimum route, identifying /fixing points for crossings such as river, railway, power line, telecom, road forest, fixing of angle points & submission of preliminary survey report, profile plotting, sag template preparation, tower spotting, preliminary schedules & other details preparation.
- 2.1.2 Detailed survey including modification in preliminary route alignment, adjustment in section details to achieve better average span, profiling, collecting actual field data along the selected route (enumeration of salient land features like crossing of rivers, nalla, road, railway lines, other transmission / distribution line, nearby habitations, forest land, proximity to airport, etc.), tower spotting & providing tower schedule with detailed land schedule (Plot No/Khata No, etc) for each tower location, estimation of tower quantities with extension and special tower requirement, sag template, marking on Khasra map and topographical map, tree enumeration, etc. & submission of detailed survey report.
- 2.1.3 Conducting detailed soil investigation at various tower locations and at other locations as necessary including 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), preparations for the type of foundations and the safe bearing capacity for different sizes of foundations, different founding strata for the various locations along the transmission lines.
- 2.1.4 Performing soil resistivity measurements as per customer specification
- 2.1.5 - Deleted -
- 2.1.6 Getting all the works mentioned above approved by BHEL/Customer.
- 2.1.7 Visit to Site/BHEL's/Customer's office/Supplier's Works as required for completion of work.
 - The Transmission Line Consultant shall depute his engineer(s) to Site or BHEL's/Customer's office for any clarification etc. as required by BHEL/Customer.
 - He shall also depute his engineer(s) to site for check surveys also.

3.0.0 SPECIFIC TECHNICAL REQUIREMENTS

- 3.1.0 The specific technical requirements shall be as per project specific input provided by BHEL from time to time after award of work.

3.2.0 The Transmission Line Consultant shall interact closely with BHEL engineering group for any input/clarification and finalize details across the table. There may be certain cases when on account of revision or change of inputs certain design/ drawing may be required to be redone. ***No claim on account of this shall be entertained.*** Only suitable time extension shall be granted on account of above.

3.3.0 The bidder / representatives of bidder may be required to make several visits to site / BHEL office / customer's office depending upon the project requirements. ***No extra claim on account of these visits shall be entertained.***

4.0.0 SCHEDULE/BOQ OF ITEMS

4.1.0 The Schedule/BOQ of Items shall be as per Annexure I. The Transmission Line Consultant is required to quote his most competitive rate for these items.

5.0.0 DOCUMENTATION

5.1.0 All design documents including computer outputs shall be neatly typed, produced on A4 size paper and shall have a 'Cover Sheet' (To be provided later).

5.1.2 All drawings shall be prepared in Autocad as per standard sizes (viz. A0, A1, A2, A3 & A4) and shall have a 'Title Block' (To be provided later).

5.1.3 The number of copies of design documents & drawings required to be submitted shall be as follows:

- | | |
|--|----------|
| <i>A. At each stage of approval.</i> | |
| i) Reports/Design Documents | 04 sets. |
| ii) Drawings | 04 sets. |
| <i>B. After Final approval.</i> | |
| i) Reports/Design Documents | 04 sets. |
| ii) Drawings | 04 sets. |
| iii) CDs (containing reports, design & drawings) | 01 set. |

6.0.0 COMPLETION SCHEDULE:

The work under this scope of work must be completed within 3 months after placement of order except check survey.

The check survey shall be done along with civil construction agency after finalization of civil construction agency by BHEL and intimation by Site in charge. Check survey should be completed within one month.


7.0.0 PAYMENT SCHEDULE:

<u>S.No.</u>	<u>Condition</u>	<u>Payment</u>
1	After conducting survey/ investigation work, report preparation, submission and approval of reports/ documents/ drawings i) Cat 2 i.e approved with comments) ii) Cat 1 i.e approved	80% 10%
2	After completion of activities under scope of works including check survey and approval of all drawings/documents in Cat-1, submission of all drg/documents in required no. of sets.	Balance 10%


SECTION-2


(N.A.)


