

**TAMILNADU GENERATION & DISTRIBUTION
CORPORATION LIMITED**

**1 X 800 MW NORTH CHENNAI TPP
STAGE III**

**TECHNICAL SPECIFICATION
FOR
DOUBLE GIRDER EOT CRANE ABOVE 50T UPTO 150T
CAPACITY**

SPECIFICATION NO.: PE-TS-423-501-A101



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**



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SUB-SECTION IA
SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)



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SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

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 design, engineering, material selection, manufacturing and assembly, inspection, testing at manufacturer's works, lubricants & consumables, packing, forwarding and transportation to site, unloading, storage & handling at site, preservation, security / safety at site, erection, commissioning and final load test at site and handing over to BHEL's customer of **One (1) no. 60 T capacity double girder EOT Crane for BC BAY** and necessary accessories including supply of mandatory spares, erection and commissioning spares and maintenance tools and tackles for 1x800 MW NORTH CHENNAI TPP STAGE III.
- 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.
- 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.



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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.

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 One (1) no. 60 T capacity double girder EOT Crane for BC Bay in TG Hall Building 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, pendant and panels etc as per datasheet A.
- f. PVC Cu insulated shrouded bus bar conductor type DSL
- g. Earthing arrangement
- h. Fill of lubricants
- i. Painting of cranes and accessories
- j. Temporary cables 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. Main Isolating switch in enclosure at operating floor for disconnecting supply to DSL while maintaining the crane.
- p. Slings and cradle for load testing on returnable basis

1.1.4 Maintenance Tools and Tackles

As per Annexure III, section-IA of this specification



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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 its 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.

1.2.0 Services to be provided by the bidder

1.2.1. Packing, forwarding and transportation to site, storage and handling at site.

1.2.2. Arranging test load at site

Collecting the test load at site within a radius of 5-6 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.

1.2.3 Erection and Commissioning

1.2.4 Demonstration / Load test

1.2.5 Obtaining clearance and acceptance certificate from the concerned competent

authority after site test. Necessary fees/expenditure as required shall be borne by the supplier.

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1.2.6 Training to customer’s O&M staff

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 MCC to isolating switch

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.

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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.

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. Gears shall be run idle for at least 4 (four) hours. 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
- viii. The test shall be carried out with actual panel, RRC, Master Controller etc.

8.0 Consumables

The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety

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of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.



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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 attached with this 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
 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.'



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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

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(four) hours. Following minimum tests shall be conducted on the crane at the works of the manufacturer:

- 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.



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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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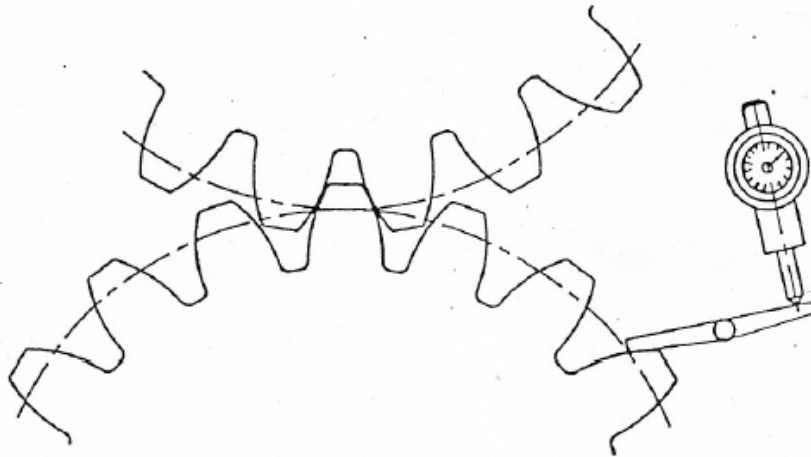


FIG.1 MEASUREMENT OF BACKLASH

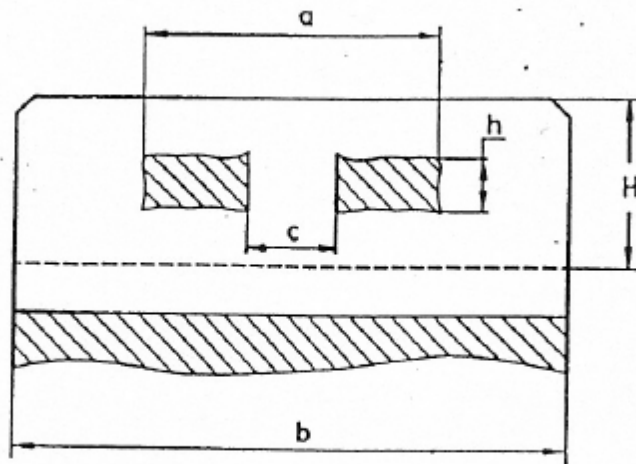


FIG.2 AREA OF CONTACT OF GEAR TEETH



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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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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		
		ABB		
7.	BRAKES	ELECTROMAG		
		SPEED-O- CONTROL		
		BCH		FOR DCEM BRAKES ONLY
		KAKKU		
		PATHE		
8.	CONTACTOR	SIEMENS		
		L&T		
		SCHNEIDER (Earlier TELE MECHANIQUE)		
		BCH		
9.	OVER LOAD RELAYS	SIEMENS		
		L&T		
		ABB		
		SCHNEIDER (Earlier TELE MACHANIQUE)		

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10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
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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			Section IA	Date NOV'16
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		
		DOWELL		
25.	PUSH BUTTONS	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		
		STANDARD		
31.	MCB	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		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		
41.	RAIL	BONGFILIOLI*		
		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

MANDATORY SPARES:

Sl. no	Description Quantity	Quantity
1	SPARES FOR LONG TRAVEL UNIT	
A	SET OF AXLE BEARINGS	1 SET
B	SET OF GEARBOX BEARINGS WITH SLEEVES	1 SET
C	LONG TRAVEL END SHAFT BEARING	1 SET
D	COUPLING	1 SET
E	SEALS FOR TRAVEL GEAR BOX	1 SET
F	LONG TRAVEL BRAKE SHOES	1 SET
G	LONG TRAVEL BRAKE SPRINGS	1 SET
H	LONG TRAVEL BRAKE SHOE LINERS	1 SET
2.	SPARES FOR CROSS TRAVEL UNIT	
A	AXLE BEARINGS	1 SET
B	SET OF GEARBOX BEARINGS WITH SLEEVES	1 SET
C	SET OF SEALS FOR GEARBOX	1 SET
D	CROSS TRAVEL END SHAFT BEARING	1 SET
E	COUPLING	1 SET
F	CROSS TRAVEL BRAKE SHOES	1 SET
G	CROSS TRAVEL BRAKE SPRINGS	1 SET
H	CROSS TRAVEL BRAKE SHOE LINERS	1 SET
3.0	SPARES FOR MAIN HOIST	
A	MAIN HOIST PULLEY BEARINGS	1 SET
B	SET OF BEARINGS FOR ROPE DRUM	1 SET
C	SET OF BEARINGS FOR GEAR BOX	1 SET
D	SET OF SEALS FOR MAIN HOIST	1 SET
E	MAIN HOIST BRAKE SHOES	1 SET
F	MAIN HOIST BRAKE SPRINGS	1 SET
G	MAIN HOIST BRAKE SHOE LINERS	1 SET
H	DISC PAD	1 SET
4.0	SPARES FOR AUXILIARY HOIST	N.A.
A	AUX HOIST PULLEY BEARINGS	
B	SET OF BEARINGS FOR ROPE DRUM	
C	SET OF BEARINGS FOR GEAR BOX	
D	SET OF SEALS FOR AUX HOIST	
E	AUX HOIST BRAKE SHOES	
F	AUX HOIST BRAKE SPRINGS	
G	AUX HOIST BRAKE SHOE LINERS	
H	PAIR OF SLINGS	
I	DISC PAD	
5.0	ELECTRICAL: CONTROL PANELS/MOTORS	
A	POWER CONTACTOR OF EACH RATING	2 NOS
B	OVER LOAD RELAYS OF EACH RATING	2 NOS



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C	MCCB/MPCB OF EACH RATING	2 NOS
D	PUSH BUTTON OF EACH TYPE	2 NOS
E	SPARES FOR VVVF DRIVE OF EACH RATING	AS REQUIRED
F	SET OF BEARINGS FOR MAIN HOIST MOTOR	1 SET
G	SET OF BEARINGS FOR AUX HOIST MOTOR	N.A.
H	SET OF BEARINGS FOR CROSS TRAVEL MOTOR	1 SET
I	SET OF BEARINGS FOR LONG TRAVEL MOTOR	1 SET

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.
2. 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.



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ANNEXURE III - TOOLS & TACKLES

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

Note: - One 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

1. Painting specification for steel structures:-

Surface preparation: De greasing and Mechanical cleaning with wire brush or blasting according to SIS 055900, Grade 2 ½ .

Primer : Zinc Silicate of approved brand. - 2 coat, DFT 60 µm per coat.

Intermediate : MIO Epoxy paint- 2 coat, DFT 90 µm per coat

Finish Coat : Polyurethane coating- 1 coats, DFT 30 µm per coat.

Total DFT : 330µ

2. Painting specification for Indoor components such as motors, electrical parts etc:-

Surface preparation: blasting according to SIS 055900, Grade 2 ½ . Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Primer : Zinc phosphate epoxy - 2 coat, Total DFT 75 µm.

Finish Coat : Chlorinated rubber paint- 2 coats, Minimum DFT 30-40 µm per coat.

Total DFT : 135 – 155 µm

3. Color Shade:

SL. No	Item Description	Color Shade	Remarks
1	Crane Structure	Golden Yellow shade 356 as per IS-5	Colour band- Black
2	Trolley and hook	Crimson shade 540 as per IS-5	
3	Motors	Light Gray shade 631 as per IS-5	
4	Control Panels	Light Gray (Powder coated) 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-V0-423-501-A103	Data sheet of motors For DOUBLE GIRDER EOT CRANE	I	6
2	PE-V0-423-501-A104	Mechanism Sizing Calculation For DOUBLE GIRDER EOT CRAN	A	3
3	PE-V0-423-501-A105	General arrangement with CT DSL details For DOUBLE GIRDER EOT CRANE	A	3
4	PE-V0-423-501-A106	Crab sub assembly for DG EOT crane with CT wheel assembly DOUBLE GIRDER EOT CRANE	I	4
5	PE-V0-423-501-A108	General arrangement for PVC shrouded DSL for DOUBLE GIRDER EOT CRANE	I	3
6	PE-V0-423-501-A109	Main hook block assembly with details of hook, nut and check plate DOUBLE GIRDER EOT CRANE	I	4
7	PE-V0-423-501-A110	Long travel Machinery Assembly for DG EOT crane with LT wheel assembly For DOUBLE GIRDER EOT CRANE	I	4
8	PE-V0-423-501-A112	Structural calculations For DOUBLE GIRDER EOT CRANE	A	4
9	PE-V0-423-501-A114	O & M Manual For DOUBLE GIRDER EOT CRANE	I	10
10	PE-V0-423-501-A115	Detailed BOM/BOQ For DOUBLE GIRDER EOT CRANE	I	8
11	PE-V0-423-501-A116	Electrical equipment layout in cabin For DOUBLE GIRDER EOT CRANE (If applicable)	I	6
12	PE-V0-423-501-A117	Schematic circuit diagram of a) Protective panel, Main and lighting circuit & BOM b) Main hoist panel & BOM c) Cross Traverse & BOM d) Long Traverse & BOM ; Including earthing diagram DOUBLE GIRDER EOT CRANE	A	5
13	PE-V0-423-501-A118	"General Arrangement of a) Protective panel b) Main hoist panel c) Cross Travel panel d) Long Travel panel e) Pendent f) Remote Radio Control For DOUBLE GIRDER EOT CRANE "	I	5



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14	PE-V0-423-501-A119	Cable Sizing and cable schedule for DOUBLE GIRDER EOT CRANE	A	6
15	PE-V0-423-501-A120	Crane Operational write up For DOUBLE GIRDER EOT CRANE	I	5
16	PE-V0-423-501-A123	Mandatory spare parts list for DOUBLE GIRDER EOT CRANE	A	8
17	PE-V0-423-501-A125	Erection procedure For DOUBLE GIRDER EOT CRANE	I	8
18	PE-V0-423-501-A127	Data sheet of DG EOT Crane with painting details For DOUBLE GIRDER EOT CRANE	A	3
19	PE-V0-423-501-A130	Electrical load for DG EOT Crane	I	8
20	PE-V0-423-501-A132	Gantry Rail installation for For DOUBLE GIRDER EOT CRANE	I	3
21	PE-V0-423-501-A145	Type test certificate (for motors) For DOUBLE GIRDER EOT CRANE , if applicable	A	8
22	PE-V0-423-501-A150	Crane lubrication drawing For DOUBLE GIRDER EOT CRANE	I	6
23	PE-V0-423-501-A151	Manufacturing Quality Plan with sub vendor list For DG Cranes	A	3
LEGENDS				
A= Approval category				
I= Information category				

Notes:

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.:-
 - a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - b) 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.
 - c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

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d) 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 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, 3 etc. 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.			

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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 1X800 MW NORTH CHENNAI TPP STAGE III DOUBLE GIRDER EOT CRANES ABOVE 50T UPTO 150 T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-423-501-A101	
		REV 00	
		Section IA	Date NOV'16

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.

	TITLE 1X800 MW NORTH CHENNAI TPP STAGE III DOUBLE GIRDER EOT CRANES ABOVE 50T UPTO 150 T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-423-501-A101	
		REV 00	
		Section IA	Date NOV'16

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.



TITLE
1X800 MW NORTH CHENNAI TPP STAGE III
DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-423-501-A101

REV 00

Section IA Date NOV'16

SECTION – IA
STANDARD QUALITY PLAN

		MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN				PROJECT:	1 X 800 MW NORTH CHENNAI III				
								PACKAGE	DOUBLE GIRDER CRANES				
				ITEM:		QP NO : PE-V0-423-501-A101		CONTRACT NO :					
						REV : 0		CONTRACTOR :					
						DATE :		VENDOR' S QAP No :					
SL.	COMPONENTS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY			REMARKS	
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M	C	N		
1	4	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
		U.T of plates.		Ultrasonic	100%	ASTM A435	ASTM A435	T.C. / I.R.	✓	P	V	V	U.T. ON ABOVE 25MM THICK PLATE
b	weld setup	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 qulification, 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/ reviewd 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:	1 X 800 MW NORTH CHENNAI III				
								PACKAGE	DOUBLE GIRDER CRANES				
								CONTRACT NO :					
								CONTRACTOR :					
								DATE :	VENDOR' S QAP No :				
SL.	COMPONENTS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY				REMARKS
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M	C	N		
1	4	3	4	5	6	7	8	9	D*	**	10		11
			Critical	DPT	100%	ASME Sec-V	ASME Sec-VIII, Div-I, Appen - 8	DP Report	√	P	W	V	DP test of fillet weld for rope drum to be conducted. After final machining random witness by BHEL
d	fillet welds	Size and surface defects	Major	Visual	100%	Manufacturing drawing	Manufacturing drawing	Vender inspection Report	√	P	V	V	
		NDT	Major	DPT	10% RANDOM	ASME Sec-V	ASME Sec-VIII, Div-I, Appen - 8	Vender inspection Report	√	P	W	V	
e	final insection of fabricated components listed in Sr.1 above	Dimensions for Girder, end carriage rope drum etc. Camber, Verticality, bend etc	Major	Dimensional Measurement	100%	Vendor Mfg. Drg.	Vendor Mfg. Drg.	vendor inspection report	√	P	V	V	
f	Heat treatment of rope drum	Stress relieving	Major	Review of SR chart	100%	Approved drawing/relevant standard	Approved drawing/relevant standard	SR Chart	√	P	V	V	If fabricated from M.S Plate
3	Gear box casing												
a	Material	Surface condition	Major	Visual	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	√	P	V	V	Refer note 1
		Chemical & mech	Major	Measurement Correlation with T.C. Check test in absesnce of T.C. Correlation	100%	Manufacturing drawing/ IS: 2062	Manufacturing drawing/ IS: 2062	T.C. & I.R.	√	P	V	V	

		MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN				PROJECT:	1 X 800 MW NORTH CHENNAI III				
								PACKAGE	DOUBLE GIRDER CRANES				
								CONTRACT NO :					
								CONTRACTOR :					
								DATE :	VENDOR' S QAP No :				
SL.	COMPONENTS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY			REMARKS	
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M	C	N		
1	4	3	4	5	6	7	8	9	D*	**	10	11	
b	Dimension	Dimensional conformity	Major	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report		P			
c	Heat treatment	stress relieving	Major	Review of SR chart	100%	Approved drawing/relevant standard	Approved drawing/relevant standard	SR Chart	√	P	V	V	
4	PLATFORMS	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	√	P	V	V	Refer note: 1
5	L.T.FRAMES	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	√	P	V	V	
6	HAND RAILINGS	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	√	P	V	V	
7	CABIN	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	√	P	V	V	
8	Current collector arms	Dimensional conformity	Minor	Measurement	100%	Mfr. Catalog	Mfr. Catalog	Vendor inspection Report	√	P	V	V	
9	DSL Guard	Dimensional conformity	Minor	Measurement	100%	Manufacturing drawing	Manufacturing drawing	Vendor inspection Report	√	P	V	V	
10	Rails	Dimensional conformity	Minor	Measurement	100%	G.A.drg./IS : 3443 Vendor T.C./Appd.Data Sheet	G.A.drg./IS : 3443 Vendor T.C./Appd.Data Sheet	Vendor inspection Report	√	P	V	V	
		Chemical , tensile & hardness	Major	Chemical & hardness	100%	IS-3443	IS:3443	Manufacturer TC	√	P	V	V	
11	MECHANICAL COMPONENTS												
A	a) wheels												

		MANUFACTURER'S NAME & ADDRESS		STANDARDARD MANUFACTURING QUALITY PLAN				PROJECT:	1 X 800 MW NORTH CHENNAI III					
								PACKAGE : DOUBLE GIRDER CRANES						
				ITEM:		QP NO : PE-V0-423-501-A101		CONTRACT NO :						
						REV : 0		CONTRACTOR :						
						DATE :		VENDOR' S QAP No :						
SL.	COMPONENTS &		CHARACTERISTCS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF		AGENCY			REMARKS
NO.	OPERATION				CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS		M	C	N	
1	4		3	4	5	6	7	8	9	D*	**		10	11
	i) raw material	Chemicals composition and Mechanical Proporties.	Major	Corelation with Mfr's TC	100%	Mfg.drg./IS:1570 / BS - 970	Mfg.drg./IS:1570 / BS - 970	Test Certificate	√	P	V	V	Refer Note:1	
	ii) Machined	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	√	P	V	V		
		c) UT		NDT	100%	ASTM A 388	ASTM A 388	Vendor inspection Report	√	P	V	V	Refer UT procedure	
		d) DPT		NDT	100%	ASME Sec-VIII-App-8	ASME Sec-VIII-App-8	Vendor inspection Report	√	P	W	V		
	b) Raw material for Gears , Pinions, Shafts,Axles 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	√	P	V	V		
		ii) UT (after machining)	Major	check for UT (abov	100%	ASME Sec-V	Refer UT procedure	Vendor inspection Report	√	P	V	V		
		iii) Hardness	Major	check for Hardness	100%	drg. & Approved Data Sheet	Mfg. drg. & Approved Data Sheet	Vendor inspection Report	√	P	W	V	Hardness witnessing by BHEL before teeth cutting.	
		iv) Dimensions	Major	Measurement	100%	Mfg. Drawing	Mfg. Drawing	Vendor inspection Report	√	P	V	V		
		V) D.P.Test on teeth	Major	NDT	100%	ASTME-165	No linear indication	Vendor inspection Report	√	P	V	V		
	c) Casting for Gears and pinions, if applicable	Chemical and Physical	Major	Chemical and Physical	100%	Approved drg/ data sheet	Approved drg/ data sheet	Mfr's T.C	√	P	V	V		
		NDT	Major	U.T.	100%	ASTM A 388	ASTM A 388	Vendor inspection	√	P	V	V	Refer UT procedure	
B	Pulleys, Brake drums, coupling & other major steel castings & forging													
	i) Materials	Physical/Chemical/Hardness	Major	Corelation with mfr's TC	100%	Mfg. Drawing	Mfg. Drawing	Mfr's T.C.	√	P	V	V		

		MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN				PROJECT:		1 X 800 MW NORTH CHENNAI III			
									PACKAGE		: DOUBLE GIRDER CRANES			
					ITEM:		QP NO : PE-V0-423-501-A101		CONTRACT NO :					
							REV : 0		CONTRACTOR :					
							DATE :		VENDOR' S QAP No :					
SL.	COMPONENTS &		CHARACTERISTCS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF		AGENCY			REMARKS
NO.	OPERATION				CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS		M	C	N	
1	4		3	4	5	6	7	8	9	D*	**	10		11
	ii) Machined		a) Dimensions	Major	Measurement	100%	Components Drawing	Components Drawing	Vendor inspection Report		P	V	V	
b) DPT after machining.			Major	NDT	100%	ASTM E-165	No linear indication	Vendor inspection Report	✓	P	V	V		
C	Gear box assy & idle running		Check for oil leakage,Noise level,vibration backlash, rise in temp. after 2 Hrs. of running, reduction ratio, backlash and contact pattern	Major	Visual & Measurement	100%	Vendor standard	Smooth running no oil leakage, Noise 85 db at 1 Mtr. Max. Temp. rise 30°C above amb temp.	Vendor inspection Report	✓	P	V	V	
D	a) Top block, bottom block		dimensional conformity	Major	Masurement	100%	Assembly drawing	Assembly drawing	Vendor inspection Report		P	V	V	
	b) Hook		i) Chemical composition, Heat treatment, Mechanical properties on integral test bar	Major	Chemical, heat treatment & Tensile , % elongation	100%	IS:1875		Test Certificate , HT chart & Insp. Report	✓	P	V	V	
ii) UT on raw material of hook			Major	UT	100%	ASME sec--v	Annex-1 (Attached)	✓		P	V	V		
iii) Forging operation of hook			Major	Visual	100%	IS:5749 /IS:15560	IS:5749 /IS:15560	✓		P	V	V		
iv) Proof load test			Major	Mechanical	100%	IS:5749 /IS:15560	IS:5749 /IS:15560	✓		P	W	V		
v) UT & MPI after proof load test			Major	UT & MPI	100%	ASME sec - v & ASTM E709-2007	Annex-1 for UT & No crack & linear indication (For MPI as per ASME Sec VIII Appen 6)	✓		P	W	V		
			Identification Punch (By BHEL &/or customer, after proof load & NDT witness)	Major	Visual	100%	-----	-----	-----	-	P			CHP - Customer Hold Point
E	Rope drum assembly		Diemnsion	Major	Measurement	100%	Mfg. Drawing	Tolerance as per drg	Vendor insp Report		P	V	V	
12	Electrical components													

