

SECTION D30

OVERHEAD TRANSMISSION LINES

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan OVERHEAD TRANSMISSION LINES	Sheet 1 of 41

1.0 **INTRODUCTION**

- The major equipment/system covered under scope of work shall be as follows:
- 11 kV Overhead transmission lines including lattice structures for stringing the conductor, fuses, air break switch, insulators, lightning arrestors, shield wire, hardwares, etc., (Stringing hardware for 11 kV lines at both the end is also included in the scope.). The transmission line shall be laid along with the road.
- Installation & erection accessories.
- Clamps & connectors required for the erection of transmission line.
- Earthing and lightning protection.
- For pole structure at sending and receiving ends.
- Civil works for electrical equipment such as foundation of towers/Structures etc.
- Essential spares and special tools and tackles required for installation, operation and maintenance of electrical equipment/transmission lines.
- The route plan indicating the number and location of various Towers like Tangent towers, angle towers etc are to be furnished by the Contractor.
- Preliminary drawing indicating the route and location of towers are to be submitted by the bidder.
- Design Calculation for all electrical system such as Sag Calculation , OH conductor sizing etc. is included in the Contractor's scope.
- Drawings such as Layout Drawings, plan & section of the structures & interconnection with towers, detailed SLD, etc are included in the scope.
- Number of tower, span, height and angle of the towers etc. shall be planned considering route portfolio, sag/tension calculation, terrain etc. It shall be as per Indian slandered (IS).

1.1 The technical specifications are covered under the following sub-sections:

- Transmission Tower
- Four pole structure
- 11kV Isolators
- 11kV Lightning Arrestors
- Conductor and Shield Wire
- Insulator assemblies and Line Accessories
- Shield wire Insulator assemblies and Line Accessories

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• Tower Grounding • Stringing of Conductor • Stringing of Overhead Shield Wire 1.2 All designs and details shall be subject to approval of the PURCHASER / CONSULTANT. The PURCHASER / CONSULTANT shall have the right to instruct the CONTRACTOR, without additional cost to the PURCHASER, to make any changes in designs and details necessary to make the construction conform to the contract documents. 1.3 The CONTRACTOR shall assume full responsibility for designing and detailing of steel towers and for their satisfactory performance. No omission or ambiguity on the drawings or in these specifications will relieve the CONTRACTOR from furnishing first class materials and workmanship. Should any inaccuracy be found, any further work done before these discrepancies are corrected will be at the CONTRACTOR's risk. 1.4 The transmission line and the equipment/materials for the same shall conform to the latest edition of applicable standards mentioned in this document. In case of conflict between this specification and the applicable standards, the Contractor shall bring the matter to the notice of the Engineer /Purchaser, who shall resolve the matter and issue appropriate directions to the Contractor. Should the Contractor/vendor during the execution of his work, find discrepancies in the information furnished by the Purchaser, he shall refer such discrepancies to the Purchaser before proceeding with such work. 1.5 All materials of construction shall be brand new and free of pittings, dents, bends and other defects. 2.0 <u>11KV ISOLATORS</u> 11kV Isolators to be used for line connection/isolation on no load shall be double break rotating type with earth switch. Isolators shall be triple pole gang operated suitable for outdoor installation mounted on structure under the specified site conditions. Clearance (P-P & P-E) shall be maintained as per relevant IS standard. Proper interlocks shall be provided between isolator and earth switch. DC supply required for indication and electrical interlock shall be arranged by the contractor. Speed of operation during opening and closing shall ensure minimum arcing. Isolator shall be manufactured as per IS: 9921 (Part - I to V). All type tests shall be conducted as per IS: 9921 on one Isolator and earth switch, which shall be witnessed by purchaser. Type test reports & certificates shall be furnished by the contractor for approval. Routine tests as per IS-9921 shall be conducted on all Isolators and earth switches. ISSUE R1		

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General technical particulars are mentioned as below:

2.1 Technical Requirements of 11kV Isolators

The isolators shall comply with the requirement indicated in the following table:

1.0	Make	As per Approved vendor list
1.1	Application	Outdoor (Transmission Line)
1.2	Quantity	As required
1.3	Voltage class	12 kV
1.4	Frequency	50 Hz
1.5	No. of phases	3 Phase
1.6	Rated current for site conditions	400A
1.7	Short time Current	
	(a) Rating and duration	40 kA for 1.0 sec.
1.8	Rated peak short circuit current	105 kA (Peak)
2.0	Design Requirements	
2.1	Ambient temperature	50°C
2.2	Insulation level	75 kV peak
2.4	Type of break	Horizontal center break
2.5	Type of mounting	Horizontal upright
2.6	Operating device	
	(a) For isolator	Motor driven (Both local & remote) (Emergency Manual)
	(b) For earth switch	Manual with electrical / Mechanical interlocks
3.0	Insulation Data	
3.1	1.2 / 50 micro sec. lightning impulse withstand	75 kV peak
3.2	Total creepage distance	31 mm/ kV