SECTION-3

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 to 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 (3 X 660 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-4410-001-2	SUB SECTION B-14 SWITCHYARD Page 59 of 102


CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
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. b) Approximate height of the tree with an accuracy of + 2 meters. c) Name of the type of the species/tree. 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	DETAILED SURVEY		
11.03.01	The detailed survey shall be carried out along the Transmission Line alignment by successful bidder/contractor.		
11.3.2	Route Marking <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	Profile Plotting & Tower Spotting <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	Sag Template <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>		
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11.03.05	the Owner for the purpose of checking the tower spotting. The templates shall be on the same scale as that of the profile.			
	Tower Spotting 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, tension 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			
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	<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) Clearance from Ground, Building, Trees, etc.</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	<p>PRELIMINARY LINE SCHEDULE</p> <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	<p>CHECK SURVEY OF TOWER LOCATIONS</p>	
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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	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)			
	<u>Indian Standards</u>	<u>Title</u>	<u>International & Internationally recognised standards</u>	
1.	IS:209	Specification for Zinc	ISO/R/752-1968 AST, B6	
2.	IS:2062	Structural Steel (Standard Quality)	ISO/R/6F30-1967 CAN/CSA G40.21 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 (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		
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10.	IS:731-1971	Porcelain Insulators for Overhead lines with a Nominal Voltage greater than 1000 volts	BS:137-1973 (I & II) Power IEC:274-1968 IEC:383-1976	
11.	IS:800-1984	Code of practice for use of structural in general Building construction	CSA STEAM 16.1 steel	
12.	IS:802	Code of practice for use of structural steel in overhead transmission Line. (Load, Permissible stresses. Fabrication, Galvanising, Inspection, and Packing and Testing)	IEC 826 ASCE 52 BS 8100	
13.	IS:1139-1966	Hot rolled mild steel medium tensile steel and high yield strength deformed Bars for concrete reinforcement	CAN / CSA G 30 18	
14.	IS:1367-1967	Technical supply conditions for threaded fasteners		
15.	IS:1489-1991	Portland Pozzolana Cement	ISO/863-1968	
16.	IS:1521-1972	Method of Tensile Testing of Steel wire		
17.	IS:1573-1976	Electroplated Coating of Zinc on Iron & Steel		
18.	IS:1778-1980	Reels and Drums of Barewire		
19.	IS:1786-1985	High strength deformed steel bars and wires for concrete reinforcement		
20.	IS:1893-1984	Criteria of Earthquake resistant design of structures.	IEEE 693	
21.	IS:2016-1967	Plain Washers	ISO/R/887-1968 ANSI B 18.22.1	
22.	IS:2070- 1962	Method of impulse voltage testing		
23.	IS:2071	Method of high voltage testing		
24.	IS:2121-1981 Part-I Part-II	Specification for conductors and earthwire Accessories for Overhead Power Lines Armour Rods Mid-span joints & repair sleeves for conductors		
25.	IS:2131-1967	Method of Standard penetration test for soils.	ASTM D 1883	
26.	IS:2551-1982	Danger Notice Plates		
27.	IS:2486	Specification for Insulator Fittings for		
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		overhead Power Lines with a nominal voltage greater than 1000 volts Part- I General Requirements and Tests Part-II Dimensional Requirements Part-III Locking Devices	BS:3288-1972 IEC:120-1960 IEC:372-1976	
28.	IS:2629-1985	Recommended practice for hot dip galvanising of iron & steel.	ASTM A 123 CAN/CSA G 164	
29.	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	ASTM A 123 CAN/CSA G 164	
30.	IS:3043-1987	Code of Practice for earthing (with amendment No. 1 & 2).		
31.	IS:3063-1994	Single Coil Rectangular Section spring washers for bolts, nuts, screws.	DIN - 127-1970	
32.	IS:3138-1966	Hexagonal bolts and nuts	ISO/R 947 and ISO/R 272	
33.	IS:3188-1980	Characteristics of string insulator units	IEC:305-1906	
34.	IS:4091-1979	Code of practice for design and construction of foundation for transmission line tower and poles.	ASCE / IEEE 691	
35.	IS:4218-1976	Metric Screw Threads.	ISO:68-1969 R-26-1963, R-262-1969 R-965-1965	
36.	IS:4826-1979	Galvanised coatings on round steel wire	BS:443-1969	
37.	IS:5300-1980	Porcelain Guy strain insulators		
38.	IS:5358-1969	Hot dip galvanised coatings on fasteners	ASTM A 153 CAN/CSA G 164	
39.	IS:5613 (Part-II) 1985	Code of practice for Design, installation & maintenance of overhead power lines		
40.	IS:6610-1972	Specification for heavy washers for steel structures.		
41.	IS:6639 -1972	Hexagonal bolts for structure	ASTM A 394 CSA B 33.4	
42.	IS:6745-1972	Methods for determination of weight of Zinc coated iron and steel articles	ASTM A 90	
43	Pub. No. 19 (N)/ 700-1963	Regulation for Electrical Crossing of Railway Tracks.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	C	5 to 30 degree.	a) Angle tower with tension insulator string b) Tension tower for uplift forces resulting from an uplift span upto half of ruling span under broken wire condition c) Also to be designed for unbalanced tension resulting from unequal ruling span as specified in table T1-2.
	D	30 deg. To 60 deg.	a) Angle tower with tension insulator string. b) Tension tower for uplift forces resulting from an uplift span upto half of ruling span under broken wire condition. c) Also to be designed for the unbalanced tension resulting from unequal ruling span as specified in Table T1-2. d) Dead end with 0 deg. to 15 deg deviation both on line and sub- station side (slack span).
	D	0deg.	e) Complete dead end.
	D	90deg.	f) To be used near switchyard with Reduced design and span