	MANUFACTURER'S NAME & ADDRESS			STANDARD MANUFACTURING QUALITY PLAN				PROJECT:		1 X 800 MW NORTH CHENNAI III			
								ITEM:		QP NO : PE-V0-423-501-A101		PACKAGE : DOUBLE GIRDER CRANES	
						REV : 0		CONTRACT NO :					
						DATE :		CONTRACTOR :					
								VENDOR' S QAP No :					
SL.	COMPONENTS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF					
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS		M	C	N	
1	4	3	4	5	6	7	8	9	D*	**	10	11	
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.	√	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.	√	P	V	V	

		MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN				PROJECT:	1 X 800 MW NORTH CHENNAI III				
								PACKAGE	DOUBLE GIRDER CRANES				
								CONTRACT NO :					
								REV : 0	CONTRACTOR :				
								DATE :	VENDOR' S QAP No :				
SL.	COMPONENTS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY			REMARKS	
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M	C	N		
1	4	3	4	5	6	7	8	9	D*	**	10	11	
c)	Control panel	Interlocking functional, IR, HV, Sheet thickness, cable laying, dressing , ferulling Overall diemsnions , painting shade, Panel surface finish, Paint Thickness, adhesive test, Component fixing, Degree of protection by paper inserting method.	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	√	P	W	V	Refer Note No. 4 VVFD Test Certificate to be submitted from app. Vendor for verification.
d)	Radio remote, Master controller	HV, IR,Functional	Major	Verification	100%	BOM/ Mfr. Catalogue	BOM/ Mfr. Catalogue	Mfr's T.C.	√	P	V	V	Refer Note No. 4
e)	Limit switches	Functional	Major	Verification	100%	Approved drawings	Approved drawings	Mfr's T.C.	√	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.	√	P	V	V	
g)	Transformer	make rating , routine test	Major	visual	100%	Appd drg	Appd drg	Mfr's T.C.	√	P	V	V	
h)	SFU, MCCB,MCB, Contactors, DSL, relays, fuses, resitance bank	make, t ype , 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.	√	P	V	V	
b)	Bearing	Type & Size	Major	Verification	100%	Appd drg/Mfr's catalogue	Appd drg/Mfr's catalogue	Mfr's T.C.	√	P	V	V	
14	Assembly of cranes												
a)	Bridge with LT	Dimesions, wheel level alignment	Major	Measurement	100%	GA drg/IS:3177	GA drg/IS:3177	Insp. Report	√	P	W	V	
b)	Crab assembly	Dimesions, wheel level alignment	Major	Measurement/ Vis	100%	GA drg/IS:3177	GA drg/IS:3177	Insp. Report	√	P	W	V	

		MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN				PROJECT:	1 X 800 MW NORTH CHENNAI III			
				ITEM:				PACKAGE	DOUBLE GIRDER CRANES			
								CONTRACT NO :				
								REV :	0			
								DATE :				
								VENDOR' S QAP No :				
SL.	COMPONENTS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY			REMARKS
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M	C	N	
1	4	3	4	5	6	7	8	9	D*	**	10	11
c)	Final Inspection (at works) with actual panel and pendent	Overall dimension: Span, Diagonal dimension check, Wheel base & gauge, overhang, LT Stopper, headroom, lift , Eqp. Layout on bridge platform, , elevations /levels etc	Major	Measurement	100%	Approved drgs./IS :3177	Approved drgs./IS: 3177	Insp. Report	√	P	W	W
		No Load & Load Tests										
		a) No load: Hoists,CT & current measurement, No Load running of LT machinery for direction and speed with VVFD	Major	Measurement	100%	Approved drgs	Approved drgs	Insp. Report	√	P	W	W
		b) SWL: Hoists, CT speed, current & Deflection measurement	Major	Operational Check & Measurement	100%	GA drg/ IS:3177/ Approved Drawing	GA drg/ IS:3177/ Approved Drawing	Insp. Report	√	P	W	W
		c) Overload: Hoisting, CT movement & current measurment (at 125% SWL)	Major	Operational Check & Measurement	100%	GA drg/ IS:3177/ Approved Drawing	GA drg/ IS:3177/ Approved Drawing	Insp. Report	√	P	W	W
		d) Operation check of brakes and limit switches .	Major	Operational Check	100%	GA drg/ IS:3177/ Approved Drawing	GA drg/ IS:3177/ Approved Drawing	Insp. Report	√	P	W	W
15	Painting	Surface preparation & Painting. DFT	Major	Visual	100%	Approved drgs/doc	Approved drgs/doc	Vendor's Report		P	V	
Note 1 : Original TCs / Photocopies certified in original by mill shall be furnished for review. Test In absence of correlated TCs Check test shall be carried out from each plate/ bar for above 10 mm thk., certificates shall be offered for review at the time of stage inspection of components / assembly. Supplier shall ensure that pitted material is not used.												
Note 2 : X-Ray to be taken for thickness upto 19 mm and Gamma Ray for thickness above 19 mm. If Gamma Ray is used for lower thickness slow speed film like D2 or equivalent which gives enough readable and interpretable film quality to be used for clarity. All NDT shall be carried out by Qualified Level II personnel.												

		MANUFACTURER'S NAME & ADDRESS		STANDARD MANUFACTURING QUALITY PLAN				PROJECT: 1 X 800 MW NORTH CHENNAI III	
				ITEM:				PACKAGE : DOUBLE GIRDER CRANES	
				QP NO : PE-V0-423-501-A101				CONTRACT NO :	
				REV : 0				CONTRACTOR :	
				DATE :				VENDOR' S QAP No :	
SL.	COMPONENTS &	CHARACTERISTICS	CLASS	TYPE PF	QUANTUM	REFERENCE	ACCEPTANCE	FORMAT OF	AGENCY
NO.	OPERATION			CHECK	OF CHECK	DOCUMENT	NORMS	RECORDS	M C N
1	4	3	4	5	6	7	8	9	D* ** 10
Note 3 : LT motors shall be of type tested quality. For each type & rating of LT motors rated above 50 KW, the bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the Bidder is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval. LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip . 5. Temperature rise test . 6. Momentary excess torque test. 7. High voltage test . 8. Test for vibration severity of motor. 9. Test for noise levels of motor 10. Test for degree of protection and									
Note 4 : Performance of electrical & control devices along with the interlocks, protection & sequence to be checked during crane assembly and parked at works.									
Note 5 : All material of construction shall be as per approved drg. / data sheet / specifications									
LEGEND :									
D: RECORDS IDENTIFIED WITH 'TICK'(✓) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION									
M : MANUFACTURER/SUBCONTRACTOR									
C: BHEL-CQS/THIRD PARTY									
N : CUSTOMER									
INDICATE "P" PERFORM "W" WITNESS AND "V" DOCUMENT REVIEW									
MANUFACTURER/ CONTRACTOR									
SUBCONTRACTOR									
SIGNATURE									
							REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL	



1X800 MW NORTH CHENNAI TPP STAGE III
DOUBLE GIRDER EOT CRANES 50T TO 150T
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-423-501-A101

VOLUME II - B

SECTION -IA

REV 00

DATE NOV 2016

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 lumpsum 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 One (1) no. of 60T CAPACITY, 25 M LIFT, 9.1 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-423-501-A101	1 set.	86 %
2.	Total lumpsum 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 MS angle type runaway conductor / PVC shrouded bus bar type DSL for 64.0 M bay length complete with all accessories for the total scope defined as per technical specification PE-TS-423-501-A101.	1 set	3.75%
3.	Total lumpsum 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 64.0 M bay length Gantry rail complete with all accessories for the total scope defined as per technical specification PE-TS-423-501-A101.	1 set	8%
4.	Lump sum price of temporary cable of 70 m length for operation of crane during erection stage of the plant for the total scope defined as per technical specification PE-TS-423-501-A101.	1 set	2%
5.	Total lumpsum 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 Maintenance tools and Tackles as per technical specification no. PE-TS-423-501-A101.	1 lot	0.25%

NOTE: -These prices shall be used for billing purpose during contract stage.

	TITLE 1X800 MW NORTH CHENNAI TPP STAGE III DOUBLE GIRDER EOT CRANES ABOVE 50T UPTO 150 T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-423-501-A101	
		REV 00	
		Section IA	Date NOV'16
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.			



TITLE
1X800 MW NORTH CHENNAI TPP STAGE III
DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-423-501-A101

REV 00

Section IA Date NOV'16

SECTION – IA
STANDARD QUALITY PLAN



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III



EPC TENDER SPECIFICATION FOR BTG PACKAGE

CRANES AND HOIST



2.1.8 CRANES AND HOIST

2.1.8.1 Scope

Cranes and hoists shall be provided to facilitate the lifting and transporting of various equipment during construction, maintenance or replacement of the plant component. Each crane or hoist shall be complete with its accessories, supporting structure, power supply, safety devices and controls and shall conform to local statutory rules and regulation.

2.1.8.2 Equipment to be supplied:

- f. All drive motors and driving gears.
- g. Runway rails for bridge and trolley including all clamps, anchors, bolts, nuts, shims, inserts, end stops and other fixtures.
- h. Operator's cabin
- i. Portable carbon dioxide fire extinguishers are to be provided in the operator's cabin.
- j. Runway conductors (D.S.L.) and power collectors complete with all supports, insulators, brackets, fixtures etc.
- k. Complete Electrical works including main disconnect switch, all controls and interlocks including all supplies with necessary wiring, grounding, protective panels etc.
- l. Limit switches for crane
- m. Illumination as specified.
- n. Suitable air conditioner Unit as well as Fan in operator's cabin
- o. Spring / rubber buffers for end trucks.
- p. Lifting lug, eye bolts etc. for handling the crane parts.
- q. Protection guard as specified
- r. Foot operated siren
- s. Repair cage as specified
- t. All platforms, handrails and ladders as specified and as required.
- u. Lifting hook block assembly.
- v. Cranes electrical grounding system
- w. All equipment, accessories & consumables required for erection, testing and commissioning.
- x. First charge of oil, lubricants and grease etc.
- y. Complete Mandatory spares as listed
- z. Set of special tools and tackles



2.1.8.3 SCOPE OF SERVICES

- a) Shop tests as specified
- b) Site tests as specified
- c) Complete erection & commissioning services
- d) erection and commissioning
- e) Final painting

Any certification / license from statutory authority required for installation & putting the crane into service.

2.1.8.4 CODES AND STANDARDS:

The design, manufacture and testing of the crane shall conform to the latest editions of the relevant Indian Standards but not limited to;

- a) IS: 807 - Code of Practices for Design, Manufacture, and Erection and Testing (Structural Portion) of Cranes and Hoists.
- b) IS: 3177 - Code of Practices for Design of Overhead Traveling Cranes and Gantry Cranes other than Steel works Cranes.
- c) All electrical installation work shall comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended upto date.
- d) ANSI-B30.2.0 - Safety codes for overhead and Gantry Cranes.

In case of any contradiction between the above mentioned codes and standards and this technical specification, the latter will prevail. However, nothing in this specification shall be construed to relieve the Bidder from his responsibility to comply with what is mentioned against relevant IS codes.

2.1.8.5 Equipment Sizing and Design Criteria

a. EOT Cranes

The turbine building EOT crane is required to handle the heaviest component other than the generator stator with the auxiliary hoist rated for 20% of main hook capacity. The main crane is used for maintenance of main steam turbine and electric generators, generator coolers, condensate pumps, lube oil units and other equipment located in turbine bay. The auxiliary hoist is used to handle smaller components more rapidly.

The EOT cranes shall of the double girder plate box type construction.

The EOT cranes shall be designed as per Class M5 for mechanical and structural components and Class M5 for all electrical components IS: 807, IS 3177.

The turbine building EOT crane shall be able to be operated both from cabin located on the crane and pendant push button station hanging from the crane. The cabin shall be air conditioned.



All cranes of capacity above 7.5 T shall be overhead EOT cranes. Cranes of capacity 7.5 T & below shall be underslung type.

Creep Speed for EOT Cranes: 10% of main speed shall be creep and shall be provided for all motions of the turbine building EOT crane viz. long travel, cross travel, auxiliary hoist and main hoist.

Layout Considerations: The span of EOT cranes shall be derived based on the building layout with considerations to clearances and hook approach.

Access walkway of minimum 500 mm width with safety handrails shall be provided along the full span length of the crane.

Other Features

The hook for hoists shall be plain shank type swiveling hook with locking device.

The EOT cranes shall be designed to operate with 125% of rated load without any permanent deformation.

The EOT cranes are designed with a maximum deflection of $1/600$ of crane span at rated load.

The cabin for operator in the turbine hall EOT cranes shall be air conditioned and window A/C shall be provided for the same.

2.1.8.6 Capacity of Cranes & Hoists

Capacity of cranes & hoists shall be selected considering a minimum margin of 25% over the maximum weight of the heaviest equipment / component to be handled by the Crane/Hoist

2.1.8.7 DESIGN REQUIREMENTS AND CONSTRUCTIONS FEATURES

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

- d. Castings and forgings shall be of tested quality and shall conform to their respective material specification and shall be free from flaws and objectionable imperfections, machined true and in a workmanlike manner.
- e. No wood or other combustible material shall be used unless specifically approved by the Engineer.
- f. Proposals for repairs or any similar operations involving plugging, welding, boring or addition of metal to the original castings or forgings shall be submitted to the owner and his approval must be obtained before any such work is carried out. Drawing showing details and location of such defects shall be submitted to the owner.
- g. All fabrication by welding shall be carried out by qualified and certified welders as per IS: 1181.
- h. Design shall provide for easy maintenance of all parts, particularly the wheel bearings on end-trucks.

2.1.8.8 STRUCTURAL DESIGN CONSIDERATION

a. Minimum thickness of metal

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

For unsealed tubes the minimum thickness shall be 8 mm. The chequered plates for platforms shall be minimum 6 mm thick over plain.

b. 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.

c. Ruling dimensions and ratio

- i. 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.

- ii. For girders, the following values of maximum span to depth ratio shall be governing:

Plate girders	:	Span / depth	=	18
Lattice girders	:	Span / depth	=	12

d. Deflections and Camber

- i. The total maximum vertical deflection of the girders for the live plus trolley and not including impact or dead load of the girder shall not exceed limit of span / 750
- ii. The girders shall be cambered by a amount equal to the maximum deflection due to dead load plus one half the live load and trolley.



e. BRIDGE GIRDER AND END CARRIAGE

- i. The crane shall have double girder as specified in the data specification sheet.
- ii. The bridge girder shall be box section type. The exterior surface shall be smooth and as free from projections etc. As possible to minimise dust collection on it.
- iii. 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 hamper. 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 bearings.
- iv. 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.
- v. 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 jointing device that will ensure uniform wheel loading. Steel pads shall be welded on the tops of end trucks where the girder rests and shall be machined to receive the girder ends.
- vi. 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.
- vii. 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.
- viii. In bridge girder strength calculations, the trolley – rails and checkered plates shall not be considered as load carrying members.

f. TROLLEY FRAME

- i. 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 steps at each end of the bridge.
- ii. 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



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

g. PLATFORM AND LADDERS

- i. Safe means of access shall be provided to the operator's cab and to every place where any person engaged in the examination of maintenance of the crane has to work adequate. Handholds and footholds shall be provided as necessary.
- ii. One-meter high double tier handrail and suitable toe-guards shall be provided along the entire length of platform (on the bridge) that shall not be less than 750 mm wide. One platform for full span length on each side of the crane girder.
- iii. Every platform shall be provided with steel chequered plate top and be securely fenced with one-meter high double tier handrails and toe guards. Platforms shall be of sufficient width to enable normal maintenance work to be under taken safely.
- iv. In case lattice riveted construction is offered for the bridge girder, full length checkered plate platform with adequate headroom shall also be provided at bottom chord level for periodic checking of all rivets/bolts and other items.
- v. Access to operators cabin from bridge girder platform shall be by staircase having adequate width and proper slopping.

2.1.8.10 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 tones and shall be of steel construction. Each hook shall be supported on ball on roller thrust bearing and shall rotate freely on its bearings. Suitable locking device shall be provided to prevent hook rotation.

The sheaves of the hook block shall encased in an oil tight casing permitting generally lubrication of wire ropes and sheaves and also preventing accidental trapping 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

2.1.8.11 GEARING

- a. 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 be operative in oil bath. The oil shall have additives of approved quality and shall be approved viscosity at standard temperature (say 60 Deg. C). The housing shall be of sufficient design not to permit a temperature in excess of 90 Deg. C for the oil bath and shall be adequately supported and readily removable without disturbing the gear assembly.
- b. Gears shall be of cast or forged steel and pinions shall be of forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.
- c. Gears shall have tooth form and modules as recommended in IS: 3961 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.

2.1.8.12 BEARINGS

- a. The type of bearings for various parts shall be as per IS: 3177 and standard of manufacturer.
- b. Provision shall be made for service lubrication of all bearings. Bearings enclosure shall be designed as far as practicable to exclude dirt and prevent leakage of oil or grease. Arrangement for centralized lubrication of bearings shall be tried to the maximum extent possible and a detailed scheme for the same shall be furnished along with the tender.

2.1.8.13 GUARDING

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

2.1.8.14 RUNWAY RAILS

- a. Crane runway rails with bolts and nuts and complete with shims, anchor bolts, inserts and other fixtures shall be provided for fixing the rails of crane girders.
- b. The length of the rails 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.
- c. The rail section shall be as per I.S. 3443 in Standard length of 12 meters.

2.1.8.15 TROLLEY RAIL

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.



2.1.8.16 RAIL JOINTS AND FIXING

The rails shall be butt jointed by either Termite welding or fusion welding process. The Bidder shall get his proposal for edge-preparation of rails, welding procedure and sequence, approved in advance by the owner.

The scheme 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 owner.

2.1.8.17 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.

2.1.8.18 DRIVE MECHANISM

- a. Equal driving effort shall be supplied at each drive wheel of bridge and trolley to prevent one end from travelling faster than the other.
- b. For bridge, the torsional deflection in the cross shaft shall be limited to safe value as per manufacturer's practice.
- c. 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.
- d. Trolley drive shall be achieved by single motor in which the motor shall drive a common output through proper gear box and tractive power shall be transmitted to the geared wheels by means of pinions mounted on both ends of the output shaft.
- e. 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 moment wherever necessary. Wherever components of considerable moment of inertia is directly mounted on the high speed shaft (e.g. Brake drum couplings etc.) They shall be balanced statically to minimize vibration.
- f. Cross and long travel motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement in the duty class specified.
- g. Main Hoist motor, auxiliary hoist motor and creep motors shall be rated considering 25% margin over the maximum power requirement at rated speed. Hoist motor shall be capable to raise 125% of design load at rated speed.
- h. At the drive mechanism adequate nos. of brake shall be provided as detailed in below. Selection and design of brakes shall be complete responsibility of the manufacturer. The breaks shall be accurate rating to step each motion within a very short distance and in a safe and smooth manner.

2.1.8.19 MOTOR DRIVE

- a. Motors shall suit the duty class S4, cyclic duration factor 60% and 300 starts per hour and shall be suitable for VVF operation. Motor pull out torque shall not be less than 2.75 times/ rated torque.



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Motor shall have class F insulation temperature rise limited to class B and enclosures shall conform to the degree of protection IP-55.

b. All motors shall be capable of the following:

- Operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- Withstand 120% of rated speed for two minutes.
- Current shall not exceed 6 times full load current for creep speed motor.
- Withstanding the stresses imposed if started at 110% rated voltage.
- Start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.
- The locked rotor motor withstand time under hot condition at 110% rated voltage shall be more than motor starting time at minimum permissible voltage by at least 3 seconds for motors upto 20 seconds starting time.
- Maximum torque shall not be below 200% of full load torque.

c. Each motor more than 30 KW rating shall be provided with space heater. All electrical equipment accessories and wiring shall have tropical protection.

d. The VVF drive control shall be used for control of each motion. The VVF drive shall be equipped at least with 1024 pulse in card, droop control for synchronization and crane software. The rating of VVF shall be decided considering 250% of full load current of respective drive motor based on in panel rating with deaerated at 50 Deg C ambient temperature.

e. The crane(s) shall be furnished complete with all electrical equipment, accessories, like drive motors with VVF drives, conductors, insulators, protective & operating devices, cables, current collectors, all protective devices, anti-collision limit switches, mechanical overload and protection for electrical faults etc.

2.1.8.20 BRAKES

Quantity, selection and design of the brakes shall be such as to meet the requirement. However, the schedule of brakes shall be as under:

As per DATA Sheet A



		type with motor
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2.1.8.21 RUNWAY CONDUCTOR (SHOP LEADS)

- a. The runway conductors shall be four (4) in number for three phase supply and ground.
- c. Sufficient allowance (minimum 20%) for wear and tear shall be provided over the calculated conductor size.
- d. The runway conductors shall be supported on brackets and insulators from the crane girder with sufficient spacing in between the conductors.
- e. The collector system per conductor shall be top running type having spring loaded cast iron / carbon metallic shoe to maintain adequate contact pressure.

2.1.8.22 CROSS CONDUCTORS ON BRIDGE

- a. Cross conductors on bridge shall be flexible trailing cable system mounted on retracting supports (festoon type).

2.1.8.23 SAFETY INTERLOCK

- a. DISCONNECT SWITCH
 - (i) 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.
 - (ii) Main / safety disconnect switch shall have provision of padlocking in OFF position.
- b. MAIN CONTACTORS
 - (i) 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.
 - (ii) The main contactor shall be also opened by means of emergency push button and hoist limit switches
- c. 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.

2.1.8.24 CRANE CONTROLS

- a) Fully magnetic control shall be provided complete with master controller for each motion, complete with contactors, time lag relays, plugging protections, resistors and other accessories to meet the controller equipment.
- b) The speed torque characteristics curve superimposing the each step-load of each motion of every drives shall be furnished.



2.1.8.25 HOIST MOTION (BOTH MAIN AND AUXILIARY)

- a) Squirrel cage induction motor shall be provided, which shall be controlled by VVVF drive.
- b) Hoist control shall be designed to achieve “creep speed” as specified in both hoisting and lowering directions with loads (no load to full) on hook. Creep speed for main hoist and auxiliary hoist system shall be achieved by provision of independent sq. cage type pony motor and planetary gear box.
- c) Hoist control in ‘tandem operation’ shall be designed to achieve the creep speed as specified.

