

TELANGANA STATE POWER GENERATION CORPORATION LIMITED

5X800 MW YADADRI TPS

TECHNICAL SPECIFICATION FOR TG HALL 140/25 T (DOUBLE GIRDER) EOT CRANES

SPECIFICATION NO.: PE-TS-417-501-A501



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA (U.P.)
INDIA**

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SECTION – I**SPECIFIC TECHNICAL REQUIREMENTS****SUB-SECTION IA – Specific Technical Requirement (Mechanical)****SUB-SECTION IB – Specific Technical Requirement (Electrical)****SUB-SECTION IC – Data Sheet A**

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PROJECT INFORMATION

YADADRI THERMAL POWER STATION

PROJECT INFORMATION

1	Name of the Project	YADADRI Thermal Power Station
2	Station Capacity	5X800 MW (Coal based)
3	Owner	Telangana State Power Generation Corporation Limited (TSGENCO)
4	Site Location	Site is located 7 km from the NH5.
5	Latitude	16° 42'20.40 N
6	Longitude	79° 34'41.56 E
7	Nearest Town	30 Km Miryalaguda
8	Nearest Railway Station	6.5 Km Damercherla
9	Nearest Airport	130 Kms (Vijayawada)
10	Site Conditions	
	Ambient Temperature	
	Daily minimum (average)	10°C
	Daily maximum (average)	47°C
	Design Ambient Temperature	50°C
	Ambient temperature (performance)	38°C
	Relative Humidity for design / efficiency	48-84 %
	Annual rainfall, mm	600 mm
	Plant Elevation above MSL	85 m above MSL
	Wind Speed	44 m/s
	Wind Pressure	As per the latest revision of IS 875/1987
	Seismic co-efficient	Zone-III as per IS- 1893 (Part-IV)

जलवायवी सारणी

CLIMATOLOGICAL TABLE

BACK

स्थान : नल्गोदा
STATION : Nalgonda

अक्षांश
LAT. 17°03'

देशान्तर
LONG. 79°16'

समुद्री तल माथ से ऊंचाई
HEIGHT ABOVE M.S.L.

मीटर
METRES

प्राप्तों पर आधारित
BASED ON OBSERVATIONS

1975-2000

STATION - NAIGUDDA		LAT. 17°03' LONG. 79°16'										HEIGHT ABOVE M.S.L. 227 METRES		BASED ON OBSERVATIONS 1975-2000									
माह	स्थान का सतह दाब	वायु तापमान										आर्द्रता	मेघ की मात्रा	बार				मास्य पवन गति					
		मास्य					वार्षिक							बार									
		शुष्क ताप	आर्द्रता	चरम ताप	माह से उच्चतम	माह से निम्नतम	दिनांक और वर्ष	और वर्ष	निम्नतम वर्ष	दिनांक और वर्ष	मासिक दिनेकी योग			वर्षा के सबसे कम मास्य माह का योग	वर्षा के सबसे अधिक मास्य माह का योग	24 घंटे की सबसे भारी वर्षा	दिनांक और वर्ष						
		AIR TEMPERATURE												EXTREMES					HUMIDITY		CLOUD AMOUNTS		RAINFALL
MONTH	STATION LEVEL PRESSURE hPa	DRY BULB °C	WET BULB °C	DAILY MAX °C	DAILY MIN °C	HIGHEST IN THE MONTH °C	LOWEST IN THE MONTH °C	DATE AND YEAR	LOWEST °C	DATE AND YEAR	RELATIVE HUMIDITY %	VAPOUR PRESSURE hPa	ALL CLOUDS	LOW CLOUDS	MONTHLY TOTAL	NO. OF RAINY DAYS	TOTAL IN WETTEST MONTH WITH YEAR	TOTAL IN DRIEST MONTH WITH YEAR	HEAVIEST FALL IN 24 HOURS	DATE AND YEAR	MEAN WIND SPEED		
जनवरी JAN	I	1989.9	21.3	19.3	30.8	18.4	33.8	16.1	36.0	17 1998	14.4	7 1992	82	21.2	2.0	1.8	13.5	0.4	155.7 1978	0.0	55.4 1978	11	
फरवरी FEB	I	1988.0	23.6	21.5	33.5	20.7	36.5	18.0	39.0	26 1980	15.4	5 1988	82	24.1	3.0	2.5	7.2	0.5	14.0 1999	0.0	49.2 2000	20	
मार्च MAR	I	1985.8	26.2	23.7	37.3	22.8	40.9	19.9	42.0	14 1983			80	27.4	1.7	1.4	6.5	0.4	88.5 1981	0.0	43.6 1981	13	
अप्रैल APR	I	1983.6	29.2	25.5	39.6	25.5	43.0	22.4	44.5	30 1991	14.6	15 1987	73	29.7	2.1	2.0	17.6	1.0	65.6 1981	0.0	40.6 1981	24	
मई MAY	I	1980.8	31.9	26.3	41.2	28.2	44.8	23.5	46.1	26 1984			63	29.7	2.7	2.5	27.0	1.4	94.3 1991	0.0	49.0 1981	5	
जून JUN	I	1978.2	29.8	25.7	37.6	27.2	42.6	23.4	46.3	2 1998	21.8	12 1991	71	29.9	5.1	4.4	65.9	3.5	48.2 2000	0.0	81.7 1991	12	
जुलाई JUL	I	1978.8	27.7	24.7	33.9	25.5	37.3	23.2	39.2	7 1992	22.0	2 1992	77	28.6	6.3	5.8	124.6	6.0	176.7 1977	36.8 1979	99.2 1977	24	
अगस्त AUG	I	1979.6	27.1	24.3	32.8	25.0	35.4	22.8	37.5	25 1979	22.0	2 1981	78	28.2	6.1	6.0	133.0	6.7	189.0 1998	33.2 1979	88.2 1977	14	
सितम्बर SEP	I	1982.0	27.4	24.4	33.6	24.9	36.4	22.8	38.5	23 1987	21.6	8 1989	77	28.3	4.9	4.2	145.5	5.8	393.1 1991	20.3 1984	152.2 1991	21	
अक्टूबर OCT	I	1985.3	26.5	23.8	33.1	23.7	36.2	21.4	36.5	1 1987	19.2	28 1980	78	27.2	4.0	3.7	104.3	3.8	333.1 1981	4.2 1984	109.2 1987	6	
नवम्बर NOV	I	1987.9	24.2	21.0	31.1	21.2	33.5	17.9	35.5	7 1996	14.6	27 1981	75	22.6	3.2	2.6	48.1	2.8	66.8 1991	1.1 1981	163.5 1987	4	
दिसम्बर DEC	I	1990.3	21.7	18.6	30.0	18.6	32.2	15.7			12.6	16 1993	73	19.4	2.7	2.3	3.8	0.3	3.1 1987	0.0	3.1 1987	10	
सर्वाधिक ताप ANNUAL TOTAL OR MEAN	I	1983.9	26.7	23.4	34.8	23.7	44.3	15.9	46.3	2 1998	12.6	16 1993	75	26.6	3.7	3.2	696.8	32.5	631.7 1982	631.7 1992	163.5 11 1987	4	
सर्वाधिक संख्या OF YEARS	I	19	19	19	19	19	21	22	19	19	19	19	19	19	18	17	20	20	16	16	23		

स्टेशन : नलंदा
STATION : Nalanda

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**SUB-SECTION IA
SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)**

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SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

- 1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles fill of lubricants & consumables along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, trial run at site and carrying out performance guarantee/Functional/Demonstration tests at site (As applicable), and OPERATION AND MAINTENANCE SERVICE including manpower, supervision, consumables etc. for operation & maintenance of cranes for 24 crane-months for each crane after commissioning & final handing over to end customer (after O & M service) in flawless condition of crane(s) for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. **Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection & commissioning and load testing of the cranes and its accessories.**
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification **within 10 days of receipt of tender documents.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

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1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.

1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, more stringent requirement as per the interpretation of the owner shall apply.

1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.11 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or customer including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.

1.12 Apart from specific design requirement for crane, design of various systems/ Sub-systems and all equipment will also strictly meet the stipulations of Customer's Technical Specification.

Note:

Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (<http://dms-server.bhelpem.com/Wrench%20Web%20Access/Login.aspx>).

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1.0.0. SCOPE OF WORK**1.1.0. SCOPE OF SUPPLY**

1.1.1. Equipment and services to be furnished by the bidder for the Four (4) nos. 140 T /25T capacity double girder EOT Cranes (Two (2) nos. working in tandem with lifting beam for TG Hall for unit 1 & 2 and Two (2) nos. working in tandem with lifting beam for TG Hall for unit 3, 4 & 5) with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the EOT crane complete for efficient operation shall also be under the bidder's scope of work.

1.1.2. Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

1.1.3. Crane shall include but not be limited to the following: -

- a. Bridge girders
- b. End carriages with wheels
- c. Crab (trolley)
- d. Cross Travel & Long Travel drive arrangement
- e. All electrical equipment including cables, junction box, VVVF drive, RRC & pendent and panels etc. as per datasheet A.
- f. PVC Cu insulated shrouded bus bar conductor type DSL
- g. Earthing arrangement
- h. Fill of lubricants till handing over.
- i. Painting of cranes and accessories including touch up painting at site.
- j. Temporary cables (For both the phase i.e. phase I of Unit 1 & 2 and phase 2 of Unit 3,4 &5) for operation of each crane during erection stage of the plant (Half the bay length + 25m)
- k. Rail including all accessories and end stopper
- l. Maintenance tools & Tackle
- m. Erection & Commissioning spares
- n. Mandatory Spares
- o. Operator's cabin.
- p. Main Isolating switch in enclosure at operating floor for disconnecting supply to DSL. Termination of incoming cable (from BHEL) into isolating



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switch shall be in Vendor's scope. For maintenance of cranes, 2 nos. isolating switches are to be provided at extreme ends of bay for both the phase.

- q. Slings and cradle for load testing on returnable basis
- r. 2 Set of Endless slings as per attached document (Method for lifting Generator Transformer & Station Transformer using slings & EOT Crane & reference drawing of handling)
- s. 2 Nos. Lifting beams of 235T capacity
- t. Storm brake (Hydraulic rail clamp) (2 nos. per crane)

1.1.4 Maintenance Tools and Tackles

As per Annexure III, section-IA of this specification

1.1.5 Mandatory Spares

A complete unused and new set of Mandatory Spare parts shall be supplied. Each part shall be stamped so as to be identified, easy for it use. The items supplied shall be of the best quality. The minimum requirement of mandatory spare parts is listed in Annexure –II section-IA of this specification.

1.1.6 Erection and Commissioning spares

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. Fill of lubricants; oil etc. till commissioning of the cranes shall also be supplied by the bidder.

1.1.7 Any supplies mentioned in GCC, SCC as relevant to the package

1.2.0 Services to be provided by the bidder

1.2.1. Packing, forwarding and transportation to site

1.2.2. Development of storage space including ward & watch of the equipment and handling at site.

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1.2.3. Arranging test load at site

Collecting the test load at site within a radius of 1-2 KM from owner's storage to final testing bed of crane shall be under bidder's scope of work. Test load in the form of rolled steel, plates, girder, angle etc., as available at the site shall be made available by the purchaser. The test load shall be put back to the place from where it was lifted by the vendor, after the load testing. Load testing sling, cradles and any other item required by the vendor during the load testing shall be arranged by the vendor at no extra cost to the purchaser. Slings & cradles will be allowed to be taken back by the vendor, after completion of the test at site.

1.2.4 Erection and Commissioning**1.2.5 Demonstration / Load test at bidder's Works and at site.****1.2.6 Obtaining clearance and acceptance certificate from the concerned competent**

Authority after site test and as and when required as per Government Norms /Statutory body till the time of final handling over to Customer. Necessary fees/expenditure as required shall be borne by the supplier.

1.2.7 Operation & maintenance for two years of each crane with details as per Annexure A which may be further extended as per requirement to be intimated by BHEL site. However bidder to note that warranty period as per relevant clause of GCC shall start after handling over the cranes to BHEL/customer after completion of O&M services.)**1.2.8 Any service mentioned in GCC & SCC as relevant to the package.****1.3.0. PAINTING & COLOUR SCHEME**

As per Annexure IV, section-IA of this specification

2.0.0. Works Excluded

Supply feeder and cable from feeder / MCC to isolating switch.

Gantry girder

Dead load for load/ overload testing at site

Space for storage.

Exclusion, if any, mentioned in GCC, SCC.

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3.0.0. Drawing and documents submission schedule along with number of prints.

Drawing and documents submission schedule along with number of prints / copies required for various drawing and documents are listed in Annexure –V, section-IA of this specification.

4.0.0. Deviations

If the offer submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the format of “Cost of withdrawal of deviation” attached in Section III and furnishing full particular of such deviations. Deviations are to be furnished with mention to specific clause number (reasons / explanations for such deviations shall be furnished). Notes / comments etc. is not acceptable. If there are no deviations from the tender document, bidder shall mention “**NO DEVIATION**” in cost of withdrawal of deviation format.

5.0.0. Makes of Sub - Vendor items

Makes of bought out items as per Annexure-I, section IA of the specification is for reference only. Sub vendor list shall be subject to customer approval and same shall not have any impact on manufacturing, delivery schedule and cost of the crane.

6.0.0 Parameter and tolerances for structural assembly including rail shall be as per the relevant standards.

7.0.0. Performance Test requirement

EOT crane along with its drives, controls and other accessories shall be checked for the rated capacity against the rated speed of motions and for the service conditions specified.

The bidder shall have the full responsibility for the safe and efficient operation of the crane with associated accessories as a single unit. If the site performance tests indicate the failure of any of the components to achieve the desired performance, the deficiency shall be made good at bidder's cost.

Performance test shall be carried out each time after the rectification /modification is carried out.

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Performance test of the crane shall include load tests and speeds in various motions at site.

7.1.0 Testing at site

Completely assembled crane at site shall be check for misalignment of gears, shafts and other items. Following minimum tests shall be conducted on the crane at the site

- i. Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.
- ii. Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated. Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177
- iii. All Other tests as per IS-3177.
- iv. Load & overload test along with deflection test of lifting beam in line with BHEL approved MQP for lifting beam (if applicable).
- v. Speed test at rated load for hoisting, CT and LT mechanism.
- vi. Brake test.
- vii. Any other test as per IS-3177

Note: The test shall be carried out with actual panel, RRC, Master Controller etc.

8.0 Consumables

The Bidder's scope includes requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. till handing over. Consumption of all these consumables till handing over shall also be included in the scope of the Bidder. Bidder shall also supply a quantity of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilized till handing over. This additional quantity shall be supplied in separate Containers.



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OPERATION AND MAINTENANCE SERVICES SHALL INCLUDE BUT NOT LIMITED TO FOLLOWING (FOR TG HALL CRANE ONLY) ANNEXURE A

- 1.0 Scope covers operation and maintenance service including manpower, supervision, consumables etc. for complete operation and maintenance of four numbers 140/25T Double Girder Crane for Power House area for two years after successful erection, commissioning & load testing. The O & M period shall be started after successful load testing at site.
- 2.0 For Operation of the Crane An experienced crane operator or shall be available for each crane as and when required by BHEL for at least 16hrs a day, daily.
- 3.0 For Maintenance of the Crane
 - a) Break-Down Maintenance
 - i) In case of any break-down of the crane during the contract period, service engineer shall be made available at site within 72 hrs.
 - ii) All the critical spares and consumables, as deemed necessary by the manufacturer shall be made available at the site. No delay in crane maintenance shall be allowed by BHEL due to non-availability of required spare at site.
 - b) Preventive Maintenance
 - i) Following work should be carried out quarterly

Bridge and Trolley wheel assembly	Checking for wear, flat spots and cracks in flange. Ensure drive wheels are of the same diameter.
Runway	Checking alignment and elevation of gantry track. Checking rail clamp bolts.
Machine Bolts	Checking all foundation bolts of Electrical and Mechanical equipment for tightness.
Structural Bolts	Checking for tightness. They should also be checked after the first month of operation.
Flexible Couplings	Checking pins and teeth for wear, cleaning and greasing.
Cross-shaft Plummer Blocks	Dismantling cap. Cleaning and checking oil seals and to be packed with fresh grease.



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Trolley Collectors	Checking of cable trolleys / cabling / chain. Ensuring connection of trolley wheels is kept through entire length of span.
Brakes	All Brake assembly will be checked for loose connection, earthing connection, linings for wear, leakages and adjustments to ensure brake is not rubbing the brake drum during operation. Greasing pins and operation adjustment of brakes.
Resistor Connections	Checking, tightening connections at grid joints and at cable terminations.
Control Station	Clean out control cabinets. Checking of all connection at push buttons, master controllers contact tips, cams and terminals.
Control Panels	All Control Panels will be checked for loose connection and cleaning the contactor contacts, if required will be replaced.
Electrical Motors	All motion motors connection will be checked for loose contacts in terminal box loose crimping of wire lugs, loose contacts on slip ring assembly with carbon brush. Earthing connection with motor.
Safety Switches	All limit switches will be checked for desired operation and limits. Emergency switches will be checked.
Main Collectors	Checking of worn collector shoes, sag in main runway wiring, ensuring contact is kept through entire length runway properly.
Electrical connections	Checking throughout electrical equipment for loose connection such as selector switches, junction boxes, min isolator switch etc.
Lubrication	All gear box and thrusters' oil level will be checked. All bearings, couplings' grease will be checked.
Testing	After completion of checking and required rectification, trolley will be checked for idle operation, for brake operation, limit switch operation & safety switch operation. All motor currents will be checked on no load.

ii) Following work should be carried out annually



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Gear Boxes	Oil seals will be checked, if required will be replaced. Gear and pinion teeth will be checked. Drain the oil cleaning gear box and refill fresh oil.
Motor	All motors' insulation test and meagre test will be carried out.
Resistance Box	All resistance boxes' step resistance value will be checked.

- iii) Besides the quarterly and annual preventive maintenance schedule mentioned above, operator shall carry out any daily, weekly, monthly maintenance schedule as deemed necessary and shall operate the crane only when the fitness of the crane for operation has been ensured.

4.0 Bidders' scope of work shall also include, arranging the statutory clearance from the concerned Government body/Authority as and when required for renewal of license till handing over. It shall be bidder's responsibility to ensure the presence of competent authority at the time of testing and obtaining the clearance and acceptance certificate from the concerned authority. Necessary fees/expenditure as required shall be borne by the supplier.

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QUALITY ASSURANCE AND INSPECTION REQUIREMENT

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1.1.0. Inspection and Testing

Bidder shall submit QAP based on the guidelines given in the specification & QAP enclosed therein.

1.1.1. Inspection and testing at Manufacturer's works

Copy of approved documents with stamp and signature (one set) shall be available at the place of Inspection which shall be ensured by supplier.

Shop inspection and tests will include but not limited to the following –

STAGE INSPECTION

Stage inspection of various components of crane shall be guided by the MQP approved during detail engineering. Indicative MQP is attached in the specification. However, following shall be ensured and read in conjunction with relevant clause of MQP w.r.t. stage inspection:

- i. All test certificates shall be in original and legible. Photocopies certified by Mill/ manufacturer of raw material used, are acceptable.
- ii. For tensile testing of hooks/ forgings, samples shall be drawn from the full cross section of the shank diameter of hooks/ forgings Samples forged to reduced cross section for testing purposes is not acceptable. **Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable.**
- iii Radiographs shall be inspected to a sensitivity of 2%.
- iv Ultrasonic test on forgings and casting of critical components like cross head (hook suspension block), Hooks, Shafts, Axles, Gears, Wheels, Pulleys etc. Ultrasonic test on forgings shall be carried out as per norms given below. UT shall be carried out in Proof machined condition (single diameter/ Flat surface without steps, keyways, teeth cutting or other profile machining which can create difficulty in ultrasonic testing). Components shall be identified with Heat number and serial number by punching). Hardening operation shall be carried out prior to Ultrasonic testing.

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps



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2. Defects giving indication larger than '4 (four) mm diameter equivalent flaw' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flaw.'
3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia. equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 40%.
4. Defects giving indication of 2 to 4 mm dia. equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws except for wheels for which Defects giving indication of 3 to 6 mm dia. Equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws Ultrasonic test on Castings shall be carried out as per ASTM E 609.

Wherever, the Quality plan calls for witness of Ultrasonic test by BHEL or BHEL's representative, the material shall be offered for UT in proof machined condition as stated above and hard stamping and subsequent stamp transferring by BHEL shall be followed at subsequent stages to ensure trace ability.

- v. Gear boxes shall be checked at No load for backlash, tooth contact, noise, temperature rise and vibration as per attached Procedure No. PEM (Q)/001.
- vi. Test certificates shall be furnished for verification of Type tests including environmental tests - for electrical and electro-mechanical items. If Type tests for items with similar / identical construction are not available, arrangement shall be made to conduct the same in the presence of BHEL/ Customer's representative (as required).
- vii. Acceptance and routine tests (HV and insulation) for all electrical and electro-mechanical components and system as per governing specification

FINAL INSPECTION- Testing At Works.

Cranes shall be completely assembled at manufacturer's works to check the misalignment of gears, shafts and other items. Gears shall be run idle for at least 4 (four) hours. Following minimum tests shall be conducted on the crane at the works of the manufacturer:

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- a) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.
- b) Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated.
- c) Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177
- d) All Other tests as per IS-3177.

Procedure for Load/Overload testing of EOT cranes at Manufacturer's Works & Site

Refer Testing requirement as mentioned at ANNEXURE-VII.

Load testing procedure of lifting beam at Works:**1) Scope:**

This covers the guidelines for load testing of lifting beams of EOT cranes.

2) ACCESSORIES AND FACILITIES NEEDED:

- a) Slings of suitable size and length, proof load tested at 2 X Safe working load (SWL).
- b) Jacking system/ Any other mechanism
- c) Supporting structure
- d) Test loads.
- e) Cradle for accommodating test load (if required).

3) PROCEDURE:

- a) Support the lifting beam on fabricated structure and hydraulic jacks at both ends as indicated in the attached sketch no LB/001.
- b) Place the load to be lifted under the lower lifting beam. Total test load shall be 1.25 times the SWL
- c) Drop the lifting slings from the lifting beam and safely tie it with the load.
- d) The sling should be tied with the lifting beam such that the slings should not be slack. This should ensure that the slings are in full tension when the lifting beam is elevated by at least 100mm

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- e) Fix the necessary measuring instrument in the lifting beam with wire and plumb to measure the initial reading for vertical deflection of both lower and upper lifting beam.
- f) Now elevate the lifting beam by means of hydraulic jacks, such that the lifting beam is elevated by at least 100mm.
- g) Ensure that the whole load is lifted clear from the floor.
- h) Ensure that the elevation is equal at both ends.
- i) Now the load is lifted by 100 mm and hence the sling is in full tension.
- j) Keep the load in lifted condition for one minute.
- k) Measure the deflection of the lifting beam structure.
- l) Bring down the lifting beam to its original position with the help of jack.
- m) Make the lifting beam free from testing position and put in safe place.
- n) Visually check the weldments of lifting beam and carryout DP test in case of doubt.

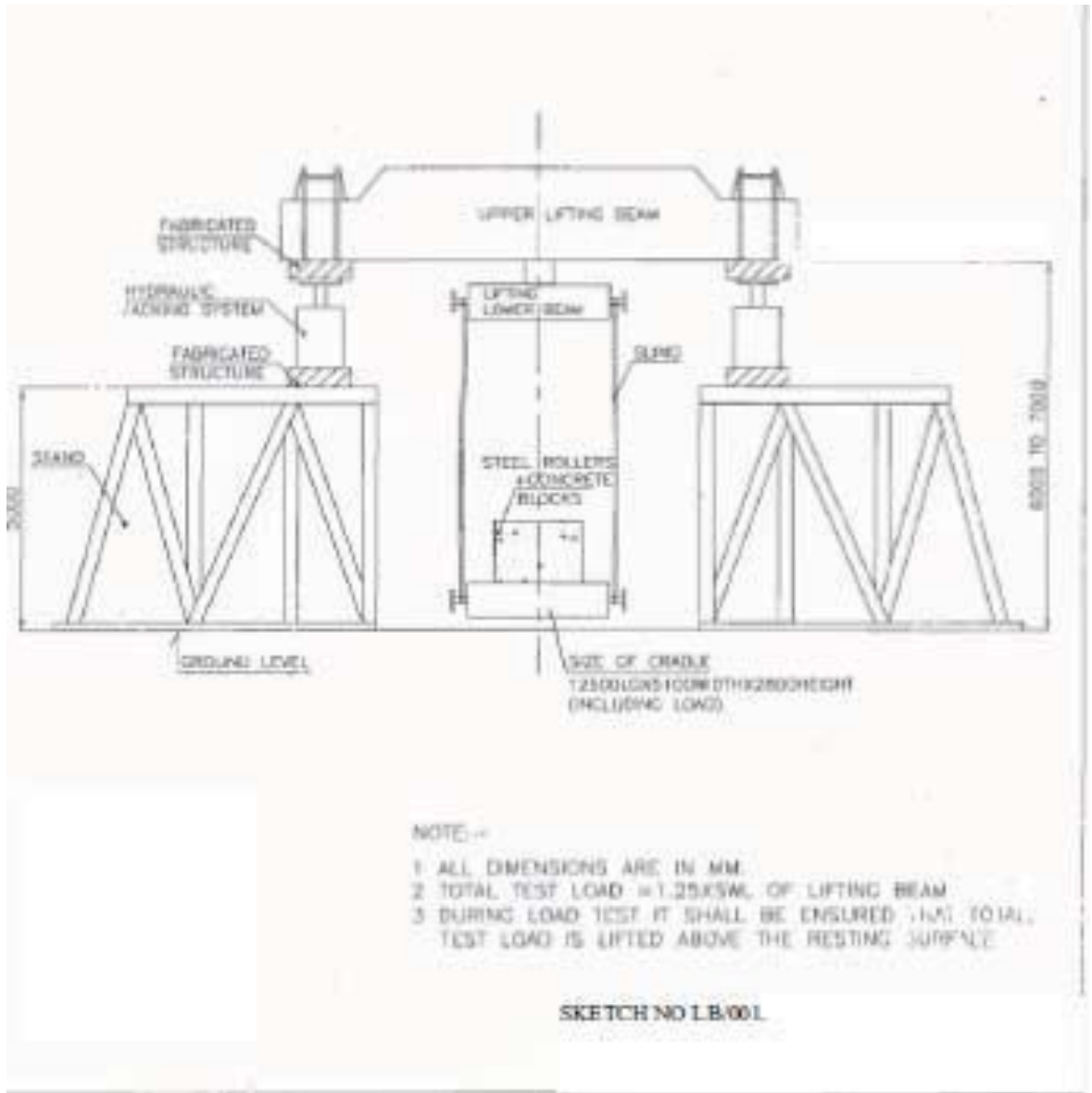
4) REMARKS:

The dimensions of stand, cradle etc. in sketch no LB/001 are illustrative only. Bidder to make suitable arrangement as per their shop facility. In case the bidder has test pit facility instead of stands (illustrated in sketch LB/001), the same can also be used.



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Procedure No. PEM (Q)/001

SHOP TEST PROCEDURE FOR GEAR BOX

1.0.0	Scope: Acceptance Norms for Crane Gear Boxes
1.1.0	This procedure lays down the Acceptance norms for the Gear boxes for EOT crane. This standard also covers vertical gear boxes. Reduction Gears shall be tested for reduction ratio, backlash & contact pattern. Gear Box shall also be subjected to No load run test to check for oil leakage, temp. rise, noise and vibration.
2.0.0	The following dimensions shall be checked:
2.1.0	i. Diameter and keyway dimensions of input and output shafts. ii. Projection of input and output shafts beyond foundation holes and Centre lines of gear box. iii. Centre distance between input and output shafts. iv. Centre Height. v. Distance between foundation holes with respect to center line of the output shaft and distance of foundation holes from center line of the gearbox. vi. Overall dimensions
3.0.0	Backlash
3.1.0	The back lash shall be checked by dial gauge preferably (refer Figure –1). Lead wire may be also be used but final decision in case of dispute shall be taken by using dial gauge. The backlash shall be within the limits specified in the drawing. If the value of the backlash allowed is not specified in the drawing, the allowed backlash shall be a given in Table-1
4.0.0	Area of Contact:
4.1.0	Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2) For final stage of Hoist gearing: h / H shall be more than 30% $(a - c) / b$ shall be more than 40% For all other gears: h / H shall be more than 40% $(a - c) / b$ shall be more than 50%
5.0.0	Running Test
5.1.0	The gear boxes shall be run under no-load condition at the rated speed for minimum four hours in each direction and the following are to be checked:



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- i. All bolts at the joints remain tight
- ii. All gear mesh lines are getting enough lubrication
- iii. All bearings are getting enough lubrication
- iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour.
- v. Vibration : Maximum limit 125 microns (peak to peak)
- vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm.
- vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.

6.0.0 General

- 6.1.0** In addition to the above specific points, the following general points shall be ensured:
- i. Inspection pockets are provided as required.
 - ii. Gear box casings are provided with at least two fit bolts/dowels at the parting line.
 - iii. Dip sticks with minimum / maximum level markings are provided.
 - iv. Drain plugs are provided at convenient locations preferably at vertical wall of the housing.
 - v. Breathers are provided.
 - vi. Lifting lugs or eye bolts are provided as required.
 - vii. Wherever bearings have splash lubrication, oil retainers are provided.
 - viii. Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint.
 - ix. In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided.
- Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.

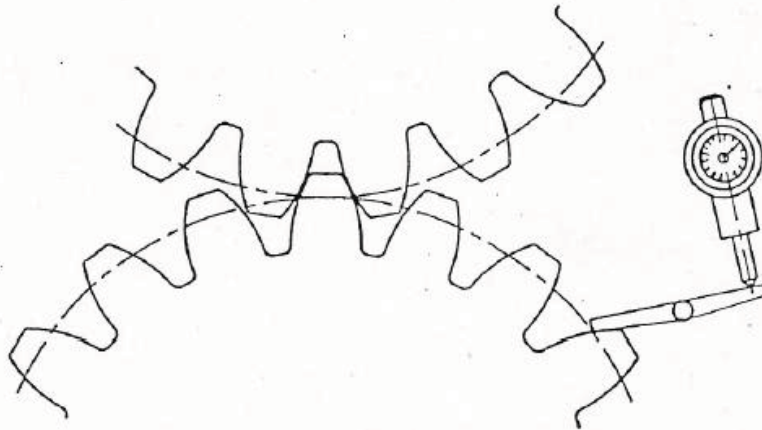
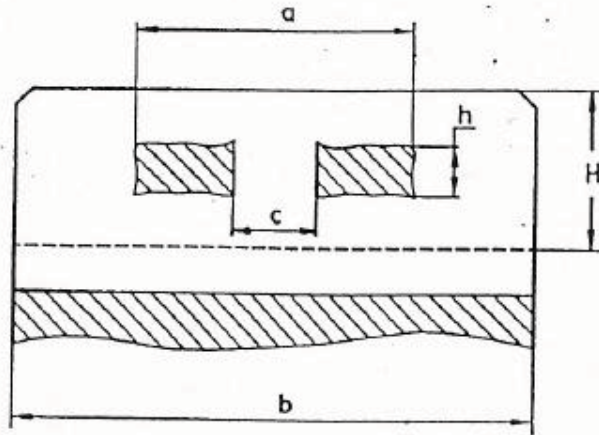
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**FIG.1 MEASUREMENT OF BACKLASH****FIG.2 AREA OF CONTACT OF GEAR TEETH**



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Table-1

Backlash for Gearing specified by module
(Clause 3.1.0)

Centre distance in mm		Tolerances in microns		
Above	Upto	Minimum	Maximum	
			For gears other than Drum gears	For Drum gears
			For all modules 1 to 50	For all modules 2.5 to 50
-	50	85	240	280
50	80	105	320	380
80	120	130	360	420
120	200	170	470	530
200	320	210	540	640
320	500	260	660	740
500	800	340	820	880
800	1250	420	970	1040
1250	2000	530	1200	1280
2000	3150	710	1500	1670
3150	5000	850	1810	1980



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CUSTOMER SPECIFICATION

1.00.00 **GENERAL INFORMATION**

This section covers the Electric Overhead Traveling Cranes (EOT) which will be required for handling various power plant equipment for erection and maintenance purposes. An indicative list of such cranes has been provided in Annexure-I. Apart from these locations, E.O.T cranes may also be provided to other locations, which the Bidder feels necessary subject to approval of Consultant/Owner.

2.00.00 **CODES AND STANDARDS**

The design, manufacture and testing of the crane shall conform to the latest editions of the following codes and standards

2.01.00	IS : 807 -	Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.
2.02.00	IS : 3177 -	Code of Practice for Design of Overhead Traveling Cranes and Gantry Cranes other than Steel Works Cranes.
2.03.00	IS : 1835 -	Round Steel Wires for Ropes.
2.04.00	IS : 2266 -	Steel Wire Ropes for General Engineering Purposes.
2.05.00	IS : 3443 -	Crane Rail Sections.
2.06.00	IS : 3815 -	Point Hook with Shanks for General Engineering Purpose.
2.07.00	IS : 5749 -	Forged Ramshorn Hooks.
2.08.00	IS : 816 -	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.
2.09.00	IS : 823 -	Code of Practice for Use of manual Metal Arc Welding of Mild Steel.
2.10.00	IS : 1181 -	Qualifying Tests for Metal Arc Welders (Engaged in Welding Structures other than pipes).
2.11.00	IS : 1323 -	Code of Practice for Oxy-Acetylene Welding for Structural Work in Mild Steel.
2.12.00	IS : 9595 -	Recommendations for metal arc welding of carbon & carbon - manganese steel.

- 2.13.00 IS : 15560 - Point Hook with Shank up to 160 tones - Specification
- 2.14.00 All electrical installation work shall comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended upto date.
- 2.15.00 ANSI-830.2.0 - Safety codes for overhead and Gantry Cranes.

In case of any contradiction between the above mentioned codes and standards (item 2.01.00 thru' 2.14.00 above) and this technical specification, the later will prevail. However, nothing in this specification shall be construed to relieve the Contractor of his responsibility to comply with what is mentioned against item 2.13.00 above.

3.00.00 **SCOPE OF WORK**

3.01.00 **Scope of work includes supply of the following :**

- 3.01.01 The required no. of E.O.T cranes as indicated in scope sheet having duty and service conditions as specified hereinafter alongwith all accessories.
- 3.01.02 Runway rails for entire runway length alongwith rail clamps, all inserts, insert plates, anchor bolts, nuts, buffers & stops, limit switches etc. as required.
- 3.01.03 Runway conductors for the entire runway length complete with all insulators, supports, support brackets, fixing clamps, bolts, nuts etc. as specified and as required to complete the installation. Power supply cabling including isolating switch complete alongwith electrical items, attachments and accessories as required to feed power to the runway conductor.
- 3.01.04 All protective devices, anti-collision limit switches etc. as required for the crane.
- 3.01.05 All facilities, accessories and attachments for single and tandem operation of the cranes.
- 3.01.06 Bridge and trolley current collectors and bridge cross conductors alongwith all wirings etc. for the crane as specified and as required to complete the scope of work.
- 3.01.07 Crane components shall be provided with lifting lugs, eye-bolts etc. at suitable locations for handling assembling, lifting and placing into position.

4.00.00 **SPECIFIC PERFORMANCE REQUIREMENTS**

4.01.00 **Capacity**

- 4.01.01 The safe working load (Y) for E.O.T cranes shall be computed as

$$Y = 1.10 a$$

Where, a = Single heaviest equipment expected to be handled ~~excluding Generator Stator.~~

4.02.00 **Highest Position**

The highest position reached by the lifting hooks should be such that during operation, the minimum vertical critical clearance between bottom of the equipment being handled and the top of any permanent structure or equipment in the operating area should be at least one metre.

4.03.00 **Lowest Position**

4.03.01 The lifting hooks of the turbine hall cranes should reach upto the ground level (0 m). The auxiliary hooks should reach upto the condenser pit level.

4.03.02 In case of all other E.O.T. cranes, the lifting hooks should reach upto the floor of its operating area or sump pits as necessary.

4.04.00 **Horizontal Clearance**

4.04.01 The lifting hooks in vertical position should reach at least upto 5m from the end stopper in case of turbine hall cranes and upto 2.5m in case of all other cranes.

4.04.02 Either the main or the auxiliary hook in vertical position should reach at least upto 1.5 m from the runway rails in case of turbine hall cranes and upto 1.0 m for all other cranes.

4.05.00 If safe and reliable handling necessitates more operating space for the E.O.T. cranes, the same shall be provided.

5.00.00 **DESIGN & CONSTRUCTION**

5.01.00 **General**

5.01.01 In the design of components on the basis of strength, factor of safety shall not be less than five (5) based on ultimate strength. Impact, fatigue, wear and stress concentration factors shall be taken into account, wherever applicable. Mechanism class shall be as indicated in the Data Specification Sheet.