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3.3	Minimum cantilever strength	* kg
3.5	Switching Impulse Withstand Voltage	NA
3.6	Corona Extinction voltage	*
4.0	Miscellaneous	
4.1	Auxiliary supply	
	Electrical	220 V DC for control and interlock. Battery and battery charger in Contractor's scope as per Section D-10.
4.2	Interlocks with circuit breakers	NA
5.0	Applicable standards	
5.1	Insulators	IS : 2544
5.2	Isolators	IS : 9921.
	* - To be furnished by bidder	

3.0 **LIGHTNING ARRESTOR**

12kV, 10kA, long duration discharge class-III heavy duty, non linear resistance , metal oxide type gapless surge arrestors shall be provided. Surge arrestors of single pole & self supporting type shall be provided. It shall be suitable for pole mounting outdoor type and shall be designed to provide maximum protection against lightning and switching surges. The arrester shall be mounted on an insulating base. Surge monitor shall be inserted between the lightning arrester and earth.

Surge arrester shall comply with IEC-60099-4 & IS:3070-1993 Part-III for all technical particulars. General technical particulars are as follows :

3.1 **Technical Requirements**

1.0	Make	As per Approved vendors list.
1.1	Quantity	As required
1.2	Installation, class	Outdoor, station
1.3	System Voltage	
	(a) Nominal	11 kV

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	(b) Highest	12 kV
1.4	Type of earthing	Effectively earthed
1.5	Type of arrester	Gap less
2.0	RATING	
2.1	Rated arrester voltage / maximum continuous operating voltage	9 kV /8 kV
2.2	Rated frequency	50 Hz
2.3	Nominal Discharge current of 8 / 20 Micro second wave shape	10 kA
3.0	Performance Data	
3.1	Impulse current withstand	
(a)	Long duration discharge class (as per IEC 99)	Class III
(b)	Long duration current impulse	As per IEC-99
(c)	Virtual duration of rectangular wave	As per IEC-99
(d)	Maximum residual voltage at rated nominal discharge current	As per IEC – 99 – 4
4.0	Arrester Housing	
4.1	Withstand Test Voltages	
(a)	One minute power frequency dry & wet	28 kV
(b)	1.2 / 50 micro second Impulse withstand voltage	75 kV
4.2	Minimum total creepage distance of whole insulator–mm	31 mm/kV
5.0	Additional requirements	
5.1	Minimum cantilever strength of arrester assembly	* kg
5.2	Pressure relief class (As per IEC – 99)	As per IEC
5.3	Minimum prospective symmetrical fault current (as per IEC – 99)	40 kA
6.0	Applicable Standards	
6.1	Lightning arrester	IS : 3070

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	For alternating current systems	IEC – 99
6.2	Insulators	IS – 2544

4.0 **TRANSMISSION TOWER**

4.1 **General**

The towers shall be of the self supporting type and designed to carry the line conductors with the necessary insulators, earth conductors and all fittings under the defined cases of loading conditions. Tower design and material shall be as per IS-802 Part-I,II&III.

4.2 **Configuration**

4.2.1 The Transmission towers shall be configured to give an economical design.

4.2.2 **Types of Towers**

The towers will be normally of the following types:

Type	Position in Use	Angle of deviation or entry	Type of Insulator
A	Straight line	0° - 2°	Suspension
B	Angle	2° - 15°	Tension
C	Angle	15° - 30°	Tension
D/DE	Angle/	30° - 60°/	Tension
	Dead End	Dead End with 0° - 30° deviation both on line and sub-station side slack spans.	

Notes:

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1. The above towers may also be used for longer spans with smaller angles of deviation, based on design charts prepared by the Contractor and approved by the Engineer.

In addition to the above, Contractor may be required to supply and erect some special towers (like transposition towers, towers for river crossing etc.) depending on final route alignment.

5.0 CONDUCTOR AND SHIELD WIRE

5.1 The conductor and shield wire - material, size etc. shall be as specified in the Data Sheet and conform to the requirements of the relevant standard specified.

5.2 The CONTRACTOR shall furnish 3 copies each of time creep curves for the conductor at specified every day temperature for tension ranging in 10 percent increment from 10 percent to 30 percent of its ultimate strength and stress-strain creep curves showing at least one hour, six months, one year, ten years and twenty years creep for the conductors furnished under this specification.

6.0 INSULATOR ASSEMBLIES AND LINE ACCESSORIES

6.1 Insulator Assemblies

6.1.1 The insulator assemblies shall consist of the identical number of porcelain insulator discs, hardware, suspension clamps, compression type dead end clamps and arcing horns. An insulator assembly complete with all hardware fittings shall not exhibit excessive corona formation and discharge likely to cause radio interference at voltages less than the flashover voltage. Insulators shall be designed to avoid excessive concentration of electric stresses in any section or across leakage surfaces.

6.1.2 The insulator disc shall be of the cap and pin, ball and socket type with zinc sleeve, radio interference free and shall have characteristics as specified in technical requirements. Each insulator disc shall comply with the following requirements.