2.1.8.26 TRAVEL MOTIONS (BOTH BRIDGE AND TROLLEY)

- a) Squirrel cage induction motor shall be provided, which shall be controlled by VVVF drive.
- b) Travel motion control shall be designed to achieve creep speed as specified in both forward and reverse direction of motion.
- c) Travel motion in ‘Tandem’ shall be designed to achieve the rated speed in both forward reverse direction as specified.

2.1.8.27 GENERAL

- a) All controls shall be designed to be fail-safe on loss of power.
- b) Control circuits shall be suitable for 110 V, 1 ph. 50 Hz supply and complete with suitable dry type control transformers one working and one standby with selector switch with isolation facility and primary and secondary fuses. Insulation level of power and control systems shall be maintained at 1.1 KV.
- c) Individual control / resistor panel shall be furnished for each motion for ease of inspection and maintenance.
- d) All switches, power and auxiliary contactors, limit switches and other electrical component shall be strictly suitable for crane duty application.
- e) Trailing cable shall be 1100 V grade, tinned copper, heat resistant, with EPR insulation and as per Class – 5 of IS-8130. Also should have inner PCP sheath and outer CSP sheath with nylon cord reinforcement & heat resistant, oil resistant and flame retardant heavy duty FRLS type.

2.1.8.28 CONTROLLERS

- a) Master controllers for all motions shall be so arranged in the operator’s cabin as to provide maximum convenience and view of the operators.
- b) 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.
- c) Each controllers shall bear suitably engraved inscription of motions controlled in English and of directions of motions by arrows.



2.1.8.30 LIMIT SWITCHES

- a) The limit switches shall be totally enclosed type IP-55 with properly designed actuators and shall be readily accessible for adjustment and repair.
- b) Each hoist shall be furnished with two (2) limit switches.
 - (i) A screw type limit with self resting features which will act in case of over hoisting / over lowering.
 - (ii) A gravity operated hand-reset type limit switch as a back-up protection against over-hoisting.
- c) Track type limit switches shall be provided on the bridge and trolley to prevent over travelling in either directions.

2.1.8.31 PANELS

- a. Protective and control panels shall have IP-54 gasketed enclosure fabricated from CRCA sheet steel, minimum 2 mm thick suitably reinforced to provide structural rigidity.
- b. The panels shall be front connected type with front hinged door for access to wiring and terminals. Engraved name plates shall be furnished for all panels and also for the equipment and device mounted thereon.
- c. All panels shall be factory wired and terminated on suitable terminal blocks (10 mm 2) for external cable connection. All internal wiring shall be identified with numbering ferrules at both ends as per relevant wiring diagram. Terminal blocks shall have 20% spare terminals.
- d. Control wiring shall be carried out with flexible, heat resistant insulated switchboard wires with minimum 2.5 mm² stranded copper conductor.
- e. Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater, suitable for operation on 240 V 1-ph 50 Hz supply. Lamps and heater circuits shall have individual ON-OFF switches.
- f. The painting of the panel shall undergo a process as per procedure stated in CI.9.00.00 or stated elsewhere and two coats of final painting shall be provided and preferably over baked. The colour sheds shall be RAL 7032 Siemens Grey. Sufficient quantity of touch up paint shall be furnished.

2.1.8.32 SWITCH

- a. All switches shall be hand operated, air break, heavy duty, make – quick break type, capable of safety breaking the full load current of connected motor / feeder.
- b. Incoming supply disconnect switch shall be interlocked with panel door so that the same cannot be opened unless the switch is in OFF position. Device to defeat this interlock shall also be included.

2.1.8.33 FUSE

- a. All fuses shall be of HRC cartridge type, mounted on plug in fuse base and provided with visible operation indicator.
- b. All accessible live parts shall be adequately shrouded so as to eliminate the danger of accidental contacts with live parts while changing the fuse.

2.1.8.34 PUSH BUTTON AND LAMP

- a. Push button shall be spring return type, with 2 NO. + 2 NC contacts rated 10 A, 240 V A.C
- b. Indicating lamps shall be LED type (22 mm) and lens cover shall be replaceable from front.



2.1.8.35 ILLUMINATION

- a. Crane lighting and space heating systems shall be designed for 240 V 1 ph 50 Hz supply and receptacle system 24 V 1 ph 50 Hz supply, suitable type transformers shall be furnished for the purpose, complete with isolation facility and primary / secondary fuses.
- b. The lighting distribution board shall be located in the operators cabin. Branch circuits for lighting and receptacles shall be individually protected by MCB
- c. 40 W florescent fixtures shall be used for lighting operator's cabin and bridge platform. Four (4) 250 W high-bay sodium vapour fixtures shall be provided below bridge for illumination of the working zones.
- d. All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
- e. 240 V – 5 A – 3 pin industrial socket outlets with switch shall be provided two (2) in operators cabin and minimum four (4) on the bridge along the walkway.
- f. One (1) portable 40 W handlamp shall be furnished with adequate length of flexible cable for inspection of crane components.
- g. Operators cabin shall be provided with one (1) suitable air conditioning unit.
- h. One (1) heavy duty type industrial siren shall be provided with crane. The crane shall be operated from foot-switch in the operator's cabin.
- i. Conduit wiring system shall be used for lighting circuits.

2.1.8.36 GROUNDING

- a. 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.
- b. Bonding of structures and crane rails shall be provided as required to ensure electrical continuity.
- c. The crane grounding system shall be connected to station ground mat. For this purpose, the owner will provide ground conductor (50 x 6 mm G.S. flat) at two agreed locations at ground level.
- d. The minimum earthing conductor size shall be 8 SWG.

2.1.8.37 ANTICOLLISION DEVICES

An anti-collision device shall be provided to protect any collision between the two cranes. It shall consist of limit switches and a striking arm for each crane. The empty of striking arm shall be decided taking in view the permissible distance between two cranes.

2.1.8.38 INSPECTION & TESTING AT MANUFACTURER'S WORKS

- a. The Bidder shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of the specification and compliance with the requirements of the applicable codes.
- b. The particulars of the prepared tests and the procedure for the test shall be submitted to the owner for approval before conducting the tests.
- c. All materials castings and forging shall be of tested quality.
- d. Crane shall be tested under full load and 25 percent overload on hoisting and cross travel motions. During full load test the speeds for different motions shall be checked. Travelling gear shall also be run light to check shaft and gear alignments. During the overload test, each motion in turn shall be non curved in both directions and the crane shall sustain the load under full control.
- e. Crane shall be subjected to deflection test as per IS:3177.
- f. If the hoisting drum offered is of welded construction, the seams of the same shall be fully radiographed.



- g. As asked for in the Data Specification sheet butt welded on structural members in tension shall be subjected to radiography. The extend of radiography shall be as specified in the Data Specification Sheet.
- h. All electrical equipment and components thereof shall be subject to routine test as per relevant Indian Standard. Type tests shall have to be performed on the equipment to prove the design. Type test certificate on any electrical equipment shall be submitted if desired by the Owner.
- i. Reports of all shop tests shall be submitted to the owner for review.

2.1.8.39 ERECTION AND COMMISSIONING SERVICES

The erection and commissioning services shall include site unloading, transportation and storage, erection, final check-up, testing and commissioning services and final painting of the equipment and accessories supplied under this specification.

2.1.8.40 TESTS AT SITE

- a. After assembly and erection at site, the crane shall be subscribed to commissioning tests as laid down in the Indian Standard IS: 3177 including the full load test as stipulated in clause 2.1.8.38 above. For load test of individual crane, the purchaser shall make available load in the form of thick plate and steel section at project stores. Bidder shall arrange to and fro transportation of the same at test site accordingly as per the instruction of project authority / site Engineer-in-charge. The Bidder shall consider a lead of approximately 5 to 6 kms. for transporting of test loads. The loading and unloading of the test load shall also be arranged by the Bidder. The Bidder shall also stack the test load properly in purchaser's stores as per the instructions of purchaser's project authorities. All slings, shackles and other T&P / material / equipment required for load test of individual cranes shall be arranged by the bidder.

After load test of EOT Cranes bidder should also give the tandem operation test of these EOT Cranes.

Bidder has to provide their services as specified in tender specification while lifting the generator stator by using these two EOT Cranes in tandem & should also carry out the lifting / placement operation of the generator stator satisfactorily.

- b. The reports on the tests shall be submitted to the Owner by the Bidder's authorised representative at site.
- c. All test gadgets and instrument necessary for conducting tests at site shall be furnished by the Bidder.

2.1.8.41 OPERATING SPEEDS FOR MISCELLANEOUS HOISTS

a	Hoist	3 m/min
b	Trolley travel	6 m/min
c	Long travel	10 m/min
d	Creep speed	10% of full speed (as applicable)
e	Crane runway rails	Rails to suit



1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III



EPC TENDER SPECIFICATION FOR BTG PACKAGE

DATA SHEET FOR **BC BAY AREA CRANE**

1	Number of Cranes	:	One (1) no.
2	Crane Classification	:	Class-II to BS:466-1947 IS:807 & IS:3177
3	Type of service	:	Indoor
4	Capacity – Main Hoist		
	a. Rated Tonnes	:	60 T
	b. Test load Tonnes	:	125% of rated load
5	Capacity – Auxiliary Hoist		
	a. Rated Tonnes	:	N.A.
	b. Test load Tonnes	:	N.A.
6	Type of Hooks		
	a. Main Hoist	:	Ramshorn type swiveling hook with locking device
	b. Auxiliary Hoist	:	N.A.
7	Number of trolleys	:	One (1)
8	Number of hoists on trolley	:	One (1)
9	Crane structure	:	Bridge Girders of box type and steel fabricated construction
10	Operating speeds with full load (M/min)		
	a. Main Hoist	:	1.5
	b. Auxiliary Hoist	:	N.A.
	c. Trolley travel	:	15
	d. Longitudinal bridge travel	:	30
	e. Creep speeds	:	10 percent of full speed for all motions
11	a. Crane runway rails	:	To suit
	b. Runway Conductors (DSL)	:	as indicated in write up
			Closed Type



TITLE
1X800 MW NORTH CHENNAI TPP STAGE III
DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-423-501-A101

REV 00

Section I B Date NOV'16

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SUB-SECTION IB
SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)

**TAMILNADU GENERATION AND DISTRIBUTION
CORPORATION LIMITED**

**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**

**DOUBLE GIRDER CRANE
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT,
NOIDA, U.P., INDIA**

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR DOUBLE GIRDER CRANE 1X800MW COAL BASED SUPERCRITICAL NORTH CHENNAI THERMAL POWER PROJECT STAGE III	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 27.10.16
		SHEET: 1 OF 1

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C	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
C	CABLE SCHEDULE FORMAT (ANNEXURE-III)	1
C	EXPLANATORY NOTES FOR CABLE ROUTING	1
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D	STANDARD SPECIFICATION FOR LT MOTORS	4
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D	QUALITY PLAN (FOR MOTORS ABOVE & 55 KW)	9
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TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER CRANE
(ELECTRICAL PORTION)

SPECIFICATION NO.
VOLUME II B
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DATE 27.10.2016

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for DOUBLE GIRDER CRANE.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet “Electrical Equipment Specification for DOUBLE GIRDER CRANE” and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
 - b) Electrical load requirement in the load data format .
 - c) If there is any conflict, customer motor specification will prevail over BHEL motor specification.



TECHNICAL SPECIFICATION FOR
DOUBLE GIRDER CRANE
(ELECTRICAL PORTION)

SPECIFICATION NO.

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- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors.
- c) Datasheets & quality plan for motors.

- e) BHEL cable listing format (Annexure –III)
- f) Sub vendor list for motors (Annexure-IV)
- g) Technical specification for lt switchgear
- h) Technical specification for motors
- i) Technical specification for actuators
- j) Technical specification lv cables
- k) Technical specification cabling
- l) Technical specification for earthing & lighting protection

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: DOUBLE GRIDER EOT CRANES

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

PROJECT : 1x800MW NORTH CHENNAI STAGE-III

<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.

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

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

ANNEXURE-IV

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

LV MOTORS (NON FLAME PROOF)	ABB
	BHARAT BIJLEE LTD.
	CROMPTON GREAVES
	GE-POWER
	KIRLOSKAR ELECTRIC CO LTD.
	LAXMI HYDRAULICS PVT. LTD
	MARATHON
	NGEF
	RAJINDRA ELECT INDUSTRIES
	SIEMENS
LV MOTORS (FLAME PROOF)	RAJINDRA ELECT INDUSTRIES

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.



TITLE

LV MOTORS**DATA SHEET-A**

SPECIFICATION NO.

VOLUME II B

SECTION

D

REV NO. 00

DATE 26.10.16

SHEET 1 OF 1

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : Upto 200KW
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Degree Of Protection : IP55
- 5.0 Cooling : TEFC
- 6.0 Details of supply system
- a) Rated voltage (with variation) : 415V $\pm$ 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
- 7.0 Class of insulation : Class 'F', with temp rise limited to class B.
- 8.0 Minimum voltage for starting : 80% of rated voltage
(As percentage of rated voltage)
- 9.0 Power cables data : Shall be given during Detailed engg.
- 10.0 Earth Conductor Size & Material : Shall be given during Detailed engg.
- 11.0 Space heater supply (**30KW & ABOVE**) : 240 V, 1 Φ , 50 Hz
- 12.0 Rating up to which Single phase motor : Acceptable below 0.20 Kw
- 13.0 TYPE OF STARTER PROVIDED IN MCC : DOL
- 14.0 Locked rotor current
- a) Limit as percentage of FLC : As per IS 12615
 - b) Permissible tolerance, if any :
- 15.0 Additional tests : As per QP
- 16.0 Flame-proof motor
- a) Enclosure suitable (As per IS:2148) : As per requirement
 - b) Classification of Hazardous area : As per requirement
(As per IS: 5572 part-I)
 - c) Degree of protection : IP65
- 17.0 Makes : AS PER ANNEXURE-I
- 18.0 Terminal box : Suitable to rotate at 90 degrees
- 19.0 Paint shade : **RAL 5012**



TITLE

LV MOTORS

DATA SHEET-A

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. 00 DATE 26.10.16

SHEET 2 OF 1

20.0 Efficiency class : **IE3**

NOTE :

1. Also detailed Customer spec. for Motors is to be referred as enclosed with technical spec.

		QUALITY PLAN		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	RELEVENT 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	RELEVENT 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		CUSTOMER :		PROJECT			SPECIFICATION :				
				BIDDER/		TITLE			NUMBER :				
				VENDOR		QUALITY PLAN			SPECIFICATION :				
SHEET 2 OF 9		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			SECTION			
ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		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	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
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	
		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, CONNEC- TORS, 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	FOR DIA OF 55 MM & ABOVE	
		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 : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		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	P	W	V	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	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		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	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 4 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
1.10	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	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	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	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	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		CUSTOMER :			PROJECT		SPECIFICATION :			
				BIDDER/ :			TITLE		NUMBER :			
		SHEET 5 OF 9		VENDOR			QUALITY PLAN		SPECIFICATION :			
		SYSTEM			NUMBER PED-506-00-Q-007, REV-03		TITLE					
					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
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
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%	MANFR'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		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE				
		SHEET 6 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	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
		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.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		FOR MV MOTOR
		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		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 7 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	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	
2.8	BRAZING/COMPRESSION JOINT	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-		
2.9	COMPLETE ROTOR ASSEMBLY	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		
2.10	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		
		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 :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 8 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	12	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$	1	\$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		SHEET 9 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
									P	W	V
1	2	3	4	5	6	7	8	9	10		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		SPECIFICATION :				
				BIDDER/ VENDOR :		TITLE		NUMBER :				
		SHEET 1 OF 2		SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE				
				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
									P	W	V	
1	2	3	4	5	6	7	8	9	10			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	-	-	NOTE -1 & NOTE-3
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		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
	SHEET 2 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
		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			



EPC TENDER SPECIFICATION FOR BTG PACKAGE

2.2.11 LT SWITCHGEAR

2.2.11.1 CODES AND STANDARDS

All equipment and materials shall be designed, manufactured and tested in accordance with the latest editions including all applicable official amendments of relevant Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

Equipment and material conforming to any other standards, which ensure 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.

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.

All works shall be carried out as per the following codes and standards.

Sl.No	Code	Description
1	IEC-60947 IEC-60439 IS-13947	Low voltage switchgear and control gear assemblies.
2	IS-8623	Specification for Low-Voltage Switchgear and Control gear Assemblies
3	IEC-60664 IS-15382	Insulation coordination for equipment with low voltage systems
4	IEC-60044	Instrument transformers
5	IEC-60529	Degrees of protection provided by enclosures
6	IS-13118	High Voltage alternating circuit breakers
7	IS-2675	Enclosed distribution fuse boards and cut outs for voltages not exceeding 1000 V AC and 1200 V DC
8	IS-8828	Electrical Accessories – Circuit breaker for over current Protection
9	IS -12021	Specification for Control transformer for switchgear and control gear for voltages not exceeding 1000V AC
10	IS-5082	Wrought aluminium & aluminium alloy for electrical Purposes
11	IS-13703	Specification for low voltage fuses for voltages not exceeding 1000 V AC and 1500 V



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**



EPC TENDER SPECIFICATION FOR BTG PACKAGE

		DC
12	IS-8187	Specification for D Type fuses
13	IS- 6005	Code of practice for phosphating iron and steel
14	IS-694	694 PVC insulated cables for working voltages up to and including 1100
15	IS-722	AC Electricity Meters
16	IS-1248	Electrical Indicating instruments
17	IS-2551	Danger Notice Plates
18	IS-2629	Hot dip galvanizing
19	IS-2705	Current Transformers
20	IS-3043	Code of practice for earthing
21	IS-3072	Code of practice for installation and maintenance of Switchgear
22	IS-3156	Voltage Transformers
23	IS-3202	Code of practice for climate proofing of electrical equipment
24	IS-3231	Electrical relays for power system protection
25	IS-8686	Static Relays
26	IS-10118 (4 parts)	Code of practice for selection, installation and maintenance of switchgear and control gear
27	IS-11171	Specification for dry type transformers
28	IS-11353	Guide for uniform system of marking and identification of conductors and apparatus terminals

2.2.11.3.1 TYPE

Circuit Breakers	Shall be air break, three pole, spring charged, and horizontal
Switchgear	Fully draw out type single front



EPC TENDER SPECIFICATION FOR BTG PACKAGE

MCC	Fully draw out type single front/Double front.
ACDB/DCDB	Fixed type single front

2.2.11.3.2 SYSTEM PARAMETERS

1)	Nominal system voltage	415 V AC	220 V DC
2)	Highest system Voltage	433 V	240 V DC
3)	Voltage variation	±10%	190 - 240
4)	Rated frequency	50 HZ	-
5)	Frequency variation	+3% to (-5%)	-
6)	One minute Power	2.5 kV	2.5 kV
	frequency withstand voltage Main circuit Auxiliary Circuit	2.0 KV	2.0 KV
7)	System Earthing	Solidly Grounded	Unearthed
8)	Maximum system fault level	50KA for 1sec	25KA for 1 sec

2.2.11.3.3 General Technical Requirements

Power from LV service transformers shall be supplied to 415 V switchgears. Power from 415 switchgears to the various MCCs, PDBs, ACDBs etc. shall be supplied from redundant incomers. These switchgears shall distribute power to LV auxiliary motors and also to other auxiliary loads viz. MCCs / ACDBs, etc. LV switchgears shall be of metal enclosed indoor type. Incomers / bus-couplers, outgoing tie feeders rated 630A & above and motor feeders rated 90 kW & above shall be equipped with air circuit breakers of fault interrupting capacity of 50 KA rms.

All PCC/PMCC/MCC shall be of intelligent type compatible with IEC-61850 communication protocol. Utility MCCs like service building MCC, Welding DBs, AC & Ventilation MCCs, etc., shall be non-intelligent type.



EPC TENDER SPECIFICATION FOR BTG PACKAGE

All the boards shall be sectionalized, except for turbine valve DB.

Not more than 2 out of 3 ACBs can be closed at a time unless at the time of planned short time paralleling through synchro check.

Under normal mode of operation each incoming source shall be connected to the respective bus sections with bus coupler open.

During the normal mode of operation if there is a loss of normal source to any bus-section, slow bus auto changeover shall be initiated to first trip the normal incomer connected to this section and further close the bus coupler to extend power from healthy bus section.

Restoration of normal operating condition (described in 1.14.6 above) shall be through planned manual changeover through synchro check paralleling or manual dead bus closing.

Incase parallel running between two sources prolong over a set time, an alarm shall be generated and the last ACB to close shall be opened.

The AC control supply voltage for motors rated below 90 kW shall be 110V AC. For this purpose each motor feeder of PMCC/MCC shall be provided with suitable rated 415/110V Control Transformer. Separate control transformer for test bus supply shall be provided for each bus section.

All circuit breakers shall have 220V DC control.

2.2.11.3.4 List of minimum required LV switchgears

S.No	N a m e of LV Switchboard
1.	UNIT PMCC
2.	BUNKER FLOOR MCC
3.	UNIT MLDB
4.	VENTILATION MCC
5.	AC MCC
6.	BOILER MCC
7.	SOOT BLOWER MCC
8.	BOILER VALVE DAMPER MCC
9.	MILL SYSTEM MCC



EPC TENDER SPECIFICATION FOR BTG PACKAGE

10. TURBINE AUX. MCC
11. TURBINE VALVE DB
12. BOILER ACDB
13. ESP # 1A PMCC
14. ESP # 1B PMCC
15. ESP # 1C PMCC
16. ESP # 1D PMCC
17. ESP # 1E PMCC
18. ESP # 1F PMCC
19. ESP ACDB
20. ESP AC & VENTILATION MCC
21. ESP MLDB
22. DG SWGR AMF PANEL
23. UNIT NORMAL CUM EMERGENCY PMCC
24. 415 V AC ELDB
25. 415 V AC TG Building
26. FUEL OIL UNLOADING PH PMCC
27. SERVICE BUILDING MCC
28. AIR WASHER MCC
29. WELDING PDBs
30. AC AND VENTILATION MCC
31. CPU REGENERATION MCC
32. Main Lighting Distribution Boards (MLDB)
33. Emergency Main Lighting Distribution Board (EMLDB)
34. DC Lighting Distribution Board (DCLDB)
35. AC Fuse Boards

Any other PCC/PMCC/MCC/DB required as per the geographical distribution of load and for any other system which is part of mechanical system under BTG package and required for safe and reliable functioning of the plant.