	NOTE: 1) For double circuit tower types, A, B, C and D shall be prefixed by 'D'. 2) Special type of tower/ higher voltage class towers, wherever required shall also be provided by the bidder under the contract at no extra cost.		
12.01.04	Extension a) The single and double circuit tower shall be designed so as to be suitable for adding 3M, 6M and 9M body extension for maintaining adequate ground clearance without reducing the specified factor of safety in any manner. b) For power line crossing 25 metre extensions with D type towers are required. The 25 metre extension should be designed in such a manner the same can also be used as 18 metre extension to normal tower after removal of bottom panels. c) For under line crossing of EHV transmission lines the bidder shall have to design minus-three metres and minus six metre extensions to D type tower.		
12.01.05	Stub Setting templates. Stub templates shall be designed and arranged by the contractor at his own cost for all types of tower with or without extension and also for leg extension. Stub templates for standard towers and tower with extension shall be of adjustable type. The stub templates shall be painted. One set of each type of stub setting template for single and double circuit tower shall be supplied to the Owner, on completion of the project, at no extra cost.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS				<div>एनटीपीसी</div> <div>NTPC</div>
12.02.00	SPANS AND CLEARANCES				
12.02.01	Ruling Span The normal ruling span of the line shall be 320 meters for 220 KV towers.				
12.02.02	Wind Span The wind span is the sum of the two half spans adjacent to the support under consideration. For normal horizontal spans this equals to normal ruling span.				
12.02.03	Weight Span The weight span is the horizontal distance between lowest point of the conductors on the two spans adjacent to the tower. For design of structures, the span limits given below shall prevail.				
	Tower type	Normal Condition		Broken Wire Condition	
		Max. (m)	Min. (m)	Max. (m)	Min. (m)
	A, B, C & D (220 KV)	390	-100	270	-100
12.02.04	Electrical Clearance				
A)	Ground clearance The minimum ground clearance from the bottom conductor shall be as per IE rules at the maximum sag conditions i.e. at maximum temperature and still air. However, to achieve the above clearance the height of tower shall be increased in the following manner:				
a)	Allowance of 150 mm shall be provided to account for errors in stringing.				
b)	Conductor creep shall be compensated by over tensioning the conductor at a temperature lower than the ambient temperature. The creep correction temperature along with calculations shall be furnished by the Contractor.				
c)	Minimum spacing The minimum electrical clearance between conductors shall be as per relevant standards.				
B)	Rail Crossing In case of rail crossing the min. height above rail level of the lowest portion of any conductor under condition of max. sag, in accordance with the regulations for Electrical Crossing of Railway tracks as prevailing at the time of construction of line shall be applicable.				
C)	Power Line Crossing Minimum clearance between power line to power line crossing shall be as per IE rules.				
D)	Live Metal Clearance The minimum live metal clearance to be provided between the live parts and steel work of super-structure shall be as per relevant standards.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>NOTE:</p> <p>i) Bidder shall adopt same cross arm design where jumper is projecting outside of cross-arm for 'D' type tower to be used as dead end and angle tower.</p> <p>ii) The design of the tower shall be such that it will satisfy all the conditions when clearances are measured from any live point of the strings.</p> <p>E) Angle of Shielding</p> <p>The angle of shielding is defined as the angle formed by the line joining the center lines of the earthwire and outer power conductor, in still air, at tower supports, to the vertical line through the center line of the earthwire. Bidders shall design the tower in such a way that the angle of shielding does not exceed as specified in relevant standard for 220KV towers. The drop of the earthwire clamp, which is in the scope of contractor supplied items, should be considered while calculating the minimum angle of protection. For estimating the minimum angle of protection the drop of earth wire suspension clamp alongwith shackle shall be taken as 150mm.</p> <p>F) Mid Span Clearance</p> <p>The minimum vertical mid span clearance between the earthwire and the nearest power conductor as per IE rules, which shall mean the vertical clearance between earthwire and the nearest conductor under all temperatures and still air condition in the normal ruling span. Further, the tensions of the earthwires and power conductors, shall be so co-ordinated that the sag of earthwires shall be at least 10% less than that of power conductors under all temperature loading conditions.</p>	
12.03.00	LOADING CONDITIONS	
12.03.01	<p>Loads at Conductor And Earthwire Points</p> <p>Contractor shall consider the ultimate external loadings at conductor and earthwire points base on IS 802-1, 1995. The Contractor shall develop the tower designs considering these loadings. The towers are to be designed to cater for the following loads:</p> <p>a) Reliability Loads (Normal condition) b) Security Loads (Broken wire condition) c) Safety Loads (Construction & Maintenance loads)</p> <p>12.03.02 Suspension towers shall be designed for full wind load under security condition</p> <p>Wind Loads on Tower Body</p> <p>The wind load on tower body shall be calculated by the Contractor as per IS:802, Part-I, 1995.</p> <p>12.03.03 Maximum Tension</p> <p>Maximum tension shall be based on either of the following (whichever is more stringent):</p> <p>a) at 0 deg C with 36% full wind pressure., or b) at 32 deg C with full wind pressure</p> <p>The value of drag co-efficient (Cd) shall be 1.2 for conductor/earthwire if the diameter of the conductor/earth is 15mm or less.</p>	
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TABLE-2
DESIGN LOADS