5.01.02 The crane shall be rigid in construction and all movements shall be smooth and non-jerky. Acceleration for cross travel and long travel motors shall be limited to reasonable values as to preclude any swinging of the load.

5.01.03 Drives shall be designed with adequate margin to give best performance and efficiency. Safety arrangements shall be incorporated to prevent damage to motors on account of mechanical overload and electrical faults and to gearing, shafts, etc. due to over-stressing and other detrimental conditions.

5.01.04 All materials shall be of tested quality and shall conform to the specification requirements and standards mentioned and shall be new and first class in all respects.

- 5.01.05 Castings and forgings shall be of tested quality and shall conform to their respective material specifications and shall be free from flaws and objectionable imperfections, machined true and in a workman like manner.
- 5.01.06 No wood or other combustible material shall be used unless specifically approved by the Owner/Consultant.
- 5.01.07 Proposals for repair or any similar operations involving plugging, welding, boring or addition of metal to the original castings or forgings shall be submitted to the Purchaser and his approval must be obtained before any such work is carried out. Drawing showing details and location of such repairs shall be submitted to the Purchaser.
- 5.01.08 All fabrication by welding shall be carried out by qualified and certified welders as per reference quality plan
- 5.01.09 Design shall provide for easy maintenance of all parts, particularly the wheel bearings on end-trucks.
- 5.01.10 Temperature Effects
- Where any portion of the structure is not free to expand or contract under variation of temperature, allowance shall be kept for stress resulting from these conditions; the co-efficient of expansion for each degree centigrade variation of temperature above and below normal being taken as 0.000012 for mild steel. The maximum range of variation of temperature shall be as given in the Lead Specification. Cl. 8 of Section II of IS: 800-1962 Code of practice for use of structural steel in General Building construction - shall also apply.
- 5.01.11 Maximum use shall be made of shop fabricated sub-assemblies.
- 5.01.12 Alternative design to those prescribed in specifications will be considered only if found technically suitable and acceptable to the Owner in the light of requirements and accompanied by substantial reduction in cost.
- 5.01.13 Material of Construction
- The material of construction of the major components of the crane shall be as indicated in the Data Specification Sheet. Manufacturers are however free to use alternative material, which are superior for the intended service. But in all cases they are required to obtain prior concurrence of Owner after furnishing chemical and physical properties of the offered material and any other information that may be asked for by the Purchaser.
- 5.01.14 Load Indication
- The crane bridge shall have permanent inscription in English on each side, readily legible from operating floor, stating manufacturer's name, serial no., the year of manufacture and the safe working load.
- 5.02.00 **Structural Design Consideration**
-

5.02.01 Minimum thickness of metal

For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8mm thick. For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8mm. The chequered plates for platforms shall be minimum 6 mm thick over plain.

5.02.02 Accessibility for maintenance

All structural parts shall be designed so that they are accessible for periodic cleaning, brushing and painting. All rivets/bolts shall also be accessible for periodic checking.

5.02.03 Ruling dimensions and ratio

- a) For compression members, the slenderness ratio shall not exceed 120. In case of other load carrying members and subsidiary members the slenderness ratio shall not exceed 180.
- b) For girders, the following values of maximum span to depth ratio shall be governing :
 - Plate girders : Span/depth = 18
 - Lattice girders : Span/depth = 12

5.02.04 Connections

- a) Unless otherwise specified, only rivetted or welded joints shall be used.
- b) Where welding or riveting is not practicable, turned and fitted bolts shall be used, preferably as per IS-1364 and IS-1367.
- c) Minimum number of rivets or turned and fitted bolts in a connection shall not be less than two.
- d) Black bolts shall not be used in main structures and high tensile bolts shall not be used unless approved by the Owner. Bolts shall preferably be not used in tension.
- e) Where bolts pass through sections having tapered flanges, tapered flats shall be welded to inside of the flanges. Tapered washers shall not be used.
- f) Transverse fillet welds on load carrying members shall be avoided. If side fillets are used in end connections, the length of each side fillet should not be less than the edge distance between the fillets.
- g) Butt welds on structural members under tensile stress shall be checked by Radiographic examination as and when directed by the Owner/Consultant.

- h) Splices shall be designed to resist one and half times the forces and moments to which it is subjected, but in no case it shall be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders shall be designed for full strength of the web in shear as well as bending. For splicing tension members, the net section of the splice plate shall be ten percent more than that of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splices are in line with the gravity axis of the member to avoid eccentricity.

5.02.05 Deflections and Camber

- a) The total maximum vertical deflection of the girders for the live load plus trolley and not including impact or dead load of the girder shall not exceed limit of Span/900.
- b) The girders shall be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.

5.03.00 **Bridge Girder and End Carriage**

5.03.01 ~~The crane shall have single girder or double girder as required.~~

5.03.02 The bridge girder shall be box section type ~~or braced I beam~~ type as per standard design of the manufacturer. The exterior surface shall be smooth and as free from projections etc. as possible to minimise dust collection on it.

5.03.03 ~~Single girder cranes shall be provided with suitable truss for supporting the bridge drive machinery and motor.~~

5.03.04 The crane bridge shall be carried on end trucks of suitable design. Each end truck shall be built up from steel plates welded together to form a closed box section with opening at each end to receive the wheels. Welded to the trucks shall be steel sections to form bearings for the wheel axles and the driving shaft. End trucks shall be provided with rail sweep and bumper. They shall also be provided with suitable jacking pads for maintenance of the wheel and bearings. The location of the jacking pads shall be such that it will not interfere with the maintenance of the wheels and its bearing. Single girder crane will be provided with suitable truss for supporting bridge device machine & motor.

5.03.05 Driving wheels shall be of the double flange and taper tread type and shall be ground to equal diameter in pairs. Wheel axles may be either of the stationary or rotating type as per standard of the manufacturer. If stationary type, they shall be prevented from turning in the truck by means of a key plate fitting into a slot in the end of the axle and if rotating type, wheels shall be keyed to them.

5.03.06 Where more than two bridge wheels are used per end truck, the end truck shall be split into two sections, each carrying one bridge independent of other. Two sections of the end truck shall be joined by suitable joining device that will ensure uniform wheel loading. Steel pads shall be welded on the top of end trucks where the girder rests and shall be machined to receive the girder

ends.

5.03.07 Trolley travel rail ends shall be curved upwards to stop the trolley smoothly and prevent it from leaving the rails in case of over travel at its maximum speed.

5.03.08 End trucks shall be equipped with spring/rubber buffers and rail sweep for bridge travel. The rail sweep shall be such that it can push away any object that may fall on the runway. The buffers shall be of substantial design and suitable for engaging the stops at the end of runway.

5.03.09 Breathing holes shall be provided in completely enclosed welded box type girders. Drain holes shall be provided in all places where water or oil is likely to collect. Where practicable, means of access shall be provided for inside inspection of completely enclosed box girders.

5.03.10 In bridge girder strength calculations, the trolley rails and chequered plates shall not be considered as load carrying members.

5.04.00 **Trolley Frame**

5.04.01 The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction.

On bottom of trolley frame, on each side shall be a double spring bumper to engage stops at each end of the bridge.

5.04.02 Equaliser sheaves shall be mounted on the trolley frame in such a manner that deflection resulting from the force on the sheaves are not directly transmitted to the hoisting mechanism.

5.04.03 Sheaves shall be so arranged on the trolley that rope reeving arrangement resulting therefrom will ensure a lifting of the load in almost a vertical line with minimum of swing or side-movement.

5.05.00 **Platforms and Ladders**

5.05.01 Safe means of access shall be provided to the operator's cab and to every place where any person engaged in the examination or maintenance of the crane has to work. Adequate handholds and footholds shall be provided as necessary.

5.05.02 One metre high double tier handrail and suitable toe-boards shall be provided along the entire length of platform (on the bridge), which shall not be less than 750 mm wide. One platform for full span length on each side of the crane girder.

5.05.03 Every platforms shall be provided with steel chequered plate top and be securely fenced with one metre high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely.

- 5.05.04 In case lattice riveted construction is offered for the bridge girder, full length chequered plate platform with adequate headroom shall also be provided at bottom chord level for periodic checking of all rivets/bolts and other items.
- 5.05.05 Access to operator's cabin from bridge girder platform shall be by staircase having adequate width and proper sloping.
- 5.06.01 **Operator's Cabin**
- a) The operator's cabin shall be closed type, suitable for indoor service & complete with light, air-conditioning & seat. The cabin shall be located on one end of the crane bridge and under one of the bridge girders, so that it is offset to one side. The cabin shall be provided with guarding hand rails and the floor shall be covered with electric insulating carpet. A clear headroom of 2000 mm shall be ensured within the cabin.
 - b) A foot operated type warning gong shall be provided within the cabin. The cabin shall be of ample size to contain controllers, protective pannel, main isolating switch and other accessories required for operating the crane. A ten (10) lbs. capacity portable CO₂ fire extinguisher shall be provided in the cabin.
 - c) Provision shall be there for emergency exit of the Crane Operator at three convenient positions in case of power failure.
- 5.06.02 **Pendant Station**
- a) The pendant station shall have the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 metre above the operating floor.
 - b) With pendant operation, foot operated bridge travel brake and the drum controllers need not be provided.
- 5.07.00 **Repair Cage**
- 5.07.01 A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. In case, the trolley current collectors are located below trolley rail level on the inside webs of the bridge girders, guards shall be provided on the trolley to prevent the hoisting ropes from coming in contact with conductors as well as a repair cage shall be provided on the trolley to attend these conductors.
- 5.07.02 Repair cages shall also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels.
- 5.07.03 The repair cages shall be adequately sized, guarded for safety and correctly
-

located for the intended service. Suitable access to the cages shall be provided.

5.08.00 Lifting Hook Block Assembly

The lifting hook block assembly shall be ramshorn type or approved equal for capacity greater than 40 Tonnes and point hook with shank for capacity below 40 Tonnes and shall be of steel construction. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely on its bearings. Safety latch shall be provided in the hook.

The sheaves of the hook block shall be encased in an oil tight casing permitting generous lubrication of wire ropes and sheaves and also preventing accidental tapping of hands. Sheave pulley block shall be provided with ball/roller bearings.

All sharp edges on the hooks shall be eliminated to prevent damage to the sling ropes. The hooks shall conform to the requirements of IS: 3177.

5.09.00 Gearing

5.09.01 Gears in the speed reducer unit for bridge drive and also all hoists and trolley drive gearing shall be enclosed in substantial housing and shall operate in oil bath. The oil shall have additives of approved quality and shall be of approved viscosity at standard temperature (say 60°C). The housing shall be of sufficient design not to permit a temperature in excess of 90°C for the oil bath and shall be adequately supported and readily removable without disturbing the gear assembly.

5.09.02 Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.

5.09.03 Gears shall have tooth form and modules as recommended in IS-3681 and they shall be adequately designed to stand shock load and vibration and shall not be excessively noisy in operation. The ratings of gears shall be established as per IS : 4460.

5.09.04 Spur and helical gears only shall be used for reduction gearing.

5.09.05 Mounting of the gears shall be such that axial thrust on the bearing is minimum. Centre distance of the connecting shafts shall be as close as possible to the theoretical value. Shafts shall be designed to keep their deflections within permissible limits.

5.10.00 Bearing

5.10.01 The type of bearings for various parts shall be as per IS-3177 and standard of manufacturer.

5.10.02 Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as practicable to exclude dirt and prevent leakage of oil or grease. Arrangement for centralised lubrication of bearings

	shall be tried to the maximum extent possible and a detailed scheme for the same shall be furnished alongwith the tender.
5.10.03	Suitable drip pans shall be provided as required to collect oil and grease which may drop from operating parts. All drip pans shall be accessible for draining and cleaning.
5.10.04	All bearings of the gearing shall be antifriction type. Angular contact ball or taper roller bearings shall be used wherever necessary. The bearings shall correctly locate the shafts while allowing for thermal expansion of the shafts. Bearings shall be enclosed in suitable housing with proper holes and plugs to prevent any ingress of dirt and to permit easy lubrication of the bearings.
5.11.00	Guarding
5.11.01	Guards of an approved design, which will push forward or off the rail track any object placed across it, such as person's foot or arm, shall be attached to each end of the end carriage.
5.11.02	Protection guards to live electrical wirings/conductors shall be provided.
5.11.03	Suitable guards to revolving shafts and coupling, long travel cross shafts and gears, shall be provided.
5.11.04	The sheaves of the hook block fitted with two sheaves or fewer shall be guarded to prevent tapping of a hand between a sheave & the running rope.
5.11.05	Effective means of guiding the wire ropes over the sheaves shall be provided so as to prevent dismounting of rope from the sheave grooves even when a slack rope condition is developed.
5.11.06	All openings in footwalk flooring, for access to bottom chord platform, if any, and to other inspection platforms, shall be provided with covers having suitable locking means to avoid any accidental opening.
5.11.07	All electrical panels, resistance boxes shall have suitable rain/ dust hoods over them to prevent water and building construction material falling on them, as it is apprehended that erection and commissioning of the crane might have to be taken up before completion of the building roof.
5.12.00	Runway Rails
5.12.01	Crane runway rails with bolts and nuts and complete with shims, anchor bolts, inserts and other fixtures for fixing the rails to crane girders shall be under the scope of supply of the present specification.
5.12.02	The length of the rail supplied shall be sufficient to cover the whole of runway length. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.
5.12.03	The rail section shall be as per IS: 3443.
5.13.00	Trolley Rail

5.13.01	The specification includes the supply of trolley travel rails complete with fixtures for fixing the rails to the body of crane.
5.13.02	The length of the rail supplied shall be adequate for maximum permissible trolley travel. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.
5.14.00	Rail Joints and Fixing
5.14.01	The rails shall be butt jointed by either thermit welding or fusion welding process. The Contractor shall get his proposal for edge-preparation of rails, welding procedure and sequence, approved in advance by the Purchaser/Consultant.
5.14.02	The schemes of securing the rails to the gantry girder/bridge structure with clamps, bolts and nuts, their alignment etc. shall be subject to the approval of the Purchaser/Consultant.
5.15.00	Tolerances
	The limits of tolerance as specified in the Data Specification Sheet shall be observed.
5.16.00	Rail End Stops
	Rail end stops of adequate design shall be provided on both ends of the runway. The end stop location and arrangement shall be such that the unavailable length of runway (for crane operation) on any end is a minimum.
5.17.00	Drive Mechanism
5.17.01	Equal driving effort shall be applied at each drive wheel of bridge and trolley to prevent one end from travelling faster than the other.
5.17.02	For bridge, the torsional deflection in the cross shaft shall be limited to safe value as per applicable code.
5.17.03	For bridge drive, the motor shall be located at mid position of the span. If twin motors are used for drive, motors shall be equidistantly located at each wheel end. Suitable interlock shall be provided to prevent single motor operation at any time.
5.17.04	Trolley drive shall be achieved by single motor in which the motor shall drive a common output shaft through proper gearbox and tractive power shall be transmitted to the geared wheels by means of pinions mounted on both ends of the output shaft.
5.17.05	All machineries for the drive unit shall be properly aligned. Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement wherever necessary. Wherever components of considerable amount of inertia is directly mounted on the high speed shaft(e.g. brake drum, couplings, etc.) they shall be balanced statically

to minimise vibration.

5.17.06 Motor ratings shall be calculated keeping margin of at least 15% over the maximum power requirement. Further, the hoist motors shall be rated to lift 110% of the design load on the hook at the rated speed. For other details the clause no. : 5.19.00 below shall be referred to.

5.17.07 Along with the drive mechanisms adequate brakes shall be provided as detailed in clause no. : 5.20.00 below. Selection and design of brakes shall be complete responsibility of the manufacturer. The brakes shall be of accurate rating to stop each motion within a very short distance and in a safe and smooth manner.

5.18.00 Crane Electricals

5.18.01 The crane(s) shall be furnished complete with all electrical equipment, accessories (like drive motors with VVVF Drives, conductors, insulators, protective & operating devices, cables, current collectors, main disconnecting switch, Illumination etc.) and cabling/wiring as may be necessary for the efficient and safe operation of the crane.

5.18.02 The crane electricals shall be designed for satisfactory operation from the available power supply as given in the Data Specification Sheet.

5.18.03 All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion.

5.18.04 All electrical equipment shall be laid out so that they are readily accessible for inspection and maintenance.

5.18.05 All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion. All cabling shall be carried out using XLPE insulated fire resistant (FRLS) cables & wiring by Heat resistance PVC wires with stranded conductors.

5.18.06 All electrical equipment shall be laid out so that they are readily accessible for inspection and maintenance.

5.18.07 The hoist structures, motor frames & metal comes of all electrical equipment on EOT crane/hoist shall be effectively grounded as per Indian Electricity Rules.

5.18.08 If the pendent control is of metal, it shall be earthed.

5.18.09 All equipment offered shall have suitable provisions for termination and connection of power and control cable inclusive of cable end box, brass compression glands terminal lugs and terminals. Incoming switch-fuse shall be provided at each panel for incoming AC/DC power supplies.

5.19.00 Drive Motors

	Motors..
5.19.02	Motors shall be squirrel cage induction , designed for crane duty requirement of frequent starting. Reversing and plugging motors of single girder EOT crane shall also be squirrel cage type. All motors shall be suitable for VVVF operation.
5.19.03	Motors shall suit the duty class S4.
5.20.00	Brakes
	Selection and design of brakes shall be such as to meet the following requirements
5.20.01	Service Brake
	a) Double-shoe type service brakes shall be provided for each motion of the crane and its hoists. The service brakes shall apply automatically when power supply to the drive motor is cut-off or fails. b) Service brakes for main hoist motion shall be electro- hydraulic thruster type for all double girder cranes either cabin or pendant operated and electromagnetic disc. type for single girder crane; adequately sized to arrest motion and hold at rest any load upto and including test load at any position of the lift.
5.20.02	Hoist Control Braking Means
	Hoist motion (both main and auxiliary) shall be provided with a self-contained sturdy braking system, electro- hydraulic thruster type, to control the speed of hoisting as well as lowering down to 10% rated speed. The braking system shall be reasonably uniform and effective with all loads (from no-load to full-load) on hooks.
5.21.00	Main Disconnect Switch
5.21.01	Main disconnect switch shall be metal-clad, 3-pole, load-break type in IP-54 enclosure, complete with compression brass glands and lugs.
5.21.02	The switch shall be provided with "Power On" red indication lamp (Clustered LED type) and shall be suitably located so that it can be manually operated from the operating floor level.
5.21.03	Power leads shall run from the main disconnect switch to the runway conductors.
5.22.00	Runway Conductors (Down Shop Leads)
5.22.01	The runway conductors shall be four (4) in number for three phase supply and ground.
5.22.02	The runway conductors shall be of M.S.angle sections, liberally sized so as not to exceed current density of 0.42 Amps/sq.mm. However, for small

- capacity cranes having lower spans i.e. compressor house crane, flexible copper cable will be used.
- 5.22.03 Sufficient allowance (minimum 20%) for wear and tear shall be provided over the calculated conductor size.
- 5.22.04 The runway conductors shall be supported on brackets and insulators from the crane girder with sufficient spacing in between the conductors.
- 5.22.05 The collector system per conductor shall be top-running type having spring loaded cast iron/carbon metallic shoes to maintain adequate contact pressure.
- 5.23.00 **Cross-Conductors on Bridge**
- 5.23.01 Cross conductors on bridge shall be flexible trailing cable system mounted on retracting supports (festoon type).
- 5.23.02 ~~Alternatively cross conductors of M.S. angles with shoe collectors, similar to the arrangement of runway conductors may be offered.~~
- 5.24.00 **Power Distribution Equipment**
- 5.24.01 From the main collector shoes, wiring shall be extended to two (2) nos., 3-pole, load-break, safety disconnect switches -one at the bridge near the collector and the other in operator's cabin within easy reach.
- 5.24.02 The safety switches shall be capable of cutting-off the supply to all power driven and associated equipment of the crane but not the auxiliary loads such as fans, lights etc.
- 5.24.03 From the safety disconnect switches, wiring shall be extended to a protective panel, containing the following as a minimum :
- a) One triple pole incoming supply disconnect switch.
 - b) One triple pole main magnetic contactor with HRC fuse backup, ON-OFF push buttons and RED-GREEN indication lamps (LED type).
 - c) Motor feeders, each comprising of triple pole fuse switch unit with thermal overload (hand reset) relays for short circuit and over load protection in all three phases of the motor.
 - d) Outgoing feeders with double-pole switch fuse units for auxiliary loads such as control supply, lights, fans, etc. with atleast one spare feeder.
- 5.25.00 **Voltage Drop**
- 5.25.01 All conductors and cables/wires shall be so sized that the voltage drop measured between the main disconnect switch and motor terminals shall not exceed 3% of rated voltage.
- 5.25.02 The voltage drop shall be computed using the total running current of all
-

crane motors that can operate simultaneously and with rated crane load.

5.26.00 **Safety Interlocks**

5.26.01 Disconnect Switch

- a) The operating handle of the main/ safety disconnect switch shall be mechanically interlocked with enclosure cover such that the same can not be opened unless the switch is in OFF position.
- b) Main/ safety disconnect switch shall have provision of pad-locking in OFF position.

5.26.02 Main Contactors

- a) The main contactor shall be electrically interlocked so that it can not close unless all the motor overload relays are RESET and all controllers are in OFF position.
- b) The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

5.27.00 **Emergency Switch**

Mushroom type emergency STOP push buttons to open the main contactor shall be furnished - at least one in operator's cabin and two on bridge platform within easy reach.

5.28.00 **Crane Controls**

Fully magnetic control shall be furnished complete with master controller (applicable for cab operated cranes only and not for pendant controlled cranes) for each motion, complete with contactors, time lag relays, plugging protections, resistors and other accessories to meet the following control requirement :

5.28.01 Hoist Motions (both main and auxiliary)

- a) VVFC or Conventional rotor resistance control shall be used in both hoisting and lowering directions, with a minimum of five (5) speed steps in each direction.
- b) Hoist control shall be designed to achieve "Inching Speed" of 10% the rated speed in both hoisting and lowering directions with loads (no-load to full-load) on hook.

5.28.02 Travel Motions (both bridge and trolley)

VVFC control shall be used in both forward and reverse directions, with a minimum of four (4) speed steps in each direction.

5.28.03 **General**

- a) All controls shall be designed to be fail-safe on loss of power.
- b) Control circuits shall be suitable for 240V 1ph 50Hz supply and complete with suitable dry type control transformer with isolation facility and primary/secondary fuses.
- c) Individual control/resistor panel shall be furnished for each motion for ease of inspection and maintenance.

5.29.00 **Controllers**

5.29.01 Master controllers for all motions shall be so arranged in the operator's cabin as to provide maximum convenience and view of the operator.

5.29.02 All controllers shall be provided with spring return to OFF position feature. When in OFF position, the controller shall disconnect power supply to the respective motor.

5.29.03 Each controller shall bear suitably engraved inscription of motions controlled in English & Hindi and of direction of motions by arrows.

5.30.00 **Resistors**

5.30.01 The resistors shall be heavy duty,punch-grid type of stainless steel. Resistors shall be rated for 10 minutes and the maximum temperature at any time shall not exceed 250°C.

The resistor grids shall be housed in expanded metal enclosures IP-23 and shall be so mounted as to prevent vibration. Sufficient space shall be provided around the resistors to ensure adequate cooling air flow. Adequate weatherproof protection shall be provided for resistor enclosure.

5.31.00 **Limit Switches**

5.31.01 The limit switches shall be totally enclosed type IP-55 with properly designed actuators and shall be readily accessible for adjustment and repair.

5.31.02 Each hoist shall be furnished with two (2) limit switches :

- a) A screw type limit switch with self resetting features which will act in case of overhoisting.
- b) A gravity operated hand-reset type limit switch as a back-up protection against over-hoisting.

5.31.03	Track type limit switches shall be provided on the bridge and trolley to prevent overtravelling in either directions.
5.32.00	Panels
5.32.01	All protection and control panels required for Cranes shall meet the technical requirements of "Electrical Equipment & Accessories, Volume-V".
5.33.00	Illumination
5.33.01	Crane lighting and space heating systems shall be designed for 240V 1ph 50 Hz supply and receptacle system 24V 1ph 50 Hz supply. Suitable dry type transformers (2x100%) shall be furnished for the purpose, complete with isolation facility and primary/secondary protection using Moulded Case Circuit Breaker (MCCB).
5.33.02	The lighting distribution board shall be located in the operator's cabin. Branch circuits for lighting and receptacles shall be individually protected by switch fuse units.
5.33.03	CFL fixtures shall be used for lighting operator's cabin and bridge platform. Four (4) 250W high-bay sodium vapour fixtures shall be provided below bridge for illumination of the working zones.
5.33.04	All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
5.33.05	24V - 5A - 3 pin industrial socket outlets shall be provided – two (2) in operator's cabin and minimum four (4) on the bridge along the walkway.
5.33.06	One (1) portable 40W handlamp with plug shall be furnished with adequate length of flexible cable for inspection of crane components.
5.33.07	Operator's cabin shall be provided with one (1) electric fan.
5.33.08	One (1) heavy duty type industrial siren shall be provided with each crane. The siren shall be operated from foot-switch in the operator's cabin.
5.33.09	Conduit wiring system shall be used for lighting circuits.
5.34.00	Wiring
5.34.01	All power, control and auxiliary circuit wiring shall be furnished and installed as per best installation practice. The design shall be such as to maximise shop wiring and minimise field wiring.
5.34.02	All wiring shall be done with 1100V grade fire resistance PVC insulated wire in conduits or by 1100V grade PVCA PVC cables with extruded inner sheath.
5.34.03	Conductors shall be stranded aluminium for power and stranded copper for control. Minimum conductor size shall be not less than 2.5 sq.mm copper or equivalent.

- 5.34.04 Conduits shall be heavy gauge, rigid steel, hot-dip galvanised, cut square, reamed, threaded and screwed tight at all joints. Conduit entry to pull box or enclosure shall have double locknuts and insulating bushing. No running thread shall be used.
- 5.34.05 Solderless connectors shall be used for all connections. No splices shall be permitted in wire or cable. No taps or connections shall be made in fittings or junction boxes.
- 5.34.06 All wires and cables shall be identified with permanent markers at terminations as per approved wiring diagram.
- 5.35.00 **Grounding**
- 5.35.01 The crane rails, structures, motor frames, metal enclosures of all electrical equipment, conduit and tray system shall be effectively grounded in accordance with Indian Electricity Rules.
- 5.35.02 Bonding of structures and crane rails shall be provided as required to ensure electrical continuity.
- 5.35.03 The crane grounding system shall be connected to station ground mat. For this purpose, the Purchaser will provide ground conductor (50 x 6mm M.S. flat) at two agreed locations.
- 6.00.00 **INSPECTION AND TESTING**
- 6.01.00 **Tests at shop**
- 6.01.01 The cranes shall be subject to full load and overload tests as per ~~IS-3177~~. after complete assembly and wiring. In case of ~~non-availability~~ of facilities for carrying out "full load and over load testing" no load testing of the crane in fully assembled condition may be carried out after obtaining consent from owner.
- 6.01.02 The crane shall be subject to deflection test as per IS : 3177.
- 6.01.03 If the hoisting drum offered is of welded construction. The seams shall be fully radiographed.
- 6.01.04 The inspection and testing of butt welded joints shall be performed in accordance with the provisions of the relevant Indian Standards or equivalent standard. Butt welded joints subject to direct tension shall be 100% radiographed. All 'T' joints shall be covered with spot radiography. Should any of the spots be found defective then radiography to be extended to 100% area.
- 6.01.05 All electrical equipment and components thereof shall be subject to routine tests as per relevant Indian Standards. Type test certificate on any electrical equipment shall be submitted if desired by the Purchaser. Otherwise, type tests shall have to be performed on the equipment to prove the design.
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6.01.06 Reports of all shop tests shall be submitted to the Purchaser/ Consulting Engineer for review.

6.02.00 **Tests at site**

6.02.01 After assembly and erection at site, the crane shall be subject to the following tests :

- a) All tests as per IS-3177, including insulation test and tests for operation.
- b) Deflection tests as per IS-3177
- c) Overload tests at 125% of working load as per IS-3177

6.02.02 Dead loads as required for conducting the tests at site shall have to be arranged by the Contractor at his own cost.

6.03.00 **Erection and Commissioning**

All cranes shall be erected and commissioned after satisfactory shop & site test.

7.03.00 **Instruction Manual**

7.03.01 The Instruction manuals shall present the following basic categories of information in a comprehensive manner prepared for use by operating and/or maintenance personnel :

- i) Instruction for erection
- ii) Instruction for pre-commissioning check up, operation, abnormal conditions, maintenance, repair and protection.
- iii) A detail write up on the crane control system including tandem operation for tubine hall cranes and also on the interlocks provided.
- iv) Recommended inspection points and periods of inspection.
- v) Schedule of preventive maintenance.
- vi) Replaceable part's list with ordering information.
- vii) Recommendation for type of lubricants, lubricating points, frequency of lubrication and lubricant changing schedule.

DATA SPECIFICATION SHEET

GENERAL INFORMATION

Location : TG Hall

Working condition : Indoor

GUARANTEED PERFORMANCE REQUIRED

Capacity :

(Safe working load)

a) Main Hoist (T) 140 T

b) Aux. Hoist (T) 25T

Above capacity mentioned for Turbine Hall EOT cranes only. ~~However, other cranes capacity shall be decided by bidder.~~

~~** Safe working load shall be 110% of weight of the heaviest equipment to be lifted.~~

Rated Speed (Turbine Hall) : (for any load from zero to SWL)

Main hoist 1 m/min.

Aux. hoist 3 m/min.

Trolley travel 10 m/min.

Bridge travel 15 m/min.

Range of speed control
for main and auxiliary
hoist and for each motions
(for any load from
zero to SWL) Down to 10% of
corresponding
rated speed.

~~Rated Speed (Other than Turbine Hall) :
(for any load from zero to SWL)~~

~~Main hoist 3 m/min~~

~~Aux. hoist NA~~

Trolley travel	15 m/min
Bridge travel	25 m/min

GUARANTEED PERFORMANCE REQUIRED (Contd.)

Range of speed control
for main and auxiliary
hoist and for each motions
(for any load from
zero to SWL) :Down to 10% of
corresponding
rated speed.

SCOPE OF SUPPLY

Crane structures complete	:	Yes
All drive motors and driving gears	:	Yes
Running rails including all clamps, anchors, bolts, nuts, sheams, inserts, end stops and other fixtures	:	Yes
Operator's Cabin	:	Yes, For Turbine Hall crane
Pendant Station	:	Yes, For other cranes
Portable fire extinguisher/CO ₂ bottle in operator's cabin	:	Yes
Runway conductors (d.s.l.) and power collectors complete with all supports, insulators, brackets, fixtures etc.	:	Yes
Complete electrical work including main disconnect switch, all controls and interlocks, with necessary wiring, grounding, protective panels etc.	:	Yes
Lower limit switches for hoists	:	Yes
Illumination of crane, operator's cabin etc.	:	Yes
Air Conditioning in operator's cabin	:	Yes
Lifting lugs, eye bolts etc. for handling of crane parts	:	Yes
Erection and commissioning service	:	Yes
All equipment, accessories and		

consumables required for erection, testing and commissioning	:	Yes
Final painting	:	Yes
First charge of oil, lubricants, grease etc.	:	Yes

DESIGN AND CONSTRUCTION

Duty Class (Turbine Hall)	:	Mechanism class	-	M-5 as per IS-3177 and IS-807
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Duty Class (Other than Turbine Hall)	:	Mechanism class	-	M5 as per IS-3177 and IS-807
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Operation	:	Cabin for Turbine Hall
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No. of Trolleys	:	One
-----------------	---	-----

Span between runway rail centres	:	}
----------------------------------	---	---

Net runway length	:	}
-------------------	---	---

Elevation of top of runway rails	:	}
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Elevation of bottom of building roof structures	:	}
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Main hook positions -	
-----------------------	--

As per CCD

a) Elevation - Highest	:	}
- Lowest	:	}

b) Minimum approach from runway rail centre lines	:	}
--	---	---

c) Minimum end approach from runway rail stops	:	}
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Auxiliary hook positions -	
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a) Elevation - Highest	:	}
- Lowest	:	}

b) Min. approach from runway rail centre lines	:	}
---	---	---

c) Min. approach from runway rail stops	:	}
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Clear space between runway rail	:	}
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DESIGN AND CONSTRUCTION

Runway conductors -

- | | | |
|--------------------------------------|---|-------------------------------|
| a) Material | : | As specified earlier |
| b) Maximum allowable current density | : | Bidder to indicate |

End Truck

- | | | |
|-------------------------------------|---|----|
| a) I-Section acceptable | : | No |
| b) Single flanged wheels acceptable | : | No |

Permissible tolerance -

- | | | |
|---|---|--------------|
| a) Difference in levels of crane rail top measured between two adjacent columns | : | 2.0 mm |
| b) Crane rail gauge | : | $\pm$ 3.0 mm |
| c) Relative shift of ends of adjacent rails in plan and elevation after welding | : | 1.0 mm |
| d) Deviation of crane rail axis from centre line of web of supporting girder | : | $\pm$ 3.0 mm |

Schedule of Brakes

Holding torque for control brakes shall be 150% of rated torque and that of service brake shall be 125%. The schedule of brakes shall be as under:

Sl. No.	Service	Type & No. (Turbine Hall)
1.	Main Hoist	Two (2) nos. Electro-hydraulic thruster type brake.
2.	Auxiliary Hoist	Two (2) nos. Electro-hydraulic thruster type brake.
3.	Cross Traverse	Two (2) nos. Electro-hydraulic thruster type brake.
4.	Long Traverse	Two (2) nos. Electro-hydraulic thruster type brake.
		Two (2) nos. Hydraulic thruster (foot operated)

Sl. No.	Service	Type & No. (Other than Turbine Hall)
1.	Main Hoist	Two (2) nos. (1DCEM + 1EHT brakes)
2.	Auxiliary Hoist	N.A.
3.	Cross Traverse	One (1) no. Electro-hydraulic thruster type brake.
4.	Long Traverse	One (1) no. Electro-hydraulic thruster type brake.
5.	Main Hoist (creep)	One (1) no. Electro-hydraulic thruster type brake.
6.	Auxiliary Hoist (creep)	N.A.

The aforesaid brake schedule is applicable for double girder either cabin or pendent operated crane. For single girder cranes and single girder under slung cranes, one (1) electromagnetic disc brake for each motion shall be provided.

MATERIAL OF CONSTRUCTION

Bridge girder	:	IS-2062
Other structural members	:	IS-2062
Lifting hooks	:	As per IS-15560 (For Turbine Hall) As per IS-8610 (Other than Turbine Hall)
Sheaves, drums	:	C.I. (IS-210, FG-260)



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ANNEXURES



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ANNEXURE-I
MAKES OF SUB-VENDOR ITEMS

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	STEEL	SAIL		
		TISCO		
		JINDAL		
		ESSAR		
2.	HOOKS	STEEL FORGING & ENGG. CO.,	KOLKATA	
		SIMRITI FORGING		
		KARACHIWALA		UP TO 25T CAPACITY
3.	GEAR COUPLINGS	ALLIANCE		
		FLEX-TRANS (formerly known as HICLIFF)		
		SAHARA		
		NUTECH		
		OEM		
4.	WIRE ROPE	USHA MARTIN		
		FORT WILLIAMS		
		BHARAT WIRE ROPES		
5.	BEARINGS	SKF		
		FAG		
		TATA		
		NBC		
6.	MOTORS	SIEMENS		
		NGEF (up to 15KW)		
		CROMPTON		
		KIRLOSKAR		
		BHARAT BIJLI		
		MARATHON		
7.	BRAKES	ABB		
		ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DCEM BRAKES ONLY
		KAKKU		
8.	CONTACTOR	PATHE		
		SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
9.	OVER LOAD RELAYS	BCH		
		SIEMENS		
		L&T		
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
11.	ISOLATING SWITCH	ABB		
		SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
		SIEMENS		
13.	TIME DELAY RELAYS	L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
		SIEMENS		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS		
		BAJAJ		
		CROMPTON		
16.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
17.	HOOTERS	BEACON		
		OSC		
		TARGET		
		KHERAJ		
18.	LIGHTING SWITCHES	ANCHOR		
		ELLORA		
		BAJAJ		
		PHILIPS		
19.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
20.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DELTON CABLES LTD	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		ELKAY TELELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		UNIVERSAL CABLES LTD	SATNA	
21.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
22.	XLPE POWER CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
23.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
24.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
25.	PUSH BUTTONS	DOWELL		
		SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
26.	LIMIT SWITCHES	SPEED-O-CONTROL ELECTROMAG		
27.	MASTER CONTROLLER	SPEED-O-CONTROL ELECTROMAG		
28.	SAFETY SWITCHES	ALSTOM L&T SIEMENS		
29.	PENDENT PUSH BUTTON STATION	OEM		
30.	INDICATING LAMPS	TECKNIC BCH SIEMENS		
31.	MCB	STANDARD MDS INDO COPP STANDARD SIEMENS L&T ABB SCHNEIDER		
32.	PANELS	OEM RITTAL PYROTECH		
33.	RESISTANCE BOXES	ENAPROS OEM		
34.	FIRE EXTINGUISHERS	ASKA EQUIPMENTS LTD. ASHOKA ENGINEERING COMPANY KANADIA FYR FYTER PVT. LTD NITIN FIRE PROTECTION INDUSTRIES LTD NEW ENGINEERING CORPORATION SAFEX FIRE SERVICES LTD UNITED FIRE EQUIPMENTS PVT. LTD ZENITH FIRE SERVICES (INDIA) PVT LTD		
35.	VVVF	YASKAWA ABB SIEMENS SCHNIEDER FUJI ELECTRIC MITSUBISHI ELECTRIC		



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
36.	SHROUDED DSL	SUSHEEL STROMAG		
37.	ANTI COLLISION DEVICE	ELECTRONIC SWITCHES INDIA		
38.	LOAD CELL	IPA SARTORIUS		
39.	RRC	ACROPOLIS ENGINEERING SNT CONTROLS	- -	
40.	GEAR BOX	OEM ELECON ENGINEERS SHANTI GEARS PBL* NAW* NORD* SEW* BONGFILIOLI*		* = Applicable for Geared Motors only
41.	RAIL	JSPL SAIL		

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL
2. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.