EPC TENDER SPECIFICATION FOR BTG PACKAGE

2.2.11.2 TEMPERATURE RISE

The temperature rise of the horizontal and vertical busbars and main bus link including all the power drawout contracts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg c with silver plated joints and 40 deg c with all other types of joints over an ambient of 50 deg c.

2.2.11.3 OPERATIONAL REQUIREMENTS

2.2.11.3.1 Breakers

- I. Breakers shall have anti-pumping feature and it shall be electrically drawout type. The incomer and bus coupler breakers for switchgear shall be electrically operated with over current releases or relays.
- II. Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. In case releases are offered, the same shall have contact for energisation of lockout relay. All breakers Shall have built in interlocks for equipment and personnel safety
- III. Paralleling of two supplies shall be avoided by except for switchgear where auto-changeover is provided. Breaker contact multiplication, if required, shall be through latch relay.
- IV. Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.
- V. Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.
- VI. Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.
- VII. Supervision relay shall be provided for trip coil monitoring

2.2.11.3.2 Switches, Contactors and Fuses

- a. Incomers for MCCs and DBs rated up to 630A could be MCCB's & for above ratings ACB are preferred.
- b. Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be of utilisation category AC-3 for ordinary and AC-4 for reversing starters. DC contactor shall be of DC-3 utilisation category.



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- c. Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the short circuit current of the LT system. Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.
- d. Motor fuse characteristics and ratings shall be chosen to ride over starting period without blowing. The fuse on incoming feeder wherever provided, shall be chosen to provide discrimination with motor/feeder fuses.
- e. Isolating switches and MCCBs shall have door interlocks and padlocking facility.
- f. Wherever two incoming switches and one bus-section switch/breaker are provided for an assembly, these shall be electrically interlocked to ensure that only two out of the three can be closed at time.
- g. Wherever two incoming switches are provided for an assembly, these shall be electrically interlocked to ensure that one of the two can be closed at time.

2.2.11.3.3 Panels

- a. All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved identification plates.
- b. Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness & shall be of DOP IP55. Push buttons shall be of latch type with mushroom knobs.
- c. Where breaker/starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.
- d. All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galvanised steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.
- e. Suitable trolley arrangement shall be provided for breaker/starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.



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- f. The incoming connection to transformer of more than 1000KVA and inter-connecting Sections between switchboards shall preferably be of bus ducts. The bus duct enclosure shall be made of minimum 3mm thick aluminium alloy. The section of the bus duct should have adequate strength to withstand internal and external forces resulting from the various operating conditions. Aluminium sheet hood shall be provided for outdoor bus duct enclosure joints to provide additional protection against water ingress. The bus duct top shall be sloped to prevent retention of water. The bus duct shall have DOP of IP55.
- g. It should be possible to carryout maintenance on a feeder with adjacent feeders alive

2.2.11.3.4 Control, Protection & Metering Requirements

- i) Control circuits shall operate at suitable voltage of 110V AC or 220V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2 x 100% per section. However the breakers shall operate on 220V DC. The auxiliary bus bars for control supply shall be segregated from main bus bars. The control supplies shall be monitored.
- ii) Contractor shall fully co-ordinate overload and short circuit tripping of breaker with upstream and downstream breakers/fuses/MCCBs motor starters. Various equipment's shall meet requirement of Type-II class of coordination as per IEC.
- iii) All relays and timers shall operate on available DC supply and not have any inbuilt batteries. They shall be provided with hand-reset operation indicator (flags) or LEDs with pushbuttons for resetting.
- iv) All equipment's shall have necessary protections. However, following minimum protections shall be provided:

MPCB with Contactor controlled LV motor feeders (Motors rated 18.5kW & below) having intelligent controller
 - a. Instantaneous short circuit protection
 - b. Overload protection
- v) MCCB with Contactor controlled LV motor feeders (Motors rated above 18.5kW but below 90 kW) having intelligent controller
 - a. Instantaneous short circuit protection



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- b. Overload protection
- vi) Single phasing protection for motors rated 30 kW and above rating
- vii) In Instantaneous short circuit protection on all phases through HRC cartridge type fuses / MCCB rated for 80 kA rms (prospective breaking capacity at 415V).
- viii) Thermal overload protection
- ix) Single phasing protection for motors protected by fuses.
- x) Breaker controlled motors feeders (motors rated above 90kW) Numerical, comprehensive motor protection relay with following minimum facility as indicated below :
 - a. Instantaneous short circuit protection
 - b. Overload protection
 - c. Under voltage protection
 - d. Locked Rotor protection
 - e. Earth fault protection
 - f. Current unbalance.
 - g. Temperature monitoring (stator, bearing etc.).
 - h. Phase reversal.
 - i. Thermal model based with RTD feedback and negative sequence current.
 - j. Voltage compensated acceleration.
- xi) Incomers (ACB):
 - a. 3 ph IDMT Overcurrent & earth fault protection (51,51N)
 - b. 3 ph Instantaneous Overcurrent protection (50)



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- c. Standby earth fault protection for service transformer protection (connected on transformer neutral CT side)
 - d. Under voltage protection (27) with Timer & Fuse failure protection
 - e. Neutral dEviation relay
- xii) Buscoupler (ACB):
 - a. 3ph IDMT Overcurrent & earth fault protection (51 & 51N)
 - b. Sync check relay (25)
- xiii) Bus PT:
 - a. Under voltage protection (27)
 - b. No voltage protection (27)
 - c. Fuse failure protection (97)
- xiv) ACB outgoing feeders:
 - 3 ph IDMT Overcurrent protection (51, 51N)
- xv) Incomer from DG Set.
 - a) Differential Protection (87) - Three Pole
 - b) Reverse Power Protection.
 - c) Overload Alarm on one phase
 - d) Earth Fault Detection Relay (64)
 - e) Voltage controlled Overcurrent relay
 - f) Generator under/over voltage Protection
 - g) Hand Reset/Lockout Relay with a blue lamp.
 - h) 3 Phase Energy Meter having accuracy of 1.0 class



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Apart from protection relays, each electrically operated breaker shall also be provided with Anti pumping (94), trip annunciation(30), lockout (86). Lockout supervision (95) and trip supervision (74) relays. Lockout relay shall be hand reset type.

2.2.11.3.5 Meters / instruments

- I. All meters/ instrument shall be flush mounted on front panel, at least 96 sq.mm. Size with 90 degree linear scales and accuracy class of 2.0. All motors above 7.5 kW shall have directly connected ammeter and Motors above 30kW shall have CT connected Ammeter with ASS. Necessary Current transducers shall be provided for the same. Bus-section shall have bus VT, voltmeter with selector switch, and other relay and timers required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.
- II. All Incoming feeders shall be provided with MFM, Ammeter with selector switches & with necessary kW transducer, Current transducers etc., Bus PT feeder shall be provided with Voltmeter + VSS & necessary Transducers. All Outgoing supply feeders shall be provided with Ammeters + ASS & necessary transducers.
 - a. In case of remote controlled breaker panels, following shall be ensured. Each feeder shall have local/remote selector switch. Closing from local shall be possible only in test position whereas closing from remote shall be possible in either service or test position. Tripping from local shall be possible only when local/remote selector switch is in local position. Tripping from remote shall be either breaker in service position or selector switch being in remote position.
 - b. Control from Remote Necessary hardware shall be provided in the switchgear panel like coupling relays (24V DC, with max. burden of 2.5VA), auxiliary relays, current/voltage transducers (4-20 mA, dual output) etc. to effect interlocks, exchange information / status and exercise control from remote.

2.2.11.3.6 DESIGN AND CONSTRUCTIONAL FEATURES

- 1) All 415V switch gear motor control centres (MCCs), AC & DC distribution boards (DBs), etc. shall have following features
- 2) Shall be of metal enclosed, indoor, floor mounted and free standing type.



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- 3) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm.
- 4) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels.
- 5) All switchboards/panels shall be of dust and vermin proof. All cut-outs shall have synthetic rubber gaskets.
- 6) All switchboards, MCCs and DB s shall have following distinct vertical sections.
 - i) Completely enclosed bus bar compartment for horizontal and vertical busbars.
 - ii) Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or switch-fuse feeder).
 - iii) Compartment for cable alley or cable box for power and control cables. In case of cable box, they shall be segregated with complete shrouding for individual feeders at the rear for direct termination of cables.
 - iv) For cable connection to circuit breaker a separately enclosed cable compartment shall also be acceptable.
 - v) Compartment for relays and other control devices associated with a circuit breaker, wherever necessary.
 - vi) The switchboards/MCC/DBs of 1600A & above rating shall be of DOP IP42 & of IP52 for less than 1600A rating.
 - vii) All 415V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process. Paint shade for complete panels excluding end covers shall be RAL7032 for extreme end covers of all boards.
- 7) Busbars shall be of high conductivity aluminium alloy or copper.
- 8) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances



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shall be at least 10mm. wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti-tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved. In case of DC DBs/ fuse boards, the busbar system shall be insulated or physically segregated with barriers to prevent interpole short circuit.

- 9) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10mm. Wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti-tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved. In case of DC DBs/ fuse boards, the busbar system shall be insulated or physically segregated with barriers to prevent interpole short circuit.
- 10) Busbar insulators shall be of track-resistant high strength non-hygro- scopic, non- combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted.
- 11) All types of relays and timer shall be subject to Purchaser's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, drawout construction for easy replacement and testing facility. The auxiliary relays and timer may be provided in fixed cases.
- 12) Maxi terminal /cage clamp type terminal blocks shall be provided for signals to be interfaced with DDCMIS/PLC.
- 13) The switchgears/MCC shall be designed to offer adequate level of safety to operating/ maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear/MCC room discribing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear/MCC.
- 14) All current and voltage transformers as required for metering & protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformer REF protection. All current and voltage transformers as required for metering and protection specified shall be completely encapsulated, cast resin insulated type. Incomers from



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transformers shall have CTs for transformer restricted earth fault protection.
The accuracy shall be as follows:

- 15) Other CT particulars like ratio, burden knee-point voltage, excitation current and secondary resistance shall be decided by the Tenderers
- 16) CT secondary shall be rated for 1 A for metering and either 5 A or 1 A for protection.
- 17) indicating lamps shall be cluster LED type
- 18) 20% spare feeders of each type & rating used in the MCC with a minimum one (1) number on each bus section shall be provided.

2.2.11.3.7 ESSENTIAL SERVICE MODULE

During auto changeover of the supply the contactors in the affected bus would have dropped off. Services, which, shall be restarted immediately without time lapse to keep the unit running, are considered essential services. Such auxiliaries shall restart automatically without any action by the operator after an auto changeover. These modules shall have additional hardware like timer (or time delayed closing from DCS), aux. contactors and associated circuitry in the module. Such essential services shall be identified during the detailed engineering stage and suitable module/scheme shall be provided.

The modules of some of the critical application motors like barring gear motor, air heater motor, lube oil pump, jacking oil pump etc. irrespective of their kW rating shall be provided with a CT, ammeter and a current transducer with remote metering in DCS.

2.2.11.3.8 Type Tests

GENERAL

All equipment's to be supplied shall be of type tested quality. The Contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five years from the zero date of the project. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

In case the Contractor is not able to submit report of the type test(s) conducted within last five years from the zero date of the project, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Purchaser and submit the reports for approval.



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All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The following type test certificates on each type & rating of L.T. Switchgear, MCC panel and distribution boards shall be submitted.

- a. Short time withstand test with circuit breaker mounted inside the switchgear panel.
- b. Temperature rise test.
- c. Type II - Short circuit co-ordination test for any three ratings of MCC module as selected by the Purchaser.
- d. Test sequence –1 & combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel.
- e. Degree of protection tests

2.2.11.3.9 ROUTINE TEST

LT SWITCHGEAR

Switchgear shall be subjected to all routine tests as per relevant standards along with following tests:

Temperature rise test on power circuits

- a. Short time current tests on power circuits.
- b. Mechanical operation test
- c. Insulation resistance and 500V DC Megger before/ after 1 minute HV xvi) test
- d. Electrical control, interlock and sequential operation tests
- e. Verification of wiring as per approved schematic.

Motors



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2.2.12 MOTORS

2.2.12.1 Design Criteria

- i. For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.
- ii. Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

1. Rating

- i. The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.
- ii. All motors shall be continuously rated (S1 duty). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.
- iii. Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

2. Starting Voltage requirement for all motors (except mill motors):

- i. 85 % of rated voltage for motors up to 1000 kW
- ii. 80 % of rated voltage for above 1000 kW and up to 4000 kW
- iii. 75 % of rated voltage for above 4000 kW

For Mill Motors:

- iv. 85 % of rated voltage for motors above 1000 kW
- v. 90 % of rated voltage for motors up to 1000 kW

3. Canopy shall be provided for outdoor motors.

4. Contractor shall provide fully compatible electrical system, equipments, accessories and services.

5. All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.



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6. Voltage and frequency variations:

- i. Frequency : (+) 3% and (-) 5%
- ii. Voltage :
 - A) AC:
 - a. $\pm 10\%$ for 11 kV/6.6 kV
 - b. $\pm 10\%$ for 415 V

B) DC: +10% to -15% for 220 V DC

- iii. Combined 10 % (absolute sum)

7. All LV motors above 10 kW with S1 duty.

8. Continuous duty LT motors rated above 0.37kW upto 200 KW Output rating (at 50 deg. C ambient temperature), shall be Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. However this is not applicable for geared motors (motors completely integrated with driven equipment) which are specifically designed to suit the driven equipment duty.

The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.

9. Type

- i. AC Motors:
 - a. Squirrel cage induction motor suitable for direct-on-line starting.
 - b. Crane duty motors shall be slip ring type induction motor
- ii. DC Motors
 - a. Shunt wound

10. Temperature Rise

- i. **Air cooled** motors - 70°C by resistance method.
- ii. Water cooled - 80° C over inlet cooling water temperature mentioned elsewhere, by resistance Method.

11. Degree of Protection

Degree of protection for various enclosures shall be as follows:

- | | | |
|-------------------|---|-------|
| 1. Indoor motors | - | IP 54 |
| 2. Outdoor motors | - | IP 55 |



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- | | | | |
|----|--|---|-------|
| 3. | CW motors (in case of screen prot. Drip proof) | - | IP 23 |
| 4. | Cable box – indoor area | - | IP 54 |
| 5. | Cable box – outdoor area | - | IP 55 |

2.2.12.2 Codes and Standards

1. All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC and CBIP standards/Publications. In case any other standard is followed that ensures equal or better quality, may be accepted. However the English version of the Standard adopted shall be submitted.
2. Major Standards, which shall be followed, are listed below. Any other applicable Indian standards for any component part even if not covered in the list shall also be followed.
 - i. Three phase induction motors : IS:325, IEC:60034
 - ii. Single phase AC motors : IS:996, IEC:60034
 - iii. Crane duty motors : IS:3177, IEC:60034
 - iv. DC motors/generators : IS:4722
 - v. Degree of protection by enclosures for rotating electrical machines : IS: 4691 , IS: 4728, IS: 6362, IS: 2253
 - vi. Noise levels for rotating electrical machines : IS: 12065
 - vii. Mechanical Vibrations for rotating electrical machines : IS 12075

2.2.12.3 Operational Requirements

1. Starting Time
 - i. For motors with starting time less than 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs more than starting time.
 - ii. For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time.



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- iii. For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- iv. Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- v. Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.

2. Torque Requirements

- i. Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- ii. Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

2.2.12.4 Design and constructional features

- 1. Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.
- 2. All motors shall be suitable for direct on line starting through any type of breaker.
- 3. All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below:
 - a. Fuel oil area : Group - IIB
 - b. Hydrogen generation plant area : Group - IIC

4. Winding and Insulation

Type	Non-hygroscopic, oil resistant, flame resistant
Starting Duty	Two hot starts in succession, with motor initially at normal running temperature.
11 kV / 6.6 kV AC motors	Class F: with winding temperature rise limited to class B. They shall withstand 1.2/50 micro sec switching surges of 4U+5 KV (U=Line voltage in KV).



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415V AC & 220V DC

The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV and 6.6 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation

Class 'F' with temperature rise limited to class 'B'

5. Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.
6. Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7. Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.
8. In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the RTD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.
9. MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.
10. Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motors (like BFP) shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor. Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.
11. MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs for motors on 11/ 6.6 kV switchgear shall be supplied as loose.



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12. Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
13. HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
14. All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
15. Motors rated 18.5kW and below shall be contactor controlled having MPCB incomers with intelligent controllers. Motors rated 18.5kW and above but below 90 kW shall be contactor controlled having MCCB incomers with intelligent controllers. Motors rated 90 kW and & above up to 200KW shall be ACB controlled with numerical relays. HV & MV Motors rated above 200 KW shall have vacuum breakers. HV motors rated 1000kW and above shall be provided with insulation bearings for avoiding bearing currents. HV Motors rated 1000KW and above shall also have differential protection. Care shall be taken by BTG Bidder to ensure that parameters of the differential CT being supplied along with motors (rated above 1000kW) match with the parameters of the differential CT being supplied by BTG bidder in 11kV Switchgear.
16. The motors shall be suitable for bus transfer schemes provided on the 11 kV, 6.6 Kv and 415V systems without any injurious effect on its life.
17. For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
18. All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.
19. The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.
20. Neutral in case of HV motors shall be kept accessible.
21. Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.



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22. Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.
23. Flow switches shall be provided for monitoring oil flow of forced lubrication bearings, if used. Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
24. For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box.
25. Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.
26. Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors.
27. Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:
- a) Hot and cold air temperatures of the closed air circuit for CACA motors.
 - b) Hot and cold, air and water temperatures for CACW motors.
28. The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
29. DIRECTION OF ROTATION
- As needed by driven equipment. The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor. If, in the case of HV & MV motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.
30. BEARINGS
- Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 40000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing. Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.
- If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.



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Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.

For MV & HV motors rated 1000KW and above, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.

When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.

Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.

Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.

Bearings shall be of reputed make subject to the approval of the Purchaser/Consulting Engineer.

Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.

31. TERMINAL BOXES

General

- i) Motors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals, Neutral CT terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and



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around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Purchaser /Consulting Engineer. All terminal boxes shall be suitable for proper termination cable to be finalized during detailed engineering.

- ii) The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HV & MV motors shall be provided with phase segregated terminal box.
- iii) Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

Main Terminal Box

- i) LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.
- ii) MV & HV Motors shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. For motors rated below 1000 KW should be interchangeable to facilitate cable routing.
- iii) Neutral terminal box for HV motors rated 1000 KW and above shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These CTs shall be mounted in the motor neutral terminal box. Stator phase terminal box shall be phase segregated terminal box suitable for both top or bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable terminating Kit. Terminal leading shall be stud type or leading wire type.
- iv) Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables.
- v) The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.
 - a) Min. fault level for 11kV Motors - 50kA
 - b) Min. fault level for 6.6 kV Motors - 40kA
 - c) Min. fault level for 415V Motors -50kA



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- d) Min. fault level for 220V DC Motors -25kA
- vi) Phase to Phase/ Phase to Earth Air Clearance:-
- a) Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:-

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

- vii) Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes.

32. TYPE AND SIZE OF CABLES

Space Heaters

- i) For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- ii) For MV & HV Motors: Six (6) mm² two core aluminium conductor XLPE insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- iii) For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- iv) Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC



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sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.

- v) For Moisture Detectors.....As for space heaters

For Main Terminals:-

- i) LT Motors

a) Three (3) core cables Stranded aluminium conductor, XLPE insulated, colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire / strip armoured, FRLS PVC type-ST2 jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).

b) Single core cables Stranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC type ST2 jacketed overall, 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

- ii) HV & MV Motors

Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire/strip armoured FRLS PVC type ST2 jacketed overall, 6.6 KV / 11 KV un earthed grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

33. GROUNDING

General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.

LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.

HV & MV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor



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specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.

34. EMBEDDED TEMPERATURE DETECTORS

HV & MV motor shall be provided with four (4) Nos. simplex or two (2) Nos. duplex platinum resistance temperature detectors (RTDs) in each phase embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C

35. BEARINGS TEMPERATURE INDICATORS

HV & MV motors shall be provided with dial type two (2) bearing temperature indicators and shall have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set shall be set to operate at lower value to give alarm and other set at a higher value to trip the motor.

36. SPACE HEATERS

Valve / Damper actuator motors; and Motors 30 KW and above shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple.

The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.

The space heater shall be wired to maintain the motor internal temperature above dew point when the motor is in idle condition.

37. HOT AIR TEMPERATURE DETECTOR

If the motor is of CACA or CACW enclosure, dial type temperature indicator shall be provided (one each for hot and cold air temperature monitoring for CACA and CACW and one each for inlet and outlet water temperature monitoring for CACW). If alarm and trip are required for cooling air temperature, temperature switch shall be provided.

38. WATER FLOW INDICATOR



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If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.

39. MOISTURE DETECTORS

Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

40. BED PLATE

Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

41. Painting

Motor including fan shall be painted with corrosion proof paints of colour shade RAL 5012.

42. Local Push Button Stations

The LPBS shall be installed near the motors to be controlled. Individual channel supports shall be used for each LPBS. These shall be installed as per approved erection detail drawing. LPBS for hazardous areas shall be CMRS certified and CCE approved.

All LPBS shall have necessary canopies. Wiring of LPBS shall be checked before giving control supply.

Local push button station having only stop push button shall be provided for all the drive motors (HV, MV & LV motors).

The degree of protection of LPBs shall be IP65 with canopy.

All PBs shall be push to actuate type and the stop PB shall be lockable in off position as per the scheme requirement.

Emergency local stop push button should not be lockable. Stop Push buttons shall be mushroom type with latched or stay put feature with protective lid/cover. Start push button shall be self-reset type.



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All push buttons shall be provided with 2 nos. NO and 2 nos. NC contacts for various interlocking purposes. One contact of stop PB shall be directly wired to the switchgear module for direct tripping and another contact to control system.

Terminals to be suitable for 2 cores of 2.5 sq.mm conductors with 20% spare terminals. All LPBs shall be of Di-cast aluminium/ FRP.

LPB shall be of following types:

1. Type-A: With Stop Push Button in FRP enclosure
2. Type-B: With Start & Stop Push Buttons in FRP enclosure
3. Type-C: With Forward, Reverse & Stop Push Buttons in FRP enclosure
4. Type-D: With Stop Push Button in flame-proof enclosure
5. Type-E: With Start & Stop Push Buttons in flame-proof enclosure
6. Type-F: With Forward, Reverse & Stop Push Buttons in flame-proof enclosure

43. OTHER ACCESSORIES

Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

44. NOISE LEVEL

Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). at 1m from operating motor measured in accordance with IS: 10265.