S.No	Tower Type	Longitudinal Loads		Transverse Loads	
		Reliability Condition	Security Condition	Reliability Condition	Security Condition
1	2	3	4	5	6
a.	A	0.0	0.5 x MT For Conductor). 1.0 x MT (For Earth Wire)	WC + WI + DY	0.6 WC + WI +0.25 DY (For Conductor) 0.6 WC + 0.5 DY (For Earth Wire)
b.	B (Section Tower-0° Deviation)	MT1	1.0 x MT	WC + WI + DY	0.6 WC + WI +0.5 DY
c.	B (15° Deviation)	MT1	1.0 x MT x Cos $\frac{\alpha}{2}$	WC + WI + DY	0.6 WC + WI +0.5 DY
d.	C (Section Tower-0° Deviation)	MT1	1.0 x MT	WC + WI + DY	0.6 WC + WI +0.5 DY
e.	C (30° Deviation)	MT1	1.0 x MT x Cos $\frac{\alpha}{2}$	WC + WI + DY	0.6 WC + WI +0.5 DY
f.	D (60° Deviation)	MT1	1.0 x MT x Cos $\frac{\alpha}{2}$	WC + WI + DY	0.6 WC + WI +0.5 DY
g.	D (Dead End with slack span of 100 Mtrs. Max.)	0.7 MT	1.0 x MT	WC + WI + (0.3 MT x Sin 15°)	0.6 WC + WI
h.	D Complete Dead End	MT	1.0 x MT	WC + WI	0.1 WC + WI

DESCRIPTION	SYMBOL	REMARKS
Maximum Tension Of Conductor/ Earth Wire under everyday temperature & full wind condition or minimum temperature & 36% Of max. wind which ever is more stringent	MT	
Wind On Conductor	WC	Wind Span shall be the normal ruling span.
Wind On Insulator	WI	In case of Double String Insulators, both their strings shall be considered
Angle Of Deviation (Degrees)	α	
Load Due To Deviation Of Tower	$DY = 2 \times MT \times \sin \frac{\alpha}{2}$	
Difference In Tension For unequal adjacent spans considering full ruling span on one side and 50% of ruling span on other side	MT1	

Note:


1. Vertical loads shall conform to IS 802 – Part I, 1995. Weight spans as furnished under Clause 2.03.00 shall be considered for computation of vertical loads.
2. Safety loads and Anti-cascade loads as specified in IS 802- Part I, 1995 shall also be considered for design of Towers.
3. Wind loads on the towers shall be considered in transverse loads as per clause 11, 12 and 13 of IS: 802 (Part-I/ Sec. I)- 1995.
4. Any additional loads apart from the loads mentioned above, as required as per IS: 802- 1995 shall be considered for design purpose.