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ANNEXURE II – MANDATORY SPARES

Sl. no	Description	Quantity
1	Long Travel Unit	
1.1	Set of Bearing of Axle	2 set for each type & capacity of EOT
1.2	Set of Gearbox Bearing with sleeves	2 set for each type & capacity of EOT
1.3	Long Travel end shaft bearing	2 set for each type & capacity of EOT
1.4	Seals for Travel gear box	2 set for each type & capacity of EOT
1.5	Long Travel Brake shoes lining with rivets	4 sets for each type & capacity of EOT
1.6	Motor	2no. for each type & capacity of EOT
2	Cross Travel Unit	
2.1	Axle Bearings	2 set for each type & capacity of EOT
2.2	Set of Gearbox Bearing with sleeves	2 set for each type & capacity of EOT
2.3	Cross Travel end shaft bearing	2 set for each type & capacity of EOT
2.4	Set of Seals for gear box	2 set for each type & capacity of EOT
2.5	Cross Travel Brake shoes lining	4 sets for each type & capacity of EOT
2.6	Motor	2 no. for each type & capacity of EOT
3	Main Hoist	
3.1	Main Hoist Pulley Bearing	2 set for each type & capacity of EOT
3.2	Set of Bearing for Gear Box	2 set for each type & capacity of EOT
3.3	Set of seals for Gearbox	2 set for each type & capacity of EOT
3.4	Aux. Hoist Gear box Bearing	2 set for each type & capacity of EOT
3.5	Aux. Hoist Gear box Seal	2set for each type & capacity of EOT
3.6	Main & Aux. Hoists Brake Shoes	4 sets for each type & capacity of EOT
3.7	Main & Aux. Hoists Brake Springs	4 sets for each type & capacity of EOT
3.8	Main & Aux. Hoists Brake Shoe liners	8 sets for each type & capacity of EOT
3.9	Motor for Main Hoists & Auxiliary Hoist	2 no. for each type & capacity of EOT
4	Electrical:	
4.1	Fixed + Moving + Spring contactors	4 sets for each type for each control panel
4.2	Control Module	4 Nos. each type and rating
4.3	Thyristor Stack	4 Nos. each type and rating
4.4	Speed setting Module	4 Nos. each type
5	Control Panel/ Desk Mounted Items	
5.1	Complete assembly	10 nos. of each color
5.2	Contact Element (1NO-1NC) Blocks	40Nos.
5.3	Selector Switch	20 Nos. of each type and range
5.4	Meter (Analog or digital) (Applicable only for TG Hall Crane)	



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5.4.1	Ammeter	20% for each type & range or minimum 2 no. whichever is more
5.4.2	Voltmeter	20% for each type & range or minimum 2 no. whichever is more
5.4.3	Frequency	20% for each type & range or minimum 2 no. whichever is more
5.4.4	MW	20% for each type & range or minimum 2 no. whichever is more
5.4.5	MVAR	20% for each type & range or minimum 2 no. whichever is more
5.4.6	Power Factor	20% for each type & range or minimum 2 no. whichever is more
4.4.7	Synchroscope	20% for each type & range or minimum 2 no. whichever is more
5.5	Indicating Lamps complete assembly	20 Nos. of each colour & type
5.6	Mimic Lamps	20 Nos. of each colour & type
5.7	MCB	4 Nos. for each type and rating
5.8	Door limit Switch	4 Nos.
5.9	Annunciation System	
6.0	Lamp Box with Facia & Lamps (LED Type)	50 Nos.
6.1	Hooter	2 No.
6.2	Each Type of PCB (for non-PLC driven system)	2 No.
7	415 Volt Motor (above 30KW Rating)	
7.1	End Shield Cover Driving & Non-Driving End	2Set for each type and rating of Motor
7.2	Driving End & Non-Driving End Bearing	2Set for each type and rating of Motor
7.3	Cooling Fan	2No. for each type and rating of Motor
7.4	Motor Space Heater	2No. for each type and rating of Motor
7.5	Motor Terminal Block	2No. for each type and rating of Motor
7.6	Complete Set of Coupling	2Set for each Application
8	415 Volt Motor (Up to 30KW Rating)	
8.1	Driving End & Non-Driving End Bearing	6Set for each type and rating of Motor
8.2	Cooling Fan	4No. for each type and rating of Motor
8.3	Motor Terminal Block	10Nos. for each type and rating of Motor
8.4	Complete Set of Coupling	2Set for each Application

Note:-

1. "One (1) Set" and "One (1) set of each type & size" is defined as 100% requirement for one crane for the entire cranes of similar size & capacity. If the cranes are of same capacity, the total quantity for the cranes shall be 100% quantity required for one crane.
2. 100% of total population of each type, size and rating is defined as 100% requirement for one crane
3. All essential spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is not applicable for particular equipment then suitable applicable alternate spare have been offered / shall be supplied without any financial implication.
4. Any item which is "not applicable" in the above list and is found to be "applicable" at a later date shall be supplied by the Vendor without any extra cost.



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ANNEXURE III - TOOLS & TACKLES

Two complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied. Each tool and wrench shall be stamped so as to be identified, easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and minimum the following shall be provided.

S-No.	Description	Qty. for Unit (1&2)	Qty. for Unit (3, 4 & 5)
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set	1 Set
2	Complete set of screwdrivers (Min. 6 Nos., Indicate the sizes)	1 Set	1 Set
3.	Adjustable Spanner	1 No.	1 No.
4.	Insulated plier	1 No.	1 No.
5	Wrench spanner	1 No.	1 No.
6.	Grease Gun	1 No.	1 No.
7.	Oil Gun.	1 No.	1 No.
8.	Hand Lamp.	1 No.	1 No.
9	Line tester	1 No.	1 No.

Note: - Two set of tool and tackles with O&M manual in the toolbox shall be supplied. Further in addition to above mentioned items, if any other items is required for maintenance of cranes, the same shall also be included as a part of maintenance tools by the bidder.

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ANNEXURE IV PAINTING SPECIFICATION

Surface preparation: De greasing and Mechanical cleaning with wire brush or hand tool. (SA 1/ ST 2 / ST 3 as applicable)

Primer : Red oxide Zinc chromate as per IS: 2074 (Alkyd medium) - 1 coat, DFT35 μ per coat.

Intermediate : Red oxide Zinc chromate as per IS: 2074 (Alkyd medium) - 1 coat, DFT35 μ per coat

Finish Coat : Synthetic enamel (Alkyd medium) as per IS: 2932- 2 coats, DFT 25 μ per coat.

Total DFT : 120 μ

Electrical /Control Panel:

Surface preparation: Seven tank process

Primer : Zinc phosphate (Alkyd medium) - 2 coat Minimum DFT 25- 35 μ per coat.

Finish Coat : Synthetic enamel (Alkyd medium) as per IS: 2932- 3 coats, Minimum DFT 20-25 μ per coat.

Total DFT : 110 - 145 μ

Color Shade:

SL. No	Item Description	Color Shade	Remarks
1	Crane Structure	Smoke Gray shade 692 as per IS-5	
2	Bottom block assembly	Smoke Gray shade 692 as per IS-5	
3	Hooks	Black	
4	End carriage sweep	Smoke Gray shade 692 as per IS-5	
5	Motors	Gray shade 631 as per IS-5	
6	Control Panels	Gray shade 631 as per IS-5	



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ANNEXURE-V

DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

S.N	BHEL drawing No.	Title	Approval category	Schedule date of submission from date of LOI.
1	PE-V0-417-501-A501	Manufacturing Quality Plan with sub vendor list For TG Hall Crane	A	3
2	PE-V0-417-501-A503	Data sheet of motors for TG Hall Crane	I	6
3	PE-V0-417-501-A504	Mechanism Sizing Calculation Including storm brake calculation for TG Hall Crane	A	3
4	PE-V0-417-501-A505	General arrangement for TG Hall Crane with CT DSL details	A	3
5	PE-V0-417-501-A506	Crab sub assembly for TG Hall crane with CT wheel assembly	I	4
6	PE-V0-417-501-A508	General arrangement for PVC shrouded DSL for TG Hall crane	I	3
7	PE-V0-417-501-A509	Main and Auxiliary hook block assembly with details of hook, nut and check plate For TG Hall Crane	I	4
8	PE-V0-417-501-A510	Long travel Machinery Assembly with LT wheel assembly For TG Hall Crane	I	4
9	PE-V0-417-501-A511	Lifting beam assembly for TG Hall Crane	A	3
10	PE-V0-417-501-A512	Structural calculations For TG Hall Crane	A	4
11	PE-V0-417-501-A514	O & M Manual For TG Hall Crane	I	10
12	PE-V0-417-501-A515	Detailed BOM/BOQ for TG Hall Crane	I	8
13	PE-V0-417-501-A516	Electrical equipment layout in cabin for TG Hall crane	I	5
14	PE-V0-417-501-A517	"Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Aux. hoist panel & BOM d) Cross Traverse & BOM e) Long Traverse & BOM Including earthing diagram For TG Hall Crane"	A	5
15	PE-V0-417-501-A518	"General Arrangement of a) Protective panel b) Main hoist panel c) Aux. hoist panel d) Cross Travel panel e) Long Traverse travel panel. f) Pendent g) Remote Radio Control For TG Hall Crane"	I	5



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16	PE-V0-417-501-A519	Cable Sizing and cable schedule For TG Hall Crane	A	6
17	PE-V0-417-501-A520	Crane Operational write up For TG Hall Crane	I	5
18	PE-V0-417-501-A521	Type test certificate (for motors) For TG Hall Crane	A	8
19	PE-V0-417-501-A523	Mandatory spare parts list For TG Hall Crane	A	8
20	PE-V0-417-501-A525	Erection procedure For TG Hall Crane	I	8
21	PE-V0-417-501-A526	Manufacturing Quality Plan For Lifting Beam	A	3
22	PE-V0-417-501-A527	Data sheet of TG Hall Crane with painting details	A	3
23	PE-V0-417-501-A530	Electrical load for TG Hall EOT Crane	I	8
24	PE-V0-417-501-A532	Gantry Rail installation for TG Hall crane	I	3
25	PE-V0-417-501-A550	Crane lubrication drawing For TG Hall Crane	I	6
LEGENDS				
A= Approval category				
I= Information category				

Notes:

- The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
- Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
- Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
- Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.
- All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought



TITLE

5X800 MW YADADRI TPS TPP

**DOUBLE GIRDER EOT CRANES ABOVE 100T
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out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

- e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc.
- f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
- g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
- h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.
- i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- j) Bidder to follow the following the drawing submission schedule:
 - i. 1st submission of drawings from date of LOI as per the submission schedule.
 - ii. Every revised submission incorporating comments – within 7 days.
- k) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

DISTRIBUTION SCHEDULE

S. No	Description	TSGENCO										Consultant			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS				
A	Letter Of Intent or Contract Documents	1	1	1	S	1	2	2	1	1	1	1	2			
B	Vendor Drawings															
1.	Preliminary	1	1	1	2	1	1	2	2	12	1	-	S			
2.	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	-	1			
3.	Final and any revision thereof															
	a. Civil	1	1	6+1T	1	1	6+1T	1	-	2+1T	1	1	S			
	b. E&M	1	1	1	6+1T	1	1	6+1T	1	2+1T	1	1	S			
C.	Design Drawings															
1.	Preliminary															
	a. Civil	1	1	2	1	1	2	1	1	4	1	1	S			
	b. E&M	1	1	1	2	1	1	2	1	4	1	1	S			
2.	Released for construction															
	a. Civil	1	1	2	1	1	6	1	1	1	1	2	S			
	b. E&M	1	1	1	1	2	1	6	1	1	1	2	S			
3.	Return marked 'As built'															
	a. Civil	-	-	1	-	-	1	-	-	1	1	S	1			
	b. E&M	-	-	-	1	-	-	1	1	1	1	S	1			
4.	As built drawings															
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	1	1+1T	-	1	S			
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	-	1	S			

S. No	Description	TSGENCO										Consultant			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS				
D	Progress Report Monthly															
1.	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1		S		
2.	M/s DCPL, Kolkata	1	1	2	2	1	1	2	1	S	1	1		Nil		
E	Test & Inspection Reports															
1.	Equipment manufacturer															
	a. Civil	1	1	1	2	1	1	1	-	11	1	1		S		
s	b. E&M	1	1	-	2	1	-	1	1	11	1	1		S		
2.	M/s DCPL, Kolkata	1	1	-	2	1	-	1	1	S	-	1		-		
F	Instruction Manuals/Data Books															
1.	Equipment manufacturer															
	a. Civil	1	1	1+1T	1	1	6+1T	1	1	2+1T	1	1		S		
	b. E&M	1	1	-	3+1T	1	-	6+1T	2	3+1T	1	1		S		
2.	M/s DCPL, Kolkata	1	1	-	10+1T	1	-	15+1T	-	S	1	1		Nil		
G	M/s DCPL, Kolkata Criteria	1	1	1	8+1T	1	1	2	1	1	1	1		S		
H	Design Calculations	1	1	1	8+1T	1	1	2	1	1	1	1		S		
I	Final consulting Engineering Report	1	1	1	10	1	1	2	1	S	1	1		Nil		

S – Source, T – Transparency & Soft Copy on CD,

TSGENCO

: Telangana State Power Generation Corporation Limited

Director, Projects, Hyd

: Director/ Projects, TSGENCO, Vidyut Soudha, Hyderabad – 500 082

**TITLE****5X800 MW YADADRI TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T****SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-417-501-A501

VOLUME: II B

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Section I A

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ANNEXURE VI – PACKING PROCEDURE**Packing and Marking**

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement.

Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

**TITLE****5X800 MW YADADRI TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T****SPECIFIC TECHNICAL REQUIREMENTS**

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ANNEXURE-VII**Procedure for Load & Overload testing of Double Girder EOT Cranes at Manufacturer's Works**

Objective: To demonstrate final NO load, Load, Overload, Deflection & Functional tests of assembled crane/s for the purpose of acceptance.

Basic Assumptions / Inputs for testing at Works:

- Actual job hook shall be used for load & overload tests for hoisting.
- Actual ropes shall be used for load & overload testing.
- Shop cables can be used for temporary connection for the purpose of showing various functional tests at shop.
- Interlock and limit switch operation check will be shown with load for hoisting and CT motion.

Procedure for Load / Overload testing:

The cranes shall be tested for no load, load test & overload test at works generally in conformance with the IS – 3177 (latest edition). Specifically with respect to the load / overload testing of crane, the following tests as per the outlined procedures shall be done at works.

- Deflection of the girder will be measured at SWL when the trolley with load is at the middle of the girder.
- No load and full load current of the motors will be measured to verify whether it is as per the approved data sheet of the motor. Resistors in the circuit will be checked for any overheating of the element.
- Overload relays will be checked for proper functioning.

Hoisting & Cross Travel motions:

The load will be gradually raised to 125 percent of the rated capacity (SWL) with actual hook. The load will be lifted upward to about 1 meter height above its support and stop again. Check for any undue drift in the load. If load drifts, check the adjustment of brakes and repeat the above procedure. Then lower the load to rest on support/ground.

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For checking the cross travel, raise the load up to one (1) meter height above supports and then move the trolley with load about one (1) meter in either direction of the bridge. Then lower the load to rest on support/ ground.

Creep speed motions shall be checked over a distance of about 500 mm.

Note: Complete No load, load & over load tests in line with IS-3177 (latest edition) shall also be done after erection of EOT crane at site.

ANNEXURE - VIII

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				

6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				



TITLE

5X800 MW YADADRI TPS

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SPECIFIC TECHNICAL REQUIREMENTS

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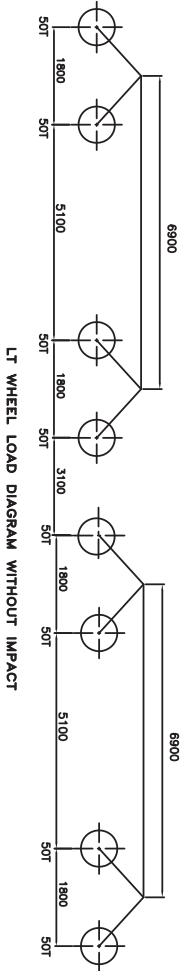
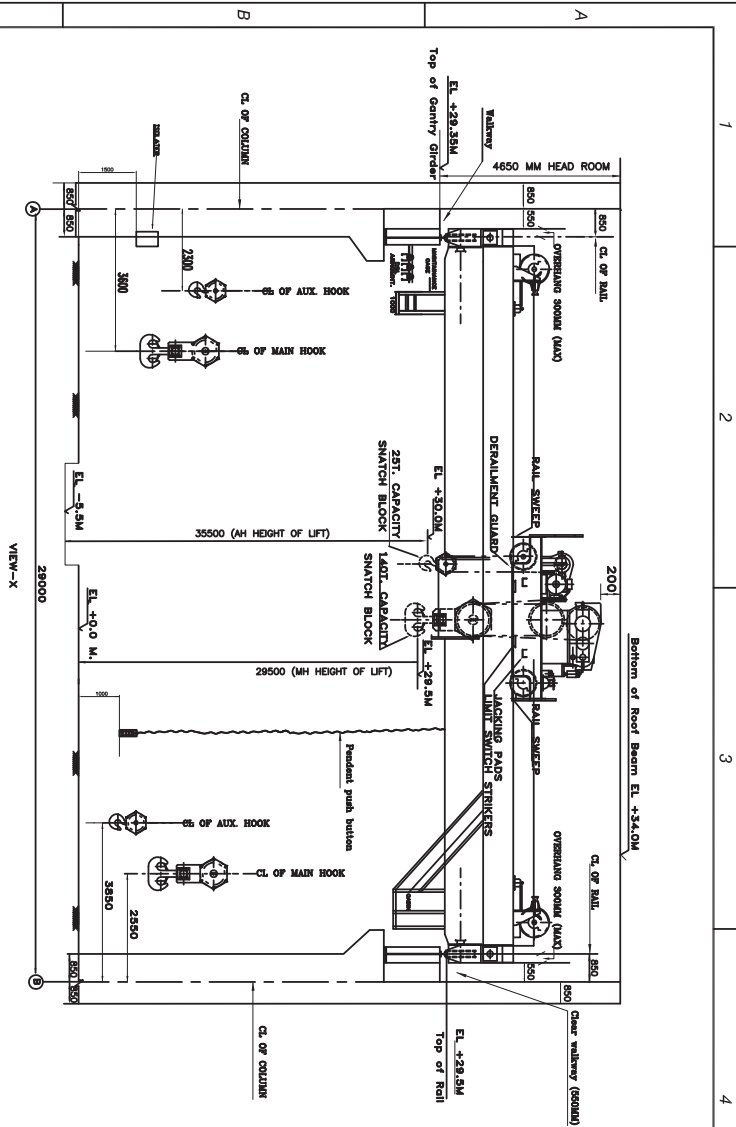
REV 00

Section IA Date JAN'18

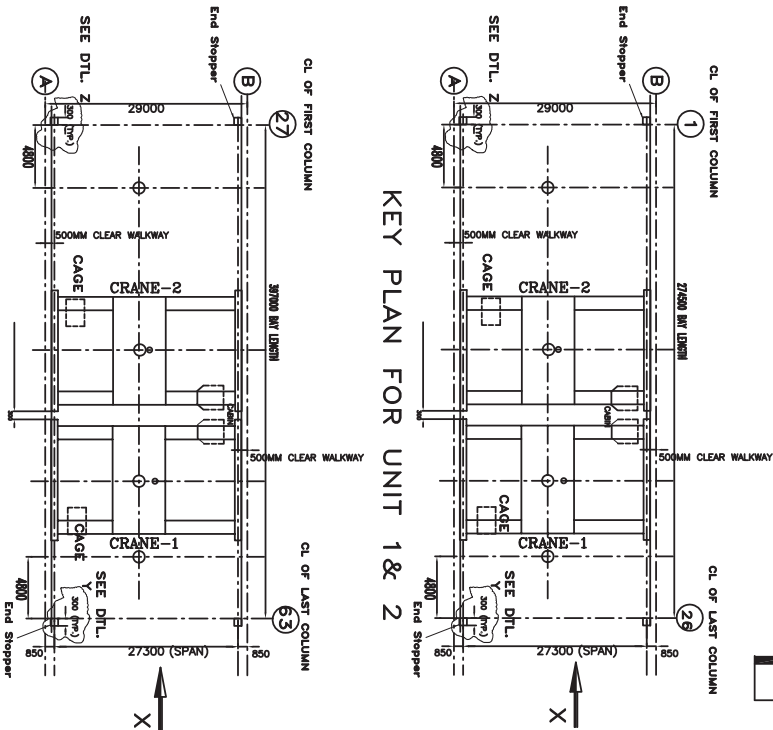
Page 1 of 2

SECTION – IA

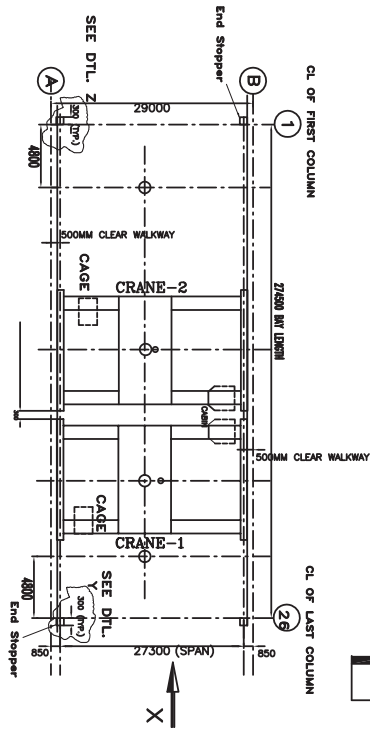
CRANE CLEARANCE DIAGRAM



KEY PLAN FOR UNIT 3,4&5



KEY PLAN FOR UNIT 1&2



- REF. DRWG:
- 1) PE-06-417-100-M007, Rev 0 (CROSS-SECTION OF MAIN PLAN)
 - 2) PE-06-417-100-M003, Rev 0 (TO EQUIPMENT PLAN AT GROUND FLOOR EL. 0.0M)
- NOTES:
- 1) DRAWING IS NOT TO THE SCALE.
 - 2) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.

		CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD PROJECT ENGINEER: TELANGANA STATE, INDIA PROJECT ENGINEER: TELANGANA STATE, INDIA
		PROJECT ENGINEER: TELANGANA STATE, INDIA PROJECT ENGINEER: TELANGANA STATE, INDIA
TITLE: CRANE CLEARANCE DIAGRAM FOR 140/25T DOUBLE CRANE FOR POWER HOUSE		SHEET NO.: 1 OF 1 REV: 0



TITLE

5X800 MW YADADRI TPS

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-417-501-A501

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Section

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SECTION – IA

STANDARD QUALITY PLAN

MANUFACTURER'S NAME & ADDRESS				STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 5X800 MW YADADRI TPS PACKAGE : DOUBLE GIRDER CRANES			
				ITEM:										QP NO :			
														REV : 0			
														DATE :			
														VENDOR'S QAP No :			
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY		REMARKS					
								M	C	N	N						
1		3	4	5	6	7	8	9		D**		10	11				
1	Fabricated components																
	Box Girder, End Carriage, Crab Frame, Rope Drum																
a	Material	Chemical & Physical Properties	Major	Corelation with T.C./ Check test in absence of T.C.	1/Heat/Batch	E250 Grade BR IS: 2062	E250 Grade BR IS: 2062	Mfr's T.C/ Check Test Report		✓	P	V	V	Refer note: 1			
b	weld setup	U.T of plates.		Ultrasonic	100%	ASTM A435	ASTM A435	T.C. / I.R.		✓	P	V	V	U.T. ON ABOVE 25MM THICK PLATE			
		dimensions	Major	Measurement	100%	Components drawings	Components drawings	Vendor's inspection report		P							
1A	Seamless pipe for rope drum	Chemical & Physical Properties	major	Corelation with T.C./ Check test in absence of T.C.	100%	ASTM A106Gr B	ASTM A106Gr B	Mfr's T.C/ Check Test Report		✓	P	V	V	Refer note: 1			
		NDT	Major	Macro etching & flattening	100%	ASTM A106Gr B	ASTM A106Gr B	MTC/Lab TC		✓	P	V	V				
		NDT	Major	UT	100%	ASTM E-213-2007	Notch depth shall not be more than 12.5% of thickness of pipe	UT Report		✓	P	V	V				
2	Welding WPS (Welding procedure specification) in line with ASME sec. IX (QW - 482) - For Box Girder, End Carriage, Crab Frame, Trolley Gear Box Casing & Rope Drum																
a	Check for welding procedure qualification, welder's performance	Welding parameters	Major	Review of documents	100%	ASME Sec-IX	ASME Sec-IX	QW-482,QW-483, QW-484 as per ASME Sec-IX		✓	P	V	V	WPS/PQR/WPQ approved/ reviewed by NTPC/ NPCIL/ BVI/ LLOYES/TUV etc. shall be accpetable			
b	Back chipping	surface defect	Major	DPT	100%	ASME Sec-VIII, Div-I, Appen - 8	ASME Sec-VIII, Div-I, Appen - 8	DP Report		✓	P	V	V				
c	Butt Welds	NDT	Critical	RT	100% in tension, 25% in compression, 100% in rope drum	ASME Sec-V	ASME Sec-VIII, CI UW-51 & 52	RT Report		✓	P	V	V				

MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 5X800 MW YADADRI TPS PACKAGE : DOUBLE GIRDER CRANES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 5X800 MW YADADRI TPS PACKAGE : DOUBLE GIRDER CRANES					
								ITEM:	QP NO : REV : 0 DATE :									

MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 5X800 MW YADADRI TPS PACKAGE : DOUBLE GIRDER CRANES			
			ITEM:										Q.P. NO. :			
													REV : 0			
													DATE :			
													VENDOR'S QAP No. :			
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS			AGENCY			REMARKS		
											M	C	N			
1	i) raw material ii) Machined	3	4	5	6	7	8	9	D*	**	10					11
		Chemicals composition and Mechanical Properties.	Major	Correlation with Mfr's TC	100%	Mfg.drg./IS:1570 / BS - 970	Mfg.drg./IS:1570 / BS - 970	Test Certificate	V	P	V	V	Refer Note:1			
		a) Dimensions	Major	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report		P	V	V				
		b) Hardness		Mechanical	100%	Approved Data Sheet / Mfg. Drg.	Approved Data Sheet / Mfg. Drg.	Vendor inspection Report	V	P	V	V				
		c) UT		NDT	100%	ASTM A 388	ASTM A 388	Vendor inspection Report	V	P	V	V	Refer UT procedure			
		d) DPT		NDT	100%	ASME Sec-VIII-App-8	ASME Sec-VIII-App-8	Vendor inspection Report	V	P	W	V				
	b) Raw material for Gears , Pinions, Shafts,Axes etc	i) Chemicals Composition & heat treatment, Physical Properties.	Major	Correlation with Mfr's TC/ Check test in absence of TC	100%	Manufacturing drawing, BS : 970 / IS : 1570 / Approved Data Sheet	Manufacturing drawing, BS : 970 / IS : 1570 / Approved Data Sheet	Mfr's T.C/ Check Test Report	V	P	V	V				
		ii) UT (after machining)	Major	check for UT (above)	100%	ASME Sec-V	Refer UT procedure	Vendor inspection Report	V	P	V	V				
		iii) Hardness	Major	check for Hardness	100%	drg. & Approved Data Sheet	Mfg. drg. & Approved Data Sheet	Vendor inspection Report	V	P	W	V	Hardness witnessing by BHEL before teeth cutting.			
	c) Casting for Gears and pinions, if applicable	iv) Dimensions	Major	Measurement	100%	Mfg. Drawing	Mfg. Drawing	Vendor inspection Report	V	P	V	V				
		V) D.P.Test on teeth	Major	NDT	100%	ASTME-165	No linear indication	Vendor inspection Report	V	P	V	V				
		Chemical and Physical	Major	Chemical and Physical	100%	Approved drg/ data sheet	Approved drg/ data sheet	Mfr's T.C	V	P	V	V				
B	Pulleys, Brake drums, coupling & other major steel castings & forging	NDT	Major	U.T.	100%	ASTM A 388	ASTM A 388	Vendor inspection	V	P	V	V	Refer UT procedure			
		Physical/Chemical/Hardness	Major	Correlation with mfr's TC	100%	Mfg. Drawing	Mfg. Drawing	Mfr's T.C.	V	P	V	V				

MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN										PROJECT: 5X800 MW YADADRI TPS PACKAGE : DOUBLE GIRDER CRANES			
							ITEM:	QP NO :					CONTRACT NO :			
								REV : 0					CONTRACTOR :			
								DATE :					VENDOR'S QAP No :			
SL. NO.	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE PF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY	REMARKS						
1		3	4	5	6	7	8	9	D*	**	10					
a)	Motors (=< 50 KW)	make , type , rating, Routine test	Major	Review mfr's TC	100%	IS:325	IS 325/Mfr's T.C.	Mfr's T.C.	V	P	V	V	Refer Note 3 for motor above 50 KW			
b)	Brakes	Make , type , rating , dia , Functional test /Routine test	Major	Review mfr's TC	100%	Appd drgs	Appd drgs	Mfr's T.C.	V	P	V	V				
c)	Control panel	Interlocking functional, IR, HV, Sheet thickness, cable laying, dressing , ferulling Overall diemnsions , painting shade, Panel surface finish, Paint Thickness, adhesive test, Component fixing, Degree of protection by paper inserting	CR	Test for HV, IR, functional check	100%	IS : 3177 / App. Panel Drg. & BOM/ Data sheet	IS : 3177 / App. Panel Drg. & BOM/ Data sheet	Vendor insp Report	V	P	W	V	Refer Note No. 4 VVVF Test Certificate to be submitted from app. Vendor for verification.			
d)	Radio remote, Master controllers	HV, IR, Functional	Major	Verification	100%	BOM/ Mfr. Catalogue	BOM/ Mfr. Catalogue	Mfr's T.C.	V	P	V	V	Refer Note No. 4			
e)	Limit switches	Functional	Major	Verification	100%	Approved drawings	Approved drawings	Mfr's T.C.	V	P	V	V				
f)	Trailing cable, Power Control Cable & DSL	Make , type , rating ,Routine & acceptance test insulation resistance values	Major	Verification	100%	IS: 9968, IS 1554- Part-1	IS: 9968, IS 1554- Part-1	Mfr's T.C.	V	P	V	V				
g)	Transformer	make rating , routine test	Major	visual	100%	Appd drg	Appd drg	Mfr's T.C.	V	P	V	V				
h)	SFU, MCCB,MCB, Contactors, DSL, relays, fuses, resistance bank	make, t type , rating size, functional, continuity check	Major	visual	100%	Appd drg	Appd drg	Mfr's T.C.		P	V	V				
i)	VVVF drives	make , type , rating, routine test	Major	visual	100%	Appd drg	Appd drg	Mfr's T.C.		P	V	V				
j)	Anti collision devices , cable gland , ,lugs , r ectifier, indicating lamps, terminal blocks, load cell.	make , type	Major	visual	100%	Appd drg	Appd drg	Mfr's T.C.		P	V	V				
13	Bought out items															
a)	Wire rope	Visual , tensile	Major	Type, grade, dia br	100%	IS:2266	IS:2266	Mfr's T.C.	V	P	V	V				
b)	Bearing	Type & Size	Major	Verification	100%	Appd drg/Mfr's catalogue	Appd drg/Mfr's catalogue	Mfr's T.C.	V	P	V	V				
14	Assembly of cranes															

		MANUFACTURER NAME & ADDRESS			MANUFACTURING QUALITY PLAN							PROJECT : CLIENT : BHARAT HEAVY ELECTRICAL LTD.			
					ITEM: LIFTING BEAM ASSEMBLY		BHEL DOC. NO. : REV : DATE :					W.O.NO:			
S.R. NO.	COMPONENT & OPERATIONS	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS		
1	2	3	4	5	6	7	8	9	D	M	C	N	11		
a)	Butt-Weld	Weld Quality	Critical	RT	100% in tension & 25% in compression	ASME SEC VIII	ASME SEC VIII Clause UW - 51	RT report & Film	✓	P	R	R	Review of radiography report		
b)	Fillet Weld	Surface defect & size	Major	DPT	100%	ASME Sec.V	ASME SEC VIII Appnd. 8	I.R	✓	P	R	R			
			Major	Visual	100%	Component Drawing	Component Drawing	I.R	✓	P	R				
iii)	Inspection of Fabricated Lifting Beam	Visual & dimensional	Major	DPT	10% at random	ASME Sec.V	ASME Sec. VIII	I.R	✓	P	W	R	W - At the time of final inspection of Lifting beam		
3)	Final assembly of Lifting beam	Visual & Dimensional	Major	Visual & Dimensional check	100%	GA Drawing of lifting beam / IS 3177 / Tech-Specification.	Individual component drawing	I.R	✓	P	W	W	CHP (AT WORKS)		
4)	Review of QA Documents	-	-	-	-	-	As per approved QAP	-	-	R	R	R			
5)	Load test at Mfg. Works as well as Site	Visual	Major	Visual	100%			I.R	✓	P	W	W			
		Deflection test at SWL	Major	Measurement	100%	Appd drawing / Load test procedure	Appd drawing / Load test procedure	I.R	✓	P	W	W			
		Overload test at 1.25XSWL	Major	Visual	100%			I.R	✓	P	W	W	Overload test to be performed at @ 1.25XSWL		
		LEGEND: RECORDS IDENTIFIED WITH "TICK (✓) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION "M" MANUFACTURER/ SUBCONTRACTOR "C" CONTRACTOR (BHEL) "N" CUSTOMER					FOR CUSTOMER USE								
MANUFACTURER	CONTRACTOR (BHEL)							REVIEWED BY				APPROVED BY		APPROVAL SEAL	
SIGNATURE															

12.00.00 SHOP TEST EOT CRANES, OTHER CRANES & HOIST

1.0 Hooks

1.1 All tests including proof load test as per relevant IS/BS/DtN shall be carried out.

1.2 MPI/DPT shall be carried out after proof load test.

2.0 Steel Casting

2.1 DPT on machined surface shall be carried out.

3.0 Girders, end carriage, crab, gear box and rope drum

3.1 The plates of thickness 25mm and above shall be ultrasonically tested.

3.2 NDT requirements on weldments shall be as follows:

- | | | | |
|----|---------------------------|---|----------------------|
| a) | BUTT WELDS IN TENSION | : | 100% RT AND 100% DPT |
| b) | BUTT WELDS IN COMPRESSION | : | 10% RT AND 100% DPT |
| c) | BUTT WELDS IN ROPE DRUM | : | 100% RT AND 100% DPT |
| d) | FILLET WELDS | : | RANDOM 10% DPT |

4.0 Forging (Wheel, Gears, Pinions, Axle, Hooks & Hook Trunion)

4.1 All forgings greater than or equal to 50 mm diameter or thickness shall be subjected to ultrasonic testing.

4.2 DPT/MPI shall be done after hardfacing and machining.

5.0 Wire rope shall be tested as per relevant standard.

6.0 Reduction gears shall be tested for reduction ratio, backlash & contact pattern. gear box shall be subjected to no-load run test to check for oil leakage, temperature rise, noise and vibration.