6.1.3 The insulators shall be made of the highest grade, dense, homogenous, wet-process porcelain, completely and uniformly vitrified throughout to produce uniform mechanical and electrical strength and long life service. All porcelain surfaces exposed to the weather shall be smoothly glazed with a good lustre and of uniform brown colour.

6.1.4 The cap and pin shall be of such design that it will not yield or distort under the specified mechanical load in such a manner as to change the relative spacing of the insulators or add other stresses to the shells. The insulator caps shall be of the socket type provided with non-ferrous metal or stainless steel cotter pins and

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shall provide, positive locking of the coupling. The insulator pins shall be made of malleable iron or drop/forged or machine steel free from cracks and airholes. All bearing surfaces shall be smooth and uniform so as to distribute the loading stresses evenly. 6.2 Line Accessories 6.2.1 All hardware, except where otherwise specified, shall be malleable iron or steel for forging, metal mould casting or drop forging, hot dip galvanised, and shall have an ultimate strengths not less than the mechanical and electrical strengths of the insulator discs for each type of insulator assembly. Where parallel insulators are used yoke plates at the end and bottom and the connecting hardware shall be of sufficient strength. 6.2.2 Fittings intended to connect two dissimilar metals shall be designed to avoid harmful bimetallic corrosion under service conditions. 6.2.3 All fittings shall be such that corona visual voltage of the insulator string with fittings shall not exceed that of the string without any fittings. The radio interference voltage of the insulator shall be lower when measured with the fittings than without the fittings. 6.2.4 The suspension clamps for the ACSR conductor shall be made of aluminium alloy suitable for use on the conductor with preformed armour rods installed. The suspension clamps shall have smooth surfaces free from burrs and the edges and fillets shall be rounded to minimise corona concentration and radio interference. 6.2.5 The clamps shall be designed to minimise magnetic loss with maximum permissible 50 Hz current flowing through the conductor with armour rods. If dissimilar metals are used in making the clamps, suitable precautions shall be taken to minimise corrosion due to electrolytic action. Each suspension clamp shall have a suitable bellmouth and shall be capable of holding the conductor with preformed armour rods without slipping under an unbalanced tension of 25% of the rated ultimate strength of the conductor and shall have ultimate strength equal to or exceeding the mechanical and electrical strength of the insulator disc. Each suspension clamp shall be furnished with bolts, two U-Bolts with lock washers, a keeper piece and other required parts. The degree of U-Bolt tightening shall be in accordance with the recommendation of the suspension clamp manufacturer. 6.2.6 The strain clamps shall be dead-end compression type and shall have ultimate strength equal to that of the conductor. 6.2.7 The compression type dead end clamps shall be suitable for use on specified conductor and shall consist of galvanised steel clevis end or steel oval eye end, ISSUE R1		

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aluminium dead end body, aluminium jumper connection with bolted connection between the jumper connector and the dead end. 6.2.8 The compression dead end clamp and jumper connection shall have an electric conductivity of not less than that of the conductor, and shall be free from all defects and shall not damage the conductor when attached. 6.2.9 Materials not specifically covered herein by detailed specifications shall be of standard commercial quality suitable for the intended use. 7.0 <u>OVERHEAD SHIELD WIRE ASSEMBLIES & ACCESSORIES</u> 7.1 The overhead shield wire assemblies shall consist of the indicated hardware and suspension clamps, compression type dead end clamps suitable for specified steel wire and shall meet the requirements hereafter described. 7.2 All line accessories to be furnished shall be made of aluminium or aluminium alloy, malleable iron or steel. All ferrous metals (except stainless steel) shall be galvanised by hot dip process. 8.0 <u>GROUNDING OF TOWER</u> 8.1 Grounding Materials 8.1.1 Unless described hereinafter, all materials shall be of standard commercial quality suitable for the intended use. 8.1.2 The ground electrodes shall be GI earth pipe of not less than 36 mm and 1.0 Meter long. 8.1.3 The ground connecting strip shall be galvanised mild steel strip of suitable size. 8.1.4. The connection between ground electrodes or stub angle and the strip shall be made by galvanised steel bolts, nuts and lock washers. The bolts shall be of sufficient length to grip steel angle and lock washers. 8.1.5 The counter poise if required, shall be galvanised mild steel strip of suitable size. 8.2 Ground Electrode CONTRACTOR shall install ground electrode for all towers to required depth by acceptable method of hand driving. If the soil is hard for hand driving, the CONTRACTOR shall use mechanically operated hammers either electric, pneumatic or petrol engine driven. 8.3 Installation of Counterpoise Where required, radial or continuous counterpoise shall be installed. 8.4 Improvement of Tower Ground Resistance		
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Where the initial ground resistance is higher than 10 Ohms, CONTRACTOR shall notify PURCHASER and carry out improvement as directed by him by either of the following or both.

- a) Driving additional ground electrodes;
- b) Installing radial or continuous counterpoise;

The revised ground resistance shall be measured and submitted for PURCHASER's approval.