2.2.12.5 Documents and Drawings

1. INFORMATION WITH PROPOSAL

AC Motor Data Sheet
Dimension Drawing/Foundation load details of motor and driven equipment.
Manufacturer's catalogue showing constructional details.

2. INFORMATION ON AWARD OF CONTRACT

Motor Data Sheet

Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.



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Following characteristics curves:-

- i) Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment except for mill motor. For mill motor torque speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment
- ii) Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current speed curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage
- iii) Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor current time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- iv) Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor thermal withstand curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- v) Efficiency, power factor, current and speed versus power output curves.
- vi) Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage except for mill motor. For mill motor speed time curve for motor at ninety (90) hundred (100) and hundred ten (110) percent rated voltage.
- vii) Negative phase sequence current withstand characteristics.

2.2.12.6 List of tests to be conducted for HV, MV and LV Motors

1. Type tests

- i. No load saturation and loss curves up to approximately 115% of rated voltage.
- ii. Momentary overload test.
- iii. Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.



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- iv. Surge withstand test on the sample coil after placing it in stator core at (4U + 5 KV) and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.
- v. Surge-withstand test with 0.3/3 micro sec. wave on each type of 6.6/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out the turns suitably. The power frequency test voltage shall be decided during detailed engineering.
- vi. Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only).
- vii. Measurement of resistance of windings of stator and wound rotor.
- viii. Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only).
- ix. Full load test to determine efficiency, power factor and slip.
- x. Insulation resistance test.
- xi. Test for vibration severity of motor.
- xii. Test for noise levels of motor.
- xiii. Test for degree of protection by enclosure.
- xiv. Temperature rise test at limiting values of voltage and frequency variations.
- xv. Over speed test.

2. Routine Tests

The following shall constitute the routine tests.

- i. Insulation resistance test
- ii. Measurement of resistance of windings of stator and wound rotor.
- iii. No load test
- iv. Locked rotor readings of voltage, current and power input at a suitable reduced voltage
- v. Reduced voltage running up test (for squirrel cage motor)



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- vi. Open circuit voltage ratio of stator and rotor windings (for slip ring motors); rotor;
- vii. High voltage test

2.2.12.7 Inspection and Testing at site

1. Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer.
 - i. Blowing hot air in case of big motors.
 - ii. Putting the motor in electric oven in case of smaller motors.
 - iii. Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.
2. Site Test
 - i. Measurement of vibration.
 - ii. Measurement of insulation resistance and polarization index.
 - iii. Measurement of full load current.
 - iv. Test running of the motors, checking the temperature rise and identifying the hot spot etc.
3. 6.6 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of $\geq 20 \text{ M}\Omega$ resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted.
 - i. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.
 - ii. By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady



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temperature of winding is reached after 4 to 5 hours and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, after steady temperature is reached, at an interval of 2 hours. In case it is essential, the drying process can be supplemented by blower.

Actuators



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2.2.13 ACTUATORS

2.2.13.1 SCOPE

This Specification covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.2.13.2 CODES & STANDARDS

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

Code	Name of standard
IS: 325	Specification for three phase induction motor
IS: 900	Code of Practice for installation and maintenance of induction motors.
IS: 996	Single Phase AC Motor
IS: 1271	Thermal evaluation and classification of electrical insulation.
IS:2223	Dimensions of flange mounted AC induction motors.
IS: 3043	Code of practice for earthing
IS: 4029	Guide for testing three phase induction motors.
IS: 4691	Degree of protection for enclosures of rotating electrical machinery.
IS: 4722	Specification for rotating electrical machinery.
IS: 4728	Terminal marking and direction of rotation for rotating electrical machinery.
IS: 4889	Methods of determination of efficiency of rotating electrical machines.
IS: 5571	Guide for selection of electrical equipment for hazardous areas.
IS:6362	Designation of Method of Cooling of Rotating electrical machines.
IS: 8789	Values of performance characteristics for three phase



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	induction motors.
IS: 9334	Electrical Motor Operated Actuators
IS: 12065	Noise level of motors.
IS: 12075	Measurement and evaluation of vibration of rotating electrical machines.
IS: 12615	Induction motors-Energy efficient, three-phase, squirrel cage – Specification
IS: 12802	Temperature rise measurement of rotating electrical machines.
IS: 12824	Type of duty and classes of rating assigned.
IEC: 60034-1	Rotating electrical machines
NEMA, MG-1	Motors and Generators

Equipment 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 furnished during detail engineering.

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.

2.2.13.3 General

- The Actuators shall be integral starters along with overload relays with built in SPP (Single Phase Preventer) with provision for operation from Control room, Local and by wireless set.
- The actuator motors shall be suitable for use on 415 Volt 3 phase 50Hz power supply. The actuator comprising motor, integral reversing starter, local control facilities and terminals for remote control and indication shall be housed within a self contained, sealed enclosure.
- Actuator working platforms shall be provided for maintenance purpose.
- Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent access to the commissioning tool.
- For some specific applications, integral starter shall also be separately mountable



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casting type and plug-in. Such applications shall be decided during detail engineering.

2.2.13.4 Actuator Sizing

The actuator shall be sized to guarantee valve closure at the specified differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. The operating speed shall be such as to give valve closing and opening at approximately 4 to 5 mm per second unless otherwise stated in the job specification. Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

2.2.13.5 Environmental

Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from 10°C to 50°C, upto 95% relative humidity. Actuators for explosion-hazardous applications shall in addition be certified Flameproof for Zones 1 and 2 (Divisions 1 and 2 Group gases).

2.2.13.6 Enclosure

Actuators shall be 'O' ring sealed, watertight to IP68 degree of protection. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed at site for cabling.

2.2.13.7 SPECIFIC REQUIREMENT

- i) The actuator shall essentially comprise the drive motor, torque/ Position limit switches, gear train, clutch, hand wheel, position indicator and transmitter, inbuilt thermostat for overload protection, space heater and internal wiring. Actuator shall be integral type. Integral starters shall have facility to hook-up with plant DCS for positioning of limit and torque switches.
- ii) The actuator enclosure shall be totally enclosed, dust tight, weather proof (NEMA-6/IP-68) suitable for outdoor use without necessity of any canopy.
- iii) All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- iv) The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.
- v) A lockable local/remote selector switch shall also be provided for selecting mode of operation.



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- vi) Gear Train:-Metal (Fibre gears are not acceptable) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.
- vii) Manual Wheel:- Shall disengage automatically during motor operation.
- viii) Duty cycle of actuators shall suit the system requirement. The actuators shall be capable of giving the required torque at the output shaft. The actuators shall be designed to take the full thrust
- ix) The integral starter which shall have sophisticated electronic controls with field programming feature. It shall be designed for remote control from DCS/Respective control system. Required interposing relays for receiving open/close/stop command from DCS/Respective control system shall be provided. Potential free contacts and transducers shall be provided to provide status indication at remote DCS/Respective control system.
- x) A three position selector switch (marked as LOCAL-OFF-REMOTE) and push buttons OPEN-STOP-CLOSE (for local operation) with indication lamps for running OPEN and running CLOSE shall be provided.
- xi) The Remote command signal (OPEN-STOP-CLOSE) from DCS/Respective control system/Control panel shall be isolated from control electronics through opto-isolator.
- xii) The following individual status annunciation LED's (Colour-Green) shall be provided locally (Integral to actuator) to annunciate the following for easy local monitoring.
 - 1. Actuator in local mode
 - 2. Actuator in remote mode
 - 3. Actuator running in OPEN direction
 - 4. Actuator running in CLOSE direction
 - 5. Actuator in inching mode.
 - 6. Actuator in self-retaining mode
 - 7. Limit switch OPEN trip
 - 8. Limit switch CLOSE trip
 - 9. Control voltage availability
- xiii) The following individual fault annunciation LED's (Colour-Red) shall be provided locally. (Integral to Actuator)
 - 1. Torque switch OPEN
 - 2. Torque switch CLOSE
 - 3. Thermo switch trip
 - 4. Electronic overload relay trip
 - 5. Motor single phasing
 - 6. Common fault (Inclusive of any one or combination of above fault)



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- xiv) View port shall be provided on integral starter unit to monitor the above status annunciation and fault annunciation.
- xv) Electronic overload relay shall be provided to trip actuator in case of overload. Plug in connections/design shall be provided between:-
 - 1. Integral starter unit and basic actuator
 - 2. Between external customer connections and actuator
- xvi) OPEN-CLOSE indication /LED shall be provided for indication of full open/close position.
- xvii) Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.

2.2.13.8 Motor

The electric motor shall be Class F insulated, with a time rating of at least 15 minutes at 50°C or twice the valve stroking time, whichever is more, at an average load of at least 33% of maximum valve torque.

- i) The squirrel cage induction motor shall be designed for full voltage direct-on-line start, with starting current limited to 6 times full-load current. The motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and also at 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each. The motors shall otherwise generally conform with technical specification for motors mentioned elsewhere in this specification.
- ii) The actuators shall be sized so as to open or close valves/ dampers at rated speed enclosure shall not be more than 70 degree 'C' over ambient temp. of 70 deg.C as these are subjected to higher ambient conditions due to their vicinity to operate fluid on continuous load operation. The actuators shall be suitable for a relative humidity of 95%. Class of insulation shall be class-F and type of enclosure shall be IP-615.0
- iii) Insulation:- The motor winding shall be insulated with class-F insulation having temperature rise limited to Class-B.
- iv) Performance:-The motor shall be capable of:
 - a) Starting at 85% of rated voltage
 - b) Running at 80% of rated voltage at rated torque for 5 minutes
 - c) Running at 85% rated voltage at 33% excess rated torque for 5 minutes.
- v) Maximum continuous motor rating shall be atleast 10% above the maximum load derived of the driven equipment under entire operating range including voltage & frequency variation.



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Vi) Bearing

The motor bearing shall be double shielded, grease lubricated and antifriction type.

vii) Earthing

At least two earthing terminals shall be provided for the motor body. Separate earthing terminal should be provided for terminal box.

2.2.13.9 Motor Protection

Protection shall be provided for the motor as follows:

- i. The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.
- ii. Motor temperature shall be sensed by a thermostat de-energising the motor in case of overheating.
- iii. Lost phase protection.
- iv. Overload protection.
- v. Short circuit protection by suitably rated long acting fuse.

2.2.13.10 Gearing

The actuator gearing shall be totally enclosed in an oil-filled gear casing suitable for operation at any angle. All drive gearing and components must be of metal construction and incorporate a lost-motion hammer blow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gear casing for inspection or disassembling without releasing the stem thrust or taking the valve out of service.

2.2.13.11 Hand Operation

A hand wheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The hand wheel or selection lever shall not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.

The hand wheel drive must be mechanically independent of the motor drive and any hand wheel gearing should be such as to permit emergency manual operation in a



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reasonable time. Clockwise operation of the hand wheel shall give closing movement of the valve unless otherwise stated in the job specification.

2.2.13.12 Drive Bushing

The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bush shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base should be of the sealed for life type.

2.2.13.13 Limit Switches

- a) Each motor actuator shall have Six (6) rotary drum position limit switches with two for open each with 2 NO + 2NC contacts and two for close each with 2 NO + 2 NC contacts positions, each with adjustable setting between fully open and fully closed positions. Each rotary drum limit switch shall have two (2) limit switches for intermediate open position each with 2 NO + 2 NC contacts. The limit switches shall have capacity of 5A at 240V AC or 0.5A at 220V DC.
- b) Each motor actuator shall also have two (2) torque limit switches with two (2) normally opened and two (2) normally closed contacts each.
- c) The torque switches shall have a minimum accuracy of 3% of set value. The torque switches shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches. The torque and position limit switches shall be housed in a separate enclosure with protection class as that of actuator.
- d) The motor operators/actuators shall be capable of meeting 150 percent of unseating torque at specified voltage.
- e) The motor actuators shall have 2 nos. potentiometric type transmitters of 100 ohm rating.
- f) Torque switches shall function to stop the motor on closing/opening. Upon actuation by the torque clutch it is restricted its attempt to open or close, thereby causing an overloading torque. Torque switches shall be self-resetting type only (i.e.) once a particular direction torque switch operates, it shall get resetted only when the equipment is operated in other direction.
- g) All six (6) limit switches shall be changeover type and adjustable besides having the snap facility. All limit switches, contacts shall be wired up independently upto the terminal block.

2.2.13.14 Remote Valve Position/Actuator Status Indication



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- iv. Four contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during hand wheel operation when all external power to the actuator is isolated.
- v. The contacts shall be rated at 5A for 240V AC, 0.5A for 220V DC.
- vi. As an alternative to providing valve position any of the four above contacts shall be selectable to signal one of the following:
 - a. Valve opening, closing or moving
 - b. Thermostat tripped, lost phase
 - c. Motor tripped on torque in mid travel, motor stalled
 - d. Remote selected
 - e. Actuator being operated by hand wheel
- vii. Position feedback has to be provided for all inching type applications. These shall be interfaced with plant DDCMIS.
- viii. Actuator local and remote indications shall be grouped and taken separately

2.2.13.15 Local Position Indication

The actuator shall include a digital position indicator with a display from fully open to fully close in 1% increments. Red, green and yellow lights corresponding to open closed and intermediate position shall be included on the indicator. End of travel indication colours shall be reversible. The digital display shall be maintained and updated during handwheel operation when all external power to the actuator is isolated. The display shall incorporate valve, actuator and control status indication. Provision shall be made to orientate the display through increments of 90°.

Provision shall be made in the design for the addition of a contactless transmitter to give a 4-20mA analogue signal corresponding to valve travel for remote indication when required.

2.2.13.16 Integral Starter and Transformer

The reversing starter, control transformer and local controls shall be integral with the valve actuator suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The starter logic shall be microprocessor- based. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapplings and be adequately rated to provide power for the following functions:



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- i. Energization of the contactor coils.
- ii. DC output where required for remote controls.
- iii. Supply for all the internal electrical circuits.

2.2.13.17 Integral Local Control and Control Mode Selector

The actuator shall incorporate local controls for Open, Close and Stop and a local/ Stop/ Remote mode selector switch lockable in any one of the following three positions: local control only, stop (no electrical operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.

The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

Provision shall be made to orientate the local controls through increments of 90°.

2.2.13.18 Control Facilities

- i. The necessary wiring and terminals shall be provided in the actuator for the following control functions:
- ii. Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.
- iii. Remote controls fed from an internal 24V DC supply and/or from an external supply rated 110V AC to be suitable for any one or more of the following methods of control:

Open, close and stop control :

- a. Open and close maintained or 'push to run' (inching) control
- b. Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact .
- iv. The following individual potential free relay contacts shall be provided in the actuator for remote annunciation to facilitate continuous monitoring of the actuator.
 - a. Actuator in local mode
 - b. Actuator in remote mode
 - c. Actuator (valve) running in OPEN direction.



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- d. Actuator (valve) running in CLOSE direction.
 - e. Limit switch OPEN trip
 - f. Limit switch CLOSE trip
 - g. Actuator in local mode.
 - h. Actuator in inching mode.
 - i. Actuator in self-retaining mode.
 - j. Actuator power switched off /single phasing.
 - k. Torque switch trip, thermo switch trip and overload relay trip (or close)
- v. Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.
- vi. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of the contactor coils.

2.2.13.19 Monitoring Facilities

Facilities shall be provided for monitoring actuator operation and availability as follows:

- i. Monitor (availability) relay, having one changeover contact, the relay being energised from the control transformer only when the Local/Off/Remote selector is in the Remote position to indicate that the actuator is available for remote (control room) operation.
- ii. Where required, it shall be possible to provide indication of Thermostat trip and Remote selected as discreet signals. The actuator shall include a diagnostic module, which will store and enable download of historical actuator operation and torque data to permit analysis of actuator and valve in-service performance. Data download shall be carried out without removing any covers and all shall be available locally to the actuator or remotely via telecom data transfer.
- iii. Diagnostic and configuration software shall be made available in a Lap Top PC for user.

2.2.13.20 Wiring and Terminals

- i. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end.
- ii. The terminals shall be embedded in a terminal block of high tracking resistance compound.



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- iii. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight sea land shall be provided with a minimum of 3 threaded cable entries with provision for a minimum of 4.
- iv. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.
- v. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:
 - a. Serial number
 - b. External voltage values
 - c. Wiring diagram number
 - d. Terminal layout
- vi. This must be suitable for the contractor to inscribe cable core identification along side terminal numbers.

2.2.13.21 Startup Kit

Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

2.2.13.22 Performance Test Certificate

- i. Each actuator must be performance tested and individual test certificates shall be supplied free of charge. The test equipment should simulate a typical valve load, and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at max. torque setting
 - c. Flash test voltage
 - d. Actuator output speed or operating time
- ii. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic and second stage gearing if provided, drive closing direction, wiring diagram number.

- 2.2.13.23** The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.
- a. Measurement of insulation resistance.
 - b. Measurement of full load current.



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c. Test running of the motors.

2.2.13.24 Drawing and Manuals

Following drawings/ data and Manuals to be submitted for approval:-

- i) Instruction manuals on Installation, tests
- ii) Actuator Data sheet.
- iii) Internal wiring diagram and control schematic.
- iv) Torque switch and Limit switch contact development.
- v) QAP for Test reports.
- vi) Manufacturers Catalogue
- vii) Instruction manuals on installation methods. tests etc.
- viii) Motor sizing calculation
- ix) Integral starter details
- x) General arrangement drawings
- xi) Test reports
- xii) Manufacturing quality plan
- xiii) Field quality plan

LV Cables



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2.2.16 LV CABLES

2.2.16.1 Codes and Standards

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS : 3961	: Recommended current ratings for cables.
IS : 3975	: Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 4905	: Methods for random sampling.
IS : 5831	: PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	: Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.
IS : 8130	: Conductors for insulated electrical cables and flexible cords.
IS : 10418	: Specification for drums for electric cables.
IS : 10810	: Methods of tests for cables.
ASTM-D -2843	: Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	: Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.
IEC-60754 (Part-I)	: Test on gases evolved during combustion of electric cables.
IEEE-383	: Standard for type test of Class IE Electric Cables.
IEC -60332	: Tests on Electric cables under fire conditions.
IS:6380	: Specification of elastomeric insulation and sheath of electric cables
IS:5608	: Specification for low frequency wires and cables with PVC insulation and PVC Sheath.



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IEC:502	: Extruded solid dielectric insulated power cables for rated voltages from 1.00 kV upto 30 kV
IEC:287	: Calculations of the continuous current rating of cables (100% load factor)
IEC:228	: Conductors for insulated cables
IEC: 60	: High voltage test techniques
IEC: 230	: Impulse tests on cables and their accessories
IEC-331	: Fire resisting characteristics of electric cables
NEMA-WC-5	: Thermoplastic insulated wires and cables for transmission and distribution of electrical energy.
IEC: 540	: Test methods for insulations and sheaths of electric cables and cords (elastomeric and thermoplastic compounds)
SS-4241475 classF3	: Cables - Testing of fire characteristics
NES-715-1	: Temperature index

2.2.16.2 Technical Requirements

1. The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.
2. Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.
3. Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.
4. XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250°C.
5. The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core



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unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

6. For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables armouring shall be of galvanised steel as follows :

Calculated nominal dia Size and Type of armour of cable under armour

- i. Up to 13 mm 1.4mm dia GS wire
 - ii. Above 13 & upto 25mm 0.8 mm thick GS formed wire / 1.6 mm dia GS wire
 - iii. Above 25 & upto 40 mm 0.8mm thick GS formed wire / 2.0mm dia GS wire
 - iv. Above 40 & upto 55mm 1.4 mm thick GS formed wire /2.5mm dia GS wire
 - v. Above 55 & upto 70 mm 1.4mm thick GS formed wire / 3.15mm dia GS wire
 - vi. Above 70mm 1.4 mm thick GS formed wire / 4.0 mm dia GS wire
7. The aluminium used for armouring shall be of H4 grade as per IS:8130 with maximum resistivity of 0.028264 ohm mm² per meter at 20 deg C. Aluminium armouring shall be same as indicated above for galvanized steel.
8. The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.
9. Cable Identification
1. Outer sheath shall be of PVC (of suitable grade) & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.
- a. Oxygen index of min. 21 (As per NES-715-1).
 - b. Acid gas emission of max. 20% (As per IEC-60754-I).
 - c. Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM D-2843.



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2. Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:
 - a. 1 core - Red, Black, Yellow or Blue
 - b. 2 core - Red & Black
 - c. 3 core - Red, Yellow & Blue
 - d. 4 core - Red, Yellow, Blue and Black
3. For reduced neutral conductors the core shall be black.
4. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.
 - a. Cable size and voltage grade - To be embossed.
 - b. Word 'FRLS' at every 5 metre - To be embossed.
 - c. Sequential marking of length of the cable in metres at every one metre-To be embossed / printed.

The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.
5. Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.
 - a. 1core - Red, Black, Yellow, Blue
 - b. 2 core - Red & Black
 - c. 3 core - Red, Yellow & Blue
10. All cables shall meet the fire resistance requirement of IEEE - 383 with cable installations made in accordance with clause "Flammability test" and as per Category-B of IEC 60332 Part -3.
11. Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum over the declared value in the technical data sheets.
12. In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc, are not acceptable.



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2.2.16.3 Cable selection & sizing

1. Cables shall be sized based on the following considerations:
 - i) Rated current of equipment.
 - ii) Maximum voltage drop limits under steady state and during starting for motor being fed from 415V switchgear restricted to 5% and 10% respectively.
 - iii) Maximum voltage drop limits under steady state for feeder (i.e. Outgoing feeders being fed from 415V switchgear) restricted to 3%.
 - iv) For cables to motors and feeders protected by MCCBs the cross section will be chosen according to the tripping time of MCCBs.
2. Derating Factors

Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

 - a. Variation in ambient temperature for cables laid in air.
 - b. Grouping of cables.
 - c. Variation In ground temperature and soil resistivity for buried cables.
3. Cable lengths shall be considered in such ways that straight through cable joints are avoided.
4. Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried. All LV power cables except trailing cables shall be XLPE insulated FRLS.
5. All control cables shall be 2.5 Sq mm copper cable.
6. Multicore control cables will generally have spare conductor (s) in accordance with the following chart and cores of a single cable will not be split for different auxiliary/ equipment:



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Conductors	Required Cables
1 or 2	: 1-3/C
3 or 4	: 1-5/C
5 or 6	: 1-7/C
7 or 8	: 1-10/C
9 or 10	: 1-12/C
11 or 12	: 1-16/C
13 or 14	: 1-18/C
Above 14 core	: Two or more of above cables

2.2.16.4 Constructional Features

i) 1.1 kV grade Power Cables

- 1.1 kV grade XLPE power cables shall have compacted aluminium conductor for cables including 10 sq. mm and above and copper conductor for cables below 10 sq.mm, XLPE insulated, PVC inner-sheathed (as applicable), armoured, FRLS PVC outer-sheathed conforming to IS: 7098. (Part-I).
- 1.1 kV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90°C continuous conductor temperature and 250 deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.

ii) 1.1 kV Grade Copper Conductor Fire Survival Power Cables

- 1100 volt grade, 90 Deg.C rating, power cables with stranded Copper conductor, heat resistance elastomeric insulation generally conforming to Type IE-2 of IS: 6380-1984, extruded Halogen free or very low Halogen elastomeric inner sheath, generally conforming to Type SE-3 of IS-6380-1984, round wire/strip armour and extruded outer sheath of elastomeric material generally conforming to Type SE-3 of IS: 6380-1984.
- The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988.
- The cables shall be rated for 3 hours fire rating.
- Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130. A suitable heat barrier tape, preferably glass mica tape shall be provided over the Conductor.