13.00.00 TOWER FOUNDATIONS


13.01.00 TYPES OF FOUNDATION

13.01.01 General

- A) Reinforced concrete footing shall be used for all type of tower in conformity with the IS Codes and the specifications. All the four footings of the tower and their extension shall be similar, irrespective of down thrust and uplift.
- B) Foundation includes supply of materials such as cement, sand, coarse aggregates, reinforcement steel etc., and all work related to construction of foundations including excavation and backfilling, form work, stub setting, placing of reinforcement, concreting etc.
- C) Design criteria for Foundations

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<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/m³ under dry condition and 940 Kg/m³ under wet condition.</p> <p>Well foundation or pile foundation shall be provided by the bidder wherever necessitated.</p>			
13.02.00	SOIL INVESTIGATION			
13.02.01	<p>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.</p>			
13.02.02	<p>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.</p>			
13.02.03	<p>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.</p>			
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>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	<p>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.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>a) Laboratory Tests on Soil Samples</p> <p>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.</p> <p>b) Laboratory Tests on Rock Samples</p> <p>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.</p>			
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	<p>The Geotechnical report shall include, but not limited to the following:</p> <p>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.</p> <p>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.</p> <p>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:</p> <p>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.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>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.</p> <p>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.</p> <p>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.</p> <p>iv) Additional investigation other then specified above, if any, the same shall be carried out by the bidder at no extra cost to owner.</p>			
13.02.09	Indian Standard References			
	<p>IS:1498 Classification and Identification of Soils for general Engineering Purposes.</p> <p>IS:1892 Code of practice for Subsurface Investigation for Foundation.</p> <p>IS:1904 Code of practice for design and construction of foundations in Soils: General Requirements.</p> <p>IS:2131 Method of Standard Penetration Test for Soils.</p> <p>IS:2132 Code of practice for Thin walled Tube Sampling of Soils.</p> <p>IS:2470 Code of practice for design and construction of Septic (Part-I) Tanks.</p> <p>IS:2720 Method of Test for Soils (Relevant Parts).</p> <p>IS:5313 Guide for Core Drilling Observations.</p> <p>IS:4968 Method for subsurface Sounding for Soils - Dynamic (Part-II) method using Cone and Bentonite slurry.</p> <p>IS:4968 Method for subsurface Sounding for Soils- Static Cone (Part-III) Penetration Test.</p>			
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:			
	<p>a) Max. tension or uplift along the leg slope.</p> <p>b) Max. compression or down-thrust along the leg slope.</p> <p>c) Max. horizontal shear or side thrust.</p>			
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.			
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PROJECT: 400/220kV Switchyard for North Karanpura Super TPP (3x660MW)

CUSTOMER: NTPC LTD.

General Project Details

PROJECT DETAILS

	Particular	Details
a)	Customer	NTPC Ltd.
b)	Engineer/Consultant/ Inspector	NTPC Ltd.
c)	Project Title	North Karanpura Super Thermal Power Project (3x660 MW) : 400/220kV Switchyard at NKSTPP end & 220kV Sub-station at Mine end
d)	Project Location	Place: Near Tandwa town District: Hazaribagh & Chatra State: Jharkhand
e)	Latitude & Longitude	400/220kV S/s at NKSTPP: North: 23°50' to 23°52' and East: 84°59' to 85°2' 220kV S/s at Chatti Bariatu & Kerandari-A mine: North: 23°52'35" and East: 85°05'25"
f)	Nearest Railway Station	Khalari Railway Station Ranchi-Garhwa section of Eastern Railways
g)	Distance of project location from the Railway station	40 Km (approx.)
h)	Nearest Major Town	Hazaribagh city
i)	Distance of the town from the project site	50 Km.
j)	Nearest commercial airport	Ranchi
k)	Distance of airport from the project site	150 Km
SITE CONDITIONS (for design purposes)		
a)	Design ambient temperature	50°C
b)	Maximum Relative humidity	95 %
c)	Height above mean sea level	Less than 1000 meters
d)	Pollution Severity	Heavily polluted (With Coal dust & Fly ash) and Highly Corrosive environment.
e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3) 1987
f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	39 m/ sec
g)	Category of terrain	Cat -2
h)	Risk Coefficient "K1"	1.06