9.0 STRINGING OF CONDUCTOR

9.1 General

Conductor shall be strung with utmost care during handling and transportation. Quantity furnished will be the actual horizontal distance of the section to be installed after check survey and staking have been performed plus a fixed extra 1.5% to cover sag, terrain irregularities and wastage.

9.2 Stringing Plan

Not later than 2 months before commencing installation work, the CONTRACTOR shall submit the stringing plan to the PURCHASER for approval. The plan shall describe the work schedule, method of stringing, temporary guying, scaffolding, personnel required in performing the work and list of tools and equipment to be employed together with printed instruction.

In addition, not later than 2 weeks before commencing stringing work of any section of the line, the CONTRACTOR shall submit the details of unreeling section, location of reel, winch, temporary guying and scaffolding and length of conductor to be strung to the PURCHASER for approval.

9.3 Tools and Equipment

- 9.3.1 Tools and equipment shall be inspected at the site by the PURCHASER after the approval of the stringing plan but prior to commencing the stringing work.
- 9.3.2 BIDDER shall clearly mention in his offer the method of stringing proposed to be adopted and the list of stringing equipment which will be mobilised by him for the purpose.
- 9.3.3 Stringing of conductor shall, in no case, be performed until 28 days after concrete foundation has been placed and until assembly and tightening of bolts of tower have been completed and inspected by the PURCHASER. Stringing of conductor and related operation shall be performed during daylight hours.
- 9.3.4 The CONTRACTOR shall repair or replace the damaged sections, including the furnishing of necessary additional materials, in a satisfactory manner and at no additional cost to the PURCHAER.

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9.3.5 The snatch-blocks, when suspended on the towers for sagging, shall be so adjusted that the conductor will lie in the sheave at the same level as the suspension clamps to which the conductor is to be secured.

9.3.6 Jointing and repairing shall not be permitted in single span of tension towers and crossing and adjoining the following objects.

- a) Highways
- b) Railroads
- c) Rivers, major canals and creek water ways
- d) Public utility lines
- e) Telecommunication lines

9.4 **Sagging of Conductor**

9.4.1 All conductor sagging shall be performed during daylight hours. Sagging operations shall not be permitted during high wind, or other adverse weather conditions which would impair the accuracy of the sagging.

9.4.2 The conductor shall be installed in accordance with the stringing sag and tension tables furnished by the CONTRACTOR and as approved by the PURCHASER. The stringing sag and tension calculation shall be based on the equivalent span method and shall cover the prevailing temperatures and span. The 10 years creep shall be considered and the effect of creep during paying out and during hanging in snatch blocks before sagging shall be taken into account.

9.4.3 After being pulled into the sheaves, the conductor shall not be allowed to hang in the snatch-blocks for more than 48 hours, before being pulled to the specified sag. The length of the conductor sagged in one operation shall be limited to the length that can be sagged satisfactorily. After the conductors have been pulled to the required sag, intermediate spans shall be checked to determine the sags are correct.

9.4.4 Where the distance between tension type towers is too great to permit the conductors to be sagged in one operation, temporary intermediate dead ends shall be established.

9.5 **Measurement of Sag**

For several spans in each sagging section, the sag shall be measured selecting one near each end and one or two near the centre. The total number of spans to be measured shall be as follows:

<u>Sagging Section Span</u>	<u>Number of Measurements</u>
1	1

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2-6	2
7-15	3
16 or more	4

The sag of all spans in excess of 500 m shall be measured. At any sharp vertical dip angle spans, the sag shall be measured on both sides of the angle of the spans. The CONTRACTOR shall provide suitable dynamometer, sighting boards, theodolites, and other suitable devices to measure sagging, as well as thermometers to measure the ambient temperature to determine the conductor sag. Dynamometers are to be tested and if necessary recalibrated.

9.6 Tolerance of Sag

A tolerance of plus or minus 15 cm in the sag in any one span will be permitted, provided that -

- The maximum difference in sag between the phase in any span shall not exceed 15 cm.
- The necessary ground clearance is obtained.
- The conductor tension between successive sagging operations is equalised so that the suspension insulator assemblies will hang in the vertical position in the transverse plane to the tower when the conductor is clipped-in.

10.0 STRINGING OF OVERHEAD SHIELD WIRE

10.1 General

Overhead shield wire(s) shall be strung for the entire length of the transmission line, and shall be attached to the towers. The equipment, methods, and limitations used for installing the overhead shield wire shall be the same as for installing the conductor except otherwise specified.

10.2 Stringing of Overhead Shield Wire

The overhead shield wire shall be strung in advance of the conductors, and the method shall be the same as specified for conductor stringing. The same degree of care shall be exercised to avoid damage or injury of the overhead shield wire. If damaged, they shall be replaced by the CONTRACTOR in a manner approved by the PURCHASER.

10.3 Sagging of Overhead Shield Wire

The overhead shield wires shall be sagged in place in advance of the conductors and shall be in accordance with the sag and tension tables for the overhead shield wire furnished by the CONTRACTOR and approved by the PURCHASER. Sagging of the overhead shield wire shall comply with the requirements specified for conductor.