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5. The insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to Date.
6. The suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass fiber binder tape shall be applied over the laid up cores.
7. Fire Survival Power & Control cables shall be provided for the following services:
 - a. DC emergency lube oil pump.
 - b. Turbine lube oil pump/barring gear.
 - c. Jacking oil pump.
 - d. Scanner air fan.
 - e. Incoming & outgoing cables for DC lighting distribution board.
 - f. Fire /smoke detection system.
 - g. DC seal oil pump.
 - h. DC emergency lighting cables for Main Plant Building.
 - i. Incomer cables for DG board, emergency board, DC lighting board
 - j. Batteries to charger and DC distribution board.
 - k. Emergency turbine trip by push button in control room.
 - l. Boiler turbine: Generator inter-trip which includes the interconnecting cables between
 1. Boiler master fuel trip and turbine trip relays
 2. Generator trip relays and turbine trip relays
 3. Generator trip relays and 765kV kV circuit breaker
 4. Generator trip relays and generator field breaker.
 5. Generator trip relays and UAT breaker.



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iii) 1.1 KV Grade Control Cable

1. Control cable shall be multi core, minimum 2.5 sq.mm cross section, stranded copper conductor, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situation where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.
2. Voltage Transformer leads shall be checked for voltage drop, which shall be limited to within 1 % for all cases other than tariff metering, for which the voltage drop shall be limited to 0.2 %. In case the voltage drop with 4 sq.mm Cu conductors exceeds this value, higher conductor sizes shall be used.

iv) 1.1kV Copper Conductor Fire Survival Control Cables

1. Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS 8130/1984 amended up to date.
2. A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.
3. The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.
4. An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores.
5. The armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 3975 amended up to date.
6. The outer sheath shall be of special low smoke and very low Halogen content (Acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.



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7. The colour of outer sheath shall be black or any other natural colour agreed mutually between Owner and Contractor.
8. The minimum sizes of L.T. cable to be chosen are as below:
 - a. Al – 16 Sq.mm (3 core)
 - b. Cu – 2.5 Sq.mm (3 core)
9. In power cables maximum conductor size to be used will be 300 sq. mm & 630 sq.mm for multi core and single core cables. In case of multi core cables not more than 3 runs to be used or otherwise single core cable to be used.

v) Cable Drums

Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

2.2.16.5 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

- i) Cable datasheets
- ii) Cable sizing
- iii) QAPs & Test Reports.
- iv) Relevant catalogues

2.2.16.6 Tests

i) Type Tests

a. For Conductor

- i. Annealing test - For copper conductor only.
- ii. Tensile test - For aluminium conductor only.
- iii. Wrapping test - For aluminium conductor only.
- iv. Resistance test.

b. For Armour Wires/ Formed Wires

- i. Measurement of Dimensions.



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- ii. Tensile Test - For aluminium wires only
- iii. Elongation test - For aluminium wires only
- iv. Torsion test - For round wires only.
- v. Winding test - For Formed wires only.
- vi. Resistance test.
- vii. Zinc Coating test - For G.S. Formed wires /wires only.
- viii. Wrapping test - For Al. Formed wires /wires

c. For XLPE insulation & PVC Sheath

- i. Test for thickness.
- ii. Tensile strength & elongation tests before ageing and after ageing.
- iii. Ageing in air oven.
- iv. Loss of mass test - For PVC sheath only.
- v. Hot deformation test - For PVC sheath only.
- vi. Heat shock test - For PVC sheath only.
- vii. Shrinkage test .
- viii. Thermal stability test - For PVC sheath only.
- ix. Hot set test - For XLPE insulation only.
- x. Water absorption test - For XLPE insulation only.
- xi. Oxygen index test – For outer sheath only.
- xii. Smoke density test - For outer sheath only.
- xiii. Acid gas generation test - For outer sheath only.

d. For completed cables

- i. Insulation resistance test (Volume resistivity method)



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- ii. High voltage test
- iii. Flammability test as per clause "Flammability test" of IEEE - 383 .
- iv. Flammability test as per IEC - 332 Part-3 (Category -B).
- v. Test for rodent & termite repulsion property.

ii) Flammaability Test

1. This test shall generally be carried out as per IEEE 383. The cable installation to be tested shall consist of as many cables as are necessary to give atleast 10 kg of organic material per metre run.
2. The following cable installation shall be tested :
Installation with single / multi core cables in touching formation.
3. Size of cables, number of cables, number of layers and laying arrangements for each installation shall be subject to Owner's approval.
4. The size of the cables selected (measured by total cross sectional area of the conductor) shall have maximum organic material per sq. mm of total cross sectional area of all the conductors.

iii) Acceptance Tests

Acceptance tests shall be carried out on each type and size of the cables on the cable drums selected at random as per following sampling plan:

Sl.no	No. of drums in the lot	No. of drums to be taken as sample
	Upto 100	10% (Subject to minimum of 1 drum)
	101 to 300	13
	301 to 500	20
	Above 500	32

The following shall constitute acceptance tests:

1. Item No. 1 to 14, 16, 19, 20, 22, 23, 24, 25 of list of type tests specified in clause 2.2.15.5.1.



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2. Fire resistance test as per SS 4241475 (F3 category).
3. One length per size / lot for surface finish and length measurement.
4. Lay length / sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Band marking.

iv) Routine Tests

Routine tests shall be carried out as per relevant standard for each drum of cables of all types and sizes.

Cabling System



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2.2.17 CABLING SYSTEM

2.2.17.1 SCOPE OF WORK

The scope of work covers supply, erection, testing and commissioning of complete electrical system including cabling, fire stop mortar seal, fire retardant cable coating system etc. the scope shall broadly cover, but not be limited to:

- i) TG Building & Transformer Yard
- ii) Boiler Area, ESP
- iii) All auxiliary buildings (including electrical rooms of respective buildings) and structures as per details in the general electrical specification/ plot plan & related drawings.
- iv) Service Building
- v) CPU Regeneration
- vi) DG House
- vii) Pipe cum cable rack (within the battery limits).
- viii) Air Washer Units
- ix) All electrical equipment as described in different sections.
- x) As built drawing for all above systems on completion of project.

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

2.2.17.2 SCOPE OF SUPPLY

- 1 The scope of work shall include complete supply, installation, testing, commissioning and putting into successful commercial operation of the cabling system for the entire plant covering all indoor & outdoor areas of BTG area.
- 2 The equipments and materials within the scope of supply shall include but not limited to
 - i. Power & control cabling works (including that of special cables):
Supply and installation of cable and cable trays/raceways, supports, conduits, duce bank, cable accessories such as jointing/termination kits, cable glands, lugs, ferrules, etc. as required for all the systems & equipments.
 - ii. Supply and installation (including laying & termination) of control cables, special cables, instrumentation cables for all equipments and systems.



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- iii. Supply and installation (including laying & termination) of all power cables (HV and LV) of all power cables (HV and LV) for all equipments and systems.
- iv. Cable routing has to be planned such that it shall not cross the steam lines, oil lines.
- v. Fire Sealing Arrangement: All cable entries into the panel (HV & MV & LV SWGR panels) should be provided with fire sealing arrangements.
- vi. Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be seated by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire
- vii. Galvanized steel rigid/ flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts & bolts etc as required.
- viii. All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
- ix. 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 Bidder without any extra charge to the purchaser.

2.2.17.3 CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.
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IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubular and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:9537	Conduits for electrical installation.
IS:9595	Metal – arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 3.3kv up to and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

2.2.17.4 DESIGN AND CONSTRUCTIONAL FEATURES

1 Inter Plant Cabling



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Interplant cabling for main routes shall be laid along overhead trestles/duct banks. However, from tap-offs, same can be through shallow trenches with sand filling. All the switchgear room shall be provided with cable spreader room at ground floor. The cable trenches are allowed between switchyard control room and transformer yard only. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering.

2 Transformer yard

In transformer yard cables shall be laid in RCC concrete trenches with RCC covers. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles/duct banks. Minimum clear height of trestle shall be 3 m and for Rail/road crossing, it shall be as per rail/road crossing norms. False floors are not to be provided for cabling purpose.

3 Cable entry

Cable entry from outdoor underground/cable routes to the buildings, if any, shall be above the finished floor level of the building.

All Buildings shall have suitable cable spreader rooms /cable vaults.

4 Trenches

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

No sub-zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant areas.

All field switches for equipments corresponding to a stream located within a radius of 4-5 m shall be wired out to a field junction box and from field junction box to control panel/Input – Output cabinet by screened instrumentation cables.

Cable trenches shall be provided in Transformer Yard and Switchgear/MCC rooms. In other areas local cable trenches with length not exceeding 5 metres are allowed just near the equipment.

Cables for one set of auxiliaries such as ID,FD & PA fans & half of the coal mills shall be routed in one route & for through other set of auxiliaries through other route.

Bidder shall provide two independent routes for cables between Switchyard Control Room & Main Plant Control Room. Bidder shall provide the cable trays along with its supporting structure arrangement on the trestle.



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5 Cable Vault:

- i) Cable vault of not less than 3.5 metres clear height shall be provided.
- ii) Clear access passage of at least 750 mm wide & 2.0 Mts clear height shall be provided at entrances & along cable ways. Wherever the passage is through cable routes clear height shall not be less than 1.5 Mts.
- iii) Cable vaults shall be provided with adequate drainage facility for drainage of fire water.
- iv) Each cable vault should have two fire proof doors.
- v) Exit signs shall be provided near doors for personnel escape in case of emergency.

- 6 Major routes in Turbine area (STG Package area) shall be on overhead cable trays either supported from available structures, building structure. Only in specific areas as shall be approved by purchaser/consultant where number of cables are too small compared to the route length and in transformer yard, cable shall be routed in cable trenches.

2.2.17.5 EQUIPMENT DESCRIPTION

Cable trays, Fittings & Accessories

- 1 Cable trays shall be ladder type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.
- 2 These shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.
- 3 Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm.
- 4 Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.
- 5 Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000 mm unless design is approved for larger span. Cable trays shall be suitable for a cable weight of 100 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively. The



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amount of zinc deposit shall not be less than 610 gm per square meter.

- 6 Cable trays fabricated from standard rolled sections shall be 50x50x6/75x75x6 sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32x6 mm / 50x6 flat for widths up to 500mm/more than 500mm respectively.
- 7 Separate coloured paint strips 2 inch width each numbers equally spaced at 5 metres interval shall be applied for identification of different type of trays depending upon types of usage/applications/area as below:

High/ medium voltage cables:

11kV/6.6kV : red strips

1.1kv power cables : yellow strips

1.1kv control cables : blue strips

Instrumentation cables : green strips

8 **Support System for Cable Trays**

Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types:

- (i) C1:- having provision of supporting cable trays on one side and
- (ii) C2:- having provision of supporting cable trays on both sides. The support system shall be the type described hereunder
 - a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.
 - b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanised.
 - c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of



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- the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
 - e. The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
 - f. Cantilever arms of 300 mm, 600 mm and 750 mm in length are required. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
 - g. Cable trays in areas subjected to excessive coal dust or mechanical damage shall have hot dip galvanized sheet steel metal trays cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run with consideration for ventilation.

The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above are indicative only. Nevertheless, the support system shall be designed by the contractor to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Contractor without any additional cost. The contractor shall submit the detailed drawings of the system offered by him along with the bid.

9 FRP CABLE TRAYS

FRP Cable trays shall be used for areas like intake raw water pump house, Desalination plant, CHP, Battery room, NDCT and chemical house.

Cable trays shall be of ladder / perforated type complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows, etc. shall be of FRP.

The FRP cable tray shall be ultra violet resistant. FRP cable trays shall be manufactured in accordance with NEMA FG-1-1984-1993 and Standards IS-6746 and ASTM E 84. Manufacturing process shall be pultrusion using automated pultrusion machines. Resin to be used shall be ultraviolet resistant polyester resin.



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All cable trays and accessories shall be corrosion / chemical resistant, weather resistant, easy to drill and cut. Lightweight, high strength and flame retardant in accordance with ASTM E-84-Class 1 Rating and as per IS-6746-Very Low Flammability. An additive material shall be mixed with the FRP to make them resistant to ultraviolet light. The oxygen index shall be minimum 30 as per ASTM-D-2863.

The minimum glass content in the FR material shall be 55%.

The Ladder type trays shall have side rails and horizontal rungs. Both of these shall be of same material i.e. the FRP with additive material. The rungs shall be placed 300 mm apart from each other. The side runner of the Ladder type FRP cable trays shall be pultruded FRP channel of 100 x 35 mm height. The minimum thickness of the tray will remain 4mm. The rungs to side member are connected to the Larger portion of the side rail by using pin made of fiberglass reinforced thermoplastic, and should have both mechanical and adhesive lock.

Minimum thickness of perforated type FRP cable tray shall be 4mm. Minimum thickness of coupler plates shall be 4mm.

HV, MV and LV power single core cable shall be laid in trefoil formation with 2D gap where 'D' is the diameter of cable.

HV & MV cables and LV power cables (95 sq. mm & above) multicore cables shall be laid in touching formation in single layer. 1100V multicore cables below 95 sq. mm shall be laid in two layers. Control and instrumentation cables shall be laid in 3 layers.

- i) Individual tray systems shall be established for the following services: -
 - a) 6.6 kV and higher voltage power cables.
 - b) 415 Volt power cables.
 - c) Special noise-sensitive circuits or instrumentation cables.
 - d) Control cables. (Control cables shall be laid along with LV power cables and instrumentation cables if required for short length near the equipment with GI separators).
 - e) Further subdivision of tray systems shall be provided if required to meet special segregation/separation requirements.
- ii) In areas having coal dust, cable trays shall be run in vertical formation while horizontal trays shall be provided in other areas. Cable depth not to exceed two cables for vertical trays.
- iii) The minimum design vertical spacing for trays shall be 300 mm measured from the bottom of the upper tray to the top of the lower tray. At least a 250 mm clearance shall be maintained between the top of a tray and beams, piping, or



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other obstacles to facilitate installation of cables in the tray. A working space of not less than 600 mm shall be maintained on at least one side of each tray. Tray covers shall be provided on the top most tray of each tier of cable trays.

10 Pipes, Fittings & Accessories

Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

GI Pipes shall be of medium duty as per IS: 1239

Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

11 Junction Boxes

Junction Boxes shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

Glass Fibre Reinforced Junction Boxes No. of Ways: 12/24/36/48 with 20% spares terminals.

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 D635/UL 94 VO. Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance shall be between – 10 to 100°C. Impact resistance shall be greater than 7 Nm, (EN 50014). 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 power coated (preferably in RAL7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.

Protection Class

Protection Category shall be IP 66 to EN 60529. There shall be guaranteed perfect seal to meet Protection class IP 66 providing 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 years. Contractor shall indicate this in data sheet. The rubber seal should be pasted at its



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place with pasting technology for like more than 20 years (double sealing arrangement is preferred).

Mounting clamps and accessories

Junction boxes shall be 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 plates etc. of steel shall be powder coated. The support rails for terminal box shall be zinc coated.

General

1. JBs shall have small canopy at the top.
2. There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage into the junction box shall be avoided and it shall fall outside.
3. Cable entry shall be from bottom side only.
4. Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

Steel Junction Boxes

No. of Ways 12/24/36/48 with 20% spares terminals.

Junction boxes shall be designed in accordance with NEC, article 370, paragraph 18, 19 & 20 or equivalent standards.

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 electrostatically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M6) shall be provided on the cover as well as door. The sheath steel thickness shall be more than 2 mm.

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

Junction boxes shall be provided with two nos. earthing terminals (externally available) suitable for connection of 8 SWG G.I. wire. Knockouts shall be provided at bottom and both sides. These shall be provided by fixing plates in order to make



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them detachable type with suitable neoprene gaskets. Bottom and side plates for cable/conduit connection shall be provided. All unused holes shall be sealed with suitable grommets.

Junction boxes shall be provided with external designation label. The label inscriptions shall be informed to the Contractor by the Owner. Junction boxes shall be provided with danger sign in case of 415V circuit.

Junction boxes shall be of two types, viz. One suitable for control cabling and the other suitable for power cabling.

Junction boxes for control cabling shall have 24 way/ 48 way terminal blocks suitable for up to 2.5 sq.mm. Cu. Cable. However, for instrumentation junction boxes there shall be 24/48 ways suitable for terminating cable of 0.5 sq.mm. Cu. Cable.

Junction boxes for power circuit cabling shall be suitable for 1 no. 3 core 16 sq.mm.AL. Incoming cable and 1 no. 3 core 2.5 sq.mm Cu. Outgoing cable.

12 Terminal blocks

Terminal blocks shall be 650 volts grade, rated for 10 Amps and in one piece, rigid, Bakelite moulded, with disconnecting /shorting link. It shall be complete with insulating barriers, Klip-on-type terminals and identification strips, terminal studs, washers, nuts, lock nuts, marking strips etc.

Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be Elmex type CSLT-1 with insulating material of Melamine conforming to ESI Standard 12.1 or equivalent. Cage clamp type terminal block suitable for terminating 2 wires of 2.5 sq mm. on both sides arranged to facilitate easy termination shall be provided. 20% spare terminals shall be provided

13 Terminations & Straight through Joints

Termination and jointing kits for 11/6.6 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 11/6.6 kV grade joints and terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solder less crimping type cable lugs & ferrule as per DIN standard.

Straight through joint and termination shall be capable of withstanding the fault level for 33kV, 11 kV and 6.6 kV systems.



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1.1 KV grade straight through joints shall be of proven design.

14 Cable glands

Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality. Necessary cable dimensions shall be furnished to the successful contractor.

Cable glands shall be single compression for indoor use, double compression type for outdoor use. Glands for classified hazardous areas shall be double compression type flameproof and weather proof duly certified by CMRS and approved by CCE.

15 Cable lugs/ferrules

The cables lugs shall be conforming to IS: 8309.

Machine ferruling shall be adopted.

Cable lugs for power cables shall be Aluminium solder less crimping type suitable for aluminium compacted conductor cables.

The cable lugs for control/instrumentation/ telephone cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.

Cable lugs shall be suitable for termination of different cross-sections of control/instrumentation/telephone cables and shall be of following types.

- i) Copper tubular terminal end for solder less crimping to copper conductors.
- ii) Cable lugs for control cable termination shall be insulated type. These lugs shall be flat type/ring type/U type to suit the terminals provided in the panel.
- iii) Pin type lugs shall not be used.
- iv) Aluminium tubular terminal ends for solder less crimping of Aluminium conductor. Solder less 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.



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16 Cable Clamps & Straps

The cable clamps required to clamp multicore cables on vertical runs shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables on horizontal trays, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.

Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the system short circuit current of 105 KA peak.

17 Galvanizing

Galvanizing of steel components and accessories shall conform to IS: 2629 & IS: 2633. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots

The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

18 Welding

The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595

2.2.17.6 INSTALLATION

1 Cable tray and Support System Installation

Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures. All cable trays shall be in vertical configuration in boiler, CHP & ESP areas. Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 1500 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per relevant Standard. The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant



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approved tray layout drawings.

All cable way sections shall have identification, designations as per approved cable way layout as and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/ stenciled with identification numbers at every floor.

In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Contractor shall fabricate at site suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining owner's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

2 Conduits/Pipes/Ducts Installation

- (a) The Contractor shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.
- (b) GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.
- (c) Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.
- (d) Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 150 to the trench wall. In case of larger dia cables i.e. 50mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Site Engineer.
- (e) Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise



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Conduit /pipe size (dia).	Spacing
Up to 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm	3.0 M

- (f) In areas like WTP, chemical handling, battery room etc. exterior surface of the conduits shall be further coated with chromate or polymer for better resistance to corrosion.
- (g) All G.I. pipes shall be laid as per approved layout drawings and site requirements.
- 1 Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. The bends formed shall be smooth. GI Pipes with bends shall be buried
 - 2 in oil/concrete in such way that that the bends shall be totally concealed. For GI pipes shall be undertaken well before paving is completed and necessary co- ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the contractor at no extra cost.

3 **Junction Boxes Installation**

Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the approved drawings or as decided by Owner and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

4 **Cable Laying and Installation**

- 1) Cable network shall include power, control, lighting, communication and fire alarm system cables, which shall be laid in trenches, cables trays/conduits as detailed in the approved drawings and cable schedules. Erection of cable trays and aligning and leveling as required shall be the responsibility of the contractor.
- 2) Cable installation shall be carried out as per IS: 1255 and other applicable standards.



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- 3) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.
- 4) Laying of cables directly buried in ground is not acceptable.
- 5) For coal handling plant the cables shall not be routed along conveyor galleries. The cables shall be routed on independent cable trestles. All tray levels shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings. The contractor shall have to secure rack/tray supports by welding to those inserts or other available building steel surfaces. Outdoor trays shall be installed by welding on the steel/concrete structure with inserts by the contractor. 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.
- 6) While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.
- 7) All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all cables shall be tapped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted.



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- 8) Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls columns. Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.

5 Laying of cables in cable trays

- 1) Cables shall be laid on cable trays strictly in line with cable schedule furnished. Where specific cable layouts are not shown on approved drawings, contractor shall route these as directed by the Owner.
- 2) Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.V. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. LT power cables above 95 sq.mm size shall be laid in single layer touching formation in trays while cables upto & including 95 sq.mm shall be laid in maximum of 2 layers. Control and Instrumentation cables can be laid upto a maximum of three layers in each tray.
- 3) All communication cables (telephone, P.A. System) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench/trays with a minimum clearance of 600mm away from electrical trench/trays as per the direction of Site Engineer and Communication cables shall cross power cables at right angles
- 4) Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.

Bending radii for cables shall be as per manufacturer's recommendations and IS1255.