7.0 The cranes shall be completely assembled at shop for final testing. all tests for dimension, deflection, load, overload, hoisting motion, cross travel etc. as per IS-3177 shall be carried out at shop.



TITLE

5X800 MW YADADRI TPS

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-417-501-A501

REV 00

Section

IB

Date JAN'18

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)



TITLE:

**TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)****5X800 MW YADADRI TPS**

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION: IB

REV NO. : **00** DATE: 18/01/2018

SHEET: 1 OF 1

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BASIC TECHNICAL FEATURES FOR LT MOTORS

(FOR BHEL-PEM SCOPE PACKAGES)

										 CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA 5 x 800 MW YADADRI TPS, NALGONDA																												
										OWNER'S CONSULTANT:																												
JOB NO. 417					 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA																																	
STATUS CONTRACT																																						
DISTRIBUTION																																						
COPY RIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED it must not be used directly or indirectly in any way detrimental to the interest of the company.										<table border="1"> <tr> <th>DEPT</th> <th>CODE</th> <th>NAME</th> <th>SIGN</th> <th>DATE</th> </tr> <tr> <td>DRN</td> <td>HC</td> <td>s.d.</td> <td></td> <td>07.12.17</td> </tr> <tr> <td>DESN</td> <td>HC</td> <td>s.d.</td> <td></td> <td>07.12.17</td> </tr> <tr> <td>CHD</td> <td>AS</td> <td>s.d.</td> <td></td> <td>07.12.17</td> </tr> <tr> <td>APPD</td> <td>PD</td> <td>s.d.</td> <td></td> <td>07.12.17</td> </tr> </table>				DEPT	CODE	NAME	SIGN	DATE	DRN	HC	s.d.		07.12.17	DESN	HC	s.d.		07.12.17	CHD	AS	s.d.		07.12.17	APPD	PD	s.d.		07.12.17
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	5 x 800 MW YADADRI TPS BASIC TECHNICAL FEATURES FOR LT MOTORS (FOR BHEL-PEM SCOPE PACKAGES)	Doc. No.	PE-DC-417-565-E003
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		Dated	07-12-2017
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1.0 This document covers the basic technical features of low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in **5 x 800 MW YADADRI TPS**.

2.0 CODES AND STANDARDS

All motors shall conform to the latest applicable standards as listed below;

- 1) Three phase induction motors: IS: 325, IEC: 60034
- 2) Single phase AC motors: IS: 996, IEC: 60034
- 3) Crane duty motors: IS: 3177, IEC: 60034
- 4) Energy Efficient motors: IS 12615 or IEC: 60034-30 with Efficiency class IE3

3.0 DESIGN REQUIREMENTS

3.1 Service Conditions

The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash. The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash. For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Upto 0.2 kW	240V/415 V	240V/415 V
Above 0.2 kW & up to 175kW	415 V	415 V

3.2.1 Supply voltage & variations shall be as follows:-

Voltage variation (AC Supply): (+/-) 10%
Frequency variation : (+) 3% to (-) 5%
Combined V & F variation : 10% (sum of absolute values)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

3.2.2 Motors shall be capable of running continuously at rated output for each of the conditions specified.

3.3 Motor Rating

All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity. LT motor rating at 50 degree C shall have at least 15% margin over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification. The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

3.4 Starting Requirements

3.4.1 Motor shall start smoothly and rapidly. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The

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accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

- 3.4.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value of 85 (eighty five) percent rated voltage.

- 3.4.3 Continuous duty LT motors up to 175 KW Output rating (at 50 deg. C ambient temperature), shall be Premium efficiency (IE3) as per IEC: 60034-30/ IS: 12615 and the locked rotor current of motors shall as per IS 12615.

However, as per system requirement drives rated in the range of 160-210 KW may be considered in either 415V or 3.3 KV

- 3.4.4 The following frequency of starts shall apply

- i) Three cold starts in succession with the motor being initially at a temperature not exceeding the ambient temperature.
- ii) Two hot starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- iii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature.(not to be repeated in the second successive hour)

- 3.4.5 Locked motor withstand time of hot motors at 110% rated voltage shall be as follows:

- a) For motors with starting time upto 20 sec.
 - at least 3 sec. more than starting time.
- b) For motor with starting time above 20 secs but not exceeding 45 secs.
 - at least 5.0 sec. more than starting time.
- c) For motors with starting time above 45 secs.
 - at least 10%. more than starting time.

The starting time of the motor referred above is at minimum permissible voltage. Wherever the above requirements are not complied with, speed switches of approved make & type shall be provided to bypass the locked rotor protection for a pre-selected time during starting of motors. The speed switches shall have one NO & one NC contacts having maximum interrupting capacity of 5 Amps at 240V AC and 0.25 amps at 220 V DC.

Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

3.5 Running Requirements

- 3.5.1 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given above.

- 3.5.2 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

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3.5.3 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

3.6 Stress during bus Transfer

3.6.1 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

3.6.2 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

4.0 SPECIFIC REQUIREMENTS

4.1 Enclosure

All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy. For hazardous area approved type of increased safety enclosure shall be furnished.

4.2 Cooling

4.2.1 The motor shall be self-ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

4.2.2 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW).

4.3 Winding and Insulation

All insulated winding shall be of copper. All motors shall have class F insulation but limited to class B temperature rise. Windings shall be impregnated to make them non-hygroscopic and oil resistant.

4.4 Bearings

4.4.1 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.

4.4.2 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

4.4.3 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

4.4.4 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

4.4.5 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.

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4.4.6 Oiled bearing shall have an integral self-cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

4.4.7 Forced lubricated or water cooled bearing shall be used as per requirement.

4.4.8 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

4.4.9 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

4.5 Noise & Vibration

4.5.1 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.

4.5.2 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.

4.5.3 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.

4.6 Motor Terminal Box

4.6.1 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation

4.6.2 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.

4.6.3 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

4.6.4 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

4.6.5 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

4.6.6 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

4.6.7 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

4.6.8 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

4.6.9 The gland plate for single core cable shall be non-magnetic type.

4.6.10 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor Minimum Ph-Ph & Ph-Earth clearance
0.415 kV : 25 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

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4.7 Grounding

The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

The cable terminal box shall have a separate grounding pad.

For 415V, 3-Ph, LT Motors cable size shall be as per approved "Design Calculation for LV Cable selection & sizing" doc no. PE-DC-417-507-E002

4.8 Rating Plate

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

- Temperature rise in Deg.C under rated condition and method of measurement.
- Degree of protection.
- Bearing identification no. and recommended lubricant.
- Location of insulated bearings.

5.0 ACCESSORIES

5.1 SPACE HEATERS

Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement. The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

5.2 TEMPERATURE DETECTORS

5.2.1 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

5.2.2 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.

5.2.3 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

5.2.4 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

5.3 INDICATOR/ SWITCH

5.3.1 Dial type local indicator with alarm contacts shall be provided for the following:

- 11000 V and 3300V motor bearing temperature.
- Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

5.3.2 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.

5.3.3 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.

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5.4 ACCESSORY TERMINAL BOX

- 5.4.1 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 5.4.2 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.

DRAIN PLUG

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

5.5 LIFTING PROVISIONS

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

5.6 DOWEL PINS

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.0 PAINTING

Colour scheme for motors shall be shade 631 of IS-5.

8.0 TESTING

8.1 Type Tests

For LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied shall be submitted.

8.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: DOUBLE GRIDER EOT CRANES

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT :5X800 MW YADADRI TPS

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 4W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

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			VOLUME	II B
			SECTION	
			REV NO. 00	DATE 18/01/2018
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1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	175 KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP55
5.0	Details of supply system		
	a) Rated voltage (with variation)	:	240V, 415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal box	:	50 kA for 0.25 sec
	f) LV System grounding	:	Solidly
6.0	Class of insulation	:	Class ‘F’,with temp rise limited to class B.
7.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
8.0	Power cables data	:	Shall be given during detailed engg.
9.0	Earth Conductor Size & Material	:	Shall be given during detailed engg.
10.0	Space heater supply (30KW & ABOVE)	:	240 V, 1Φ , 50 Hz
11.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
12.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
13.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS-12615
	b) Permissible tolerance, if any	:	As per IS-12615
14.0	Terminal box	:	Suitable to rotate at 90 degrees
15.0	Paint shade	:	Shade 631 of IS-5

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			VOLUME	II B
			SECTION	
			REV NO. 00	DATE
			SHEET	1 OF 2

S. No.	Description		Data to be filled by successful bidder	
A.	General			
1	Manufacturer & country of origin			
2	Motor type			
3	Type of starting			
4	Name of the equipment driven by motor & Quantity			
5	Maximum Power requirement of driven equipment			
6	Rated speed of Driven Equipment			
7	Design ambient temperature			
B.	Design and Performance Data			
1	Frame size & type designation			
2	Type of duty			
3	Rated Voltage			
4	Permissible variation for			
5	a	Voltage		
6	b	Frequency		
7	c	Combined voltage & frequency		
8	Rated output at design ambient temp (by resistance method)			
9	Synchronous speed & Rated slip			
10	Minimum permissible starting voltage			
11	Starting time in sec with mechanism coupled			
12	a) At rated voltage			
13	b) At min starting voltage			
14	Locked rotor current as percentage of FLC (including IS tolerance)			
15	Torque			
	a) Starting			
	b) Maximum			
16	Permissible temp rise at rated output over ambient temp & method			
17	Noise level at 1.0 m (dB			
18	Amplitude of vibration			
19	Efficiency & P.F. at rated voltage & frequency			
	a) At 100% load			
	c) At 75% load			

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	MOTOR DATA SHEET – C 5 X 800 MW YADADRI TPS	SPECIFICATION NO.	
			VOLUME	II B
			SECTION	
			REV NO. 00	DATE
			SHEET 2	OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

ANNEXURE III

ANNEXURE III

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

6. Once a cable list has been given to PEM for routing, any subsequent changes required in the cable list (which may be in the form of addition of cables, deletion of cables, change of type or size of cable, etc.) must be informed as specific changes (as a separate file MS Excel of the same format as the original file) to the cable list given earlier if the cable list has been routed and cable schedule generated. The routing status of the cable list shall be got confirmed from PEM by the agency that has prepared the cable list before the changes are intimated. In case PEM confirms that the cable list in question has not been taken up for routing, and the revised cable list is acceptable, the same may be sent. Since cable routing through the program involves adding each cable list to the project cable schedule database, the original cable schedule shall not be furnished to PEM with revisions incorporated within.

			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
SHEET 1 OF 9			SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 2 OF 9		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
				SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	10
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED FOR DIA OF 55 MM & ABOVE
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION :			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		NUMBER :			
SHEET 3 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10	11	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*
		2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		

		QUALITY PLAN SHEET 4 OF 9		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11		
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
		1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
		1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG/ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 5 OF 9		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANUF'S SPEC./BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 6 OF 9		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
				SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE FOR MV MOTOR THREE DIPS TO BE GIVEN
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 7 OF 9		CUSTOMER :			PROJECT TITLE		SPECIFICATION :			
				BIDDER/ :			QUALITY PLAN		NUMBER :			
				VENDOR			NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION :			
SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
SHEET 8 OF 9				BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03 ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SPECIFICATION : TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			VOLUME III
									P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3.VIBRATION & NOISE LEVEL 4.OVERALL DIMENSIONS AND ORIENTATION 5.DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	MA MA MA MA MA MA MA	ELECT.TEST -DO- -DO- MEASUREMENT & VISUAL ELECT. & MECH. TEST -DO- -DO- VISUAL EXPLOSION FLAME PROOF TEST VISUAL & MEASUREMNT BY ELKOMETER	1/TYPE/SIZE 100% 100% 100% 1/TYPE/ SIZE 100% 1/TYPE SAMPLE	IS-325/ BHEL SPEC./ DATA SHEET -DO- IS-12075 & IS-12065 APPROVED DRG/DATA SHEET RELEVANT IS -DO- -DO- IS-325 & DATA SHEET IS-3682 IS-8239 IS-8240 BHEL SPEC. & DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET -DO- IS-12075 & IS-12065 APPROVED DRG/DATA SHEET & RELEVANT IS BHEL SPEC. AND DATA SHEET -DO- -DO- IS-325 & DATA SHEET IS-3682 IS-8239 IS-8240 BHEL SPEC. & DATA SHEET	TEST REPORT -DO- -DO- INSPC. REPORT TC -DO- -DO- INSPC. REPORT TC TC TC	2 2 2 2 2 2 2 2	1* 1 ^s 1 ^s 1 1 ^s 1 ^s 1 ^s 1 ^s	1 1 1 - 1 1 1 1	* NOTE - 1 NOTE - 2 NOTE - 2 - TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3 NOTE - 2 NOTE - 2 NOTE - 2 TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3 NOTE - 2 SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 9 OF 9		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
				SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION :			
			BIDDER/ :			QUALITY PLAN			NUMBER :			
			VENDOR			NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
SHEET 1 OF 2			SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./MFG. SPEC.	MFG. DRG./MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/BHEL SPEC./DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

		QUALITY PLAN SHEET 2 OF 2		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ :			QUALITY PLAN			SPECIFICATION :		
				VENDOR SYSTEM			NUMBER PED-506-00-Q-006, REV-01 ITEM AC ELECT. MOTORS BELOW 55KW (LV)			TITLE : SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

VOLUME : V-B

SECTION-IX

**TECHNICAL SPECIFICATION
FOR
ERECTION - CABLING, GROUNDING AND
LIGHTNING PROTECTION SYSTEM**

CONTENT

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ANNEXURE-A	NOTES AND DETAILS FOR CABLING SYSTEM
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SECTION-IX
TECHNICAL SPECIFICATION
FOR
ERECTION - CABLING, GROUNDING AND
LIGHTNING PROTECTION SYSTEM

1.00.00 SCOPE OF WORK

1.01.00 The scope of work covers complete and efficient design, supply, erection, testing and commissioning of Plant lightning protection system, all cabling and electrical grounding works. The scope shall broadly cover, but not be limited to :

1. Main Power House Building
2. Boiler area, ESP stack
3. Transformer yard
4. All auxiliary buildings (including electrical rooms of respective buildings) and structures as detailed in the Lead Specification.
5. Overhead interplant cable trestle and pipe cum cable trestle.
6. All electrical equipment as described in Volumes V-A & V-B.
7. 400kV Switchyard.

1.02.00 The scope of work shall also include all civil and structural works necessary for successful installation and commercial operation of all electrical equipment to be erected under this specification.

2.00.00 SCOPE OF SUPPLY

2.01.00 The scope of supply shall include but not be limited to the followings

2.01.01 Timely procurement and transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

These materials and miscellaneous items shall include but not be limited to the following :

- a) Galvanised steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, etc.
- b) Galvanised steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanised sheet steel junction boxes, cable fixing clamps, nuts & bolts, etc. as required.
- c) Cable termination and jointing kits as necessary.

- d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
 - e) Mild steel rods, galvanised steel flats, galvanised steel rods, lead coated copper tube suitably brazed with galvanised steel Bend ring galvanised steel wires, etc. required for grounding and lightning protection system shall be supplied in standard lengths.
 - f) Fire Stop mortal seal, fire retardant cable coating system.
 - g) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the contractor without any extra charge to the Purchaser.
- 2.01.02
- a) Main Ground Mat

Laying underground conductors and arc welding the conductors at each crossing and straight run (lap joint). Bidder shall select the diameter of conductor for the underground mat with supporting calculation. Suitable pigtails shall be provided.
 - b) Grounding Electrode

Ground electrodes will be 3 metre long, 40mm dia. M.S. rod. These are to be fabricated and driven into the ground by the side of mat conductor. All connections to the conductors shall be done by are wilding process.
 - c) Column Grounding
 - i) Concrete Columns

Erection of 1 no. M.S. rod (of diameter identical to ground mat conductor) from grounding mat to all concrete columns including necessary fixing, welding of one end of the rod with ground mat and the other end with the column above ground by welding with a short GS flat to edge angles.
 - ii) Steel Columns

Erection and connection of 1 no. M.S. rod (of diameter identical to ground mat conductor) from grounding mat to all steel columns including necessary fixing, welding of one end with ground mat and the other end with the column above ground with a short GS flat.
 - d) Risers

Erection and connection of all risers from underground mat to above ground levels where the ends will be left free for connecting to the equipment. Connection to the ground mat shall be done by arc welding and the other end is to be kept free at least 300 mm above grade level/concrete floor level unless otherwise shown.

e) Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chassis and to be terminated to an insulated ground bus.

Insulated ground bus (400x100x10mm) of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar as shown in the Grounding Notes and details drawing.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipments and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system. Separate Earth pit shall be made of 3M X 3M (diameter to be selected by Bidder).

f) All other ancillary works in connection with the items of work described above which are not specifically mentioned but are necessary to complete the work, shall be under the scope of this specification.

2.01.03

a) Air Terminal

Installation of vertical 20mm dia galvanised steel rod (except for chimney). The projected length of the rod shall be as required to protect the object. (on which the rod is fixed from lightning stroke).

Installation of air terminal at the top of the stack/chimney for lightning protection shall be 20mm dia coated solid copper rod.

b) Horizontal Air Terminal

Erection of horizontal air terminal of 75X 10 mm GS flat conductor in such a way that no part of the roof will be more than nine meters from the nearest roof conductor.

c) Down conductor

Erection of down conductor 75 X 10 mm GS Flat and 25 X 6 mm GS flat (Conveyor Gallery) conductor. one end of this down conductor connected with air terminal rod/ horizontal conductor at the top of roof/structure and other end connected to the nearest MS rod riser through test link located at approximately 1500mm above ground level.

d) Electrode (for Lightning protection)

Fabrication and driving into ground 3000 mm long, 40mm dia. M.S. rod and connecting them to the grounding mat by arc welding.

e) Risers (for Lightning protection)

Erection and connection of all risers from underground mat to above ground levels where the ends will be left free for connecting to the equipment. Each riser will be projected minimum 300 mm above grade level/concrete floor level. Riser will be of M.S. rod with diameter identical to ground mat conductor.

f) Shielding Mast

Erection of shielding mast at the top of steel columns cap plates of power house building.

g) All other ancillary works in connection with the items of work described above which are not specifically mentioned but are necessary to complete the work, shall be under the scope of this specification.

2.02.00 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

2.03.00 Necessary drawings, data sheets and Technical leaflets on each piece of material.

2.04.00 **Scope of Services**

The scope includes but is not limited to the followings;

2.04.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work.

2.04.02 The items of erection work shall be performed with respect to the following equipment/materials :

a) Power Cables

b) Cables laid in trench

c) Control, instrument and special cables

d) Supply and erection of entire cable tray and cable shaft arrangements indoor as well as outdoor area and all associated civil and structural works including foundation and cable trenches for complete plant.

e) Supply and Erection of Grounding system.

f) Supply and Erection of Lightning Protection system.

3.00.00 **GENERAL REQUIREMENTS**

3.01.00 **Codes and Standards**

3.01.01 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

- 3.01.02 Cable and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.
- 3.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.
- 3.02.00 **Erection Schedule**
- 3.02.01 The entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the tenderer for this purpose.
- 3.02.02 The erection schedule, as approved by the Owner's Engineer shall be strictly followed by the contractor. If, for any reason beyond the control of the Contractor, the work is held-up then the Contractor shall bring it to the notice of the Owner's Engineer without any delay.
- 4.00.00 **DESIGN CRITERIA**
- 4.01.00 **Grounding System**
- 4.01.01 Grounding shall follow the relevant standards/codes amended till date as below:
- a) Indian Electricity rules
 - b) National Electrical Code
 - c) Code of Practice of Earthing IS 3043
 - d) Protection of building and allied structures against lightning IS 2309
 - e) IS- 732, IS 226, IS 2629, IS 2633 & IS 4759
 - f) IEEE -80-2000, IEEE-665
- The station grounding system shall be an interconnected network of MS conductor and MS ground rods. The system shall be provided to protect plant personnel and equipment from the hazards, which can occur during power system faults and lightning strikes
- 4.01.02 The main objectives of grounding system are to :
- a) Provide safety to personnel from contact of dangerous potential caused by ground fault.
 - b) Ensure sufficient grounding current for effective relaying.
 - c) Stabilize circuit potential with respect to ground.

Design Basis

The station grounding system shall be designed in compliance with the IEEE-80-2000/ IEEE- 665 considering fault current of 50kA for 1 sec. and shall be subject to approval of Owner.

Actual soil resistivity measurement shall be carried out at proposed site for new units during dry season.

The surface resistivity shall be considered as 3000-ohm meter for Gravel and 1000 ohm-meter for concrete.

- a) Major items of equipment, such as generator, switchgear, transformer, motor, relay panels and control panels etc shall have integral ground buses or connection points which shall be connected to the under ground grid.
- b) Electronic panels and equipment, where required, shall be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations. Where practical, electronics ground loops shall be avoided. Where this is not practical, isolation transformers shall be furnished. All indoor and outdoor electrical equipment and associated non current carrying system, metal works, support structures, buildings columns, fence, neutrals, masts, arrestors, etc shall be connected to the plant ground system.
- c) Instrumentation cable screens shall be single point bonded to the instrument earth network to minimize the effects of electrical interference.
- d) For Signal/case/intrinsically safe signal, grounding of control room instruments, separate earth pit not connected to main ground grid shall be used. Control cabinets shall be connected to this separate earth pit.
- e) A grounding conductor (steel wire armor) shall be routed parallel to all power conductors operating above 240 volts.
- f) All ground wires installed in conduits shall be un-insulated.
- g) Embedded grounding grid of 75x10mm GI flat at basement/grade slab as well as upper floor/suspended slabs shall be provided.
- h) In addition mild steel ground pads at different locations i.e. on wall/floor/ceiling inside the buildings/tunnels/trenches shall be provided. These pads will be in turn connected to below ground level earth mat through galvanized steel flat or riser. Each ground pad shall have provision for connection of at least two 75x10mm GI flats.
- i) Treated earth pit shall be provided for system earthing at locations where generator and transformer neutrals are grounded. Two separate earthing leads shall be provided for each of the transformer and generator neutrals and shall be directly connected to a separate treated earth pit which in turn shall be connected to two different runs of earth grid. Heavy duty 50mm G.I. pipe shall be provide for treated earth pits with charcoal, salt, etc. as per IS:3043.

- j) Dedicated treated earth pit shall be provided for lightning protection system.
- k) Clean earthing for instrumentation shall be provided with dedicated earthing system and separate treated earth pits below the main control room, feed water pump house in turbine house etc.
- l) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

4.01.03 In order to meet the above objectives, ground grid mesh will be provided for the main plant complex, viz., switchyard, transformer yard adjacent to power house building, power house building and boiler area up to stack, auxiliary buildings, etc. The earth mats of main plant and BOP area will be interconnected by two or more connections.

All electrical equipment, non current carrying metal parts, structures, building steel, lightning protection system, generator/transformer neutrals will be connected to this station ground grid.

The major aspects to be considered for grounding system design are given below :

4.01.04 Ground Grid Conductor

- a) Ground grid conductor of mild steel rod shall be used.
- b) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years.

4.01.05 Underground Grid

- a) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80 & IEEE 665.
- b) The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than 0.5 ohm.
- c) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.
- d) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.
- e) All ground grid conductor connections will be welded type.
- f) Main Plant ground grid shall be connected with the switchyard and other auxiliary building /area ground grid at least at two (2) points.

- g) For test pits, the Electrode will be 100 mm dia. Heavy duty C.I. pipe with perforations. Electrodes installed in test pits will have disconnecting facilities
- 4.01.06 Above Ground Connections
- a) Galvanised steel flats shall be used for all connections above earth.
 - b) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.
 - c) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.
 - d) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.
- 4.01.07 Equipment Ground Lead
- Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.
- 4.01.08 The minimum ground conductor sizes for various equipment and structures are given in Annexure-B.
- 4.01.09 Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.
- 4.02.00 **Lightning Protection System**
- Lightning protection system design shall be as per IS:2309
- 4.02.01 The main purposes of lightning protection system are to :
- a) Provide protection to structures from lightning strokes.
 - b) Provide a low resistance-conducting path to lightning discharge.
- 4.02.02 Lightning protection shall be provided for Power House building, auxiliary building , chimney, cooling tower and other structures.
- 4.02.03 Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS:2309.
- 4.02.04 For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.
- 4.02.05 System Design

- a) Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.
- b) Horizontal air termination shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.
- c) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.
- d) Down conductors will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.
- e) An earth electrode will be provided at the connection point of the down conductor with the station ground.
- f) Galvanised steel rods and flats will be generally used for air termination and connections. All connections will be welded type.
- g) For air terminals of chimney, lead coated copper tube suitably brazed with G.S. Band ring shall be provided.

4.03.00 **Cabling System**

4.03.01 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all station auxiliaries.

4.03.02 Cable routing will be done on unit basis as far as possible.

4.03.03 Erection of cabling work shall be executed keeping in view all necessities and requirements of fire fighting codes for Generating Stations having an adverse industrial environment.

4.03.04 Suitable embedded steel inserts shall be provided on wall/floor/ ceiling surfaces for welding of cable tray bracket in order to make the cable tray system withstand horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays such as on Boiler platforms in addition to normal tray cable loadings.

4.04.00 All erection work to be carried out under this specification shall conform to the notes and details given in Annexure-A and drawings attached to this specification.

5.00.00 **SPECIFIC REQUIREMENTS - SUPPLY**

5.01.00 **Equipment and Material**

5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

5.01.02 Equipment and materials furnished shall be complete and operative in all details.

- 5.01.03 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.
- 5.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.
- 5.02.00 **Pre-fabricated Cable Trays**
- 5.02.01 Cable trays shall be pre-fabricated ladder type sheet steel with hot dip galvanising furnished in standard length of 2.5 metres.
- 5.02.02 Cable trays shall be of standard width specified in Annexure-A and drawings.
- 5.02.03 Cable trays shall be complete with all necessary hot dip galvanised sheet steel accessories such as coupler plates, ground continuity connections and associated nuts, bolts, washers, hangers, clamps, etc. Also horizontal / vertical bends, horizontal / vertical Tee, Reducers, Horizontal cross-pieces, protective covers shall be supplied along with straight runs in order to take care of cable tray alignments in different routes.
- 5.02.04 All fittings like horizontal/ vertical elbow, horizontal crosspiece, reducer, horizontal tee, etc. should be pre-fabricated. Each fitting shall be provided with two nos. hot dip galvanised side coupler plates & associated bolts, nuts and washers on each side.
- 5.02.05 Cable trays, fittings & accessories as well as elbows, reducers, tees, crosses, etc. shall be fabricated out of 14 gauge (2 mm thick) hot rolled mild steel sheets.
- 5.02.06 Contractor shall supply 14 gauge (2 mm thick) perforated type hot rolled mild steel sheet covers for vertical cable shafts up to a height of 2.5 metres from floor level. The perforated covers used for the vertical raceways may be of one or more pieces along the width of the raceway, depending on the width of the raceway and shall be bolted to the structural framework of the raceway.
- 5.02.07 The cable trays, fittings and accessories including all bolts, nuts, screws, washers, etc. shall be hot dip galvanised after fabrication as per IS:2629. Galvanising shall be uniform, clear, smooth and free from acid spots. Should the galvanising of the samples be found defective, the entire batch of steel will have to be re-galvanised at Contractor's cost.
- The amount of zinc deposited shall not be less than 610 gms per square metre of surface area and in addition the thickness of the zinc deposit at any spot whatsoever, shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elcometer or any other instrument and reject any component, which shows thickness of zinc at any location to be less than 75 microns.
- 5.02.08 The Contractor shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and that such tests are adequate to demonstrate that the equipment will comply with the requirement of this specification.

The tolerance on dimensions shall be in accordance with appropriate Indian Standards. The extent of the tests to be performed by the contractor shall include but not be limited to the following:

Deflection Test

A 2.5 metre straight section of each type of cable trays shall be simply supported at the two ends. A uniformly distributed load of 100 Kg per metre will be applied along the length of the tray. The maximum deflection at mid span shall not exceed 7 mm.

- 5.02.09 For other details refer CABLING NOTES AND DETAILS annexed to this specification.
- 5.03.00 **Conduits and Accessories**
- 5.03.01 Conduits shall be of rigid steel, hot-dip galvanised, furnished in standard length of 5 metres, threaded at both ends.
- 5.03.02 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.
- 5.03.03 Each piece of conduit shall be straight, free from blister and other defects, internal surface shall be of smooth finish and covered with capped bushings at both ends.
- 5.03.04 The contractor shall provide and install all rigid steel conduits, mild steel pipes, flexible conduits rigid PVC pipes, etc. complete with accessories such as tees, bends, adapters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work.
- 5.03.05 Steel conduits with interior coating of silicon epoxy ester for ease of wire/cable pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanised. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS:9537. In chemical handling areas, Battery Room, etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.
- 5.03.06 For sizes above 63 mm mild steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. Pipes shall be manufactured by electric welding process. These pipes shall be of heavy duty class as per IS:1239 and shall have ISI mark. Pipes shall be supplied in lengths of approximately 5 metres. Pipes, fittings & accessories shall be hot dip galvanised both on inside and outside.
- 5.03.07 Flexible conduits shall comply with IS:3480. They shall be made with bright, cold-rolled, annealed and electro-galvanised mild steel strips. Flexible conduits shall be used between embedded conduits/pipes and the motor terminals. Flexible conduits shall also be used between fixed conduit and any equipment terminal boxes where vibration is anticipated or equipment that require regular removal.

5.03.08 Rigid PVC conduits conforming to IS:4985 shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are straight ones generally the PVC pipes with special Bell Mouthing shall be of 110 mm, 160 mm & 200 mm outside diameter and shall be suitable for working pressure of 6 kg/sq. cm. The length of each pipe shall be 5 to 6 metres. Necessary fittings & accessories as may be required for the installation shall also be provided.

5.04.00 **Junction Boxes**

5.04.01 Glass Fibre Reinforced Junction Boxes

a) No. of Ways: 12 / 24 / 36 / 48 with 20% spare terminals.

b) Design

Junction boxes shall be Glass Fibre Reinforced with saturated polyester conforming to standards like DIN 16911 type 803 / 16913 type 834, 5 self extinguishing in accordance with ASTM D 635 / UL 94 VO.

c) Enclosure

Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance between – 10 to 100 deg C. Impact resistance shall be greater than 7 Nm, (EN 50 014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/ mm, halogen free toxicity, the enclosure and door cover shall be painted and electro-statically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M6) shall be provided on the cover as well as door.

d) Doors

With integrated viewing window of 3 mm resistant plexi – glass or equivalent. The doors shall have industrial heavy – duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

e) Protection Class :

Protection Category shall be IP 66 to EN60 529. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane / chloroprene. The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 yrs. Bidder shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 yrs (double sealing arrangement is preferred).

f) Mounting clamps and accessories :

Suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass. The accessories like mounting plants etc. of steel shall be powdered coated. The support rails for terminal box shall be zinc coated.

- g) General :
 - i) JBs shall have small canopy at the top.
 - ii) There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage in to the junction box shall be avoided and it shall fall outside.
 - iii) Cable entry shall be from bottom side only.
 - iv) Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

5.04.02

Steel Junction Boxes :

- a) No. of Ways:12 / 24 / 36 / 48 with 20% spare terminals.
- b) Design :

Junction boxes shall be designed in accordance with NEC, article 370, paragraph 18, 20 or equivalent standards.
- c) Enclosure :

Junction boxes for use in outdoor or damp locations shall be sturdy steel construction. The enclosure and door cover shall be surface finished clean, degreased, phosphated, deep coated primed (preferably in RAL 7044) and electro-statically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door. The sheath steel thickness shall be minimum 2 mm.
- d) Doors :

The doors shall be hinged and lockable. The doors shall have industrial heavy – duty hinges. The doors shall be easily but firmly lockable with quick release fastener.
- e) Protection Class :

Protection Category shall be IP 66 to EN60 529 / 10.91 complies with NEMA 4. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane. There shall be an arrangement like multifold protection channel for additional stability and prevention of ingress of dust and water when the enclosure is open.

The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 yrs. Bidder shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 yrs (double sealing arrangement is preferred).

- f) Mounting clamps and accessories:
- Suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required
- 5.04.03 The junction boxes shall have the following indelible marking
- Circuit nos. on top by white-stenciled paint at site.
 - Circuit nos. with ferrules (inside) as per approved drawing.
 - Danger sign in case of 415V circuit.
- 5.05.00 **Terminals**
- 5.05.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.
- 5.05.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.
- 5.06.00 **Cable Termination & Jointing Kits**
- 5.06.01 The Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables, etc. along with all accessories & consumables required for making termination and joints complete. All the materials and components of the termination/joints shall be suitable and compatible with the type of cables for which the terminals/ joints are intended.
- 5.06.02 The straight through joints of H.T. and L.T. cables shall be of Tapex/ Paracast/Parawrap type/approved make.. The end termination kits for H.T. cables shall be of Raychem/3M/Elastimold type/approved make. Cable joint or end terminations on Electrical equipment shall be suitable for Indoor & Outdoor use, as the case may be.
- 5.06.03 Glands and lugs required for termination of H.T., L.T. and instrumentation cables shall be supplied by the Contractor in required quantity.
- 5.07.00 **Cable Glands**
- Cable glands shall be tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Cable glands shall match with the sizes of different HT/LT/Control cables.
- 5.08.00 **Cable Lugs**
- Cable lugs shall be suitable for termination of different cross-sections of H.T./L.T./Control/Instrumentation cables and shall be of following types :
- i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

- ii) Copper tubular terminal end for solderless crimping to copper conductors.

Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

- iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.

5.09.00 **Consumables and Hardware**

5.09.01 The Contractor shall furnish all erection materials, hardware and consumables required to complete the installation.

5.09.02 The materials shall include but not be limited to the following :

Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials, etc.

Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims, etc.
5.09.03 Supply of cement, sand, stone, etc. required for the execution of the contract shall be the responsibility of the Contractor.

5.10.00 **Testing Equipment**

5.10.01 The major testing equipment that are required to be provided by the Contractor are listed below :

- a) Insulation Tests
 - i) Power operated Meggar - 1 KV and 10 KV grade
- b) Hand driven earth Resistance Meggar, range 0-1/3/30 ohms.
- c) High potential testing set - roller mounted type
- d) Tong testers of suitable ranges.
- e) Contact resistance measuring set for micro-ohms.
- f) Torque wrench of various sizes.
- g) Multimeters, test lamp, field telephone with buzzer set, different gauges, etc.

5.10.02 The list of equipment is indicative only. Any other test equipments required will be arranged by the Contractor.

6.00.00 **METHODS AND WORKMANSHIP**

- 6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/ electricians skilled in the trade involved.
- 6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.
- 6.03.00 All details on installation shall be electrically and mechanically correct.
- 6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.
- 7.00.00 **INSTALLATION**
- 7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.
- 7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- 7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits, etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/ termination kits, lugs, glands, ferrules, tapes, etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.
- 7.01.04 Grounding installation work shall mean erection, jointing/ brazing/ welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.
- 7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors, etc. of lightning protection system.
- 7.02.00 **Cable Trays**
- 7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.
- 7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.
- 7.02.03 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.

- 7.02.04 The cable trays shall be supported in general at a span of exceeding 1.25 metres horizontally and 1.0 metre vertically.
- 7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing & maintaining the cables.
- 7.02.06 Complete cable tray support structure after installation shall be inspected/ tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.
- 7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship, etc.
- 7.02.08 The Contractor shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.
- 7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.
- 7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.
- 7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.
- 7.02.12 Cable tray/conduit system will be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.
- 7.02.13 Cable tray/conduit system will be constructed to prevent drainage of water into equipment or building.
- 7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.
- 7.02.15 Different voltage grade cables will be laid in separate trays when trays are run in tier formation. Power cables will normally be on top trays and control/instrumentation cable on bottom trays.
- 7.03.00 **Cable and Conduits**
- 7.03.01 The Contractor shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.
- 7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.
- 7.03.03 Approximate lengths of cable and conduit runs will be shown by the contractor in the cable schedule for guidance only. Before commencement of work the Contractor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.

- 7.03.04 The Contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.
- 7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.
- 7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the owner's Engineer.
- 7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.
- 7.04.00 **Conduit and Accessories**
- 7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.
- 7.04.02 The Contractor shall furnish all conduits complete with accessories as required.
- 7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the Contractor.
- 7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.
- 7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.
- 7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.
- 7.04.07 Pull boxes will be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.
- 7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting, etc. Conduits shall be supported at least every 2000 mm.
- 7.05.00 **Cables : Storage and Handling**
- 7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.
- 7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.
- 7.05.03 In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.