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11.0 **TEST**

11.1 The Tower supplied by the Contractor shall be type-tested towers and shall be fabricated as per the design and drawing approved by the Purchaser/Consultant.

11.2 Same type of towers which has already been type tested shall be offered by the Contractor and necessary Type testing certificate shall be produced for Purchaser/Consultant's acceptance.

If type tested tower are not available, then the proto type tower shall be type tested. Proto-model test, on each type of suspension tower to be supplied, shall be made at the manufacturer's plant or at such location as may be mutually agreed. The tests shall be in accordance with IS:802 : Part-III "CP FOR USE OF STRUCTURAL STEEL IN OVERHEAD TRANSMISSION LINE TOWERS", Part-III "TESTING", latest revision.

11.3 For all other equipment , type, routine and acceptance tests shall be conducted as per relevant standards in the presence of purchaser and certificates shall be furnished. Type tests shall be carried out on one piece of each type and rating of equipment.

11.4 Routine test certificates for all the materials including structural steel used in the work shall be furnished for approval.

11.5 The ACSR conductor / earth wire shall undergo all the tests as specified in the relevant IS with latest amendments if any, at any Government approved Laboratory in the presence of Purchaser's representative at Contractor's cost.

11.6 Sampling of Insulators for testing shall be as per applicable standards. Tests shall include vibration test on complete assembly as an Acceptance test apart from those specified in relevant applicable standards.

11.7 The CONTRACTOR shall furnish certified copies of all tests whether or not inspection is waived.

11.8 PURCHASER/ENGINEER will attend type and Routine tests on all the units and Acceptance tests on samples drawn from the lots as per standards.

11.9 Type tests, all routine and sample tests shall be done in the presence of the PURCHASER's representative. All tests for hardware's and fittings shall be carried out in accordance with the applicable standards.

11.10 The PURCHASER reserves the right to inspect and test the finished material as per standard specifications. The notice of the proposed date of such inspection shall be advised to the PURCHASER one month in advance.

11.11 Any inspection and tests whether carried out or waived, by the PURCHASER shall not relieve the CONTRACTOR from his responsibility to supply the

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hardware's and fittings in accordance with the specification and/or from any of his obligations under the Contract.

DATA TO BE FURNISHED BY THE CONTRACTOR AFTER AWARD OF CONTRACT

The Contractor shall furnish copies of the following document to the Purchaser for the approval.

- 1.0 Report on survey including soil investigation.
- 2.0 Plan and profile of the transmission line route indicating the spotting of towers and ground clearance of conductor as per statutory requirements.
- 3.0 Detailed design, drawings for all types of towers including their extension and stubs.
- 4.0 Profile of Transmission line.
- 5.0 Soil investigation report along the transmission line route.
- 6.0 Detailed design, drawing for all types of foundations for all the types of towers.
- 7.0 Drawings for insulators/insulator strings hardware's /fittings and accessories for transmission line.
- 8.0 Test certificates for materials such as structural steel, bolts, nuts, spring washers, insulators, hardware's/fittings, accessories, conductors, ground wire, earth conductor, step bolts, ladders, barbed wire etc. as per specifications and applicable standards.
- 9.0 Test report on tower.

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TECHNICAL REQUIREMENTS

1.0	GENERAL		
1.1	Line Designation		11 kV transmission lines
1.2	No. of circuits in each tower	No.	two
1.3	Approximate length of each circuit	Km	6
1.4	Nominal system voltage		11 kV
1.5	Highest system voltage		12 kV
1.6	Design of tower to suit hot line washing required	Yes/	No
1.7	Spans		
	a) Normal (ruling) span b) Wind span c) Weight span i. Maximum ii. Minimum for suspension iii. Minimum for tension	m	As per IS-5613-2-1 . 1.1 x normal span 1.5 x normal span 0.65 x normal span (-) 0.65 x normal span
1.8	Diameter of bolts for connection of tower members		12 / 16 / 20 mm
1.9	Configuration of phase conductors for each circuit		By bidder
1.10	No. of conductors per phase	No.	One

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

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1.11	Route survey carried out by the PURCHASER	Yes/	No
2.0	TOWER		
2.1	Design Loads		As per IS 802 (Part 1/Sec 1)
3.0	CLEARANCE IN AIR Minimum clearance in air		As per IS 5613
4.0	INSULATOR STRINGS		
4.1	Type		Suspension / Tension anti fog type
4.2	size of each insulator disc (Dia x Height)	mm	254x146
4.3	Weight of each insulator disc	kg	5.8
4.4	Creepage distance protected/ total	mm/ mm	420/840
4.5	Electro-mechanical strength of each disc	kN	90
4.6	Power frequency voltage withstand Dry wet	KV	70 75

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan OVERHEAD TRANSMISSION LINES	Sheet 17 of 41