- 5) Individual cables or small groups which run along structures/walls etc will



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be clamped by means of 16 SWG GI saddles on 25x6mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables. Alternatively small group of cables can be taken through 100mm slotted channel/ISMC 100. They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be drilled where the minimum weakening of the structure will result.

- 6) Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300mm for cables upto 25mm diameter and maximum 500mm for cables larger than 25mm dia and cables laid in vertical run of cable trays shall be clamped at an interval of 900mm.
- 7) Where cables cross roads/rail tracks, the cables shall be laid in Hume pipe/PVC pipe.
- 8) At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.
- 9) Power and Control Cables, as far as possible, shall be laid in complete, uncut lengths from one termination to the other. Straight through joints in power cable shall be allowed only in nearest of rare situation only after approval of owner.
- 10) Joints for less than 250 Meters run of cable shall not be permitted.
- 11) In each cable run some extra length shall be kept at suitable point to enable one LV/two HV straight through joints to be made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
- 12) Wherever few cables are branching out from main trunk route troughs shall be used.
- 13) Cables shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the contractor.
- 14) The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of



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cable laying, cable drum schedule shall be prepared by electrical contractor and get that approved by site engineer to minimize/avoid straight through joints. The actual number of straight through joints required shall be worked out by the contractor. During the erection period the contractor shall furnish a monthly report on cable position in an approved proforma so as to keep the owner apprised of the position.

- 15) The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
- 16) Minimum number of spare cores required to be left for interconnection in control cables shall be as cl.3.07.00, chapter 16. Electrical cable trays exposed to hazardous process fluid shall be covered with detachable G.I. covers. The covers shall be suitable to resist wind forces.
- 17) For cables laid above ground in cable racks, asbestos sheeting of 3mm thickness shall be provided below the bottom cable tray to protect the cables from fire.
- 18) Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.
 - a) Separation
 - b) Sufficient spacing not less than 300 mm shall be provided between different tiers of trays and the same shall be maintained to permit adequate access for installation and maintenance of cables.
 - c) At least 300mm clearance shall be provided between HV power & LV power cables, LV power & LV control/instrumentation cables,
 - d) Segregation
 - e) Segregation means physical isolation to prevent fire jumping.
 - f) Cables from two different services viz. supply from Station Board and Unit Board shall be segregated.
 - g) Interplant cables of station auxiliaries and unit critical drives shall be



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segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

- h) For Coal Handling Plant all the cables of one stream shall be segregated from the cables of the other stream and shall run on either side of the trestle.

6 Cable fire sealing

- i) Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.
- ii) Wherever the cables/cable trays pass through walls/floors, fire proof cable penetration seals rated for one hour shall be provided. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-20) or equivalent standard.
- iii) In order to prevent fire propagation through cable penetrations, after laying, dressing & clamping of cables, all the openings shall be properly sealed by using Fire Stop Mortar Seal and Fire Retardant Cable coating compound. Also the cable runs both before and after the fire scale shall be suitably sprayed with anti-fire propagation liquid.

7 Cable laying in trenches between switchyard and Transformer yard

- 1 RCC cable trenches with removable covers will be provided by the contractor. Cables shall be laid in 3 or 4 tiers in these trenches. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases. RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. Removal of concrete covers for purposes of cable laying and reinstating them in their proper positions after the cables are laid shall be done by the contractor at no extra cost.

For cable trays are laid in trench in more than two tiers a space of minimum 600 mm shall be available for maintenance. In case two or



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more tiers of cable trays are running parallel along both sides of trench walls there shall be space of minimum 600 mm between them.

Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cable leaving trenches shall be coiled and provided with a protective pipe or cover till such times the final termination to the equipment is completed.

- 2 Prior to laying of cables inside trenches, the contractor shall properly clean inside of those trenches.
- 3 When cables are laid in multiple tiers, spacing between individual tiers shall be as approved by Site Engineer. Space between individual tiers shall be filled and compacted with soil and sand.
- 4 As each row of cables is laid in place and before covering with sand every cable shall be given on insulation test in the presence of Site Engineer. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.
- 5 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.
- 6 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 150mm above grade.
- 7 Cable ends shall be carefully pulled through the conduit, to prevent damage to these cables. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.

Following guide of the pipe fill shall be used for sizing the pipe size:

1. 1 Cable in pipe - 53% full
2. 2 cables in pipe - 51% full
3. 3 or more cables - 43% full
4. Multiple cables - 40% full.

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/'PUTTI' for sealing purpose. Alternatively, G.I. Lids or PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. pipe and



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no separate payment shall be allowed.

- 8 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Site Engineer before cutting is done.

2.2.17.7 CABLE IDENTIFICATION

1. 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 & exit, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties of 'TY-CAB' or equivalent type with cable number heat stamped on the cable tags.
2. If laying of underground cable is specifically agreed by Owner as a special case then the underground cables shall be provided with identity tags of Stain less steel securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas cable trenches shall be identified by means of markers. These posts shall be placed at location of changes in the direction of cables and at intervals of not more than 30 M for straight run and at cable joint locations with additional inscription 'Cable Joint'. For buried cables the marker shall project 150mm above ground.
3. Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

2.2.17.8 CABLE TERMINATIONS & CONNECTIONS

1. The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer'' instructions, drawings and/or as directed by Site Engineer. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.



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2. Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Engineer in charge of TANGEDCO.
3. Responsibility of proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by the contractor.
4. The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.
5. Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. If the cable end box or terminal chamber provided on the equipment is found unsuitable and requires major modifications the same shall be carried out by the contractor at the discretion of the Engineer- in-Charge.
6. Control cable cores entering control panel/switchgear/MCC/ miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
7. The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similarly ferrules with a suffix letter 'S' alongwith cable numbers and coiled up after end sealing.
8. All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
9. It is the responsibility of the Contractor to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.
10. All cables upto 1.1KV grade shall be terminated at the equipments by means of compression type cable glands. They shall have a screwed



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nipple with conduit electrical threads and check nut.

11. All cable entries shall be through bottom only and top entry terminations are made only after getting approval of Site Engineer.
12. Power cables, wherever colour coding is not available, shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.
13. In case of control cables all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules. Wire numbers shall be as per schematic/ wiring/ inter-connection diagram. Contractors shall have the samples of PVC markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends. Control cables shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
14. Where threaded cable gland is screwed into threaded opening of different size, suitable brass threaded reducing bushing shall be used provided.
15. The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals. In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom, close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.
16. Cable leads shall be terminated at the equipment terminals by means of crimped type solder less connectors. Crimping shall be done by hand crimping/hydraulically-operated tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open the terminals.



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17. All cable entry points shall be properly sealed and made dust and vermin 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.

18. Cable accessories for H.V. Systems

1. The H.V. cables terminations/joints shall be done by skilled, certified and experienced jointers duly approved by the Site Engineer.
2. The termination and straight through joint kits for use on high voltage system shall be suitable for the type of cables offered by the contractor or the type of cables issued by owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction shall be included in each kit.
3. The termination kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/motor. The termination kits shall preferably be as of the following types.
 - a. 'PUSH ON' type for LV cables.
 - B Heat-shrinkable sleeve type for LV & HV cables.However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner.
For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.
4. The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.
 - a. 'TAPEX' of M-seal make or equivalent for LV cables
 - b. Heat-shrinkable sleeve type for LV & HV cables.However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner. For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

2.2.17.9 QUALITY ASSURANCE PROGRAMME

Contractor shall furnish detailed Quality Assurance Programme and Quality Plans for all materials and accessories to be supplied and installed under the



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scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

2.2.17.10 LIST OF TESTS TO BE CONDUCTED

1 Type tests on Cable Trays support system

a) Test 1A

On main support channel type-C2 for cantilever arms fixed on one side only.

A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per appropriate fixing arrangement. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the following load intervals and other necessary points:

- a) Working load
- b) Working load + point load
- c) Off load
- d) Proof load + point load
- e) Off load

The deflection measured at working loads shall not exceed 16 mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

- b) Test 1B:** Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2

On Main support channel type -C2 for cantilever arms fixed on both sides

- a) Test 2A:** A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per appropriate fixing arrangement. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load



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of twice the working load on all the arms; deflection shall be measured at the following load intervals and other necessary points.

- i) Working load
- ii) Working load + Point load
- iii) Off load
- iv) Proof load + Point load
- v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

- b) Test 2B:** The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

- c) Test 3: Tests on Channel Fixed on Beam/Floor**
A length of main support channel section shall be fixed to steel structure/floor and have loads applied as detailed below and other important points not mentioned herein.

- c) Test 3A** A length of steel structure shall be rigidly supported it should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.

- d) Test 3B** With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.

- e) Test 3C** With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line. The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.



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- d) Test 4 Channel nut slip characteristics (what ever applicable)

Tests 4A1, 4A2, 4A3:

A length of channel C1 section 200 mm long shall have fitted bracket with the two bolts fixing. With loads applied at the appropriate position nut slip shall be determined with bolt torque of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting. A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

Tests 4B1, 4B2, 4B3:

The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing. With loads applied at the appropriate position, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting. A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 6 NM

Test 5 Weld Integrity Test

After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any. Cable termination kit and straight through joints should have been tested as per IS: 13573 for 6.6kV and 11kV class. Fire proof Cable Penetration system should have been tested for the following tests:

- a) Accelerated Ageing test
- b) Water absorption test
- c) Fire rating test
- d) Hose Stream test
- e) Vibration test followed by fire rating test

2 Routine/ Acceptance Tests

Following routine/acceptance tests shall be carried out on all the equipments, devices & materials supplied:

a) Galvanizing Tests

The quality of galvanizing shall be inspected visually and shall be smooth, continuous, and free from flux stains.

- i) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.



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- ii) The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplated areas, blisters and modules.
- iii) In addition, the plating thickness shall be determined microscopically/chemically or electronically.

3 Welding

The quality of welding shall be visually inspected, particular attention being paid to the following points.

- 1) The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.
- 2) The weld metal shall be properly fused with the parent metal without undercutting.
- 3) The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.
 - 1. Physical and dimensional checks for all items.
 - 2. All conduits/pipes, etc. shall be routine/acceptance tested as per relevant standards.
 - 3. All acceptance and routine tests on cable glands as for BS: 6121. Additionally Proof torque test shall be carried out as acceptance on each body group of cable glands.
 - 4. Deflection test cable trays.
 - 5. All acceptance and routine tests on Junction boxes.
 - 6. Following tests shall also be carried out on each type of equipments, devices and materials/items supplied:
 - 1) Physical and Dimensional checks
 - 2) Check/measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs.
 - 3) Check chemical composition of brass parts for cable glands.
 - 4) Hardness check on gaskets.
 - 5) Test for uniformity of galvanization.

4 Cable trays / supports and accessories

- 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.
- 2) Check for continuity of cable trays over the entire route.
- 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
- 4) Check for earth continuity

Earthing and Lightning Protection System



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2.2.18 EARTHING AND LIGHTNING PROTECTION SYSTEM

2.2.18.1 Earthing System

2.2.18.2 Scope

- ii. The Contractor shall provide all required material and carry out main earth grid, treated earth pits, raisers and inter connections, equipment earthing, interconnection to the existing, BOP area earth mats etc. for the following areas and all areas/buildings/structures including but not limited to:
 - a) Main Plant Building (TG Building)
 - b) Boiler Area, ESP area, Circulating water system, DG room & other electrical systems.
 - c) Service building
 - d) Air washer room
 - e) Transformer yard
 - f) All other miscellaneous building not mentioned herein but in BTG supplier scope.
- iii. Earthing system shall consist of earth grids and electrodes buried in soil in the plant area, embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons. The earthing system shall conform to IS 3043 and Indian Electricity Act/rules.
- iv. The Contractor shall furnish the detailed design, layout and calculations for Owner's approval. Contractor shall obtain all necessary statutory approvals for the system.

2.2.18.3 Codes and Standards

- i. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards / codes as applicable.
- ii. Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed below. In such a case, the Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
POWER PROJECT STAGE III**



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- | | | |
|-----|---------------------------|---|
| 1. | IS:513 | - Cold rolled low carbon steel sheets and strips |
| 2. | IS:802 | - Code of practice for the use of Structural Steel in Overhead Transmission Line Towers |
| 3. | IS:1079 | - Hot Rolled carbon steel sheet & strips |
| 4. | IS:1239 | - Mild steel tubes, tubular and other wrought steel fittings |
| 5. | IS:1367 Part-13 | - Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners) |
| 6. | IS:2309 | - Code of Practice for the protection of building and allied structures against lightning |
| 7. | IS:2629 | - Recommended practice for hot dip galvanising of iron & steel |
| 8. | IS:2633 | - Method for testing uniformity of coating on zinc coated articles |
| 9. | IS:3043 | - Code of practice for Earthing |
| 10. | IS:6745 | - Methods for determination of mass of zinc coating on zinc coated iron & steel articles |
| 11. | IS:9595 | - Metal – arc welding of carbon and carbon manganese steels – recommendations |
| 12. | IEEE:80 | - IEEE guide for safety in AC substation grounding |
| 13. | IEEE:142 | - Grounding of Industrial & commercial power systems |
| 14. | Indian Electricity Act. | |
| 15. | Indian Electricity Rules. | |

2.2.18.4 Design Criteria

1. Fault Current & Duration



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Earthing system network/earth mat shall be interconnected mesh of mild steel rods buried in ground in the plant. For earth mat design, the size of earthing conductor shall be calculated considering maximum fault current 50 kA for duration of 1 second and corrosion factor. The maximum permissible step and touch potentials shall be calculated in accordance with the formula, given in IEEE-80.

2. Conductor Material

- i. The earthing system conductors and accessories as proposed are to be as:
 - (a) Conductors above ground level and in trenches : Galvanized steel
 - (b) Conductors buried in ground or embedded in concrete : Mild Steel
 - (c) Electrodes : GS Pipe / Rod
- ii. The contractor shall undertake the soil resistivity measurements at site and shall select suitable type of conductors.
- iii. The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects.

3. Size of Conductors

The minimum sizes of earthing conductors for various electrical equipments shall be as below:

Sl.No	Equipment	Earth Conductor buried in earth	Earth conductor above ground level & in built up trenches
1.	Main earth Grid	40 mm dia. MS Rod	---
2.	Transformeryard	40 mm dia. MS Rod	---
3.	Switchyard	40 mm dia. MS Rod	---
4.	Power Transformer		75 x 10 mm GS Flat
5.	11kV / 6.6 kV / 415 V Switchgear / Equipment	---	75 x 10 mm GS Flat
6.	415 V MCC / Distribution Boards/ Distribuion Transformers	---	75 x 10 mm GS flat
7.	LV motors		
	Above 100 to 200 kW	---	75x10 mm GS flat
	Above 55 KW to 100 KW	---	50x6 mm GS flat



**1X800 MW COAL BASED NORTH CHENNAI THERMAL
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	Above 22 KW to 55 KW	---	50x6 mm GS flat
	Above 5.5 KW to 22 KW	---	25x6 mm GS flat
	Fractional HP LV Motors	---	8 SWG GS Wire
8.	Control panel & Control Desk	---	50x6 mm GS flat
9.	Push Button Station / Junction Boxes	---	8 SWG GI Wire
10.	Column, Structures, Cable tray, fence , gate and busduct enclosures	---	50x6 mm GS flat
11.	Crane, Rail, Rail tracks & other non-current carrying metal parts	---	50x6 mm GS flat

4. Soil Treatment to lower Resistivity

The soil resistivity study shall be carried out by the contractor. In order to reduce the resistivity of the soil the earth pits shall be treated with high purity electrically conductive material having ultra-low resistance value (typically, 0.001 ohm-m). The properties of the material shall be such that it does not require periodic re-watering or recharge of salt or earth enhancing compound during the life of the power plant. The material should be such that it does not reach chemicals into the adjacent soil or underground water channels and should be PH neutral. Earth enhancing material should permanently protect the encased metal components of the earthing systems. Earthing electrodes encased in high strength concrete mixed with the conductive material shall be preferred instead of electrode buried directly in the earth.

5. Rod Electrodes

Galvanized steel pipe/rod electrodes of suitable diameter and length shall be used as per the recommendation of IS-3043. For test pits electrodes shall be heavy duty type (Class – C) GI pipe of suitable diameter with perforations. For treated earth pits, GI pipe shall be provided as per IS 3043 including charcoal, salt etc. Necessary number of treated earth pits shall be provided for UTs, UATs in the transformer yard and other UATs in the main power house building and for all LT transformer Neutral & body earthing. Electrodes installed in the test pits will have disconnecting facilities.

6. Earthing of Electrical equipment on cranes and travelling machines



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- i. Every electrical equipment shall have double earthing. A ring earthing system shall be provided within the crane/machine to which electrical equipment shall be connected at least at two places.
- ii. The earth ring on the crane/machine shall be connected to the plant earthing system through gantry rails. Two sets of earth collector brushes shall be provided on each side of crane/machine to connect its earth ring to the gantry rails. Each end of each gantry rail shall be bonded to the plant earthing system.
- iii. In addition, intermediate earthing bond shall also be provided on the rails at every 60 m in case of longer tracks. Flexible copper bonds shall be provided across any gap in the running gantry rails. For mobile equipment with flexible cables, one separate copper conductor of adequate size shall be provided for earthing.

7. Equipment Earthing Leads

The size of the earthing leads shall be decided based on the type of equipment and structure to be earthed and shall be provided generally as per IS-3043.

2.2.18.5 Earthing System Layout

1. General

- i. Metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, structures in contact with switchyard earth, lightning protection system conductors and neutral points of various systems shall be connected to a single earthing system.
- ii. All the offsite areas shall be interconnected together by minimum two parallel conductors.
- iii. Crane rails, tracks, metal pipes and conduits shall be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing lead ensured by bonding the different sections of hand rails and metallic stairs.
- iv. For all other equipments, two earthing leads shall be used if rated voltage of equipment is above 250V. In case the rated voltage is 250 V or below, one earth lead can be used. Metallic structures adjacent to electrical equipment shall be earthed by one earthing lead.
- v. Earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm.



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- vi. Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 metre. Wherever earth mat is not available Contractor shall do the necessary connections by driving an earth electrode in the ground.
- vii. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable .
- viii. The cable sheaths, screens armour shall be earthed at both ends for multi-core cables. For single core cables the same shall be done at one end (switchgear end) only.
- ix. Electronic earthing shall be provided as per relevant international standard for all control systems (such as DDCMIS,PLC,SAS,EDMS,etc.,). For electronic equipment chemical earthing pit shall be provided. The earth pit shall be tested and type proven and shall be guaranteed for service life of 40 years. The chemical earth pit shall comprise pipe electrode,crystalline conductive mixture, bentonite, etc., constructed in a pit of not less than 4000mm depth. The pit shall be effective in all weather conditions and offer medium resistance. For electronic earthing system, earthing conductor shall be copper.
- x. Neutral of Service transformers shall be earthed through minimum of 400 sq.mm single core cable through two numbers treated earth pit and return shall be connected to station earth grid.
- xi. LV Neutral points of the following transformers shall be connected to Neutral Grounding Resistors(NGR). NGR shall be connected to earth through two numbers treated earth pit.
 - a) Unit transformers
 - b) Station Transformer
 - c) Unit , station and other Auxiliary transformers
- xii. Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- xiii. Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and switchgear end, Sheath and armour of single core power cables shall be earthed at switchgear end only.
- xiv. Earthing conductors along their run on cable trench, ladder, walls etc., shall be supported by suitable welding/cleating at intervals of 1000mm. Wherever it passes through walls, floors etc., pipe sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.



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- xv. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations.
- xvi. Electronic panels and equipments shall be grounded utilizing an insulated copper ground wire terminated at separate earth electrodes.

2. Earthing Conductor layout

- i. Main earthing conductors shall be laid in the form of a grid. Spacing between conductors, number of parallel conductors, etc., shall be decided such that step and touch potential are within safe limits.
- ii. The maximum permissible step and touch potentials shall be calculated in accordance with the formula, given in IEEE-80.
- iii. Earthing conductors shall be provided around the outside edge of fence at a distance of approximately 6000 mm. This shall be connected to the main earthing grid.
- iv. Grounding conductor around the building shall be buried in earth at a minimum distance of 1200 mm from the outer boundary of the building.
 - i. Every alternate post of the fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post.
 - ii. Each of the earth leads of transformer neutral, lightning arrester shall be directly connected to two separate electrodes. Neutral points of HV transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors Lightning protection down conductor shall be directly connected to a separate earth electrode.
 - iii. All earth electrodes in turn shall be connected to main earthing system. The earth grids of different areas of the plant shall be interconnected through, test pits to enable measurement of earth resistance for each area separately.
 - iv. Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm.
 - v. Earth pit shall be constructed as per IS: 3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be atleast equivalent to twice the length of the electrode.



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3. Earthing Conductors inside the building

- i. Main earthing conductors shall be buried in earth around the building. Minimum two taps-off from this earthing loop shall be taken inside the building and connected to the earthing grid embedded in the floor slab with approximately 50 mm concrete cover. The requirement of electrodes around the building shall be specified.
- ii. In case the building has more than one floor, each floor shall be provided with separate earth grid. These floor earthing grids shall be interconnected.
- iii. Each RCC / Steel column of the building shall be interconnected to the floor earthing grid in the ground floor.
- iv. Instrumentation system and computer system shall be provided with a dedicated earthing system suitable for the equipment. Separate electronic earthing for the PLC equipments, SAS panels and all other equipments wherever necessary shall also be provided.
- v. Earthing grids of all the buildings, outdoor yards shall be interconnected to form a single grid for the plant.
- vi. Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm.
- vii. Suitable earth risers as approved by Owner shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.
- viii. A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trenches, tunnels, underground pipes, foundations, railway tracks etc. The ground grid conductor shall be re-routed in case it fouls with equipment foundations.

2.2.18.6 Earthing System Installation

- i. The spacing between two electrodes shall be at least equivalent to twice the length of the electrode.
- ii. Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively. 8 SWG earth wire should be run along with lighting conduits and shall be earthed at both ends. The wire should be suitable clamped with conduit at equal interval at not more than 500 mm.