- 7.05.04 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending.
- 7.05.05 The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.
- 7.05.06 While laying cable, cable rollers shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. Cables shall not be dragged on ground or along structure while laying out from cable drums.
- 7.05.07 Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.
- 7.05.08 Empty cable drums shall be returned to the Owner.
- 7.06.00 **Cable Laying**
- 7.06.01 Cables will generally be laid on ladder type prefabricated cable trays, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle as per approved drawing. For outdoor area cable rack shall be used in Pipe Bridge for outdoor area cable interconnection. Cables shall be run in concrete trenches in transformer yard and switchyard only and in those electrical rooms at ground level, which are without any spreader room below. Cables buried directly in ground are not acceptable except for street lighting cable.
- In indoor pumps, mechanical equipment areas overhead cable trays shall generally be used.
- A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables. Cables for redundant equipment system shall be run in separate trays, as far as possible.
- 7.06.02 Cables laid on trays and risers shall be neatly dressed and clamped with self-locking type fire resistant nylon ties at an interval of 750 mm. for horizontal and vertical runs, in case of both power, control and instrumentation cables.
- 7.06.03 All single core power cables for 3 Ph. AC circuits shall be laid in trefoil formation and suitably clamped with self-locking type fire resistant nylon ties at an interval of 750 mm.
- 7.06.04 All H.T. multicore power cables and L.T. multicore power cables with cross-sectional area including & above 95 sq.mm shall be clamped individually by self-locking type fire resistant nylon ties.
- 7.06.05 L.T. power cables of cross sectional area less than 95 sq. mm. and all control and Instrumentation cables shall be clamped in bunches with self-locking type fire resistant nylon ties. The number of cable in one bunch shall not exceed eight (8).

- 7.06.06 Prior to laying of cables inside the indoor and outdoor trenches, the contractor shall properly clean the trenches.
- 7.06.07 For underground crossing of railways, road, etc. additional protection shall be provided in form of hume pipe or concrete encased rigid steel conduits (duct bank).
- 7.06.08 After completion of installation and prior to connection, all power cables shall be subjected to a high potential test.
- 7.07.00 **Cable Tags & Markers**
- 7.07.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, bends, every 30.0M and exit from any equipment, junction box. When a cable/conduit passes through a wall, tags shall be fitted on both sides of the wall.
- 7.07.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire. For single core cable the wire shall be of non-magnetic material.
- 7.07.03 The location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.
- 7.07.04 The Contractor shall furnish and install all tags and markers stated above.
- 7.08.00 **Cable Termination and Connection**
- 7.08.01 The termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.
- 7.08.02 The work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of Contractor's procurement.
- 7.08.03 Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.
- 7.08.04 Cable joint kits for all cables shall be supplied by Contractor under this specification. Responsibility for proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by Contractor.
- 7.08.05 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.
- 7.08.06 The Contractor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.

- 7.08.07 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the contractor.
- 7.08.08 Control/instrumentation cable cores entering control panel/ switchgear/ MCC, etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
- 7.08.09 The Contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.
- 7.08.10 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.
- 7.08.11 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.
- 7.08.12 All cable entry Points shall be properly sealed and made vermin and dust proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.
- 7.09.00 **Termi-point Connection**
- a) The conductor (solid or stranded) is forced against the contact area of the 2.4 x 0.8 mm or 1.6 x 0.8 mm connection pin by means of a tin-coated bronze clip, which maintains a constant pressure. In the Maxitermi-point method, 2.4 x 0.8 mm pins is used without exception.
 - b) The conductor is "shot" onto the pin together with the clip. The resulting friction causes both the wire and the contact area of the pin to be cleaned and any oxide layers to be penetrated.
 - c) Apart from this the wire and the clip are deformed in such a way that a gas-tight connection with very good electrical and mechanical properties is established.
 - d) A special manually or pneumatically driven gun is required. Up to 3 adjacent connections can be "shot" onto one pin. In most cases only one clip at the base of the pin is attached. The sections above usually remain vacant. Any part of a connection pin may be reused several times after removal of the existing clip connection. Contact areas below existing connections that have become vacant can be reused by pushing the connections above the vacant space downwards, so that the new connection can be "shot" on above the top connection. The single jumper wires need not be specially prepared as the end insulation is stripped within the tool.
 - e) This connection method requires special insulation of the wires. The diameter of solid conductors is 0.8 mm the cross-section of stranded conductors 0.5 Sq.mm.
 - f) The conductor is deformed greatly when attached and is to be shortened by 3 mm when disconnected and reused.

- g) Strips and special tools for termi-point connection shall be supplied by the Contractor.

7.10.00 Cable Joints

- 7.10.01 Cable shall be installed without joints as far as practicable.
- 7.10.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.

7.11.00 Grounding

- 7.11.01 The Contractor shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc. The grounding work shall be carried out as per provisions of I.E. rules Indian standards and enclosed grounding and lightning protection notes and details.
- 7.11.02 The grounding shall be done by conductors of adequate sizes (size shall be selected by the bidder with supporting calculation) and the same shall be connected to the risers of main ground mat.
- 7.11.03 For fabricated cable trays, a separate ground conductor (50x6 mm G.S. flat) shall run along the entire length of each route of cable tray being suitably clamped on the cable tray. Individual cable trays of each section shall be connected to above ground conductor through 50x6 mm G.S. flat to maintain continuity of ground path.
- 7.11.04 All ground conductor connections shall be made by electric arc welding/ brazing unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers. The rods/connection shall be coated with cold galvanizing /weather resistance anti corrosive paints.
- 7.11.05 All ground conductors shall be painted black for easy identification.
- 7.11.06 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.
- 7.11.07 Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.
- 7.11.08 If there is no provision to ground the L.T. transformer neutral at transformer end, to make an effectively earthed 415V system the neutral bus of all 415V distribution boards shall be connected to ground grid at two different and distinct points.
- 7.11.09 The underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth of minimum 1 metre below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300

mm below the bottom elevation of such trenches/pipes as shown in the relevant drawing.

The Contractor will plan and organise works to lay the grounding mat in the same sequence in which the building and equipment foundation is being done.

7.12.00 Painting

7.12.01 The Contractor shall paint steel fabrications at site with two (2) coats of red oxide primer. Finish paint shall be as per TSGENCO standard practice which will be informed to Bidder during detail engineering. Also refer to clause no. 1.16.00 of Section-I, Volume V-A.

7.13.00 Galvanising

7.13.01 The galvanising shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanising of the samples be found defective, the entire batch of steel has to be regalvanised, at Contractor's cost. The amount of zinc deposit shall not be less than 610 grams per square metre of surface area and in addition, the thickness of the zinc deposit at any spot whatsoever shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elkometer or any other instrument and reject any component which shows thickness of zinc at any location less than 75 microns.

7.14.00 Excavation and Back Filling

7.14.01 The Contractor shall perform all excavation and backfilling as required for buried cable and ground connections.

7.14.02 Excavation shall be performed up to the required depth. Such sheeting and shoring shall be done as may be necessary for protection of the work.

7.14.03 The Contractor shall make use of his own arrangements for pumping out any water that may be accumulated in the excavation.

7.14.04 All excavation shall be backfilled to the original level with good consolidation.

7.15.00 Steel Fabrication

7.15.01 All racks, trays, supports, hangers & brackets wherever necessary shall be fabricated by the Contractor.

7.15.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge and burns so as not to cause any damage to personnel or cables.

7.16.00 Cleaning up of Work Site

7.16.01 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

- 7.16.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.
- 8.00.00 **TESTS**
- 8.01.00 Shop Tests
- 8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.
- 8.01.02 Tests on panels/junction boxes shall include :
- a) Wiring continuity tests.
 - b) High voltage and insulation tests.
 - c) Operational tests.
- 8.02.00 **Site Tests**
- 8.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.
- 8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.
- 8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.
- Cable cores shall be tested for :
- a) Physical damage
 - b) Continuity
 - c) Correctness of connections as per relevant wiring diagram
 - d) Insulation resistance to earth
 - e) Insulation resistance between conductors
 - f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.
- 8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.
- 8.03.00 **Test Certificates**
- 8.03.01 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.
- 9.00.00 **DRAWINGS, DATA & MANUALS**

- 9.01.00 To be submitted with the Bid
- 9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.
- 9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.
- 9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.
- 9.01.04 Layout of Grounding system & lightning protection system showing connection and other details along with backup design calculations and detailed write up.
- 9.01.05 Bill of materials for grounding and lightning protection system.
- 9.01.06 Drawing showing details of equipment grounding.
- 9.02.00 **To be submitted after Award of Contract**
- 9.02.01 Make, type & catalogue number of cable termination kits, joints & accessories.
- 9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.
- 9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.
- 9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.
- 9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.
- 9.02.06 Bill of material for grounding system and lightning protection system.
- 9.02.07 Drawing showing details of equipment grounding system.
- 9.02.08 Cable schedule and inter-connection charts for the entire power plant.

ANNEXURE-A
NOTES AND DETAILS
FOR
CABLING SYSTEM

1.00.00 GENERAL

1.01.00 These notes and details shall be read and construed in conjunction with Specification and the drawings meant for cable tray details and supporting arrangements in Trench, Racks etc., enclosed elsewhere. In case of conflict between these notes and drawings, the latter shall prevail.

1.02.00 The Cabling System installation work shall conform to the requirements of the latest revisions of the following standards/codes

- a) Indian Electricity Rules, 1956, with up to date amendment.
- b) I.S. Code of Practice.

2.00.00 CABLE ROUTING/LAYING

2.01.01 Cables shall generally be laid on ladder type cable trays either in trenches or overhead supported from building steel/structures except in some cases cables may have to be laid underground and for short runs in conduits for protection or crossing.

2.01.02 For interplant connections, the cables may be directly buried or routed through an overhead cable bridge or cable trenches/tunnels selection being dependent on site constraints.

2.01.03 For underground crossing of railways, roads etc. hume pipes shall be used and shall be laid at a depth of minimum 1000 mm such that cables shall not be damaged.

2.01.04 In boiler area, trench will be avoided as far as practicable. The cable racks shall be supported from Boiler structure in vertical configuration with suitable cover to avoid deposition of coal dust as far as practicable.

2.01.05 Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers. Power cables shall be on top trays and Control/Instrumentation cables on bottom trays, and it is recommended that trays for cables of different voltage levels be stacked in descending order with higher voltage level above.

2.01.06 Cables for redundant equipment/system shall be run in separate trays in separate route.

2.01.07 Cables from two different services viz. supply from station board and supply from unit board shall be fully segregated to prevent simultaneous damage due to fire in one of the services.

- 2.01.08 Low level signal cables and other special Instrumentation and Control cables shall run in separate trays. In general, a minimum of 1500 mm clearance shall be maintained between these cables and noise generating equipment (large motors, generators, transformers etc.).
- 2.01.09 The cable spreaders of each unit shall be compartmentalized by provision of fire proof partition wall.
- 2.01.10 The floor of the cable spreader rooms will have to be made water proof so that water does not percolate to lower levels in the event of fire fighting operations. Adequate arrangement for efficient drainage of water shall be provided. The cable raceways should also be suitably curved to avoid water entry through this place.
- 2.01.11 Cabling System for CHP
- a) Cable in CHP area shall be generally routed through the conveyor gallery / tunnel, TP / Buildings by separate supporting structures, Pipe cum cable bridge. The cables shall be laid in vertical trays.
 - b) In substation & switchgear room cable shall be laid in horizontal cable trays installed in cable vault room.
 - c) Cables may also be routed through hume pipes to enter into various buildings from the nearest overhead cable trestle/substation building.
 - d) Overhead cable trestle/cable bridge shall be provided for routing of cables between the following Sub-Stations/buildings:
 - i) Main CHP Substation Building and Crusher House.
 - ii) Main CHP Substation Building and Pump House (if required).
 - iii) Wagon Tippler Substation Building and TP.

The bottom of the steel supporting structure shall be generally at 2.5m above the grade level except for road crossing and rail crossing where the same shall be 6.5 m and 9.0m respectively above grade level.
 - e) Cable trays shall be laid out horizontally in sub-station buildings and pump-house whereas the same shall be installed vertically inside transfer points, crusher house, conveyor gallery/tunnel etc. The cable trestle shall have a minimum 600mm clear walk way all along its routes and shall have maintenance platforms as required.
 - f) Separate trays shall be provided for H.T., L.T., control and instrumentation cables. LT multicore Power cables shall be laid in single layer & touching formation and single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meter while control and instrumentation cables shall be laid in maximum of two layers formation. Single core HT power cables shall be laid on trefoil formation with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meter and Multi core power cables shall be laid in single layer & touching formation. Normally cable trays shall be designed with 70% fill-in criteria and

conduit 40% fill-in criteria. Same cable laying philosophy shall be considered in other areas of the plant, if not specifically mentioned.

2.02.00 Cable Trays/Supports

2.02.01 Cable trays and covers shall be pre-fabricated type, constructed from minimum 14 SWG sheet steel for trays and 16 SWG for covers and hot-dip galvanized after fabrication.

2.02.02 Cable tray supports shall be cantilever type for each installation. All supports and hardware shall be hot-dip galvanised.

2.02.03 Standard cable tray width shall be 600 mm. However, trays with 450, and 300, 150 mm width may be used in some places considering the requirement and space restrictions. For instrumentation and control purpose, some perforated type cable trays of width 150 and/or 100mm may be used particularly in Boiler Platform area, and 600, 450, 300 mm perforated trays may be used depending on site requirement.

2.02.04 Cable trays shall be ladder type with 250 mm rung spacing, 100 mm depth and rung width not less than 50 mm. Ladder type trays for power & control cables and perforated type for instrumentation cables shall be provided.

2.02.05 All weld for cable tray supports shall have a min. throat thickness of 6 mm.

2.02.06 Cable trays in areas subjected to excessive coal dust, or mechanical damage will have hot-dip galvanised sheet metal tray cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run.

Where covers are used on trays containing power cables, consideration should be given to ventilation requirements. Areas where corrosive chemicals are likely to be handled, cable tray and covers shall be epoxy painted.

2.03.00 Conduits

2.03.01 Conduits shall be rigid steel coated type; minimum size of conduit shall be limited to 19mm.

2.03.02 Steel conduits with interior coating of silicon epoxy ester for ease of wire pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanised. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS:9537 Part-II. In chemical handling areas, Battery room etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion.

2.03.03 Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run.

2.03.04 Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following :

One Cable	:	53%
Two Cable	:	31%
Three Cables & Up	:	40%

- 2.03.05 Conduit runs shall be provided with necessary bends as required.
- 2.04.00 **Installation**
- 2.04.01 The Contractor shall install terminate and connect up all cables and conduits with supporting arrangements as per drawings, cable schedules and interconnection chart/drawings.
- 2.04.02 The HV power cables of 11 KV/3.3 KV shall be laid in trays or racks as follows :
- a) In single layer only.
 - b) Multi core cables to be laid in touching with each other.
 - c) Single core cables to be laid in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centerlines and clamp every two meter.
- 2.04.03 1100V grade power cables shall be laid in single layer in trays.
- 2.04.04 1100V grade mutlicore power cable shall be laid in touching formation to each other.
- 2.04.05 1100V grade Single core cables to be laid in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centerlines and clamp every two meter.
- 2.04.05 Control and Instrumentation cables can be laid up to a maximum of two layers in each tray.
- 2.04.06 Normally cable trays shall be designed with 70% fill-in criteria and conduit 40% fill-in criteria. Same cable laying philosophy shall be considered in other areas of the plant, if not specifically mentioned.
- 2.04.07 The trays shall be run with a vertical spacing of 300 mm for overhead cable trays as well as inside cable trenches. A minimum of 225 mm clearance shall be provided between the top of tray and beams, cold piping, 500 mm clearance for hot piping/object to facilitate installation of cables in tray.
- 2.04.08 Adequate pull boxes shall be provided in conduit run to facilitate cable pulling in long runs and also to ensure that there will be no more than 270 Deg. bends between pull points.
- 2.04.09 Cable tray/conduit system shall be installed to accommodate cable manufacturer's recommended maximum pulling tension and minimum bending radius.
- 2.04.10 All openings in the floor and wall for cable access shall be sealed after installation of the cable system with non-inflammable materials, as follows :
- i) Fire stop/Penetration seal shall be installed in the cable spreaders and cable raceways.
 - ii) Similarly in the trenches fire stop/penetration seals shall be provided at suitable interval to avoid spread of fire.

- iii) For all H.T., L.T., Relay and Control panels, Control desk, instrumentation panels, battery charger, D.C. Dist. boards and other miscellaneous panels, fire-stops should be provided below base plate.
- 2.04.11 All floor/wall openings for cable entry to the electrical equipment and accessories shall be sealed with non-inflammable materials, after completion of cable installation. Thickness of such materials shall be equal to the thickness of floor/wall unless specified otherwise.
- 2.04.12 The portion of galvanised steel, which, if required, undergoes any welding at site shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.
- 2.04.13 Refer Clause No. 3.00.00 below for details of fire-proof sealing and fire protection coating.
- 2.05.00 **Identification**
- 2.05.01 The complete cabling system shall be properly identified. Methods for identification of cabling system shall be furnished to the successful EPC Contractor shall strictly adhere to the said methods.
- 2.05.02 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.
- 2.05.03 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate, projected above ground level.
- 2.05.04 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, at each bend and at every thirty (30) metres in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, MCC, control & relay panels etc. wherever required for cable identification, such as where a number of cables enter together through a gland plate.
- 3.00.00 **FIRE-PROOF SEALING / FIRE PROTECTION COATING SYSTEM**
- 3.01.00 The Fire proof sealing / fire stop system / fire protection coating system is required to prevent spreading of fire from one place to other place (or one zone to other zone) through the openings in wall / floor, cables laid in trays / racks and openings below Electrical Switchgear / MCC / Distribution boards / Cabinets / Panels, etc. The fire proof sealing system shall conform to the latest edition including amendments of BS-476.
- 3.02.00 **Scope of Work**
- 3.02.01 The scope of work includes but is not limited to the following supply and services:
 - i) Fire Stops in wall / floors.
 - ii) Fire stops below switchgear / MCC / Switchboards, junction boxes / panels / cabinets, etc. which are floor mounted type.
 - iii) Fire retardant coating to be applied for installed cables.

- iv) Minor civil / structural works for installation of the entire work.
- v) All necessary erection materials, consumables and sundry items to complete the entire work for satisfactory and trouble free operation.
- vi) Any special tools & tackles.
- vii) Conducting the type test of fire proof sealing system in presence of Owner's engineers.
- viii) All relevant Drawings, Data sheets and instruction manuals.
- ix) Fire proof barrier walls.
- x) Fire proof doors.

3.03.00 **Design Criteria**

3.03.01 Fire Proof Sealing System

The material / components used for fire-proof sealing system shall be provided to meet the following requirements:

- i) Life expectancy should not be less than 30 years from the date of installation.
- ii) Free from shrinkage or cracking or asbestos in composition and should achieve smoke and gas tightness during fire and should be modifiable.
- iii) Not to generate toxic gas and harms to the personnel handling the system.
- iv) Prohibition of production of acid or alkali during gas generation.
- v) Will not produce suffocating / corrosive gas.
- vi) Repellant to paste / rodent / termite.
- vii) Expansion co-efficient - very low which is to be comparable with masonry concrete.
- viii) Not soluble / reactive to acid, water, alkali.
- ix) Thermal conductivity - low.
- x) The material in contact with the cables in the fire-proof sealing system shall be compatible with the material used for outer sheath of cables.
- xi) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.

- xii) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.
- xiii) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.
- xiv) The F.P.S. system shall maintain its integrity and perform satisfactory even after
 - a. Remaining in water for a long time.
 - b. Accelerated thermal aging.
 - c. Sustaining vibrations.
- xv) The design and construction of F.P.S. system shall specifically take into account the fact that under seismic disturbances, normal load, short circuit and fire conditions, the cable / cable trays will be subject to movement, expansion and oscillation and this shall not result in any damage or cause dislocation of the F.P.S. system or the material constituting the FPS System.
- xvi) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not contain volatile solvents which may cause a fire hazard during application.
- xvii) The fire rating shall not be less than one (1) hour and the system shall be stable after applicable of water jet in the exposed side in order to extinguish fire.

3.03.02 Fire Protection coating to be applied on installed Cables:

The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:

- i) At fire stops in walls and floors on either side upto 500 mm length.
- ii) At fire stop below Electrical Switchgears/ MCCs/ Panels/ Cabins, etc. on one side coating of 500 mm length, i.e., on the cable vault side / cable trench side.
- iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/ cable trench.
- iv) In fire risk areas and where specified at suitable intervals as decided upon site conditions in open cable routes.
- v) Where necessary and specified at site intervals along cable routes in cable trenches.
- vi) The coating shall be applied evenly on the cables only.

3.03.03 The fire protection coating shall have the following properties/composition:

- i) Asbestos free, non-volatile, not eatable by vermin, harmless and non-irritant to skin of human.
- ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.
- iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEEE - 383.
- iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum size cable at 180°C.
- v) The limiting oxygen index of the material shall not be less than 60% as per ASTM D - 2863.
- vi) Life expectancy equivalent to the cable installations.

3.03.04 The various openings in the cable vault, vertical/ horizontal raceways of cables penetrating walls/ floors and the bottom of Electrical switchgears/ MCCs/ distribution boards/ Cabinets/ Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/ racks in the bunch formation. Bidder shall visit the site to assess and get acquainted with the type of cable installation where fire stops and fire protection coating are to be provided. In case steel frames are required to be fabricated and fixed in the openings, the fabrication of frame & fixing of the same shall have to be done by the Contractor without any extra cost. The necessary steel section for fabrication of frames shall be supplied by the Contractor without any extra cost. Any civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools & accessories required for addition or removal of cables after the seal is made.

3.04.00 The bidder shall quote the unit rates for provision of supply, installation, testing & commissioning of the fire proof seals as given in the specification. Bidder is requested to quote the unit rates per square metre (i.e., area) basis of the area of the fire sealing material.

3.05.00 **Type Test On Penetration Seals**

3.05.01 The type tests for fire proof/ penetration seal for floor and wall opening/ fire stop system for bottom of electrical switchgear/ MCC/ panel base are as under:

- i) Fire rating test.
- ii) Hose Stream test.
- iii) Accelerated aging test.
- iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test.
- v) Temp. rise test for cable in the fire stop.

- vi) Water absorption test followed by fire rating test.
- vii) Flame Resistance test for fire retardant coating material.
- viii) Anti-rodent test.

3.05.02 Fire Rating Test

This test shall be carried out to prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system. The penetration seal system as a whole conforming to ASTM 814 and as per BS:476 Part-8 shall be built with the necessary component. The fire test shall be built with the necessary component.

The test specimen of the penetration seal built with 9-10 nos. armoured cables of various sizes passing through the seal shall be fitted to the gas fired furnace and shall form the upper most face of the furnace. The gas fired furnace shall have provision to achieve standard time temperature characteristics for fire tests as mentioned in BS-476 Part-8, according to which the temperature required to be maintained are as under:

<u>Heating time in minutes</u>	<u>Temperature in the furnace</u>
30 minutes	821°C
90 minutes	886°C
120 minutes	1029°C
150 minutes	1062°C
180 minutes	1090°C
210 minutes	1113°C
240 minutes	1133°C

The pressure inside the furnace at the time of test shall be more than 2 mm water gauge. The penetration shall be subjected to fire test with surface exposed to controlled fire in the furnace conforming to time / temperature characteristics as mentioned above. During the test, the temperature of both the faces of the penetration seal, i.e. one which is exposed to fire and the other unexposed, shall be measured by calibrated thermocouples after regular interval of 5 minutes. At least 3 thermocouples shall be provided for temperature measurement of each face.

3.05.03 The results at the end of the tests shall be interpreted or failure criteria as under:

- i) The system is deemed to have failed to maintain stability if there is a total collapse of the penetration seal.
- ii) In case cracks are seen on the face of the penetration seal or cracks through the sealing system through which the flame / or gas can pass,

the system is deemed to have failed to maintain integrity. The development of crack is characterized by ignition cotton wool held near the seal on the unexposed surface at a distance of about 30 mm from the aperture.

- iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall be deemed to have failed in respect of insulation characteristics.
- iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

3.05.04 Hose Stream Test:

The intention of the hose stream test is to ascertain whether the penetration seal assembly maintains its stability on application of water jet after withstanding the fire for 1 hour i.e. the guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for carrying out the fire rating test. The penetration seal system shall be subjected to the action of hose stream at the nozzle pressure of 30 psi supplied for a duration of 1.5 sec./ sq.ft. of exposed area. The hose stream shall be applied with 1.1/ 8" dia. nozzle at a perpendicular distance of approximately 17 ft. from the centre of the assembly on a line approximately 270 deg. from the line normal to the centre for the test assembly. The water stream shall be applied within 4 minutes and 30 seconds after completion of fire rating test.

However, this period shall not exceed more than 10 minutes in case of practical difficulties experienced by testing stations. The application of water stream shall be maintained throughout the test duration and shall traverse the complete fire stop system.

The fire stop assembly is deemed to have passed the hose stream test successfully if no through projection of water is noticed on the unexposed surface of the seal. Further on completion of hose stream test, the appearance of the penetration seal system shall not alter substantially indicating thereby that the stability of the system has been maintained.'

3.05.05 Accelerated aging test

The intention of accelerated aging test is to ascertain whether the artificial aging of the systems and components thereof results into change in the mechanical properties or in the form. In order to simulate aging, artificial aging shall be resorted to.

For the purpose of subjecting the penetrations seal system components to accelerated aging, the system / components shall be stored for 336 hours in air furnace where the temperature of the inside air, shall be maintained at 100 degree centigrade. However, for system components in pliable form, system component shall be stored for 448 hours in air furnace where temp. of air inside the furnace shall be maintained at 75°C. It is assumed that the

changes occurring during test period would roughly correspond to the effect on aging over a period of about 40 years.

After completion of 336 hours / 448 hours, the mechanical properties such as tensile strength element, elongation and hardness of the material (as may be applicable) shall be tested. These results shall be compared with corresponding values before subjecting to accelerated aging test.

The change in the form of system / components shall also be compared with the form before the tests to ascertain whether the system / components thereof have undergone any permanent change.

In case the mechanical properties before and after the accelerated aging do not indicate substantial change, the system shall be deemed to have passed the accelerated aging test. Similarly the variation in the form of the system components at the end of the test shall not indicate permanent deformation which is likely to affect the ceiling properties of the system.

3.05.06 Fire Rating test After Accelerated Aging:

Intention to this test is to ascertain whether the penetration seal built out of components already subjected to accelerated aging still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test mentioned above. The assembly or the penetration seal shall be carried out with the components which were subjected to accelerated aging test based on the test procedure mentioned above. In case there is a problem of co-ordination with the test station, the prototype assembly may be subjected to aging in manufacturer's works under the conditions mentioned above and live fire test should be carried out at manufacturer's works in presence of Owner's representative.

In live fire test, the temperature of fire shall be of the order of 1000 deg.C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

The interpretation of test results for failure shall be similar to those mentioned under fire rating test/live fire test at (1) - (c) above.

3.05.07 Temperature rise test for cable in the fire stop:

This test shall be carried out to ascertain whether due to inadequate dissipation of heat at the location of fire stop, the temperature of cable conductor or outer sheath in contact with the fire stop, rises beyond the acceptable limits due to which whether any derating is required for cables.

Fire stop systems shall be erected with, at least 8-10 armoured cables, specially power cables. While laying the cable through penetration seal, thermocouple shall be placed on the outer surface of cable in contact with the fire stop system. The location shall be selected where there exists possibility of inadequate dissipation of heat from cables to the atmosphere due to fire stop components. Two thermocouples shall also be located on the two surfaces of the fire penetration seal system. Similarly thermocouples shall also be placed on the other surface of cables where there exists contact of free air without any obstruction so as to enable adequate nature cooling.

In case the temperature of outer surface of the cable in contact or inside the fire stop system does not exceed 75 degree centigrade, it is inferred that no derating of cable is required for cable when used in conjunction with the particular fire stop system.

Test shall be repeated with reduced current till the temperature of cable outer surface in contact with fire stop system is limited to 75°C. The rate of the current so guaranteed by the cable manufacturer as free air rating shall be the derating factor.

3.05.08 Water Absorption Test:

The test specimen shall be immersed in fresh clean water at a temp. of 20°C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hours soak period, the specimen shall be removed from the water and mopped up with a damp cloth.

Fire rating test after water absorption is to ascertain whether the penetration seal subjected to water absorption still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test at Sr. No.1. In case there is problem of coordination with test stations, the prototype assembly may be subject to water absorption test at manufacturer's works followed by live fire test which should be carried out at manufacturer's works in presence of Owner's representative. In line fire test, the temp. of furnace shall be of the order of 1000°C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

3.05.09 Flame Resistance Test for fire Retardant Coating Material:

Sample strips shall be of ½ " wide, 12" long and approximately 70 mills in thick (without any reinforcement). Each strip shall be held vertically (clamped at the top) in a natural gas burner flame, (blue cone of flame touching bottom edge of sample) for 10 minutes. The flame shall then be removed and observation shall be recorded. In case, any flaming of the samples should cease after the removal of gas burner. White charred length of the sample should not exceed 1 & ½".

3.05.10 Anti-Rodent Test:

Physical tests:

- a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.
- b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of inspect / vermin such as rat for about 20 days.
- c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition

before commencement of the test. The fire stop shall be deemed to have passed this test in case no marks of growth are seen on the surface.

3.05.11 Test Certificates

Certified copies of all tests carried out at works and at site shall be furnished in requisite number of copies.

Test reports shall be complete with all details and shall also contain limit values specified in the relevant standards, wherever applicable, to facilitate review of Test Report/ Certificates.

The fire proof sealing system shall be installed only after receipt of approval of the test reports.

3.05.12 Testing Charges

The bidder has to indicate that unit rates for conducting the type test successfully alongwith the offer, which will be considered for evaluation of tender.

SECTION-IV

TECHNICAL SPECIFICATION FOR CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Power and Control Cables shall cover the requirement of entire Plant including the switchyard.

Other cables including special cables, if any, which may be necessary as per proven engineering practice for satisfactory and trouble free operation of the entire cable system of the plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures :

- a) 11kV & 3.3 kV Power cables : Annexure - A
- b) 1100V Power Cables : Annexure – B
- c) Control Cables : Annexure – C
- d) Fire Survival Cables : Annexure – D
- e) Flexible Trailing cable : Annexure – E

1.03.00 All relevant drawings, data and instruction manuals

2.00.00 CODES & STANDARDS

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Cable and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 Cables will be generally laid on ladder type trays or drawn through rigid PVC/GI /HDPE pipe/conduits. Cable tunnels shall be avoided as far as possible, except at locations where overhead trays are not possible, with prior approval of the Owner.

- 3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.
- 3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.
- 3.05.00 The outer sheath shall have flame retardant low smoke halogen evolution (FRLSH) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.
- 3.06.00 Core identification for multicore cable shall be provided by colour coding.
- 3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.
- 4.00.00 **SPECIFIC REQUIREMENTS**
- 4.01.00 **General Description**
- All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.
- 4.02.00 **Drum Length and Tolerance**
- The cables shall be supplied in non-returnable packing steel drum for 11 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is $\pm 5\%$.
- 4.03.00 **Non-Standard Length**
- Non-standard lengths upto 5% of the total ordered quantity may be accepted. However the Contractor will be required to obtain approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.
- 4.04.00 **Cable identification**

Cable identification shall be provided by embossing on every meter on the outer sheath the following :

- a) TSGENCO
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE/PVC/HR85/IE2 etc.
- f) No. of core and size of cables.
- g) Type of improved fire performance, e.g. FR/FRLSH/FS
- h) IS number

4.05.00 **Packing**

4.05.01 Cables shall be supplied in non returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

4.05.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.05.03 The cable drums should carry the following details in printed form:

- a) TSGENCO
- b) Manufacturer's name or trade make
- c) Type of cable & voltage grade
- d) Year of manufacture
- e) Type of insulation e.g. XLPE/HRPVC/IE2
- f) No. of core and size of cables
- g) Cable code e.g. FRLSH/FS
- h) Length of cable on drum
- i) No. of length on drum, if more than one
- j) Direction of rotation, by arrow
- k) Approx. gross mass.

- l) IS/IEC number and ISI mark

4.06.00

Joints and Terminations

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.07.00

Selection Criteria

4.07.01

- a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.
- b) While sizing power cables, following aspects shall be reckoned:
 - i) Ground/Ambient Air temperature
 - ii) Depth of Laying.
 - iii) Power Cables touching each other.
- c) Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time 0.16 Sec. for outgoing feeder, 0.5 Sec. for Tie feeder and 1.0 Sec. for Incomer.
- d) HT cables shall be sized based on the following considerations:
 - Rated current of the equipment and ground/ambient temperature.
 - Touching/spacing of cable.
 - Laying on multi-tier racks, trench
 - Depth of laying.
 - The voltage drop of the cable , during motor starting condition , shall be limited to 15% and during full load running condition shall be limited to 3 % rated voltage. For BFP motor, the voltage drop during motor starting condition shall be limited to 20% and for Mill motor shall be limited to 10%. Other outgoing feeder / transformer feeder shall be limited to 3% rated voltage.
 - Short circuits withstand capability
- e) For fuse/MCCB/Breaker protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered for loads fed from 415V PMCC. Incase of other out going line feeder voltage drop shall be limited to 3%.

- f) For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.
- g) As per national electric code (NEC) current rating capacity of motor feeder/cables should be 125% of full load current.
- h) For welding receptacle, 3% running drop shall only be considered.

The minimum sizes of L.T cable to be chosen are as below:

AL - 16 mm² (3 core) & 16mm² (2 core) Cu - 2.5 mm²

4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4.07.03 The standard cable sizes, amp capacities, derating factors. as given in IS/IEC will be generally followed.

4.07.04 a) For breaker protected circuits minimum size of the cable shall be as follows:

1100V Power Cable : 240 Sq mm XLPE AL

3300V Power Cable : 185 Sq mm XLPE AL

11000V Power Cable : 240 Sq mm XLPE AL

b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.07.05 For fuse/MCCB protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below :

a) Aluminium : 6 Sq mm.

b) Copper : 2.5 Sq mm.

4.07.06 All control cables shall be 2.5 Sq mm copper cable.

4.07.07 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C
7 or 8	1-9/C

	9 or 10	1-12/C
	Above 10	Two or more of above cables
4.07.08	Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.	
	a) Power. b) Control, interlock and indication. c) Metering and measuring. d) Alarm and annunciation. e) C.T. Cables. f) V.T. Cables.	
4.08.00	Cable Identification Cable identification shall be provided by embossing on the outer sheath the following : a) Manufacturer's name or trade mark b) Manufacturer's name or trade mark c) Voltage grade d) Year of manufacture e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc. f) No. of core & size of cables g) Type of outer sheath e.g. FRLSH, FS etc.	
4.09.00	Selected sizes of power and control cables are given in Annexure-G.	
4.10.00	Fire Survival Cables shall be used for important auxiliaries / area as recommended in Standard Technical Specification by CEA for the following services. The fire survival time of these cables shall not be less than 3 hours at 750 deg. C. i. DC emergency lube oil pump ii. DC hydrogen seal pump iii. Turbine lube oil pump/barring gear iv. DC emergency lighting for main building and service building v. DC cables for battery to charger & DC distribution boards	

- vi. Jacking oil pump
- vii. Emergency turbine trip in control room
- viii. Boiler Turbine : Generator inter trip which include the interconnection between
 - Boiler master fuel trip and turbine trip relays
 - Generator trip relays & turbine trip relays
 - Generator trip relays & generator breaker
 - Generator trip relays & field breaker
 - Generator trip relays & unit auxiliary transformer breaker
 - Incomer cables for DG board, emergency board, DC lighting board etc.

5.00.00 **TESTS**

5.01.00 **Shop Tests**

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below:

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance Tests on 1 drum out of every 10 drums chosen at random for acceptance of the lot for every size.

5.01.03 Type test on each type and size of cable, inclusive of measurement of armour DC resistance of power cables on one drum out of every 10 drums of cable.

5.02.00 **Additional Tests**

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (category C1, Type FR/ Category C2, Type FRLSH)

5.02.01 Oxygen index test (both C1 & C2)

The Oxygen index shall not be less than 29.

5.02.02 Temperature Index Test (both C1 & C2)

The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables

5.02.03 Flame Retardance test on single cable and on bunched cables (both C1 & C2)

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC-331

5.02.04 Halogen acid gas evolution test (for Category C2)

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not be exceed 2% for FS cable.

5.02.05 Smoke density test (for Category C2)

The cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for FS cable.

5.02.06 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

Flammability test shall be carried on finished cables as per following standards-

- a) Swedish Chimney test – SS: 424-14-75
- b) IEEE std.383 – 1974 latest
- c) IEC std. 332-1, 332-3 and IEC 331

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 Drawings, Data and Manuals shall be submitted with the bid and for approval/ reference and subsequent distribution after the issue of Letter of Intent in quantities and procedures as specified in General condition of contract and/or

6.02.00 **To be submitted with the Bid**

- a) Manufacturer's catalogues giving cable construction details and characteristics.