4.7	Power frequency voltage puncture	KV	1.3 times the dry flash over voltage
4.8	Impulse voltage withstand	KV	75
4.9	Visible discharge power frequency test	KV (rms)	9
4.10	No. of insulators per string a) Suspension b) Tension	No. No.	By bidder By bidder
5.0	CONDUCTOR		
5.1	Material		ACSR
5.2	Code name		DOG

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan OVERHEAD TRANSMISSION LINES	Sheet 18 of 41

5.3	Size and no, of steel strands	mm/n	1.57/7
5.4	Size and no. of aluminium strands	mm/n	4.72/6
5.5	Overall diameter	mm	14.15mm
5.6	Resistance	/km	0.272 ohms
5.7	Weight	kg/km	395.9
5.8	Ultimate tensile strength	kg	1150
5.9	Modulus of elasticity	Kg/sq	0.75
5.10	Coefficient of linear expansion	/degC	19.8
5.11	Number of conductors per phase	No.	One
5.12	Maximum operating temperature of conductor	°C	50

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
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6.0	<u>OVERHEAD GROUND WIRE</u>		
6.1	Material		GI
6.3	Size and no. of strands	mm/n	3.66/7
6.4	Overall diameter	mm	10.98
6.5	Weight	kg/km	574
6.6	Ultimate tensile strength	kg	7700
6.7	Modulus of elasticity	kg/	1.965×10^6
6.8	Coefficient of linear expansion	/degC	11.5×10^{-6}
6.9	Number of ground wires	No.	One
6.10	um temperature of ground wire	°C	50

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
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	<u>APPLICABLE STANDARDS</u>				
1.	Site Investigation	☐ IS	☐ BS 5930		
2.	Methods of test for stabilised soils	☐ IS 4112	☐ BS 1924		
3.	Code of practice for site investigation	☐ IS	☐ CP 20 01		
4.	Code of practice for safety precautions in the construction of large dia bore holes for piling and other purpose	☐ IS	☐ CP 20 11		
5.	Method of subsurface sounding Static cone penetration test	☐ IS 4968 P3	☐ BS		
6.	Methods of test for soils for Civil Engineering purposes.	☐ IS 2720 P7 P8	☐ BS 1377		
7.	Core drilling equipment	☐ IS	☐ BS 4019		
8.	11 grade ordinary Portland Cement	☐ IS 269	☐ BS		

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
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9.	Recommended guidelines for concrete mix	☐ IS 10262	☐ BS	☐ ACI 613	
10.	Code of practice for plain and reinforced concrete	☐ IS 456	☐ BS		
11.	Foundation bolts	☐ IS 5624	☐ BS		
12.	Steel for general structural purposes	☐ IS 2062	☐ BS 15	☐ ASTM A36	
13.	Structural steel -microalloyed (medium and high strength qualities)	☐ IS 8500	☐ BS 4360	☐ ASTM A441	
14.	Tolerance for fabrication of steel structures	☐ IS 7215	☐ BS		
15.	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel	☐ IS 814	☐ BS	☐ ASTM A 5.1	
16.	Recommended practice for hot dip galvanising of iron and steel	☐ IS 2629	☐ BS 729		
17.	Hot dip zinc coatings on structural steel and other allied products	☐ IS 4759	☐ BS		

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
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18.	Method of testing uniformity of coating of zinc coated articles	☐ IS 2611	☐ BS 729	☐ ASTM A 239
19.	Method of determination of mass of zinc on zinc coated iron and steel	☐ IS 6745	☐ BS 443	☐ ASTM A3
20.	Hexagon bolts for steel structures	☐ IS 6639	☐ BS 4190	
21.	Hexagon head bolts, screws and nuts of product grade C.	☐ IS 1363	☐ BS 916	
22.	Step bolts for steel structures	☐ IS 10238	☐ BS	
23.	Fasteners - single coil rectangular section spring washers.	☐ IS 3063	☐ BS	
24.	Plain washers	☐ IS 2016	☐ BS	☐ ASTM A 363
25.	Hot dip galvanised coating on fasteners		☐ BS	☐ ASTM A 153
26.	Hot dip galvanised coatings on threaded fasteners	☐ IS 1367 (Part 13)	☐ BS	
27.	Disc insulators	☐ IS 731	☐ BS 177	☐ IEC

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
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CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

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28.	Insulators fittings	☐ IS 2486	☐ BS 3288 PI, II	☐ IEC
29.	Fittings for aluminium and steel cored Al conductors for overhead lines.	☐ IS 2121	☐ BS 3288 PI. II	☐ IEC
30.	AAC/ACSR conductors	☐ IS 398	☐ BS	☐ IEC 209
31.	Copper conductors	☐ IS 282	☐ BS 125	☐ IEC
32.	Electric power connectors	☐ IS 5561	☐ BS 159	☐ IEC 30 5/ 383
11.	Galvanisation of steel wires	☐ IS 4826	☐ BS	☐ IEC
34.	Reels and drums for bare conductors	☐ IS 1778		

☐AST

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan OVERHEAD TRANSMISSION LINES	Sheet 24 of 41

35.	Tower tests	☐ IS 802 P3		
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NOTE : Materials, equipment, accessories, ☐ IS ☐ BS ☐ IEC ☐ AST
parts, tests, etc. shall in general
conform to :

REV. NO.	R0	R1		JOB NO.	CLIENT: RRVUNL
PPD.BY	UM	SK		TCE.	
CKD.BY	MSVM	MSVM		5750A	PROJECT: 2x660 MW STAGE V SURTGARH
DATE	DEC 09	JUN 12			TPS, RAJASTHAN

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
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DATA SHEET

(To be filled by the Bidder)

	<u>GALVANISED STEEL TOWERS</u>		
1.0	Name and country of tower fabricator		
2.0	Name and location of tower test facility		
7.0	Tower Particulars	Type	A B C D/DE
7.1	Overall height from GL	m	
7.2	Height of bottom cross arm from GL	m	
7.3	Cross arm length from Centre line of tower		
	a) Top b) Bottom	m m	
7.4	Vertical spacing between cross-arms		
7.5	Approximate weight of normal tower including bolts, nuts, gussets, stub etc.		

NOTE TO BIDDER

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SIGNATURE OF BIDDER	
DATE	

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7.7	Overall base width of normal tower		

	<u>INSULATOR ASSEMBLIES</u>		
1.0	<u>INSULATOR STRINGS</u>		
1.1	Manufacturer		
	a) Insulator b) Hardware		
1.2	Applicable Standard		
1.3	Type of insulators		
	a) Ball & Socket/other b) Normal/antifog		
1.4	Insulating Material		
1.5	No. of units per string		
1.6	Size of each unit		

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	a) Diameter of disc b) Spacing between adjacent units	mm mm	
1.7	Weight		
	a) Each disc b) Complete string	Kg Kg	
1.8	Creepage distance		
	a) Each disc total/protected b) Complete string total/protected	mm/mm mm/mm	
1.9	Power frequency withstand voltage		
	a) Each Disc		
	i) Dry ii) Wet	KV KV	
	b) Complete String		
	i) Dry ii) Wet	kV kV	

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1.10	Impulse withstand voltage		
	a) Each Disc		
	i) Positive ii) Negative	KVp KVp	
	b) Complete string		
	i) Positive ii) Negative		
1.11	Power frequency puncture withstand voltage of each disc.	KV (rms)	
1.12	Electro mechanical strength of each disc/ complete string	Kg.	
1.13	R.I.V. at 10 kV and 1000 KHz	V	
1.14	Visual Discharge voltage	kV	
2.0	<u>INSULATOR HARDWARE</u>		

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2.1	Manufacturer		
2.2	Applicable Standards		
2.3	Material :		
	a) Ferrous parts b) Nuts and bolts c) Cotter pins d) Split pins e) Strain and suspension clamps		
2.4	Ultimate Strengths :		
	a) Complete assembly b) Suspension clamp c) Dead end compression type clamp d) D - Shackle e) Ball eye f) Ball clevis g) Clevis eye h) Socket eye i) Socket clevis j) Yoke plate	Kg. Kg. Kg. Kg. Kg. Kg. Kg. Kg. Kg. Kg.	

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	<u>OVERHEAD SHIELD WIRE SUSPENSION AND TENSION ASSEMBLIES</u>		
1.0	Manufacturer		
2.0	Applicable Standards		
3.0	Material :		
	a) Ferrous parts b) Nuts and bolts c) Cotter pins d) Split pins e) Strain and suspension clamps		
4.0	Ultimate Strength		
	a) Complete Assembly b) Suspension Clamp c) Strain Clamp d) D - Shackle		

NOTE TO BIDDER

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	e) Clevis eye		
	<u>ACSR CONDUCTOR</u>		
1.0	Conductor code name and stranding		
2.0	Manufacturer's name and country		
	a) Aluminium rods b) Steel wire/rods c) Complete conductor		
3.0	Applicable Standards		
4.1	Purity of Aluminium	%	
4.2	Percentage of carbon, sulphur, phosphorous in steel wire/rod		
	a) Carbon	%	
	b) Sulphur	%	

NOTE TO BIDDER

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	c) Phosphorous	%	
	d) Combined sulphur and phosphorous	%	
5.0	Overall diameter of conductor	mm	
6.0	Guaranteed ultimate breaking strength	Kg.	
7.0	Weight	Kg/km	
8.0	Resistance	Ohms/k m	
9.0	Coefficient of linear expansion	°C	
10.0	Equivalent modulus of elasticity (average value from actual stress-strain curve)	Kg/cm ²	
11.0	<u>GALVANISING</u>		
11.1	Minimum weight of coating	gm/m ²	
11.2	Uniformity of coating (Preece Test)		

NOTE TO BIDDER

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	No. of dips for duration in minutes :		
	a) ½ minute b) 1 minute		
12.1	Maximum permissible temperature which the conductor may be allowed to reach without appreciably reducing the ultimate strength of the conductor	°C	
12.2	Current rating based on specified ambient temperature and maximum temperature as per 12.1 above	A	
13.0	Standard length of conductor on one drum	m	
14.0	<u>DRUM</u>		
14.1	Material		
	a) Flanges b) Barrel c) Hub		
14.2	Diameter of flanges	mm	