- b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.
- c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.
- d) Type test reports on 11 KV & 3.3 KV Power, LT FRLSH Power & control, FS power and control cables.
- e) Filled-up proposal particulars.

6.03.00

To be submitted for Owner/Purchaser's Approval and Distribution

All relevant drawings and data pertaining to the equipment like GTP, QAP, etc. shall be submitted by the Bidder for the approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

RATINGS AND REQUIREMENTS HV POWER CABLES (11 KV & 3.3 KV)

- 1.0 11000/11000V & 3300/3300V grade 90°C continuous rating under normal condition and 250°C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V/3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen.
- 1.1 Conductor : Stranded and compacted aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS: 8130.
- 1.2 Conductor Screen : Extruded semi-conducting compound.
- 1.3 Insulation : Extruded cross linked polyethylene (XLPE) conforming to IS: 7098 (Part-2)
- 1.4 Insulation Screen : Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
- 1.5 Core Identification : By coloured strips applied on (For three core cables) cores.
- 1.6 Inner Sheath : Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC.
- 1.7 Armour : Galvanised single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.8 Overall Sheath : Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
- 1.9 Drum : Steel Drum

ANNEXURE-B

RATINGS AND REQUIREMENTS LV POWER CABLES [1.1KV (XLPE TYPE)]

- 1.0 1100 V grade, 90°C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm² conforming to IS:8130.
- 1.2 Insulation : Extruded cross-linked polyethylene (XLPE) conforming to IS: 7098 (Part-1)
- 1.3 Core Identification : By color coding
- 1.4 Inner Sheath : Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
- 1.5 Armour : Galvanized single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.6 Overall Sheath : Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS-10418 (Wooden drum)

ANNEXURE-C

RATINGS AND REQUIREMENTS CONTROL CABLES

- 1.0 1100 V grade 85°C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWW) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.
- 1.1 Conductor : Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
- 1.2 Insulation : Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5×10^{14} ohm-cm at 27°C and 3.5×10^{11} OHM-CM at 85°C.
- 1.3 Core Identification : By color coding and numbering at interval of 100mm or less
- 1.4 Inner sheath : Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
- 1.5 Armour : Galvanised single round steel wire for twin and multicore cables.
- 1.6 Overall sheath : Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS: 10418 (Wooden drum)

ANNEXURE-D

RATINGS AND REQUIREMENTS (1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES)

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material, single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 750 deg.C for 3 hours. The cables shall be in compliance with IEC-60331, Part 11.

RATINGS AND REQUIREMENTS (1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES)

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material, single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 750 deg.C for 3 hours. The cables shall be in compliance with IEC-60331, Part 11.

ANNEXURE-E

RATINGS AND REQUIREMENTS FLEXIBLE TRAILING CABLES

i) 3300 V Unearthed Grade

Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLS HD CSP sheathed overall, conforming to IS:9968. Alternatively PCP sheathing may be acceptable.

ii) 1100 V Grade

1100 V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLS CSP outer sheath.

ANNEXURE-F

CABLE SIZES

Following sizes are given as a general guideline. Standard sizes as per IEC/IS shall be adopted.

Sl. No.	Cable Size	Conductor	Insulation
1.0	H. T. CABLES (11kV)		
1.1	1 core 1000 sq.mm	AL	XLPE (FRLS)
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 400 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	1 core 70 Sq.mm	AL	XLPE (FRLS)
1.0	H. T. CABLES (3.3kV)		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 300 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	3 core 185 Sq.mm	AL	XLPE (FRLS)
1.5	1 core 70 Sq.mm	AL	XLPE (FRLS)
2.0	L. T. POWER CABLES		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLS)
2.2	2 core 16 Sq.mm	AL	XLPE (FRLS)
2.3	3 core 16 Sq.mm	AL	XLPE (FRLS)
2.4	4 core 16 Sq.mm	AL	XLPE (FRLS)
2.5	2 core 35 Sq.mm	AL	XLPE (FRLS)
2.6	3 core 35 Sq.mm	AL	XLPE (FRLS)
2.7	4 core 35 Sq.mm	AL	XLPE (FRLS)
2.8	3 core 70 Sq.mm	AL	XLPE (FRLS)

Sl. No.	Cable Size	Conductor	Insulation
2.9	3.1/2 core 70 Sq.mm	AL	XLPE (FRLS)
2.10	3 core 95 Sq.mm	AL	XLPE (FRLS)
2.11	3.1/2 core 95 Sq.mm	AL	XLPE (FRLS)
2.12	3 core 185 Sq.mm	AL	XLPE (FRLS)
2.13	3.1/2 core 185 Sq.mm	AL	XLPE (FRLS)
2.14	3 core 240 Sq.mm	AL	XLPE (FRLS)
2.15	3.1/2 core 240 Sq.mm	AL	XLPE (FRLS)
2.16	3 core 300 Sq.mm	AL	XLPE (FRLS)
2.17	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)
2.18	1 core 630 Sq.mm	AL	XLPE (FRLS)
3.0	CONTROL CABLE		
3.1	2 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.2	3 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.3	5 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.4	7 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.5	9 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.6	12 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.7	20 core 2.5 Sq.mm	CU	HRPVC (FRLS)
4.0	FS POWER CABLES		
4.1	3 core 2.5 Sq.mm	CU	EPR
4.2	2 core 16 Sq.mm	CU	EPR
4.3	3 core 16 Sq.mm	CU	EPR
4.4	4 core 16 Sq.mm	CU	EPR
4.5	2 core 35 Sq.mm	CU	EPR

Sl. No.	Cable Size	Conductor	Insulation
4.6	3 core 35 Sq.mm	CU	EPR
4.7	4 core 35 Sq.mm	CU	EPR
4.8	3 core 95 Sq.mm	CU	EPR
4.9	3.1/2 core 95 Sq.mm	CU	EPR
5.0	FS CONTROL CABLE		
5.1	2 core 2.5 Sq.mm	CU	EPR
5.2	3 core 2.5 Sq.mm	CU	EPR
5.3	5 core 2.5 Sq.mm	CU	EPR
5.4	7 core 2.5 Sq.mm	CU	EPR
5.5	9 core 2.5 Sq.mm	CU	EPR
5.6	12 core 2.5 Sq.mm	CU	EPR

VOLUME : VI
SECTION-VII
SUB SECTION - C
INSTRUMENTATION AND CONTROL CABLES

1.00.00 **GENERAL TECHNICAL REQUIREMENTS**

1.01.00 Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety. Repaired cables are not acceptable.

1.02.00 FRLS marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Durable marking at intervals not exceeding 625mm shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / type of compensating /extension cable), Insulation material, FRLS etc.

1.03.00 Progressive sequential length marking shall also be provided at every meter interval on outer sheath of cable.

1.04.00 Non returnable standard seasoned wooden drum containing minimum 500 /1000 M $\pm$ 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.

1.05.00 Thermocouple Extension & Compensating Cable

- | | | | |
|-----|-------------------------|---|--|
| 01. | Conductor | : | Solid conductor |
| 02. | Conductor size | : | 16 AWG (1.31 Sq. mm) |
| 03. | Type | : | KX (Compensating) (Chromel Alumel)
RX (Compensating) (Copper-Copper alloy) JX (Compensating) (Iron Constantan) |
| 04. | Conductor Insulation | : | HR PVC Type-C (IS-5831,1984) 0.6 mm thick |
| 05. | Operating Voltage | : | 650V |
| 06. | Twisting | : | Pair twisted with lay of 60 mm (max) |
| 07. | Twisting Direction | : | All pairs in the same direction. Lapped to form bunch with mylar tape. |
| 08. | Screen (Pair & Overall) | : | Aluminium mylar tape with a thickness of 28 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. |
| 09. | Drain wire | : | Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm) (For both individual and overall screen) |
| 10. | Inner Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) |

		HR PVC Type ST2 of IS-5831,1984
		Thickness as per IS-1554Part-I 1976
11.	Rip Cord	: Non metallic under sheath
12.	Armouring	: GI wire / strip as per IS 3975
13.	Outer Sheath	: Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
		HR PVC Type ST2 of IS-5831,1984
		Thickness 1.8 mm (Min)
14.	Filler	: Non hygroscopic with FRLS property
15.	Temperature Range	: Up to 85 °C
16.	Insulation at 20 ⁰ C	: 100 MOhms/Km [Min]
17.	Capacitance at 800 Hz	: 200 nf/km
18.	Cross talk	: 60 dB
19.	Attenuation	: 1.2 dB/Km
20.	Codes & Standards	: a) IEC 332-1 b) ANSI MC 96.1 c) IS-8784-1987
21.	Tests	: a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863) a) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I b) Temp Index : Min 250 DEG C at 21Oxy. Ind. (ASTM-D-2863) c) Smoke Density Rating : Max.60% (ASTM-D-2843). d) Flammability Test : as per IEC 332 Part-I /IEEE-383 Swedish Chimney Test - SS-424-1475 F3 e) High voltage test Core to core- 2.0 KV for 1 min. Core to screen- 2.0 KV for 1 min. f) Insulation Resistance 100 M Ohm / Km Min g) Rodent & Termite repulsion test (Presence of lead shall be confirmed)
22.	Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1	

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

23. Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs. Each core printed with number or numbered binder tape shall be provided on each pair.

1.06.00 Instrumentation multi Paired Signal Cable

01. Conductor type : Stranded (7) annealed tinned copper
02. Conductor size : 0.5
03. Conductor resistance : 39 Ω
04. Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick
05. Operating Voltage : 650V
06. Twisting : Twin twisted with lay of 60 mm
07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
 - * Analog signals- Individual pair & overall shield to be considered.
 - * Binary signals- overall shield to be considered.
09. Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)

- | | | |
|----------------------------|---|---|
| 10. Inner Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976 |
| 11. Rip Cord | : | Non metallic under sheath |
| 12. Armouring | : | GI wire / strip as per IS 3975 |
| 13. Outer Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness 1.8mm (Min) |
| 14. Filler | : | Non hygroscopic with FRLS property. |
| 15. Temperature Range | : | 85 °C |
| 16. Insulation at 20 Deg.C | : | 100 MOhms/Km [Min] |
| 17. Capacitance at 800 Hz | : | 120 nf/km |
| 18. Cross talk | : | 60 dB |
| 19. Attenuation | : | 1.2 dB/Km |
| 20. Codes & Standards | : | a) IPCEA-S-61-402
b) BS 5308
c) IEC 332-1
d) ASTM-B-33
e) IS-8130-1984
f) IS 1554 Part-1
g) IS 10810 |
| 21. Sheath colour | : | Inner- Black and Outer- Gray |
| 22. Tests | : | a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60% (ASTM-D-2843).
e) Flammability Test : as per IEC 332 Part-I
f) Swedish Chimney Test-SS-424-1475 F3
g) Insulation Resistance 100 M Ohm / Km Min
h) High voltage test |

Core to core- 2.0 KV for 1 min.
Core to screen- 2.0 KV for 1 min.

- i) Rodent & Termite repulsion test
(Presence of lead shall be confirmed)

23. Colour of core for Instrumentation Cable (As per IS-9938)

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

1.07.00 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, and twisted & shielded.

1.08.00 Control & power Cable

Bidder shall refer to Volume IIF of the electrical specification for detail.

1.09.00 Optical Fiber Cable

Bidder shall supply and install optical fiber cable and all cable accessories and fittings like Light Interface Unit, Surge suppressors, Opto isolators, Interface converters, Fiber Optic Card Cage, Fiber Optic Line Driver, Repeater/ Modem, cable glands, grommets, lugs, termination kits etc on as required basis.

Optical Fiber Cable shall be 4/8/12 core. Each core shall be of ultra pure fused silica glass with UV cure acrylate suitable to withstand temperature between 20 and 80°C. The cable shall have multiple mono mode fiber. On as required basis so as to avoid usage of any repeaters. . Fiber optic cable shall be of loose buffer tube design with 4 fibers per buffer tube (minimum). Interstices and buffer tubes shall be filled with water blocking compound such as thixotropic gelly to protect against moisture and vibration. Buffer tube shall

be made of materials like Poly-Butelene Terathylate (PBT). They shall be colored for easy identification.. Buffer tubes shall be stranded around Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure.

The central strength member shall be Fiber Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti-buckling strength to cable.

The interstices between buffer tube and jacket layers shall be protected from water intrusion by a combination of dry water blocking yarns and tapes. These dry materials shall be easily removable from core during cable preparation without use of cleaning solvent.

In addition to central strength member, additional strengthening substance like aramid yarns shall be applied helically over the cable core to provide additional tensile strength to cable.

The cable shall be of dual jacket and armoured. Inner sheath consists of medium density poly ethylene extruded over cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. Electrolytically chrome plated corrugated steel taped (ECCST) armouring is provided around inner jacket to provide additional cable compression strength and rodent protection. The armour is covered with outer black MDPE sheath with FRLS and UV resistance properties. A ripcord is also placed under neath the armour for easy outer sheathing removal. The cable shall be suitable for a maximum tensile force of 2000N during installation and once installed, a tensile force of 1000N minimum. The compressive strength of cable shall be 3000N minimum and crush resistance 4000N minimum. Minimum bending radius shall be equal to or more than 15D.

Specification for G.652 Monomode Fiber:

Sl. No.	Attribute	Value
1	Core Diameter	9±1 micrometer
2	Cladding Diameter	125±1 micrometer
3	Cladding non circularity	≤1.0%
4	Attenuation coefficient at (i) 1290 nm to 1340 nm (ii) 1525 nm to 1575 nm	<0.36 Db/km <0.25 Db/km
5	Chromatic dispersion coefficient at (i) 1310 nm (ii) 1550 nm	<3.5 ps/ nm.km <18 ps/ nm.km
6	Polarization Mode Dispersion (PMD)	≤0.5 ps/√km

	coefficient	
7	Mode field diameter at (i) 1310 nm (ii) 1550 nm	9.2±0.4 micrometer 10.50±1.0 micrometer
8	Mode field concentricity error	≤0.5 micrometer
9	Proof test	≥1%
10	Fiber Curl	≥ 4.0 m
11	Macro bend test on fiber at 1550 nm	≤0.1 dB

The entire length of the cable shall be marked with the manufacturer name, month and year of manufacture, coded description of the cable based on Telcordia's(Bellcore) SR-2014 Suggested Optical Cable Code (SOCC), progressive sequential length marking at every meter interval on outer sheath.

Following tests as per any approved standards such as FOTP, IEC etc shall be carried out on the cables:

- a. Attenuation and dispersion characteristics test
- b. Proof test
- c. Macro-Bend Resistance Test
- d. Mechanical Tests
- e. Low and High Temperature Cable Bend Test
- f. Impact Resistance Test
- g. Compressive Strength Test
- h. Tensile Strength Test
- i. Cable Twist Test
- j. Cable Cyclic Flexing Test
- k. Environmental Characteristics Test
- l. Temperature Cycling Test
- m. Color Performance Test
- n. Cable Aging Test
- o. Water Penetration Test
- p. Lightning Test
- q. Routine Test/ Sample Test
- r. Site Test (Continuity and Attenuation)

s. FRLS Test

1.10.00

Coaxial Cable

1	Standard	: MIL-17G, IS-5026
2	Inner conductor	: Tinned copper (Cu Sn)
3	Size	: 0.94 mm dia (19 stranded)
4	Dielectric insulation	: Cellular foam polyethelyne
5	Overall diameter	: 2.95 mm
6	Shielding	: Aluminium mylar tape
7	Outer conductor	: Cu Sn- Braid, 96% lapping (Overall dia 3.60 mm)
8	Armoring	: Galvanized mild steel
9	Outer sheath	: FRLS PVC
10	Temperature range	: 85°C
11	Attenuation	: Up to max 39.5 Db/100 m



TITLE

5X800 MW YADADRI TPS

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-417-501-A501

REV 00

Section

IC

Date JAN'18

SUB-SECTION – IC

DATA SHEET A



TECHNICAL SPECIFICATION FOR
140/25T TG HALL EOT CRANE
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DATA SHEET FOR TG HALL EOT CRANE WITH VVVF DRIVES

* Information's are to be furnished by bidder during detail engineering stage only.

Sr. No.		DESCRIPTION	TECHNICAL PARTICULARS	
1.0.0		General		
1.1.0		Name of manufacturer	*	
	a.	EOT Crane	*	
	b.	Crane motors	*	
	c.	Runway conductors	*	
1.2.0		Weight of equipments		
	a.	Bridge assembly	*	
	b.	Trolley assembly	*	
	c.	Total crane weight	*	
	d.	Total weight of the gantry rail	*	
	e.	Total weight of DSL	*	
	f.	Total weight of all the equipments under this specification	*	
1.3.0		Design, fabrication and testing of the crane confirm to standard / code number	Mechanical and Electrical as per IS: 3177-2006 & Structure design in accordance to IS 807:2006.	
1.4.0		Number of crane	Four (4) nos.	
1.5.0		Crane classification	M5 (Mechanical and Electrical) as per IS: 807-2006 and 13834 (part-5)-1993	
1.6.0		Suitable for outdoor or indoor duty	Indoor	
1.7.0		Capacity and lift	140/25T	
1.7.1		Main hoist		
	a.	Rated SWC – tonnes	140T	
	b.	Test load SWC – tonnes	Rated SWC and over load test : 125% of SWC	
1.7.2		Aux. hoists		
	a.	Rated SWC – tonnes	25T	
	b.	Test load SWC – tonnes	Rated SWC and over load test : 125% of SWC	
1.8.0		Span	27.3 m	
1.9.0		Operation from	Cabin + Pendent Push Button+ Radio remote control	
2.00		CRANE PERFORMANCE		
2.1.0		Crane speed with full load	Full speed M/Min	Creep speed M/Min



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	a.	Main hoist	1.0	0.10 (10% of main speed thru' VVVF drives)
	b.	Aux. hoist	3.0	0.3 (10% of main speed thru' VVVF drives)
	c.	Trolley travel (CT)	10.0	1.0 (10% of main speed thru' VVVF drives)
	d.	Longitudinal bridge travel (LT)	15.0	1.5 (10% of main speed thru' VVVF drives)
2.2.0		Acceleration values	LT motion (bridge travel)	CT motion (trolley travel)
			As per IS: 3177	As per IS: 3177
2.3.0		Lift in Metres		
	a.	Main Hoist	29.5m	
	b.	Aux Hoist	35.5 m	
2.4.0		Hook Approaches		
	a.	Main hook (cabin end)	As per Crane clearance diagram	
	b.	Aux. Hook (cabin-end)	As per Crane clearance diagram	
	c.	Main hook (other end)	As per Crane clearance diagram	
	d.	Aux. Hook (other end)	As per Crane clearance diagram	
2.5.0		Hand Rail Pipes	32 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1100 mm and 600 mm and vertical post spacing not exceeding 1750 mm with provision of kick plate (100 mm high and 6mm thick)	
3.0.0		COMPONENT DETAILS		
3.1.0		Trolley	The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction and should be covered by flooring as far as possible. On bottom of trolley frame, on each side a double spring bumper shall be provided to engage stops at each end of the bridge.	
	a.	Type	Fabricated	
	b.	Method of fabrication	Fusion welded	
	c.	Material	Mild Steel (Fe410) Gr-B IS: 2062 100% killed, normalized & Ultrasonically tested	
	d.	Centre to centre distance of wheels (on the same rails)	*	
	e.	Whether jacking pads for lifting trolley provided or not	Yes	
3.2.0		Rope drums	Main hoist	Aux. Hoist



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	a.	Dimensions in mm length and diameter (PCD)	*		*	
	b.	Material (Indicate IS)	Seamless pipe ASTM -106 Gr. B or fabricated rolled section to IS: 2062 Gr. B & stress relieved			
	c.	Flange / flangeless	Flanged			
	d.	Numbers provided	One for each hoist			
	e.	Number of grooves	*		*	
	f.	Type of grooves	Identical Right hand and Left hand			
	g.	Diameter on bottom of grooves	*		*	
3.3.0		Rope details				
	a.	Construction	Extra flexible plough steel , 6 x 36 or 6x37 construction			
	b.	Grade	*			
	c.	Standard conforming to	IS: 2266 (latest edition)			
	d.	Diameter in mm	*		*	
	e.	Breaking strength	*		*	
	f.	Tensile designation	*		*	
	g.	Factor of safety	5.25 as per IS		5.25 as per IS	
	h.	Type of core	Steel		Steel	
	i.	Number of falls	*		*	
	j.	Length of rope	*		*	
3.4.0		Sheaves details	Main hoist		Aux. Hoist	
	a.	Material	Fe 410 WA IS: 2062 Gr. A or B / CS Gr. 280-520 IS: 1030 Design as per IS: 3177- 1999			
	b.	Diameter of main sheaves in mm on Root	*		*	
	c.	Diameter of Equalizing sheaves (in mm) on Root	Should not be less 62% of calculated main sheave diameter		Should not be less 62% of calculated main sheave diameter	
	d.	Type of guards provided	Fabricated from rolled steel plate			
3.5.0		COUPLINGS & SHAFTING				
3.5.1		Coupling details (between motor and gear box)	Main hoist	Aux. Hoist	Cross Travel	Long Travel
	a.	Type	Flexible shock absorbing coupling excepting pin bush type			
	b.	Size & Torque rating	*			
	c.	Guards and enclosures	Provided			
	d.	Coupling material and hardness	All couplings shall be of cast, wrought or from forged steel, tooth portion to be heat treated to hardness HB241-280			
3.5.2		Coupling details (between gear box and wheels)	Cross Travel (CT)		Long Travel (LT)	



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	a.	Type	Flexible geared type			
	b.	Size & Torque rating	*			
	c.	Guards and enclosures provided	Yes			
3.5.3		Coupling details (between gear box and rope drum)	Main hoist		Aux. Hoist	
	a.	Type	One of the following arrangements will be adopted for connecting the rope drum with the gear- box. 1. Flexible joint, incorporating flexible geared coupling housed within the drum. 2. Fully flexible geared coupling between the drum & gearbox.			
	b.	Size	*			
	c.	Guards and enclosures provided	Yes			
3.5.4		Shafting (Output)	Cross Travel		Long Travel	
	a.	Diameter in mm	*		*	
	b.	Factor of Safety	As per IS: 3177-2006			
	c.	Number of support bearings	*		*	
	d.	Type of support bearing	*		*	
	e.	Arrangement of lubrication	Grease cups / Nipple			
	f.	Type of lubricant	Grease			
	g.	Max unsupported length of shaft in mm	*		*	
3.6.0		Gear box details				
3.6.1		Hoist Motions	MH	MH Micro	AH	AH micro
	a.	Type of mounting of gear box	Horizontal / Vertical			
	b.	Classification	Suitable for M5 duty			
	c.	Total number of reductions	*	Thru' VVVF drive	*	Thru' VVVF drive
	d.	Type of gears	Helical / Spur		Helical / Spur	
	e.	Reduction ratio	*			
	f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
	g.	Hardness (BHN) – gear	217 to 255 BHN			
	h.	Hardness (BHN) – pinion	266 to 300BHN			
	i.	Difference in Gear and pinion hardness	Min 20 BHN			



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	j.	Materials (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1or 2. Pinions En 19/EN 24. Hardness conforming to IS: 3177 (latest edition) Gears to be hardened, tempered & heat treated as per IS 4460			
	k.	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved			
	l.	Noise level	85 db	NA	85 db	NA
	m.	Standard conforming to	IS: 4460 / AGMA			
3.6.2		Travel Motions	CT	CT micro	LT	LT micro
	a.	Type of mounting gear box	Vertical/ Horizontal	NA	Vertical/ Horizontal	NA
	b.	Classification	M5 duty			
	c.	Total number of reduction	*	Thru' VVVF drive	*	Thru' VVVF drive
	d.	Type of gears	Helical / Spur		Helical / Spur	
	e.	Reduction ratio	*		*	
	f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication			
	g.	Hardness (BHN) – gear	217 to 255 BHN			
	h.	Hardness (BHN) – pinion	266 to 300BHN			
	i.	Difference in Gear and pinion hardness	Min 20 BHN			
	j.	Materials (gear / pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1or 2. Pinions En 19/EN 24. Hardness conforming to IS: 3177 (latest edition) Gears to be hardened, tempered & heat treated as per IS 4460			
	k.	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved			
	l.	Standard conforming to	IS: 4460 / AGMA			
3.7.0		Wheels details	Cross travel		Long travel	
	a.	Material	C55 Mn75			
	b.	Hardness	300 – 350 BHN			
	c.	Depth of hardness	10 mm (min)			
	d.	Tread diameter in mm	*		*	
	e.	Tread width in mm	*		*	
	f.	Process of hardening	Volume hardening			
	g.	Type	Double flanged			
	h.	Numbers provided	4 nos.		8 nos.	
	i.	Specification conforming to	IS: 3177			
	j	Arrangement of lubrication	Grease			
3.8.0		Lifting hooks	MH		AH	



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	a.	Type	Ramshorn shank with safety latch swiveling type as per latest edition of IS: 5749		Plain with safety latch swiveling type as per latest edition of IS: 15560	
	b.	Safe lifting capacity	140 T as per IS 5749		25 T as per IS: 15560	
	c.	Material	✓ Class 2 as per IS 1875:1992 (re affirmed 2004) for hooks conforming to IS : 5749 ✓ Class 1A or class 3 for hook of grades L & M respectively as per IS 1875:1992 for hooks conforming to IS : 15560			
	d.	Standard conforming to	IS: 5749		IS: 15560	
	e.	Hook can rotate	Yes			
	f.	Safety latch on hook provided	Yes			
	g.	Locking device on swivelling hook required or not	Provided			
3.9.0		Buffers	Cross travel		Long travel	
	a.	Type	Spring loaded type. To be designed to bring the loaded crane to rest from speed of 100% of the rated speed.			
	b.	Numbers provided	4		4	
	c.	Details of end stop	Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate.			
3.10.0		Brakes				
3.10.1		Hoist Motions	MH	MH micro	AH	AH micro
	a	Type of brake	AC Electro-Hydraulic Thruster operated			
	b.	Diameter of brake in mm	*	NA	*	NA
	c.	Torque rating Kg. M	*		*	
	d.	Number provided per motor	2		2	
	e.	Braking capacity (% of torque transmitted to the brake drum with full load.)	150%		150%	
	f.	Braking torque actually required	*		*	
	g.	Material				
		• Brake liners	Ferodo liners			
		• Drum	CS IS : 1030 / CL 4 IS : 1875			
		• Springs	As per manufacturers standard			
	h.	Braking distance in mm	*	NA	*	NA
3.10.2		Travel Motions	CT	CT micro	LT	LT micro



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	a.	Type of brake (ac / dc / thruster)	AC Electro-Hydraulic Thruster operated	NA	AC Electro-Hydraulic Thruster operated+ Hydraulic Thruster (foot operated)		
	b.	Dia of brake in mm	*		*	NA	
	c.	Torque rating Kg.M	*		*		
	d.	Number provided per motor	2		2		
	e.	Braking capacity (% of motor rated torque before derating)	125%		125%		
	f.	Braking torque actually required	*		*		
	g.	Material					
		Brake liners	Ferrodo liners				
		Drum	CS IS : 1030 / CL4 IS : 1875				
		Springs	As per manufacturers standard				
		Thrusters	*				
	h.	Braking distance in mm	*	NA	*	NA	
		Storm brakes per Crane	2 No's LT parking brake (storm brake) shall be provided				
3.11.0		Drive system for hoisting					
	a.	Arrangement of drive from motor to rope drum (main)	Through geared coupling and gear box				
	b.	Arrangement of drive from pony motor to rope drum (creep speed)	NA				
3.12.0		Bearings	Crane hook	Trolley wheels	Rope drum	Gear box	Any other assembly
	a.	Type	Antifriction ball / roller bearings				
	b.	Number provided for each	As per assembly requirements				
	c.	Method of lubrication	Centralised grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice.				
	d.	Bearing life	40,000 working hours.				
3.13.0		Bridge girder					
	a.	Type & Quantity	Box type – 2 nos. Material: Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate.				



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	b.	Size	*
	c.	Vertical Deflection	Span / 900
	d.	Type of connection to end carriage	By fitted bolts
	e.	Width	*
	f.	Length	*
3.14.0		Rails	
	a.	Type / section	Rails sections as per IS: 3443 Grade 50 C 12. Joint to be butt-welded by thermit welding & fusion welding.
	b.	Standard conforming to	IS: 3443
	c.	Weight per metre	*
	d.	Material	50C12
	e.	Top width in mm	*
	f.	Height in mm	*
3.15.0		Type of platform required on the bridge	Chequered plate platform 6mm thick over plain as per IS : 3502
	a.	Length	Full span length
	b.	Walkways	Access walkways of not less than 800 mm (clear) with hand railing of height of 1100 mm along the both side of bridge girder and cross over walkways.
	c.	Type of access from gantry girder level to crane bridge	Rung ladder at ends from gantry girder level walkway to crane bridges walkway
	d.	Type of access to maintenance cage from crane bridges walkway	Rung ladder
	e.	Type of access to Cabin from crane bridges walkway	By Staircase
	f.	Provided at both ends	Yes
3.16.0		Operators cabin	
	a.	Type of construction	Closed type, Air conditioned Cabin
	b.	Area and minimum clear height	2500x1850 mm with a head room of 2000 mm
	c.	Operator's seat	Revolving type



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	d.	Warning gong	A foot operated electric warning horn of double bell type suitable for 240 V AC. of noise level 95 dB at 3.5 m. One brass gong suspended outside the Cabin and operated from inside.			
			A distinct type alarm with conspicuous warning lights on either side of the crane bridge to indicate overloading of crane.			
	e.	Position of controllers	In front/ side of operator's chair			
	f.	Ventilation	One no non oscillating ventilating electric fan in cabin + AC			
	g.	Siren	One (1) heavy duty type industrial siren shall be provided with Each crane. The siren shall be operated from foot-switch in the Operator's cabin.			
3.17.0		End carriage span (wheel base)	As per IS 807 (latest edition)			
3.18.0		Motors				
3.18.1		Hoist Motions	MH	MH micro	AH	AH micro
	a.	Type	Three phase squirrel cage induction motors to be operated from VFD system. Motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for inverter duty	Thru VVVF drive	Three phase squirrel cage induction motors to be operated from VFD system. Motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for inverter duty.	Thru VVVF drive
	b.	Enclosure	TEFC	NA	TEFC	NA
	c.	Numbers furnished	One per motion			
	d.	Voltage, phase and frequency	415V $\pm$ 10%, 3 Ph., 4 wire, 50 Hz, $\pm$ 5 % Combined voltage & frequency variation = 10% absolute			
	e.	Class of protection	IP – 55			
	f.	Rated capacity (KW)	The motor shall be suitable for 150 starts / hr and 40% CDF. Motor nameplate rating at 50 C shall have Motor rating will be calculated keeping margin of at least 15% over the maximum power requirement in the duty condition specified. Further, the hoist motors will be rated to lift 110% of the design load on the hook at the rated speed.			
	g.	Duration factor/duty	40 % CDF / S-4			
	h.	Speed (rpm)	*			
	i.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to that of class B			
	j.	Number of starts/ hour	150 starts / hr			
	k.	Contactors for motor	*			



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	l.	Overload protection for motors provided	Yes			
	m	Space heater requirements	For motors of rating 30 KW and above			
3.18.2		Travel Motions	CT	CT micro	LT	LT micro
	a.	Type	Three phase squirrel cage induction motors to be operated from VFD system. Motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for inverter duty.	Thru VVVF drive	Three phase squirrel cage induction motors to be operated from VFD system. Motors shall be provided with VPI insulation and insulated bearing on one side and shall be suitable for inverter duty.	Thru VVVF drives
	b.	Enclosure	TEFC	NA	TEFC	NA
	c.	Numbers furnished	1	NA	2	NA
	d.	Voltage, phase and frequency	415V + 10%, 3 Ph., 4 wire, 50 Hz, $\pm 5\%$ Combined voltage & frequency variation = 10% absolute			
	e.	Class of protection	IP – 55			
	f.	Rated capacity (KW)	The motor shall be suitable for 150 starts / hr and 40% CDF. Motor nameplate rating at 50 C shall have Motor rating will be calculated keeping margin of at least 15% over the maximum power requirement in the duty condition specified.			
	g.	Duration factor/duty	40 % CDF / S-4			
	h.	Speed (rpm)	*			
	i.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited to that of class B			
	j.	Number of starts/ hour	150 starts / hr			
	k.	Contactors for motor	*			
	l.	Overload protection for motors provided	Yes			
	m.	Space heater requirement	For motors of rating 30 KW and above			
3.18.3		Motor Duty and pull out torque	Duty S4 and pull out torque 275% of full load torque			
3.19.0		Limit switches	Main hoist	Aux. hoist	Cross Travel	Long Travel
	a.	Type	Rotary gear + Gravity		Lever type (one way/ two way)	
	b.	Number provided	1+1	1+1	2/1	2
	c.	Rating of contacts	*			
	d.	Material of contacts	Double break Silver Cadmium			



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	e.	Control voltage / Enclosure	110 V/ IP 55			
3.20.0		Power conductors (DSL)				
	a.	Type	LT: PVC shrouded Cu conductor bus bar. CT: Flexible trailing cable mounting on retracting support (Festoon type) 1100V-(E) grade power & control flexible trailing, annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed and shall have conductor screen of rubber. Cables shall conform to IS requirements and any other applicable standards.			
	b.	Size	Shall be sized with a margin of 20% over load requirement. Voltage drop at motor terminal shall be limited to 3% at extreme positions of cranes. Protective cover over DSL to be provided.			
	c.	Material	*			
	d.	Numbers	*			
	e.	Length	Suitable for bay length			
	f.	Guard provided	Yes			
3.21.0		Protective Panel				
	a.	Make	OEM			
	b.	Size	*			
	c.	Material	Sheet steel 2 mm size			
	d.	Numbers and location	One number located in cabin			
	e.	DOP	IP 54			
3.22.0		Control panel				
	a.	Make	OEM			
	b.	Size	*			
	c.	Material	Cold Rolled sheet steel 2mm size			
	d.	Numbers and location	One each for MH, AH, CT and LT located on bridge platform with space heaters.			
	e.	Degree of protection	IP 54			
3.23.0		Master Controllers (Desk Type)	Main Hoist	Aux Hoist	Cross Travel	Long Travel
	a.	Number of steps	5	5	4	4
	b.	Voltage & current rating	415 V/10 A			
	c.	Type	Heavy duty type having DOP IP54. Release of operators' hand from the controls shall stop motion and set brakes automatically.			
	d.	Location	In cabin			
3.24.0		Control for Hoists /CT/LT operations	Through Variable Voltage Variable frequency drive			
	a.	Speed control	Thru' VVVF with minimum 6 pulse design			
	b.	Starting torque of VVVF	Up to 400 % typical with encoder			



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	c.	Starting current	Less than 150 % of rated torque.	
	d.	Temperature	VVVF system shall be capable of withstanding up to 50 ° C without derating.	
3.25.0		Cable	Power	Control
	a.	Material	Copper	Copper
	b.	Type	All cabling shall be carried out using XLPE insulated fire resistant (FRLS) cables & wiring by Heat resistance PVC wires with stranded conductors.	
	c.	Size	Min. 2.5 mm ² for Cu.	Min. 2.5 mm ² for Cu.
	d.	Voltage grade	1100 V	
	e.	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 3% of rated voltage at motor terminals.	
3.26.0		Earthing		
	a.	Material of earthing	G.I / Copper	
	b.	Earthing as per specification	Yes	
3.27.0	a.	Contactors	AC 4 duty for reversing application. AC 3 duty for non-reversing application	
	b.	Switches	AC 23 for motor application, AC 22 for other application.	
	c.	Fuses	HRC	
	d.	Overload relay	Temperature compensated bi metallic with single phasing preventor.	
3.28.0		Power supply	Owner shall provide one (1) no. 415 V, 3 phase, 3 wire supply at operating floor near A row column at centre of bay length shall be provided. Bidder shall provide change over switch in enclosure to receive above power supply.	
3.29.0		Transformer		
	a.	Quantity	2 X 100 % for control, 1 no for lighting & 1 no for hand lamp.	
	b.	Voltage Rating	Control 415/110V, Lighting 415/240V and hand lamp 415/24V.	
	c.	KVA rating	20% over loading to be considered while sizing the rating	
3.30.0		Illumination		
	a.	In cabin	Two 10W CFL fixture, 2nos. 24V – 5A – 3 pin industrial socket. 15A/20A.15A/20A socket outlet shall be provided for A/C	
	b.	Over Bridge	4 nos 60 W Bulk-head fittings with incandescent lamps and 4nos. 24V – 5A – 3 pin industrial socket	
	c.	Under bridge	4 nos. 250 W HPSV lamps along with shock absorbing and anti swing suspension arrangement	
	d.	For inspection of crane components	One (1) portable 40W hand lamp with min. half span length flexible cable for inspection of crane components	
	e.	Hand lamp socket and hand tool sockets	Hand lamp socket outlets (2 pin, 10A, 24V) and power socket outlets (3 pin, 20A, 240V) shall be provided for use of hand tools along with switches.	
3.31.0		Fire Extinguisher		
	a.	Type and size	4.5 kg CO ₂ type	



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	b.	Location	One in cabin and Three on bridge
3.32.0		Maintenance cage	Suitable inspection cages to accommodate two persons to facilitate inspection of down shop lead.
3.33.0		Type of control for Hoists/ CT/LT operation	Through VVVF drive
3.34.0		VVVF Drive	Minimum 6 pulses and necessary input and output devices to reduce the Harmonics as per IEEE 519. It shall be capable of providing Pull out torque 400% of Starting torque with taking less than 150% of Full load current during starting.
3.35.0		Mechanical overload protection (Load Cell)	To be provided for hoist mode
3.36.0		Painting	As per Annexure- IV
3.37.0		Isolating switch	Two nos. isolating switch shall be provided at extreme ends of the bay length, at a distance of approximately 20 mtrs. From the centre line of first & last column for maintenance of the cranes.
3.38.0		Whether tandem operation envisaged	YES

Note: Other requirements for the system.