NOTE TO BIDDER

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14.3	Diameter of drum	mm	
14.4	Width of drum	mm	
14.5	Spindle hole diameter	mm	
14.6	Weight of empty drum	kg.	
14.7	Gross weight of drum including weight of conductor	kg	

	<u>OVERHEAD SHIELD WIRES</u>		
1.0	Manufacturer		
2.0	Applicable Standard		
3.0	Stranding - No. of Strands/ Diameter of each strand	mm	
4.0	Overall diameter	mm	
5.0	Cross-Section (Total)	sq.mm	

NOTE TO BIDDER

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6.0	Percentage of -		
	a) Carbon	%	
	b) Sulphur	%	
	c) Phosphorous	%	
	d) Combined sulphur and Phosphorous	%	
7.0	Galvanising		
	a) Minimum weight of coating	gm/sq.m	
	b) Uniformity of coating (Preece Test)		
	i. No. of ½ minute dips	No.	
	ii. No. of 1 minute dips	No.	
8.0	Weight	Kg/km	
9.0	D.C. Resistance at 20° C	Ohms/k m	
10.0	Coefficient of Linear Expansion	°C	
11.0	Equivalent Modulus of Elasticity	Kg/sq.c m	
12.0	Guaranteed ultimate breaking strength	Kg.	

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13.0	Standard length	m	
14.0	Drum :		
	a) Diameter of Flanges	mm	
	b) Width of drum	mm	
	c) Spindle hole dia	mm	
	d) Weight of empty drum	Kg.	
	e) gross weight of drum including weight of ground wire	Kg.	
	<u>ACCESSORIES FOR ACSR AND STEEL WIRES</u>		
1.0	<u>MID SPAN JOINT</u> <u>(COMPRESSION TYPE)</u>		
			<u>ACSR</u> <u>Steel Ground Wire</u>
1.1	Suitable for (Conductor size)		
1.2	Manufacturer's Name and Country		
1.3	Applicable standards		

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1.4	Ultimate Strength	Kg.	
1.5	Conductivity as percentage of conductivity of conductor	%	
1.6	Corona and R I Performance		
1.7	Weight :		
	AL Sleeves ST Sleeves Total	Kg. Kg. Kg.	
1.8	Standard Specification to which materials manufactured and tested		
1.9	Dimensioned Drawing showing AL and ST sleeves before and after compression enclosed (Give reference)	Yes/No	
1.10	Details of Filler compound		

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2.0	<u>ARMOUR RODS</u>		
2.1	Type	Perform e d t y p e	
2.2	Applicable Standards		
2.3	Suitable for conductor diameter	mm	
2.4	Overall Diameter of conductor with armour rods	mm	
2.5	Weight of Armour rod set	Kg.	
2.6	Size of Corona sphere	mm	
2.7	Total weight of armour rods with Corona spheres	Kg.	
2.8	Corona and RI Performance		
2.9	Standard specification to which materials manufactured and tested		

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OF BIDDER
DATE**

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D30
PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan OVERHEAD TRANSMISSION LINES	Sheet 39 of 41

2.10	Dimensioned drawings enclosed		
3.0	<u>VIBRATION DAMPERS</u>		
3.1	Type		
3.2	Make		
3.3	Applicable standards		
3.4	Total weight of each damper		
3.5	Weight of each Balancing Weight		
3.6	Tolerance in Balancing Weight		
3.7	Mechanical Resistance		
3.8	Mechanical Reactance		
3.9	Natural Frequency		
	Upper		
	Lower		

NOTE TO BIDDER

- ITEMS WHICH DEViate FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK(*) (DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS)
- THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

**SIGNATURE
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PART B	RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan OVERHEAD TRANSMISSION LINES	Sheet 40 of 41

3.10	Corona and RI Performance		
3.11	No. of Dampers Recommended by Bidder per Span		
3.12	Distance of Damper from clamp mouth		
	At Tension Point		
	i) First Damper ii) Second Damper iii) Third Damper		
	At Suspension Point		
	i) First Damper ii) Second Damper iii) Third Damper		
3.13	Diagram showing power dissipated by Damper in watts for various frequencies and amplitudes enclosed		
3.14	Standard to which materials will be manufactured and tested		

NOTE TO BIDDER

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	<u>EARTHING</u>		
1.0	Size of electrode		
2.0	Size of steel conductor from electrode to tower footing.		
3.0	Whether galvanised or not		
	a) Electrode	Yes/No	
	b) Steel conductor in 2.0 above	Yes/No	
4.0	Size of conductor for counter poise		
5.0	Whether conductor for counterpoise is galvanized	Yes/No	

Note :- The specifications are indicative only and cover minimum functional requirements. It is total responsibility of Contractor to ensure full functionality of the system and all essential equipment / installation shall be deemed to be in the scope of the Contractor.

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