- Centralized grease lubrication with hand operated grease pump for all bearings.
- Two (2) nos. isolating switches in enclosure shall be provided at extreme ends of operating floor for disconnecting supply to DSL during crane maintenance.
- The crane electrical shall be designed for ambient air temperature of 50 Deg. C relative humidity of 100%. The equipment shall operate in highly polluted environment.
- All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- Emergency Switch-Mushroom type emergency STOP push buttons to open the main contactor shall be furnished at least one in operator's cabin and two on bridge platform within easy reach.
- DSL phase indicating lamps to be provided.
- Pull out torque of motor at rated voltage shall be 275% of full load torque.
- Additional features in operator's cabin and on pendant push button:
 - Emergency Push Button
 - Switches for lights and bells
 - Lamps for Power 'ON' indication and emergency corner switch operation
- Two nos. per crane fail safe LT storm/parking brakes, truck end mounted, hydraulic rail clamp type of adequate capacity (depending on wind pressure) to be provided. The setting shall include automatic engagement of clamps in case of crane is left idle for five minutes (adjustable).
- The following parameters shall be considered for design and selection of LT storm /parking brakes.
 - The basic wind speed "Vb" at ten metres above the mean ground level: **44 meters /second**
 - Category of terrain Category-2
 - Other factors in line with IS 875.



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SECTION – II

STANDARD TECHNICAL SPECIFICATION

SUB-SECTION IIA – Standard Technical Requirement (Mechanical)

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DOUBLE GIRDER EOT CRANE**1.0.0 SCOPE**

This specification covers the design, material, manufacture, assembly, inspection and testing at manufacturer works for EOT cranes and shall be applicable unless the requirements are addressed otherwise in BHEL / BHEL's Customer approved documents.

2.0.0 CODES AND STANDARDS

The equipment to be supplied under this specification shall conform to the following codes and standards (latest revisions) unless otherwise specified hereinafter.

- | | | |
|-------|------------------|---|
| i) | IS 807 | Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists |
| ii) | IS: 3177 | Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes. |
| iii) | IS: 2266 | Specification for steel wire ropes for general Engineering purposes. |
| iv) | IS: 4029 | Guide for testing induction motor (for temperature rise). |
| v) | IS: 15560 | Steel hooks for standard shank design. |
| vi) | IS: 3443 | Specification for crane rail section. |
| vii) | IS: 325 | Three phase induction motors. |
| viii) | IS: 900 | Code of practice for installation and maintenance of induction motors. |
| ix) | IS: 4237 | General requirement of switchgear and Control gear for voltage not exceeding 1000V. |
| x) | IS: 434 (Part I) | Copper conductors rubber insulated cables for voltage up to 1000V. |
| xi) | IS 1596 | Polyethylene insulated PVC sheathed cables |



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xii)	IS 3043	Code of practice Earthing
xiii)	IS: 3938	Electric Wire Rope Hoists.
xiv)	IS: 2147	Degree of protection provided by enclosures for Low voltage switchgear and control gear.
xv)	IS: 1554 Part I	PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts.
xvi)	IS: 691	Flexible trailing cables rubber insulated.
xvii)	IS: 1653	Steel conduits for general engineering purposes.
xviii)	IS: 2509	Rigid non-metallic conduit for electric- Installations
xix)	IS: 2062	Steel for General Engineering purposes.
xx)	IS: 1030	Carbon Steel castings for general engineering purposes.
xxi)	IS: 1570	Schedules for Wrought steels.
xxii)	IS: 1875	Carbon steel billets, blooms, slabs and bars for forgings.
xxiii)	IS: 808	Dimensions for hot rolled steel beam, column, channel and angle sections.
xxiv)	IS: 1852	Rolling and cutting tolerances for Hot rolled steel products.
xxv)	IS: 2291	Tangential Keys and Keyways.
xxvi)	IS: 2292	Taper Keys and Keyways.
xxvii)	IS: 3961	Recommended current rating for cables.
xxviii)	IS: 694	PVC insulated cables for working voltages up to and including 1100V)
xxix)	IS: 1554 (part-I)	PVC insulated (heavy duty) electric cables: Part 1: for working voltages up to and including 1100 volts.
xxx)	IS: 4289	Flexible cables for lifts and other flexible connections: Part 1: Elastomer insulated cables.
xxxi)	BS: 970	Wrought steels in the form of blooms, billets, bars and forgings.
xxxii)	IS: 5749/ BS 3017	Specification for Forged Rams horn Hooks

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Indian electricity rules - 1956.

In the event of any conflict between the specification and standards mentioned above, the more stringent of the two as per interpretation of purchaser shall govern.

3.0.0 DOUBLE GIRDER EOT CRANE**3.1.0 DESIGN REQUIREMENTS**

3.1.1 The crane shall be designed in accordance with the latest edition of IS-3177, IS-807 and any other standard as referred there in and subject to any modification and requirement as specified herein after.

Class of crane mechanism shall correspond to that of the crane requirement and as specified elsewhere.

3.1.2 Safety devices should be provided with all equipment/parts covered under this specification.

3.1.3 Parts requiring replacement or lubrication shall easily be accessible without dismantling the other equipment or structures. All electrical cables shall be laid to comply with recognized standards and purchaser's requirements.

3.1.4 For welded construction such as bridge girders, end carriages, rope drum, gearboxes etc. steel shall be conforming to IS-2062 quality. Welding shall be carried out only by qualified welders and subjected to NDT as specified in Quality Plan.

a. Welding shall be performed by shielded electric arc, gas or other approved methods. The electrodes used for welding shall conform to AWS A5.1.

b. Wherever lateral welding of the main plates of box girders are required, it shall be butt-welded.

c. Qualification of welding procedure and welder: These shall be carried out as per ASME Boiler and Pressure vessel code Sec. IX - Welding and brazing qualifications.

d. Electrode designations and qualifications shall be as per AWS A 5.1.

e. Electrodes should be of radiography quality with heavy covering as per IS: 814 and relevant requirement of ASME Sec IX and IIC.

f. Bare electrodes as per IS: 7280 and flux wire combination as per IS: 3613.4e

3.1.5 VOID

3.1.6 Guard shall be provided on crane to prevent the hoist ropes coming in contact with down shop leads.

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Guards/ rail sweep of an approved design, which will push forward or off the track any object such as a person foot or arm, placed across it. Guards shall be attached to each end of the end carriages.

Suitable guards shall be provided to revolving shafts, coupling etc.

3.1.7 All cables shall be clamped individually. All trailing cables shall be clamped with PVC or non-metallic clamp.

3.1.8 Walkways of CT shall be of chequered plate minimum 6 mm thick O/P at least 800 mm clear inside with non-skid toe plates 8mm thick, projecting 100 mm above the floor. Walkways shall be of rigid construction and designed to sustain a distributed load of not less than 300 kg/ sq. mm.

Intermediate posts for supporting handrails shall not be spaced more than 1.5 meters apart.

Ladders provided shall have at least 450mm clear width with 20 mm rungs (rods) spaced 300 mm apart.

3.1.9 All wheels, couplings, open gear etc. shall be provided with covers.

3.1.10 All bolts except those with locknut shall be provided with grip lock nuts or spring washers.

3.1.11 Fasteners for pedestal blocks, motors, gearboxes etc. shall be easily removable from the top. Studs shall not be used as fasteners for mechanical items except for fixing covers.

3.1.12 Defects in the material like fractures, cracks, blowholes, pitting etc. are not allowed. Rectification of any such flaw is permissible only with the approval of the purchaser.

3.1.13 All parts of the crane shall be thoroughly cleaned of mill scales, rust or foreign matter and then painted as per the specification requirements.

The permissible camber shall be shown in drawing or data sheet submitted for approval.

3.2.0 STRUCTURAL DETAILS

3.2.1.0 Crane structure shall be designed in accordance with the latest edition of IS-807 after taking the following additions/deviations as applicable.

3.2.1.1 Black bolts shall not be used in the main structure of the crane. The calculated strength of other bolted joints in structural members shall not be less than net strength of member plus 25%.

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3.2.1.2 The calculated strength of riveted joint or joints made by friction grip bolts in structure members shall be not less than the calculated net strength of the member. 3.2.1.3 Bolts used in shear shall be fitted in to reamed hole. 3.2.1.4 Nuts and Bolts will be as per IS:1363, IS: 1364 and IS: 1367 High-tension friction grip bolts as per IS: 3757 and High- tension friction grip nuts as per IS: 6623 3.2.1.5 Transverse filled welding on load carrying member shall be avoided. 3.2.1.6 All butt welds on structural members subjected to tensile stress shall be of radiographic quality as ASME Sec VIII Div.1 acceptance norms. 3.2.1.7 Fillet welding on load carrying members shall be avoided. 3.2.1.8 For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8mm thick. For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8mm. 3.2.1.9 The cranes working out door or in corrosive environment, an allowance of 1.5 mm shall be added to the calculated thickness. 3.2.1.10 Minimum thickness of chequered plates for platform shall be over 6 mm over plain. Chequered plates shall not be considered for strength calculations of load carrying members. 3.2.1.11 Splice shall be designed to resist all the forces and moments to which it is subjected to plus 50% thereof. 3.2.1.12 However, in no case the strength developed by the splice shall be less than 50% of the effective strength of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splice in line with the gravity axis of the member joined so as to avoid the eccentricity of the loading. 3.2.1.13 The material of construction of the major components shall be as specified in the specification/data sheet. Manufacturer are however free to use alternate material material which are superior for the intended service. But in all the cases, prior concurrence of the purchaser is must. 3.2.1.14 Splices shall be designed to resist one and half times the forces and moments to which it is subjected, but in no case it shall be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders shall be designed for full strength of the web in shear as well as bending. For splicing tension members, the				

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net section of the splice plate shall be ten percent more than that of the material spliced. Splices shall be proportioned and arranged, so that the gravity axes of the splices are in line with the gravity axis of the member to avoid eccentricity.

3.2.2 Bridge Girder

3.2.2.1 The bridge girder shall consist of a box construction with double Web plate girders or lattice girders and shall be of adequate strength to withstand the rolling loads and other stresses it is subjected to.. The design of the girder shall be in accordance with latest edition of IS- 807.

3.2.2.2 Maximum deflection of the bridge girder, with safe working load, shall not exceed 1/900 of the span or as per latest IS. The girder shall be supported on the centerline of LT wheels during the deflection check. The girder shall be cambered by an amount by an amount equal to the maximum deflection.

3.2.2.3 Box section shall be adequately reinforced by internal diaphragms and ribs to withstand the most severe combination of load that may develop under different working conditions. Additional Internal diaphragms shall be provided at points where external members are welded for providing support to drives etc.

3.2.2.4 Box girders shall be provided with end plates sealing. Diaphragms inside the girder shall extend to the full - width & depth of the girder and the web plates shall be reinforced by angles all along the full length of the plates spaced midway between the diaphragms. Full depth diaphragms or stiffeners shall be furnished at bridge drive supports and below the line shaft bearings.

3.2.2.5 Short diaphragms shall be furnished and are required to transmit the trolley wheel loads to the web plates. Trolley rail section shall not be considered into design of bridge girders.

3.2.2.6 Full length chequered platforms on both side shall be provided on the side of bridge girders as specified in data sheet - A.

3.2.2.7 There should not be accumulation of water/oil inside the box girders. If required breathing holes can be provided for expansion / contraction, due to change in temperature. Tapped (threaded) holes shall be provided with ½” NPT plug in the bottom of the girders, at both ends, to drain off any accumulation of water / Oil inside the girder. Instruction shall be painted on the girders to remove the plug and check for water/oil before lifting. Plug shall be replaced after installation.

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3.2.2.8 All connection splices shall be designed for full strength of member of loads indicated unless otherwise approved. Beams and connections shall be designed for 60% of shear capacity of beam section plus additional axial load if any. Not more than one splice shall be provided to make up full length of number.

3.2.2.9 Maximum Span/ Depth ratio for Plate Girder shall be 25 or as per IS 807 latest edition.

3.2.3 **End carriage**

3.2.3.1 End carriages shall be fabricated from rolled steel section or plates. End carriage shall be of ample strength to resist all stresses likely to be imposed on them under service conditions including collision with other cranes or stops. The length of the end carriages shall be such that no other part of the crane is damaged in collision. End carriage shall be so designed as to distribute the load evenly between the wheels from each bridge girders.

3.2.3.2 The wheel base shall not be less than 1/6th of the span up to 20m, 3.5m for spans above 21m but less than 24.5m & 1/7th of span above 24.5m (as per IS 807 latest edition). End carriage shall be fitted with safety stop to prevent the end carriage falling more than 25 mm in the event of breakage of a track wheel, bogies or axle.

3.2.3.3 Suitable jacking pads at a suitable height from rail level shall be provided on each crane for crane jacking. Jacking pad dimensions shall be suitable for full seating of the jacking pad seat without any instability. When changing the track wheel, jacking pads shall not interfere with replacement of track wheel.

3.2.4 **Crab (Trolley)**

3.2.4.1 The crab frame shall be built from heavy steel section, welded properly to form single piece frame & to resist vertical, lateral and torsional strain and to support all loads without undue deflection. It should be properly machined to receive hoisting mechanism, cross traverse arrangement/mechanism, wheels etc. etc.

3.2.4.2 Sheaves, part of hoisting mechanism, shall be so arranged on trolley that rope reeling arrangement shall ensure lifting of load in vertical line with minimum of swing or side movement. Trolley shall be provided with chequered plates all over except for opening required for ropes and equipment foundation. Equipment foundation shall not be welded/ supported on chequered plates. Toe plates 100 mm high and 6mm thick shall be provided around opening provided for movement of ropes. Suitable railing shall also be provided around the opening for rope in case the opening is large.

3.2.4.3 **Platforms and Ladders**

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a) Safe means of access shall be provided to every place where any person engaged in the examination or maintenance of the crane has to work. Adequate handholds and footholds shall be provided as necessary..

b) Every platform shall be provided with steel chequered plate top and be securely fenced with 1050 mm high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely

c) Safety hand railing of tubular construction 32 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1100 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick) shall be provided on bridge walkways and on end carriages, staircases, trolley and at any other place where access is provided. Bends shall be neat and made by machine. The top rail should be so laid that there is no intermediate obstruction and hand need not be lifted from rail while walking

d) In case lattice riveted construction is offered for the bridge girder, full length chequered plate platform with adequate headroom shall also be provided at bottom chord level for periodic checking of all rivets/bolts and other items.

3.2.5.0 Brief description of crane operation, Maintenance and periodical lubrication etc. typed in English and in local language neatly framed in a permanent frame for easy reference.

3.2.6.0 Suitable inspection cages to accommodate two persons to facilitate inspection of DSL.

3.3.0 MECHANICAL**3.3.1 Rope drums**

Rope drums shall be of mild steel plate fabricated/ cast steel/ as per IS 3177. All fabricated rope drums shall be stress relieved. The drum shall be so designed to take full length of hoisting rope in single layers. The end of the rope shall be anchored to the drum in such a way that the charger is readily accessible. Each rope shall have not less than two (2) full turns on the drum when the hook is at lowest position not taking into consideration the turns covered by the rope in charge. One spare groove shall be provided for each rope drum when the hook is at the highest position. Each rope end shall be clamped with minimum two clamping wedges with at least two bolts on each clamping arrangement.

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The pitch diameter of the drum shall be as per IS - 3177 or as specified elsewhere. The depth of the groove shall not be less than 0.35 times the rope diameter. Each rope shall be clamped to drum with two clamp wedges with at least two numbers of bolts on each clamping arrangement.

For evaluation of Radiography the designed thickness of the drum (top of crest to ID) shall be taken into consideration and not the thickness of plate selected.

3.3.2 Hoist ropes

Ropes of steel core as specified in Data sheet "A" shall be of 6x36 or 6x37 construction of extra flexible plough steel as per IS 2266 having minimum UTS of 1770 kN.

3.3.3 Rope sheaves

Sheaves shall be of cast (Castings to IS: 1030 Gr. II with Y.P. greater than 50% of UTS) or forged steel. All sheaves shall be identical, however, exception may be made for equalizer sheave. Sheave groove shall be ground finished for getting increase rope life. Equalizer sheave shall be arranged to turn and swivel in order to maintain rope alignment under all circumstances.

3.3.4 Wheels

LT & CT wheels shall be double flanged with straight tread. The wheels shall be capable of taking up misalignment in span. Solid wheel shall either be of forged steel or as specified in Data sheet. The wheel rim shall be with minimum hardness of BHN 300-350. Wheels may be either hardened on tread portion as per IS -3177 or Volume hardened. Contact stresses between wheels and rails should be within permissible limits.

3.3.5 Buffer

Each End carriage shall be provided with buffer as per data sheet 'A'. Buffers should be so located that removal is not required while changing wheels or bogies. Buffers shall have sufficient tension on energy absorption capacity to bring the unloaded crane to rest from the speed of 100% of the rated speed to zero speed. Buffer is to be fitted to each end of carriage assembly and crab so that buffer contact takes place before the bridge or trolley reaches the end of rail.

3.3.6 LT drive

The bridge motion shall be achieved by suitable drive arrangement as specified

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elsewhere. When twin drives are used, these shall be operating in unison to avoid skewing effect. The drives shall be interlocked for simultaneous starting, stopping & speed control.

3.3.7 CT drive

Trolley drive shall be achieved by suitable drives & power shall be transmitted to the geared wheel by means of pinions mounted on both ends of the output shaft.

3.3.8. Gearing

3.3.8.1 Gears in speed reducer unit for bridge drive, hoists and trolley drive gearing shall be enclosed in substantial housing and shall operate in oil bath. The housing shall be of sufficient design not to permit temperature in excess of 90°C for the oil bath. Spur and helical gearing shall normally be used for all motions. Worms and bevel gears shall not be used. First high-speed reduction shall be through helical gears. All gears shall be hardened and tempered and of alloy steel with machine cut teeth 1.6 Micron finish or better and lapped with some minimum applied load to remove high spots and to improve tooth contact. Cast alloy steel is acceptable only for gears in the last stage of speed reduction. Surface hardening of teeth is not acceptable. Gear teeth shall preferably be cut in metric module system. Gears shall be designed to meet requirement of crane duty as per IS: 3177. The ratings of gears shall be established as per IS: 4660.

3.3.9 Gear Box

3.3.9.1 All gears shall be completely covered and enclosed in oil tight casing & sealed with gasket. In case of totally enclosed gearboxes, splash or automatic lubrication system shall be used. Covers shall be split horizontally at each shaft centre line, so that top half can be removed for inspection and repair without disturbing the bottom half. Gear shafts shall be supported on ball/roller bearings mounted in gearbox unless specially agreed otherwise. The gear boxes shall be provided with breather, air vent, oil level indicator, dip stick, drain plug and lugs for lifting.

Radial clearance between the gear boxes inner surface and outside diameter of the gears shall be at least 1.25 times the depth of larger gear tooth inside the gear box or 20mm whichever ever is higher. Facial clearance between inner surface of gearbox and face of gear or pinion shall be at least 20 mm. Gearbox shall be inspected in line with QP and as per PEM (Q)/001 enclosed.



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3.3.9.2 The gearboxes shall be of mild steel or cast steel. All fabricated gearboxes shall be stress relieved at a temperature between 590 to 680 deg. C. The temperature shall be maintained within ± 20 deg. C and at no time during the soaking cycle the temperature shall fall below 590 deg. C or exceed 680 deg. C. Soaking shall be done for a period proportionate to 1 (one) hour/ 2.5 cm. of wall thickness.

3.3.10 **Bearing**

3.3.10.1 Ball and roller antifriction bearing of attached sub-vendor list, make shall be used throughout, except where specified otherwise. Drive side bearing on Hoisting equipment shall be ball / roller bearing type. Rated life of ball and roller bearing shall be not less than total working life as per data sheet-A. Life of bearing shall be calculated in accordance with manufacturer's recommendations.

3.3.10.2 Provision shall be made for service lubrication of all bearings. Lubrication arrangement and clamping shall be done neatly. Bends in pipe shall be done with the help of machine. Bearing enclosures shall be designed as far as practicable to exclude dirt and shall prevent oil leakage. Accessibility should be such that parts may be safely lubricated from the walkway or ladder when the crane is not in motion.

3.3.11. **Shafts, Couplings and axles**

3.3.11.1 Shafts and axles shall be made from solid rolled or forged steel bars and shall have ample strength and rigidity and adequate bearing surface. If shouldered, they shall be provided with fillets of ample radius and /or be tapered to avoid stress concentration.

Motor shafts shall be connected to gearbox input extension shafts through flexible gear coupling. Solid coupling shall be used for connecting intermediate lengths of long travel shafts. For driving hoist drum full-gear couplings shall be used between hoists drum & hoist gearbox output shaft. Couplings shall be of cast steel/wrought steel conforming to IS: 1030 grade 280-520 and shall be designed to suit service conditions.

3.3.11.2 Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement whenever necessary. Whenever components of considerable amount of inertia are directly mounted on the high-speed shaft (e.g. brake drum, coupling etc.) they shall be balanced statically to minimise vibration.

3.3.12 **Repair Cage**

A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. The repair cage shall be adequately sized to accommodate two



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persons. And guarded for safety and correctly located for the intended service. Suitable access to the cage shall be provided. Repair cage shall be provided at the corner of the crane.

3.3.13 Lifting hook

Standard hooks shall be used unless otherwise specified. These hooks shall conform to the latest edition. All hooks used shall be in normalized condition only.

3.3.14 LIFTING HOOK BLOCK ASSY

3.3.14.1 Lifting hook block assembly shall be Ram shorn type or approved for capacity greater than 50 Tonnes and point hook with Shank for capacity below 50 Tonnes and shall be of forged steel construction. Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable. All hooks used shall be in normalized condition only. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely.

3.3.14.2 The sheaves of the hook block shall be enclosed in a casing permitting generous lubrication of wire ropes, sheaves and also preventing accidental tapping of hands.

3.3.15 Brakes

3.3.15.1 Selection and design of brakes shall be such as to meet the requirement. Brakes shall be designed to suit 150% of torque transmitted to the brake drum with full load for hoist motions and 125% of motor rated torque before de-rating for LT/CT motion. Brakes shall be provided as specified in Data Sheet 'A'. Brake drum shall be separately mounted and coupling halves shall not be used as brake drum.

i) SERVICE BRAKE

Double shoe types & disc type service brakes shall be provided for each motion of the crane as/or as specified in Data Sheet. The service brakes shall apply automatically when power supply to the drive motor is cut off or fails.

ii) HOIST CONTROL

Hoist motion shall be provided with a self-contained sturdy braking system to control the speed of hoisting as well as lowering motion. The braking system shall be reasonably uniform and effective in all loads at any position.

3.4.0 ELECTRICAL

3.4.1 The scope of supply shall cover all electrical equipments comprising from Main isolating switch, down shop leads, trolley conductors, current collectors etc.



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- 3.4.1.1 Main Disconnecting/Isolating Switch fuse unit shall be provided at 1.5M above the operating floor level at one end / at both the ends of bay length or in the middle as specified in the data sheet A. Termination of incoming power supply cable to isolating switch fuse unit and further cable from switch to down shop leads shall be included in the bidder's scope of work. The switch shall be provided with Power ON Red indication lamp.
- 3.4.1.2 Run way conductors (Down shop leads) shrouded conductor as specified in the data sheet A shall have four conductors. One of the conductors shall be connected to earth grid for earthing connections of all electrical equipment on the crane and shall be connected to suitable collecting gear of earth conductor. Voltage drop across the down shop leads shall be less than 3% or specified in data sheet "A". It shall be supplied with brackets. Maintenance cage for DSL shall be provided on crane.
- 3.4.1.3 The current collectors shall be with adequate current carrying capacity and shall maintain adequate contact pressure. Spacing between current collectors shall be such as to provide sufficient quenching area for sparks coming out of collectors surface. The collector system per conductor shall spring loaded CI/carbon metallic shoes to maintain adequate contact pressure.
- 3.4.1.4 The cable, supplying power to crane trolley shall be flexible trailing cable as per IS-9968 Part I (latest edition) and mounted on retracting supports (festoon type).
- 3.4.2 DRIVE MOTORS**
- 3.4.2.1 Crane Motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The starting torque of motor shall not be less than 2.25 times the rated torque and pull out torque shall not be less than 275% of the rated full load torque of motor. In case of VVVF drive system, the creep speed will be achieved through VVVF drives and the motors for Main hoists, Auxiliary hoist, CT and LT will be Squirrel cage. Hoisting drive motors shall be provided with antifriction roller / ball bearings on the drive side.
- 3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending up on the ambient temperature and voltage /frequency variation shall be applied to de-rate the motors. The minimum margin of 10% shall be considered over the calculated rating of the motor. The protection class of the motors shall be as IP-55. Motors shall be tested at manufacturer's works in accordance with IS-325/as per agreed Quality plan & Reports shall be submitted for approval. Motors shall comply with the requirement of IS-325 or as per the motor spec.

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3.4.2.3 All the motors shall be provided with lifting lugs two earth terminals of adequate size to accept the earthing conductors shall be provided at diametrically opposite points unless specifically designed For higher speeds, motors shall be capable of with-standing 2.5 times the rated speed.

3.4.2.4 Motors shall be painted in line with painting instructions specified in Painting Scheme Annexure IV attached along with the technical specification.

3.4.3 **Limit switches**

The hoist mechanism of the crane shall be provided with rotary type limit switch to open the control circuit & in order to prevent the crane hook from over hoisting and over lowering, one gravity type back up limit switch of hand reset type shall also be provided. This switch will operate in the event of failure of main limit switch. Lever operated limit switches shall be provided at both ends of longitudinal travel and cross traverse. These limit switches shall be self-reset type. The limit switches shall be as per “Data Sheet A”

3.4.4 **Switch**

All switches shall be hand operated; air break, heavy duty, quick make and quick break type. Incoming supply disconnect switch shall be interlocked with panel door so that the same cannot be opened unless the switch is in OFF position. Safety Interlocks-Disconnect Switch-The operating handle of the main/ safety disconnect switch shall be mechanically interlocked with enclosure cover such that the same cannot be opened unless the switch is in OFF position. Main/ safety disconnect switch shall have provision of pad locking in OFF position

3.4.5. **Contactors.**

Contactors shall be suitable for heavy duty, with current rating not less than connected motor full load current. All reversing contactors shall be mechanically and electrically interlocked.

Each contactor shall be provided with three positive acting ambient temp. Compensated thermal overload relay with adjustable setting to suit the motor current. The relay shall be hand reset type, suitable for current. The relays shall be replaceable from front. The main contactor shall be electrically interlocked so that it cannot close unless all the motor overload relays are RESET and all controllers are in OFF position. The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

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3.4.6 **Push button and lamp**

Push button shall be spring return type with 2 NO + 2 NC contacts, rated 10A, 240 V AC. Indicating lamps and lens shall be replaceable from front.

3.4.7 **Protective Panel**

3.4.7.1 The electrical protective panel shall be a cubicle fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick with lockable-hinged door. The control cabinet's door shall be interlocked with the operating handles of isolating switches of supply circuits so as to prevent opening of the door when an isolating switch is closed. A device for bypassing the interlock shall also be provided. It shall be dust and vermin proof with degree of protection as IP-54 or as specified in data sheet A. All the equipment inside the panel shall have permanent identification. The panels shall be front connected type with front-hinged door for access to wiring and terminals. Engraved nameplate shall be furnished for all panels and also for the equipment and devices mounted there on.

The following minimum equipment shall be provided.

- a) One triple pole air break type main contactor with thermal overload relay.
- b) One triple pole main line connecting/disconnecting switch.
- c) Emergency push button at convenient height for the operation for interruption of the entire power.
- d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.
- e) Contactors, timer and auxiliary contactors.
- f) Portable Lighting Transformer rated for 415/24V.
- g) Lighting Voltage Transformer with fuse 415/24V.
- h) Control transformer with fuses.
- i) Indicating lamps to indicate the live condition of all three phases.
- j) Main supply ON/OFF lamps on the door of the protective panel.
- k) Electrical interlock shall be provided to prevent the main contactor being closed unless all controllers are in OFF position.
- l) Other equipment as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The main contacts shall have the rating for 5 Amps or as specified in the data sheet A. The contactor drop off voltage shall be between 45-50% of rated voltage.

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- m) All internal wiring shall be identified with numbering rules at both ends as per the relevant wiring diagram.
- n) Each panel shall have internal illumination with fluorescent lamp. The inside of the panel shall be painted white.
- o) Separate terminal blocks shall be provided for terminating circuits of various voltage classes. At least 20% spare terminals for the wire terminations shall be provided in the cabinet.

3.4.8 Starter Panel

Separate panels shall be provided for CT, LT & hoist motion (Main and Auxiliary), with following type of items.

- a) Contactors : AC4 duty for reversing applications
AC3 duty for non-reversing applications
- b) Switches : AC23 for motor application.
AC22 for other application
- c) Fuses : HRC
- d) Overload relays: Temperature compensated bi-metallic with single phasing preventer.

3.4.9 MOTOR CONTROL PANEL

The motor control panels shall be dust and weatherproof to IP-54/55 or as specified in "Data Sheet A" & shall be provided separate for each motion. The panel shall contain minimum the following components.

- a) Switch fuse unit with contacts of adequate rating for each motion.
- b) Thermal overload relay for each drive. These shall be ambient temperature compensated adjustable type.
- c) Contactors, timers and auxiliary contactors.
- d) The panel shall be provided with space heater. The space heater with thermostat shall be located at the bottom of the panel and shall have individual ON/OFF switch.
- e) Terminal blocks shall be stud or snap on type. A protective cover shall be fixed on top of terminal blocks to prevent accidental contact. A minimum of 20% spare terminals shall be provided.
- f) Air break contactors shall be provided for main supply as well as for motors. They shall conform to category AC-4 as per IS-1322. These shall have



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three main contacts and 2 No. & 2 NC auxiliary contacts.

- g) The main contacts shall have the ratings as per duty requirement but auxiliary contact shall be rated for 5 amp 240V AC. The contactor drop off voltage shall be between 45-50% of rated voltage. The contactor coil shall be suitable for 240V AC supply.
- h) The auxiliary contactors shall have 4 No. + 4 NC contacts for control and interlocking purposes. The contacts shall be convertible. The contacts rating shall be suitable for 5 amps at 240 Volts AC.
- i) Adequate protection for overload and short circuit shall be provided for all the three phases of each motor.
- j) Double pole switch fuse unit for control circuit of the contractor 'START (push button and a pilot lamp with the red lens for indicating the contactor "CLOSED" shall be furnished.

3.4.11 Illumination

Crane lighting and space heating system shall be designed for 240V, 1Phase 50Hz supply and receptacle system with 24V 1Phase 50Hz supply or as specified in the Data sheet A. Suitable dry type transformers shall be furnished for this purpose, complete with isolation facility and Primary/secondary fuses.

- a) Branch Circuits for lighting and receptacles shall be individually protected by switch fuse units.
- b) CFL fixtures shall be used for lighting operator's cabin and bridge platform.
- b) 60W bulkhead fittings with fluorescent lamp shall be used for lighting bridge platform.
- c) Four (4) no.s - 250 W HPSV lamps shall be provided under the bridge as specified in the data sheet "A"
- d) All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
- e) 24V - 5A - 3 pin industrial socket outlets shall be provided. Minimum four (4) on the bridge along the walk way on both sides of full length platforms.
- f) One (1) portable 40 W hand lamp with min. half span length flexible cable for inspection of crane components.

3.4.13 Grounding

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3.4.13.1 The crane structure, motor frame and all other electrical equipment/s shall be grounded in accordance with the Indian Electricity Rules. The connections from Crane Bridge to 4th conductor of down shop leads shall be by means of current collector.

3.4.13.2 The equipment fed by flexible cables shall be grounded by means of fourth core provided in the flexible trailing cable. Pendant push button station shall be earthed Separately.

3.4.14 Red warning light 3 Nos. shall be provided at both ends of the gantry girder to indicate the aliveness of DSL.

3.4.15 **Wiring Systems**

- a) All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion. All cabling shall be carried out using XLPE insulated fire resistant (FRLS) cables & wiring by Heat resistance PVC wires with stranded conductor
- b) All wiring shall be done with 1100V grade fire resistance PVC insulated wire in conduits or by 1100V grade PVCA PVC cables with extruded inner sheath.
- c) For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.
- d) Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.
- e) Each motor shall be wired independently. Power and control wiring shall be effectively separated.
- f) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.
- g) All wire termination to the panels shall be provided with clamp type connections screw. Screw Type terminals with screw directly impinging on conductors are not acceptable.
- h) Multi way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring.
- i) Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points
- j) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

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1.0 General a) This part of the specification describes the general requirements for the Variable Voltage Variable frequency Drives, herein referred to as AC Drives, for use with standard IEC design AC squirrel cage induction motors. The nominal values, the standard documents and the drive's minimum performance are defined in this part. To avoid any mismatch between the motor and its control equipment, the AC Drive shall be capable of auto adjustment by automatic measurement of the motor parameters with/without motor rotation. b) Inverter construction and related devices: Construction shall be divided in 3 broad sections. Section one converts AC Supply into DC supply. Section 2 Converts and controls DC supply into AC Supply with regulation. Section 3 shall be used for braking action of the motor and Dynamic Braking Unit (DBU) can be inbuilt or external depending upon the drive capacity. VVVF can be used in open loop (without external speed feed back) like in Travel motions or close loop (With external speed feed back) like in Hoist motions. Chokes on input supply side are generally used in crane application for power regulation. Like all other electronic / electric devices VVVF drives are also protected by MCB / MCCB / Fuses. VVVF drives are sensitive to temperature and hence drive internal as well as external cooling fans are provided. c) Programming of VVVF Drives. VVVF drives shall be programmable and for that purpose detachable digital Operator display unit shall be supplied along with the VVVF having required buttons for setting the user constant, functions etc. The VVVF drive is to be fine tuned by matching the motor parameters and setting the parameters on full load. d) VVVF drives shall be connected with power supply and these drives generate their own low voltage control supply. Potential free contacts shall be connected to this control supply and few programmable control terminals. Starting / stopping / set speeds operations of VVVF drive shall be achieved by above control connection. e) VVVF shall give smooth control over acceleration and deceleration making the motion jerk free and using Variable voltage variable frequency limits the inrush current to the squirrel cage motors. VVVF provides controlled torque to the motor due to which crane operations are jerk free. 1.1 Experience The Frequency Converter Manufacturer shall have adequate experience in frequency converter manufacturing and have adequate business volume in order to provide credibility in his commitments and a capability of long term support. 1.2 Local support			



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The Supplier shall have a permanent representative office with a trained and skilled support staff, in the country where the goods are delivered, in order to prove his commitment for local support and to provide a channel for communication.

The engineers employed by the Supplier's regional office shall be certified by the Manufacturer and provide start-up service including physical inspection of the drive, connected wiring and final adjustments, to ensure that the AC Drive meets the required performance.

The Supplier shall be able to give basic drives training to the Customer's engineers, preferably on the site. The training shall, as a minimum, include system concepts and basic troubleshooting.

2.0 Basic requirements for the AC Drives

2.1 General requirements

The AC Drive shall comply with National(country of origin) and International standards and the recommendations for electrical industrial control devices (IEC, EN, UL, NFC, VDE).

The AC Drive shall be of the most modern design, yet user friendly and be simple to install, commission and maintain. The AC Drive shall be able to start and control the speed of a standard squirrel cage induction AC motor. The AC Drives shall be : CE marked, conforming to European Low Voltage (73/23/CEE and 93/68/CEE) and EMC (89/336/CEE) Directives, UL/CSA marked according to UL 508C.

The AC Drives have to be built to comply with the IEC standards.

The AC Drive shall be a digitally controlled drive, using, at least, the Pulse Width Modulation (PWM) with flux vector control open loop(for travel) and closed loop(for hoist). It shall have diodes / thyristors in rectifier and IGBT's in the inverter section in their entire power range, and it shall have the following minimum specifications.

Rated Input Voltages	380V -15% 480V +10%, three-phase
Rated Input Frequency	50Hz +/- 5%
Output Voltage	0 – Input voltage, three-phase
Output Frequency Range	0 to 400 Hz
Acceleration / Deceleration Time	0.01 – 999s, adjustable, linear, with S, with U or customised shapes
Overload capability (Constant Torque)	150% of nominal current for 1min.
Operating ambient Temperature	-10°C up to 50°C(shall be derated suitably)



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	if not rated at 50°C)
Storage ambient Temperature	-25°C up to 70 °C
Maximum operating altitude	1000 m without de-rating, 1000...3000 (shall be de-rated suitably)
Max. Relative Humidity	95 %, without condensation and dripping water.
Main Protections	Over current, short circuit between phase, short circuit between phase and ground, input phase loss, output phase loss, motor overload, over speed, over voltage, under voltage, drive over temperature

The AC Drive shall be able to give a 100 % output current continuously in the above specified conditions. In order to ensure that the drive can provide the required output current in the specified ambient conditions, the Manufacturer shall inform the required derating, if the ambient temperature given in the project-specific specification is higher than rated ambient of the drive or if the installation altitude is more than 1000 m above the sea level. The de-rating factor shall be specified so that neither the lifetime of the AC Drive nor the unit's performance, overload capability included, nor the reliability of the AC Drive shall suffer.

The VVVF drives shall have all necessary protections i.e input phase loss, earth fault, over voltage, output short circuit, load loss , input transient protection, overload etc

Suitable encoder shall be provided for all motions.

3.0 User interface

3.1 General

The user interface shall be identical throughout the power range and type to avoid confusion amongst the users and need for training in several different units.

3.2 Inputs and outputs

A. At least, the following standard Inputs and Outputs shall be provided, to be used in interface with the control system:

Analogue Inputs	:	1 x Programmable differential voltage input $\pm 10V$, 1 x Programmable current input 0(4) - 20mA 1 x Programmable voltage input 0 – 10V
Analogue Output	:	1 x Programmable analogue outputs 0(4) - 20mA or 0 – 10V
Logic inputs	:	6 x Programmable logic Inputs isolated from the mains



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Relay Outputs : 2 x Programmable Digital outputs with a changeover dry contact

All the control terminals shall be clearly marked.

B. At least, it shall be possible to assigned the following functions to the I/Os:

Analogue input	Analogue outputs
Speed reference Summing reference	Motor current Motor frequency Motor torque Motor power
Logic input	Relay or logic outputs (open collector)
Forward Reverse Jog Preset speeds Reference switching Ramp switching Parameter sets selection Fast stop Freewheel stop + speed - speed External fault	Ready Drive running High speed attained Drive fault Frequency threshold attained Motor thermal state attained Torque or current limitation attained Brake control

3.4 Programming terminal

- A. The AC drive shall have a keypad /display for programming and controlling purposes. An IP54 or IP65 remote mounting shall be possible at a distance of 10m.
- B. Password protection shall be provided to avoid unauthorized tampering with the set parameters.
- C. The programming terminal shall be able to display the commercial reference of the AC drive and of the options, the software version, the serial number
- D. Direct keypad entry shall be provided to observe the following actual parameters. Any one of the following parameters or actual values shall be selected to be always displayed:-
- i) Input Voltage
 - ii) Input Frequency
 - iii) Output Frequency
 - iv) Output Power
 - v) Output Current

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vi) Motor Speed

The following parameters shall always be displayed during normal operation:-

i) Drive Status

The following drive control functions at least shall be available from the keypad:-

i) Run

ii) Stop

iii) Local / Remote selection.

iv) Forward/Reverse (if function enabled)

v) Accelerate

vi) Decelerate

vii) Parameter setting

3.5 Application programming

The AC Drive shall be designed for both simple and the most complicated applications, yet it shall be user friendly. It shall be possible to reset the parameter settings back to the original factory settings through the keypad.

3.6 PC Tools

The AC Drive Supplier shall have a Windows based PC software available for monitoring and controlling the AC Drives, and the software shall be offered as an option. The software shall be supplied with the necessary hardware and a provision for connecting a PC with the AC Drives. It shall be possible to set and modify parameters, control the drive, read actual values and make trend analysis using the software.

4.0 Software features

A. Restart

In the event of a fault trip due to over voltage, over current or loss of analogue signal, the AC DRIVE shall be programmable to attempt an automatic restart. For safety reasons, the maximum number of attempts shall be within a selectable time. If the fault does not clear after the attempts, the drive shall lock out.

B. Brake logic control

The AC Drive shall have a built-in function to control a mechanical brake in order to move the load in a smooth and safe way. The brake logic control shall be adapted to the different movements, hoisting, travel, and orientation.

5.0 Preferred makes:

As per attached sub-vendor list

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SECTION – II

Site Storage and Preservation Guidelines

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1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

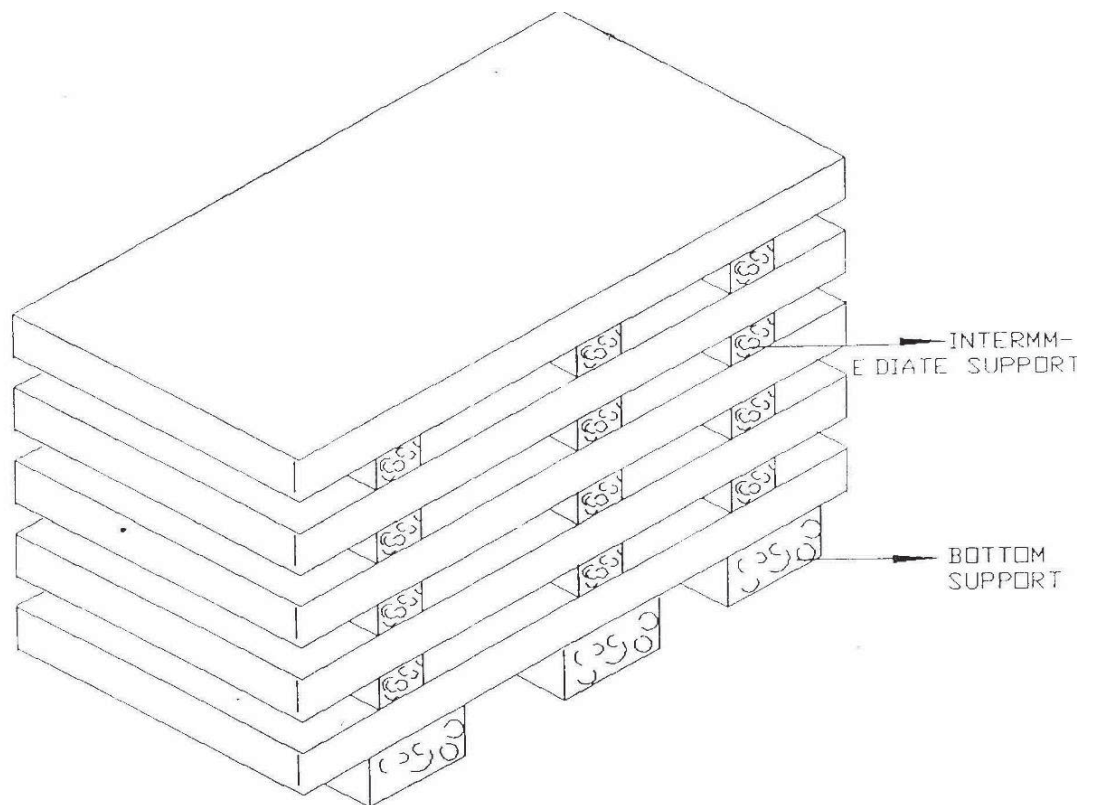


Figure – 1 – PLATE STACKING ARRANGEMENT

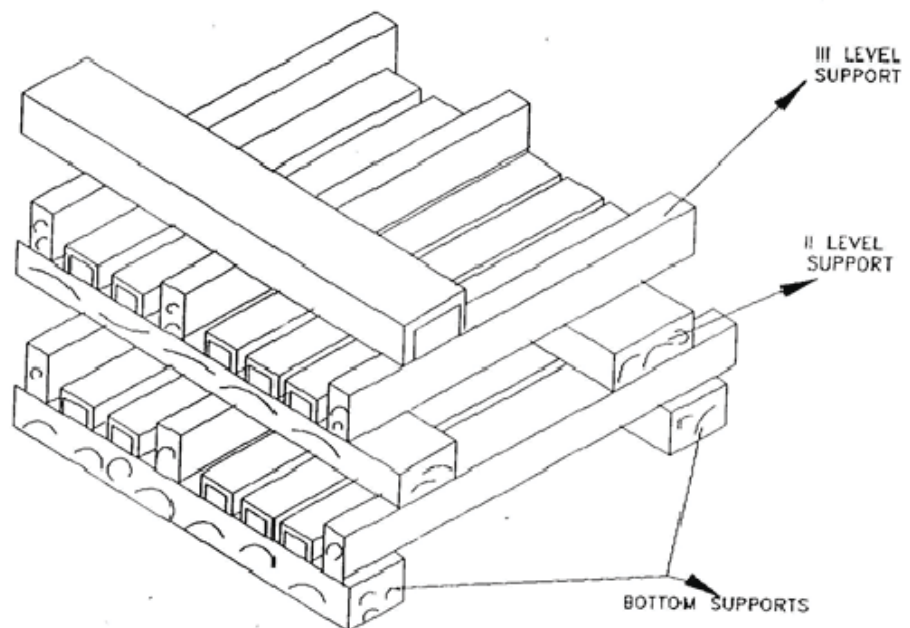


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

GENERAL TECHNICAL REQUIREMENTS (As Applicable)

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.

1.06.00 Successful Bidder to furnish two (2) sets of latest of national/inter-national codes and standards to owner.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

- 2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.
- 2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.
- 2.04.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.
- 2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.
- 3.00.00 **NAME PLATES (RATING PLATES)**
- 3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.
- 3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.
- 3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.
- 3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.
- 4.00.00 **SAFETY AND SECURITY**
- 4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and

property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

5.00.00 **GUARDS**

5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

- a) The minimum width of clear access corridors around equipment shall be 1.2 meter.
- b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.
- c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.5m shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.
- e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified

elsewhere in this specification shall be complied with.

- f) All rail/road crossings for pipe/cable racks shall be done with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.
- g) Cubicle for operating personnel shall be located at safe place near the equipment.
- h) Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Employer's prior approval.
- i) Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered to. Any departure from this suggestive layout is primarily not recommended.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common

components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 **MATERIALS**

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Owner to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 **LUBRICATION**

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00	LUBRICANTS AND CONTROL FLUIDS
10.01.00	The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of the unit.
10.02.00	The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.
10.03.00	No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.
11.00.00	OPERATION AND MAINTENANCE
11.01.00	The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised. The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.
11.02.00	Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.
11.03.00	All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.
11.04.00	All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.
11.05.00	On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.
11.06.00	All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 **PLANT LIFE AND MODE OF OPERATION**

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

Cold start-up (>72 hrs. shutdown)	:	6 per year
Warm start-up (between 10 to 72 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	160 per year

13.00.00 **PACKAGING & MARKING**

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

- | | | | |
|----|---|---|-------------|
| a) | Width of the Package
(from centre-line of rails
- 1.6 metres on both sides) | : | 3.2 Meters |
| b) | Height of the package from rail top | : | 4.47 Meters |

The above indicates the dimensions which can be normally transported on the

wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00

PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of

pipings, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 **ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT**

15.01.00 **Environment Protection**

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

15.01.01 For Liquid Effluent

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

15.01.02 For Air Emission

- a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm³ (with worst coal and one field out at TMCR).
- b) NO_x - 365 ppm Max. or 750 mg/Nm³ (Equivalent NO₂).
- c) SO₂ - Concentration based standard 2000 mg/Nm³. Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

15.02.00 **Noise Level Requirement**

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.
- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

16.00.00 **INSPECTION AND TESTING**

16.01.00 **Inspection and Tests during Manufacture**

- 16.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.
- 16.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.
- 16.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.
- 16.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the

consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

- 16.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner's Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer along with Defect Map.
- 16.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
- Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.
- 16.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material or any other test as required by approved QAP/ Material specification.
- 16.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure or as required by design code of that part, for a period not less than one hour.
- 16.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.
- 16.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.
- 16.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers (ASME).
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission (IEC) Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).

-
- x) Electric Power Research Institute (EPRI).
 - y) Standards of Manufacturer's Standardization Society (MSS).
 - z) Bureau of Indian Standards Institution (BIS).
 - aa) Indian Electricity Rules.
 - bb) Indian Boiler Regulations (IBR).
 - cc) Indian Explosives Act.
 - dd) Indian Factories Act.
 - ee) Tariff Advisory Committee (TAC) rules.
 - ff) Emission regulation of Central Pollution Control Board (CPCB).
 - gg) Pollution Control regulations of Dept. of Environment, Govt. of India
 - hh) Central Board of Irrigation and Power (CBIP) Publications.
 - ii) The Air Prevention and Control of Pollution Act.
 - jj) The Environmental Protection Act
 - kk) The Public Liability Insurance Act.
 - ll) The Forest Conservation Act
 - mm) The Wildlife protection Act.
 - nn) The EIA Notification, 1994.
 - oo) IS: 14665-Specification for Electric Traction Lift
 - pp) Any other statutory Codes/Standards/Regulations
-



TITLE

5X800 MW YADDRI TPS

DOUBLE GIRDER EOT CRANES ABOVE 100T

DOCUMENTS TO BE SUBMITTED ALONG WITH BID

SPECIFICATION NO. PE-TS-417-501-A501

REV 00

Section III Date JAN'18

Page 1 of 2

SECTION-III

DOCUMENTS TO BE SUBMITTED ALONG WITH BID

**TITLE****5X800 MW YADDRI TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T****DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

SPECIFICATION NO. PE-TS-417-501-A501

REV 00

Section III Date JAN'18

Page 2 of 2

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid

- a) Signed and Stamped copy of Compliance cum Confirmation Certificate
- b) Electrical load list, duly signed and stamped
- c) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format attached in the tender
- d) Un priced copy of price format indicating quoted/ not applicable against each row/column
- e) Signed and stamped copy of Supply price percentage break-up (enclosed with section-IA)

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF ABOVE DOCUMENTS. DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND WILL NOT BE CONSIDERED FOR BID EVALUATION.



TITLE:

**TECHNICAL SPECIFICATION
5X800 MW YADADRI TPS
DOUBLE GIRDER EOT CRANE ABOVE
100T
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPEC. NO.: PE-TS-417-501-A501

SECTION: III

REV. NO. 0 DATE JAN 2018

SHEET 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and/ or consultant's comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to

	TITLE: TECHNICAL SPECIFICATION 5X800 MW YADADRI TPS DOUBLE GIRDER EOT CRANE ABOVE 100T COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPEC. NO.: PE-TS-417-501-A501	
		SECTION: III	
		REV. NO. 0	DATE JAN 2018
		SHEET 2	OF 2

BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

**TITLE****5X800 MW YADADRI TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T****PRE BID CLARIFICATION SCHEDULE****SPECIFICATION NO. PE-TS-417-501-A501**

REV 00

Section III Date JAN'18

Page 1 of 1

PRE-BID CLARIFICATION SCHEDULE

S. No.	Section/Clause /Page No.	Statement of the referred clause	Clarification Required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

		LOAD DATA (ELECTRICAL)		JOB NO.		417		ORIGINATING AGENCY		PEM (ELECTRICAL)	
				PROJECT TITLE		5 X 800 MW YADADRI TPS		NAME		DATA FILLED UP ON	
				SYSTEM / S		Cranes & Hoists		SIGN.		DATA ENTERED ON	
DEPTT. / SECTION		MAUX-MH		SHEET 1 OF 1		REV.0		DE'S SIGN. & DATE			

LOAD TITLE		RATING (KW / A)		UNIT (U)/STN (S)		Nos.		VOLTAGE CODE*		FEEDER CODE**		EMER. LOAD (Y)		CONT.(C)/INTT.(I)		STARTING TIME >5 SEC (Y)		LOCATION		BO AR D NO.		CABLE		BLOCK CABLE		CONT RO L CO DE		RE MA RK S		LO A D No .					
NA ME PLA TE		MAX. CONT. DEMA ND (MCR)				RUNNING		STANDBY														SIZE CODE		Nos											
2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19	
1																																			

TG Hall Crane		110KW		U		1		0		D		S		N		I		AB Bay															
---------------	--	-------	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	--------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)



TITLE

5X800 MW YADADRI TPS TPP

**DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-417-501-A501

REV 00

Section IA

Date JAN'18

SUPPLY PRICE PERCENTAGE BREAKUP

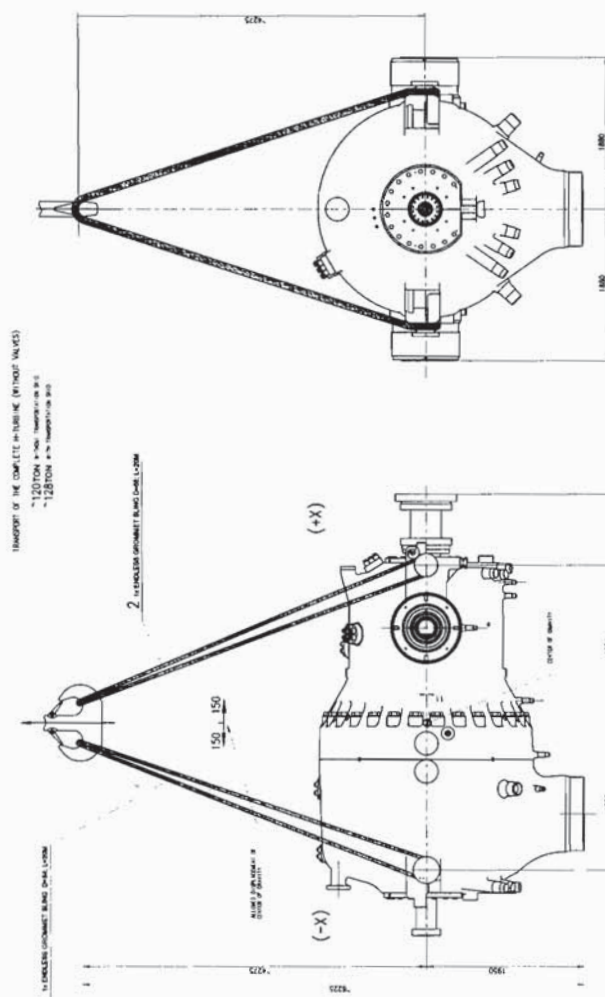
S. N.	Details of Works or Equipment/System	Qty. (LOT / Nos.)	Percentage (%) Break up proposed for billing purpose during contract for Supply
1.	Total lump sum firm price for design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight , unloading, storage and handling at site in line with drawings/ documents/ test procedures approved by BHEL / Customer for Four (4) nos. of 140/25 T capacity, Double girder EOT cranes with 29.5 M lift of main hook, 35.5 m lift of auxiliary hook, 27.3 M span, , complete with all accessories, isolating switch and power cable from isolating switch to DSL, Erection and commissioning spares for the total scope defined as per technical specification PE-TS-417-501-A501.	4 set.	65 -71 %
2.	Total lump sum firm price for design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight, unloading, storage and handling at site in line with drawings/ documents/ test procedures approved by BHEL / Customer for PVC shrouded bus bar type DSL for 671.5 M bay length complete with all accessories for the total scope defined as per technical specification PE-TS-417-501-A501.	1 set	3-6 %
3.	Total lump sum firm price for design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight , unloading, storage and handling at site in line with drawings/ documents/ test procedures approved by BHEL / Customer for 671.5 M bay length Gantry rail complete with all accessories for the total scope defined as per technical specification PE-TS-417-501-A501.	1 set	10-15 %
4.	Lump sum price of temporary cable for operation of crane during erection stage of the plant (equal to half the bay length plus 25 M) for the total scope defined as per technical PE-TS-417-501-A501.	2 set	1-3 %
5.	Lump sum price of STORM BRAKE (LT hydraulic rail clamps/parking brakes) as per technical specification PE-TS-417-501-A501.	4 set	1-5 %
6.	Lump sum price of MAIN HOOK AND AUXILLIARY HOOK ASSEMBLY as per technical specification PE-TS-417-501-A501.	4 set	1-2 %
7.	Lifting beam with slings as per technical specification PE-TS-417-501-A501.	2 set	7-10 %
8.	Total lump sum price for Maintenance tools and Tackles as per technical specification PE-TS-417-501-A501.	2 set	0.1-5 %

NOTE: -These prices shall be used for billing purpose during contract stage.

Note:

1. The supply price percentage breakup is for progressive payment purpose only. This breakup does not relieve vendor from any contractual obligations and responsibilities with respect to condition of technical and commercial scope of contract.

2. Any item/quantity not specifically indicated in this break up but required as per system requirement, shall be supplied by vendor without any additional financial implication to BHEL.

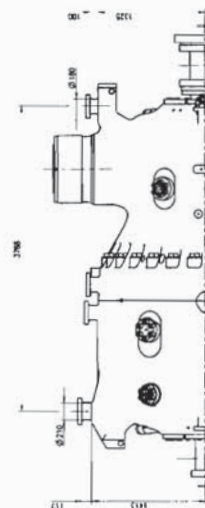


TECHNICAL REQUIREMENTS

- ### TECHNICAL REQUIREMENTS

ATTENTION

ATTENTION
 EMPLOYERS ARE URGED TO MOVE AND TURNING FOR JOB SEEKERS ASSISTANCE AND REVISION



DATE	TIME	TYPE OF PRODUCT	STEAM TURBINE
NAME OF CUSTOMER/PROJECT	MAYNARD ELECTRICALS LTD		
ADDRESS	10000 150TH AVE SUITE 100 VANCOUVER BC V6P 1C4		
QUANTITY	UNIT	WEIGHT	NO. OF LBS
100	100' ROLLS	100	100
DATE	TIME	TYPE OF PRODUCT	STEAM TURBINE
NAME OF CUSTOMER/PROJECT	MAYNARD ELECTRICALS LTD		
ADDRESS	10000 150TH AVE SUITE 100 VANCOUVER BC V6P 1C4		
QUANTITY	UNIT	WEIGHT	NO. OF LBS
100	100' ROLLS	100	100



Form No. 2038

उत्पाद मानक

परिणामित्र

शाप/अभि. निर्देश

PRODUCT STANDARD

TRANSFORMER

SHOP/ENGG INSTRUCITONS

TR 10271L

1 पृष्ठों में 1

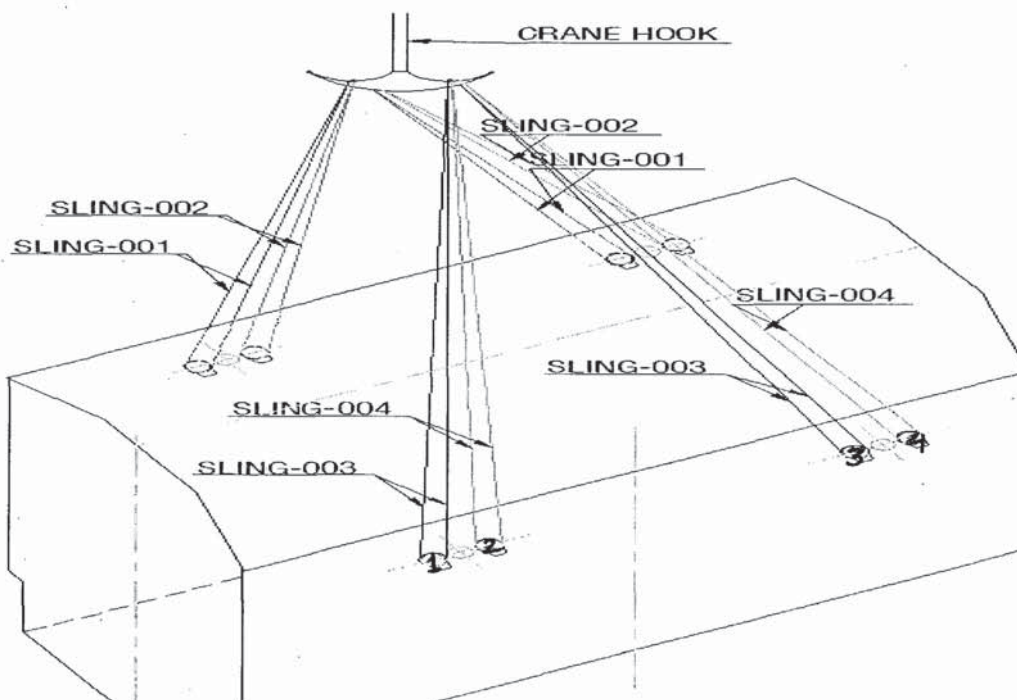
Page 1 of 1

TITLE-METHOD FOR LIFTING TRANSFORMER USING SLINGS & EOT CRANE**8 point lifting arrangement**

1. Use 4 nos. of Endless sling of Dia. 52 mm and Lifting capacity of 35T each.
2. The Length of Sling should be sufficient to form included angle between sling less than 60 degree.
3. Being endless, the loops so formed at the ends of sling shall be placed in Bollards & the centre of sling shall be on the crane Hook.
4. The sequence of slings & Lifting Bollard points is to be strictly maintained as shown below, i.e Ends of Sling 3 should be placed in Lifting Bollard 1 & 3 similarly Ends of Sling 4 should be placed in lifting Bollard 2 & 4.

Same is applicable for Sling 1 & 2 on opposite side.

This arrangement has maximum lifting capacity of 240 ton.



Note:Slings of dia.52MM is minimum. However as per load if higher dia. required same shall be provided.

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PAGE 1 OF 1

पुनः
Rev.
00
दिनांक
Date

वितरण
DISTRIBUTION.

TRE/TRM/FTM
TRX/TTG/
QC-TCB/QA-TCB/
JHANSI

सं.

CHECKED &
APPROVED

तैयार किया PREPD.
sd *Amelgandi*
N.K.M

जारी किया ISSUED
टीआरई/मानक TRE/STD.

दिनांक
Date
10.08.12



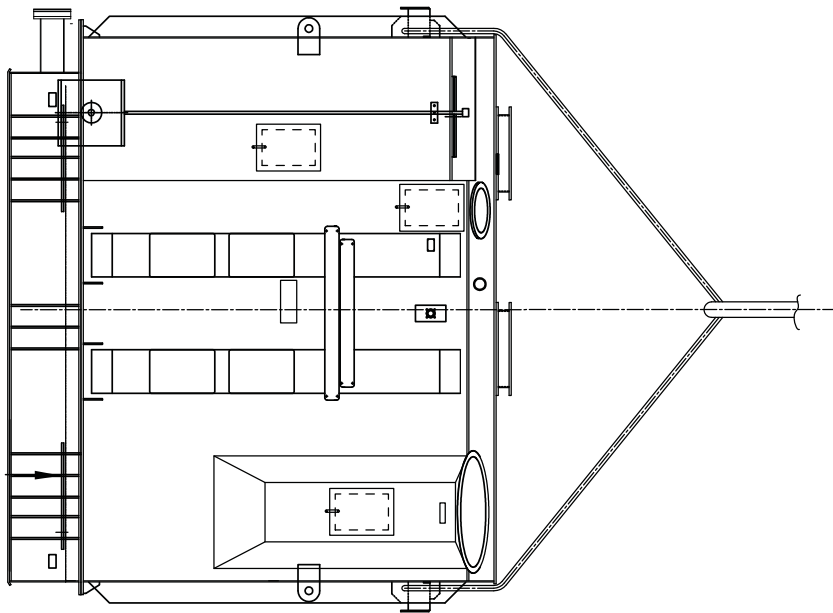
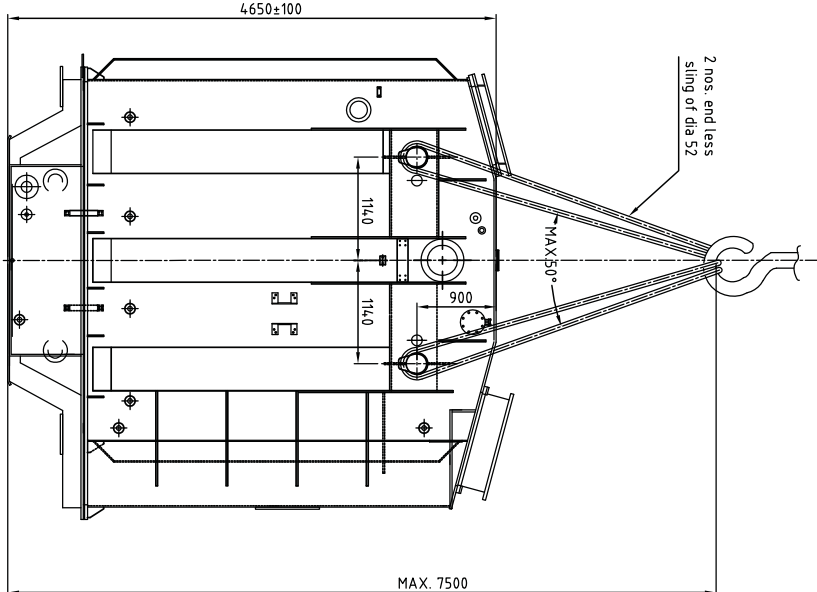
MIN. AIR CLEARANCES (IN MM)	
H.V. - EARTH	3500
NEUTRAL - EARTH	320
LV-EARTH	230

FOR REFERENCE ONLY

NO. OF TRANSFORMERS
PROJECT
LOA NO.
TYPE OF PRODUCT
NAME OF CUSTOMER
403

[illegible]

NAME	SIGN	DATE
DRN		
CHD		
APPD		
DRG NO.	3 452 00 00694	REV.
SHEET	04 OF 04	01



NOTE:
ABOVE DIMENSION DOES NOT INCLUDE TRAILER HEIGHT/ROLLER HEIGHT.

REV/	DATE	ALT	REV/	DATE	ALT	BHEL DRG. NO.	NO. OF TRANSFORMERS	PROJECT	LOI NO.	TYPE OF PRODUCT	NAME OF CUSTOMER
001			002			04	1X 800 MW	TSGENCO KOTHAGUDEM STAGE-VII		330 MVA, 27400/5 KV, 1 PH. GENERATOR TRANSFORMER	TSGENCO KOTHAGUDAM

CUSTOMER:

TELANGANA STATE POWER GENERATION CORPORATION LTD

1x800 MW KOTHAGUDAM TPS STAGE-VII UNIT#12, PALONCHA

OWNERS CONSULTANT:

BHARAT HEAVY ELECTRICALS LTD. BHOPAL

KOLKATA MUMBAI CHENNAI NEW DELHI

DEVELOPMENT CONSULTANTS PVT. LTD.

CONSULTING ENGINEERS

W.O.	DATE	REV	DEPT	CODE	WEIGHTING	SCALE	CHK.	DATE	REV.
100	10/03/16	01	TRF	406	---	COMP SCALE: 1:1	DRG. NO.	3 452 00 00984	00

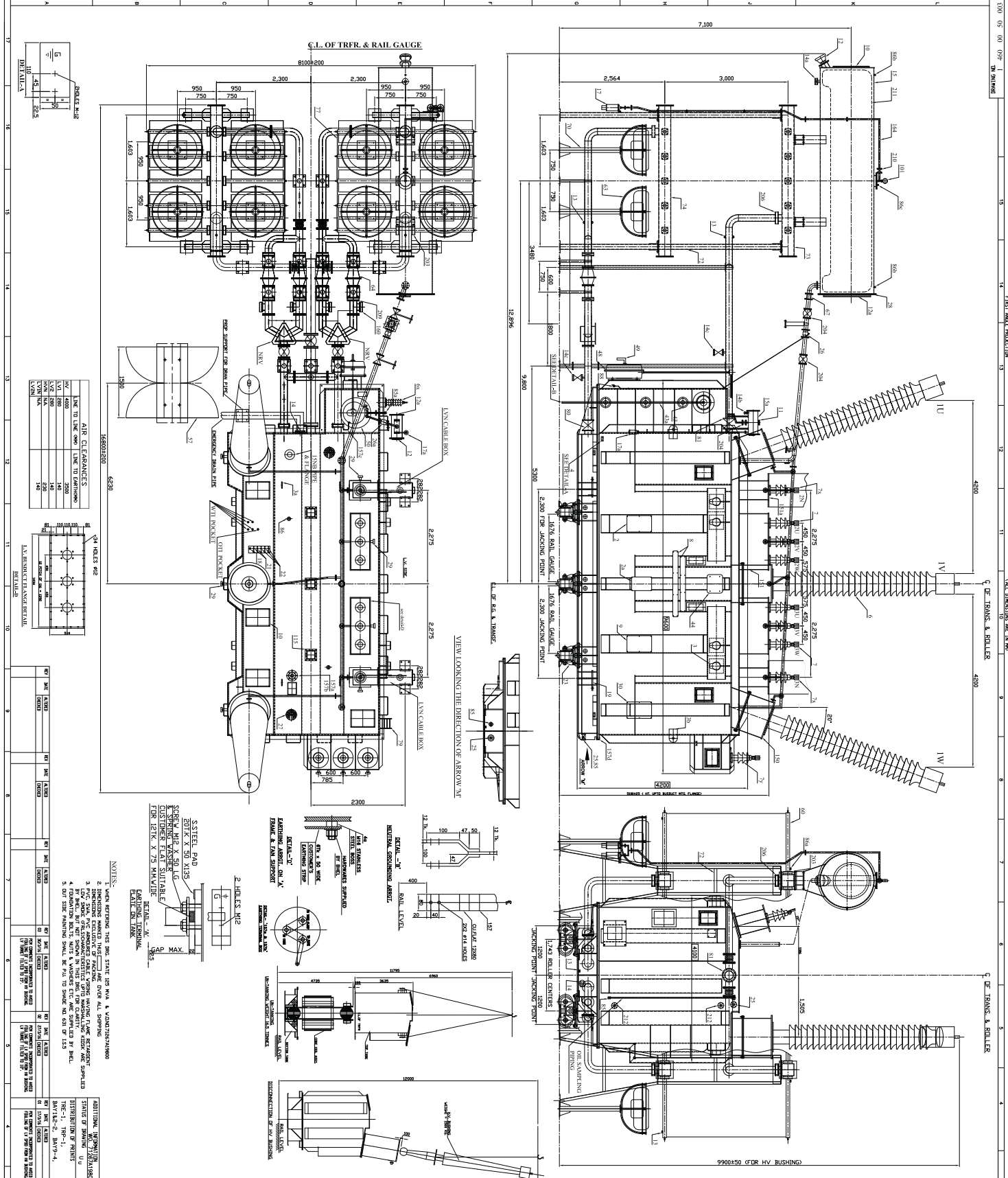


TABLE OF FITTINGS		
ITEM	DESCRIPTION	QTY
1	CHANGED BANGING & TIGHTENING PLATE (CONE) & ENGLISH	200
2	VALVE (SCHEDULE PLATE)	200
3	VALVE (SCHEDULE PLATE)	200
4	VALVE (SCHEDULE PLATE)	200
5	VALVE (SCHEDULE PLATE)	200
6	VALVE (SCHEDULE PLATE)	200
7	VALVE (SCHEDULE PLATE)	200
8	VALVE (SCHEDULE PLATE)	200
9	VALVE (SCHEDULE PLATE)	200
10	VALVE (SCHEDULE PLATE)	200
11	VALVE (SCHEDULE PLATE)	200
12	VALVE (SCHEDULE PLATE)	200
13	VALVE (SCHEDULE PLATE)	200
14	VALVE (SCHEDULE PLATE)	200
15	VALVE (SCHEDULE PLATE)	200
16	VALVE (SCHEDULE PLATE)	200
17	VALVE (SCHEDULE PLATE)	200
18	VALVE (SCHEDULE PLATE)	200
19	VALVE (SCHEDULE PLATE)	200
20	VALVE (SCHEDULE PLATE)	200
21	VALVE (SCHEDULE PLATE)	200
22	VALVE (SCHEDULE PLATE)	200
23	VALVE (SCHEDULE PLATE)	200
24	VALVE (SCHEDULE PLATE)	200
25	VALVE (SCHEDULE PLATE)	200
26	VALVE (SCHEDULE PLATE)	200
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100	VALVE (SCHEDULE PLATE)	200