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- iii. The earthing conductor crossing the road / track shall be laid in hume pipe or laid at a greater depth to avoid damage.
- iv. When earth conductor passes through floors, walls, etc., suitable pipe sleeves shall be provided and the same shall be sealed after installation.
- v. The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks & splices.
- vi. Cable trays, metal pipes / conduits, steel columns, etc., shall not be used as earth continuity conductors.
- vii. Street lighting poles, flood light poles & towers, their junction boxes shall be connected to the earthing conductor to be run along with supply cable. This earth conductor shall be in turn connected to earth grid at two extreme points.
- viii. Flexible earth conductors shall be provided at expansion joints for earthing the gates, operating handles, etc.
- ix. Equipment bolted connection after being checked and tested shall be painted with anti-corrosive paint / compound be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.
- x. Proper earth connections for cable glands, cable boxes, cable armour, screens, etc. to be provided.
- xi. All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.
- xii. The contractor shall demonstrate the effectiveness of earthing system by measurement of earth resistance, step and touch potential at different locations. Earth resistance at earth terminations shall be measured in presence of Owner's representatives. All equipment required for testing shall be furnished by contractor.
- xiii. Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti-corrosive paint/compound.
- xiv. Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding. The overlapping of earthing conductor in welded joints should be 6 times diameter. Cleats should be



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provided at both sides to increase contact area. Angles/ cleats should be welded at the point of crossing of longitudinal and transverse earthing conductors.

- xv. Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.
- xvi. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Trenches after laying earth rods should be closed with approved filling materials in layers and not with debris.

2.2.18.7 Other Requirements of Earthing System

Life expectancy	40 years
System Fault level	50kA for one second
Minimum Steel corrosion	0.3mm/year (on dia. of conductor)
Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.
Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.

2.2.18.8 Lightning Protection System

- i. The main purpose of lightning protection system are to :
 - Provide protection to structures from lightning strokes.
 - Provide a low resistance-conductive path to lightning discharge.
- ii. Lightning protection system shall be in strict accordance with IS: 2309 for the structures, equipments and buildings within the battery limits.

2.2.18.9 Conductor material

For Lightning protection, material & minimum sizes shall be as follows:

- a. Vertical air termination : 20 mm dia MS rod
- b. Horizontal air termination : 25X6 mm Galvanised steel flats
- c. Down conductor : 25X6 mm Galvanised steel flats
- d. Test link : 150x50x6 mm Galvanised steel Strip with Box
- e. Earth Electrodes : Treated earth pit with pipe electrode as per IS:3043



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The above sizes are indicative only. Actual size shall be arrived at as per design by the Bidder.

2.2.18.10 Lightning Syatem Layout

- i. Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc.
- ii. Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided for the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.
- iii. Suitable lightning protection shall be provided to protect
 - a) Main Power House building as per IS requirement
 - b) Boiler Area, ESP area, DG room, Service building & other electrical systems.
 - c) All other miscellaneous building & electrical systems not mentioned herein but in scope of main plant (BTG) supplier.
- iv. Installation of lightning conductors on the roofs of buildings shall include construction of support, laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / welding of the down comers on the walls / columns of the building and connection to the test links to be provided above ground level.

2.2.18.11 Air Terminations

- i. The vertical air terminal rods shall be installed at the roof of buildings for MCC/Switchgear rooms, ESP Control rooms etc to protect these objects from lightning strokes.
- ii. ii) The projected length of the Air termination rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.
- iii. The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building, the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.
- iv. All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 25 x 6 mm galvanized steel flats. Horizontal air



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termination (i.e. G.S. Flat conductor) shall be so laid that no part of the rod shall be more than nine (9) metres from the nearest roof conductor.

2.2.18.12 Shielding Masts

- v. The shielding mast for lightning protection shall be installed at the top of steel columns cap plates of the associated building.
- vi. The shielding mast shall be made of galvanized steel rod and the height of the same shall be decided considering the zones to be protected.
- vii. Each shielding mast shall be connected to grounding grid by a down conductor 50 x 6 mm minimum. Galvanised steel flat run along the building column. In addition all building columns joints shall be electrically bonded.

2.2.18.13 Down conductors

- i. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.
- ii. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.
- iii. All joints in the down conductors shall be welded type.
- iv. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.
- v. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm.
- vi. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.
- vii. Lightning conductors shall not pass through or run inside GI Conduits.
- viii. Testing link shall be made of galvanized steel of size 25x 6mm.
- ix. Pulser system for lightning shall not be accepted.
- x. Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.



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- x. Lightning protection conductors/ air termination rods and circumferential band provided at the top position of chimney stack shall be lead coated in order to avoid melting by exposure to hot flue gases.
- xii. For tall buildings and structures, early streamer emission (ESE) type, air terminal system is preferred.
- xiii. Horizontal air termination flats provided on top of boilers, main plant building & other buildings shall be laid such that no part of the roof shall be more than 9 metres.
- xiv. Conductors of lightning protection system shall not be connected with conductors of earthing system above ground level.
- xv. Lightning protection shall have as few joint as possible and avoid sharp bends. Down conductors shall have as far as possible, no joint except at test point and end termination.
- xvi. Termination at the metallic equipments on roof should be made by suitable nuts, bolts, pressure washer and bitumen washers with good electrical conductivity.
- xvii. All lightning protection conductors shall be exposed to atmosphere unless specifically mentioned. The lightning protection in the transformeryard shall cover the following equipments in the protection zone.
 - a) Generator Transformer
 - b) Station Transformer
 - c) Unit Transformers
 - d) Auxiliary Transformers
- xviii. All areas of the power station shall be provided with lightning protection. The lightning protection system for buildings shall consist of Air termination network, Down conductors, Test link and earth electrodes.
- xix. Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided over the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.
- xx. For lightning protection, material thickness of galvanizing shall be at least 610 gm / sq.mm for all galvanised steel conductor.



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- xxi. The lightning protection system shall not come in direct contact with other equipment / systems such as cables, conduits, electrical equipment, under ground metallic ducts etc., All metallic structures within vicinity shall be bonded to the lightning protection system.
- xxii. All welded / brazed joints shall be coated with anti-corrosive paints for rust protection.
- xxiii. Lightning conductor when used above ground level and shall be connected through test link with earth electrode / earthing system. Down conductors shall be as short and straight as practical and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level.
- xxiv. Each down conductor shall be provided with attest link at 1500 mm above ground level for testing. But it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. All joints in the down conductors shall be welded type.
- xxv. Down conductors shall be cleated on outer side of the building wall / welded to out side building columns at 750 mm interval.
- xxvi. Lightning conductor on the roof shall be cleated on surface of roof using insulated clamps / saddles for conductor fixing at an interval of 1000 mm for horizontal run and 750 mm for vertical run.
- xxvii. Conductor of the lightning protection system shall not be connected with the conductors of the safty earthing system above ground level.
- xxviii. Installation of lighting conductors on the roofs of the buildings shall include construction of supports, laying , anchoring, fastening and cleating of horizontal conductors, grounding of vertical rods wherever necessary, laying , fastening / cleating / welding of the down comers on the walls / columns of the buildings and the connections to the test links to be provided above ground level.

2.2.18.14 Electrodes (for Lightning Protection)

- i. The electrodes shall be 40 mm diameter 3000 mm long mild steel rod. These shall be driven into the ground.
- ii. All the electrodes shall be interconnected by means of one (1) 40 mm dia mild steel rod which shall be laid under ground at a minimum depth of 1000 mm below finished grade level unless stated otherwise. This ground mats/electrode in turn shall be connected to main grounding grid.



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2.2.18.15 Riser (for Lightning Protection)

All risers connected to grounding mat shall be 40 mm mild steel rods and shall be projected 300 mm above grade level unless stated otherwise.

2.2.18.16 Jointing & Connection

- i. All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode.
- ii. The projected portion of riser above ground shall be coated with two (2) coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.
- iii. The joints in the lightning conductors shall be kept to a minimum and there shall be no joint in the underground portions of conductors.
- iv. All the joints shall be done by arc welding process overlapping of the conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be cleaned properly before jointing.
- v. The portion of galvanized steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanizing anti-corrosive paint after welding.
- vi. The bolted joint of the test link shall be covered with thick coating of bitumen paint after successful testing.
- vii. The air terminal rods and shielding mast shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).
- viii. The steel to copper connection shall be brazed type.
- ix. The lightning protection of inflammable liquid storage tanks wherever required, shall be provided with horizontal conductors strung between tall poles covering the entire zones or with air terminal rods mounted on top of poles/structure. These horizontal conductors/vertical air terminal rods shall be connected to rod electrodes, which in turn shall be connected to station ground mat.

2.2.18.17 Quality Assurance Program

Contractor shall furnish detailed Quality Assurance Programme and Quality Plans for all



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materials and accessories to be supplied and installed under the scope of the specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

2.2.18.18 Inspection and Testing

1. Earth Continuity Checks.
2. Earth resistance of the complete system as well as sub system
3. The earthing and lightning conductors should be type tested as per IS 2669. Following minimum tests shall be conducted.
 - a) Freedom from defects
 - b) Uniformity in thickness
 - c) Mass pf coating
 - d) Adhesion tests
 - e) Any other applicable tests not mentioned in the specification but required.

2.2.18.19 Drawing and Documents

The following drawings and documents shall be submitted for approval during detail engineering stage.

1. Soil resistivity report
2. Design basis report for earthing and lightning protection system
3. Earthing design calculation
4. Typical installation drawings for earthing and lightning protection system
5. Electronic earthing layout and details
6. Earthing layout for Transformer yard
7. Earthing layout for power house building, boiler and ESP.
8. Earthing layout for all auxiliary plant buildings
9. Earthing layout for all non-plant buildings
10. Lightning Protection design calculation and layout



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DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
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DATA SHEET - A



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DATA SHEET FOR DOUBLE GIRDER EOT CRANE

‘*’ marked information are to be furnished by bidder during detail engineering stage only

S.N.	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 equipment	
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 equipment 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/s	One (1) no. for BC Bay
1.5.0	Crane classification	M5 for Mechanical and M5 for Electrical as per IS:807-2006 and 13834 (Part-5)-1993 and M5 for Structural
1.6.0	Suitable for outdoor or indoor duty	Indoor
1.7.0	Capacity (T)	
1.7.1	Main hoist	



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	Rated SWL – tones	60 T	
	Test load SWL – tones	Rated SWC and over load test : 125% of SWC	
1.7.2	Aux. Hoists		
	Rated SWL – tones	N.A.	
	Test load SWL – tones	N.A.	
1.8.0	Span	As per attached crane clearance diagram	
1.9.0	Lifting Beam	N.A.	
1.10.0	Operation from	Pendant Push button	
2.0.0	CRANE PERFORMANCE		
2.1.0	Crane speed with full load (mtrs/min.)		
	Main Hoist	1.5	
	Aux. Hoist	N.A.	
	Crab travelling speed (CT motion)	15.0	
	Crane travelling speed (LT motion)	30.0	
	Creep speed M/Min	@ 10% of main speed for all the motions through VVVF drive	
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 Meters		
	Main Hoist	As per attached Crane Clearance Diagram	
	Aux Hoist (NOT APPLICABLE)	N.A.	
2.4.0	Hook Approaches	As per attached Crane Clearance Diagram	
2.5.0	Hand rail pipes	50 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1000 mm and 500 mm and vertical post spacing not exceeding 1200 mm as far as possible but can be adjusted to suit the length of railing with provision of kick plate (100 mm high and 6mm thick)	



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3.0.0	COMPONENT DETAILS	
3.1.0	Trolley	
a.	Type	Fabricated
b.	Method of fabrication	Fusion welded
c.	Material conforming to IS:	IS: 2062 Gr. A or B 100% killed, normalized & Ultrasonically tested
d.	Centre to center distance of wheels (on the same rails)	*
e.	Whether jacking pads for lifting trolley provided or not	Yes
f.	Other requirements	Refer Section IA-Customer specification, Clause 2.1.8.8.f
3.2.0	Rope drums	
a.	Dimensions in mm length and diameter (PCD)	*
b.	Material (Indicate IS)	Seamless pipe ASTM -106 or fabricated E250 Grade BR IS: 2062 & 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	*
h.	Other requirements	a) Drum will have minimum one spare groove when this hook is at its highest position. b) Rope will be of sufficient length so that drum has two full turns when hook is at the lowest position.
3.3.0	Rope details	
a.	Standard	IS:2266
b.	Construction	Ropes shall be regular right hand lay as per IS: 2266-1989. The



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		construction of the rope shall be 6 x 36.		
c.	Grade	1960		
d.	Diameter in mm	*		
e.	Breaking strength	*		
f.	Factor of safety	5.25 as per IS		
g.	Type of core	Steel		
h.	Number of falls	*		
i.	Length of rope	*		
3.4.0	Sheaves details			
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 than 62% of calculated main sheave diameter.		
d.	Type of guards provided	Fabricated from rolled steel plate		
3.5.0	Coupling & Shafting			
3.5.1	Coupling details (between motor and gear box)	Main 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 (gear box and wheels)	Cross Travel	Long Travel	
a.	Type	Flexible geared type		



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b.	Size and Torque rating	*	
c.	Guards and Enclosures	Provided	
3.5.3	Coupling details (gear box and rope drum)		
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	
3.5.4	Shafting (Output)		
a.	Diameter in mm	*	
b.	Factor of Safety	As per IS : 3177 (latest edition)	
c.	Number of support bearings	*	
d.	Type of support bearing	*	
e.	Arrangement of Lubrication	Grease cups/ Nipples	
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
a.	Type of mounting of gear box	Horizontal / Vertical	
b.	Classification	Suitable for M5 duty	
c.	Total no. of reductions	*	
d.	Type of gears	Helical / Spur	NA (Through VVVF drive)
e.	Reduction Ratio	*	
f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication / Pump lubrication (In case of three reduction, vertical mounted gear-box (having limited motion)	



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g.	Hardness (BHN)- Gear	215-260 BHN			
h.	Hardness (BHN) pinion	255-300 BHN			
i.	Difference in Gear and pinion hardness	Min 20 BHN			
j.	Material (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/EN 24 Hardness conforming to IS: 3177 (latest edition) All gears shall be hardened and tempered alloy steel, heat treated and confirming to IS: 4460 having metric module. Overhung gears shall not be used.			
k.	Casings	Fabricated E250 Grade BR IS: 2062 & stress relieved			
l.	Noise Level	85db			
m.	Standard conforming to	IS 4460 / AGMA			
3.6.2	Travel Motions	CT	CT micro	LT	LT micro
a.	Type of mounting of gear box	Horizontal / Vertical	NA	Vertical/ Horizontal	NA
b.	Classification	Suitable for M5 duty			
c.	Total no. of reductions	*			
d.	Type of gears	Helical / Spur	NA.	Helical / Spur	N.A.
e.	Reduction Ratio	*			
f.	Type of lubrication (grease / splash / pump lubrication)	Splash Lubrication / Pump lubrication (In case of three reduction, vertical mounted gear-box (having limited motion)			
g.	Hardness (BHN)- Gear	215-260 BHN			
h.	Hardness (BHN) pinion	255-300 BHN			
i.	Difference in Gear and pinion hardness	Min 20 BHN			
j.	Material (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1 or 2 Pinions En 19/EN 24 Hardness conforming to IS: 3177 (latest edition) All gears shall be hardened and tempered alloy steel, heat treated and confirming to IS: 4460 having metric module. Overhung gears shall not be used.			
k.	Casings	Fabricated E250 Grade BR IS: 2062 & stress relieved			
l.	Noise Level	85db			



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m.	Standard conforming to	IS 4460 / AGMA	
3.7.0	Wheels details	Cross travel	Long travel
a.	Material	Solid wheels shall be C55 MM-75. Wheels from 400 mm diameter and above may consist of hardened, rolled / forged steel type of not less than 60 mm thickness, shrunk on to cast iron center.	
b.	Hardness	300 – 350 BHN	
c.	Depth of hardness	10 (min.)	
d.	Tread Diameter (mm)	*	
e.	Tread width (mm)	*	
f.	Process of hardening	*	
g.	Type	Crab/crane wheels shall be double flanged. Wheels shall be mounted in anti-friction roller bearing housed in 'L' shaped bearing brackets for easy removal during maintenance. Flangeless wheels with guide rollers are also acceptable.	
h.	Numbers Provided	4	4
i.	Specification conforming to	IS: 3177 (latest edition)	
j.	Arrangement of lubrication	Grease	
k.	Other details	Refer Section IA-Customer Spécification, Clause no. 2.1.8.8.e.iv & v	
3.8.0	Lifting hooks		
a.	Type	Ram shorn, shank with safety latch swiveling type as per latest edition of IS: 5749	
b.	Safe lifting capacity	60T	
c.	Material	Class 2 as per IS 1875:1992 (re affirmed 2004) for hooks conforming to IS : 5749	
d.	Standard conforming to	IS: 5749	
e.	Hook can rotate	Yes	
f.	Safety latch on hook provided	Yes	
g.	Locking device on	Provided	



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	swivelling hook required or not		
h	Other requirements	Refer Section IA-Customer Specification, Clause no. 2.1.8.10	
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 50% of the rated speed.	
b.	Numbers provided	4	4
c.	Details of end stop	Mild steel, E250 Grade BR IS: 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate.	
d.	Design basis	Buffers to be designed in laden (crane with full load) condition	
3.10.0	Brakes		
3.10.1	Hoist Motions		
a.	Type of brake	AC Electro-Hydraulic Thruster operated	
b.	Diameter of brake	*	
c.	Torque rating	*	
d.	Number provided per motor		
e.	Braking capacity (%age of motor torque)	2	
f.	Braking torque actually required	150%	
g.	Material		
i.	Brake Liner	Ferrodo liners	
ii.	Drum	CS IS : 1030 / CL 4 IS : 1875	
iii.	Springs	As per manufacturers standard	
h.	Braking Distance in mm	*	
3.10.2	Travel Motions		
		Both CT and LT motion	
a.	Type of brake	AC Electro-Hydraulic Thruster	



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		operated
b.	Diameter of brake	*
c.	Torque rating	*
d.	Number provided	2
e.	Braking capacity (%age of motor torque)	150%
f.	Braking torque actually required	*
g.	Material	
i.	Brake Liner	Ferodo liners
ii.	Drum	CS IS : 1030 / CL 4 IS : 1875
iii.	Springs	As per manufacturers standard
h.	Braking Distance in mm	*
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	
a.	Type	Antifriction ball / roller bearings
b.	Numbers provided for each	As per assembly requirements
c.	Method of lubrication	Centralized grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice.
d.	Bearing life	10,000 working hours.
3.13.0	Bridge girder	
a.	Type & Quantity	Box type – 2 nos. Material: Mild steel, E250 Grade BR 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	Refer Section IA-Customer Spécification, Clause no. 2.1.8.8.d
d.	Type of connection to end carriage	By fitted bolts
e.	Length	*
f.	Width	*
g	Other requirements	Refer Section IA-Customer Spécification, Clause no. 2.1.8.8.e
3.14.0	Rails	
a.	Type / section	Rails sections as per IS: 3443. Joint to be butt-welded by thermit welding & fusion welding/ end clamping
b.	Standard conforming to	IS: 3443
c.	Weight per meter	*
d.	Material	50C12 or 55C11
e.	Top width in mm	*
f.	Height in mm	*
g	Other details	Refer Section IA-Customer specification, Clause no. 2.1.8.14
3.15.0	Type of platform required on the bridge	Chequered plate platform 6 mm thick as per IS :3502 with adequate headroom shall also be provided at bottom chord level for periodic checking of all rivets/bolts and other items. Platforms shall be of sufficient width to enable normal maintenance work to be under taken safely.
a.	Length	Full span length
b.	Walkways	Access walkways of not less than 800 mm (clear) with hand railing of height of 1000 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.	Provided at both ends	Yes



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f	Other requirements	Refer Section IA-Customer specification, Clause no. 2.1.8.8.g			
3.16.0	Motors				
10.1	Hoist Motions	MH	MH micro		
a.	Type	SC, suitable for Inverter duty	NA		
b.	Enclosure	TEFC	NA		
c.	Numbers furnished	1	NA		
d.	Voltage, phase and frequency	3 Ph., 4 wire, 415V ± 10%, 50 Hz ± 5% Combined voltage & frequency variation = 10% absolute			
e.	Class of protection	Refer Section IA-Customer specification, Clause no. 2.1.8.19			
f.	Rated capacity (KW)	The motor shall be suitable for 300 starts / hr and 60% CDF. Motor nameplate rating at 50 ⁰ C shall have Motor rating will be calculated keeping margin of at least 25% over the maximum power requirement in the duty condition specified.			
g.	Rating	Refer Section IA-Customer specification, Clause no. 2.1.8.19			
h.	Class of insulation				
i.	Number of starts/ hour				
j.	Pull out torque				
k.	Space heater requirement (For motor above 30 KW)				
l.	Other requirements				
m.	Speed	*			
n.	Contactors for motors	*			
10.2	Travel Motions	CT	CT micro	LT	LT micro
a.	Type	SC, suitable for Inverter duty	NA	SC, suitable for Inverter duty	NA
b.	Enclosure	TEFC	NA	TEFC	NA



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c.	Numbers furnished	1 (MIN)	NA	2 (MIN)	NA
d.	Voltage, phase and frequency	3 Ph, 4 wire, 415V ± 10%, 50 Hz ± 5% Combined voltage & frequency variation = 10% absolute Motors shall be capable of starting /running with normal load at 85% of rated voltage.			
e.	Class of protection	Refer Section IA-Customer specification, Clause no. 2.1.8.19			
f.	Rated capacity (KW)	The motor shall be suitable for 300 starts / hr and 60% CDF. Motor nameplate rating at 50 ⁰ C shall have Motor rating will be calculated keeping margin of at least 25% over the maximum power requirement in the duty condition specified.			
g.	Rating	Refer Section IA-Customer specification, Clause no. 2.1.8.19			
h.	Class of insulation				
i.	Number of starts hour				
j.	Space heater requirement (For motor above 30 KW)				
k.	Pull out torque				
l.	Other requiriements				
m.	Speed	*			
n.	Contactors for motors	*			
3.17.0	<u>Limit switches</u>	Main hoist		Cross Travel	Long Travel
a.	Type	Rotary gear (screw type) + Gravity		Lever type (one way/ two way)	Lever type (one way/ two way)
b.	Number provided	1 + 1		2/1	2/1
c.	Rating of contacts	*			
d.	Material of contacts	Double break Silver Cadmium			
e.	Control voltage/ Enclosure	110 V/ IP 55			
3.18.0	<u>Power conductors (DSL)</u>				
a.	Type	LT: PVC shrouded copper conductor shall be supported from B-row side with insulators CT : Flexible trailing cable mounting on retracting support (Festoon			



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		type) EPR insulated and CSP Sheathed type	
b.	Sizing	Voltage dip on the starting of largest LT motor shall be limited to 15% of the nominal voltage at the motor terminals. Total voltage dips on starting of large motors on crane shall be limited to 3% on crane and 6% in DSL system. Protective cover over DSL to be provided.	
c.	Material	*	
d.	Number	*	
e.	Length	Suitable for entire bay length	
f.	Guard provided	Yes	
3.19.0	<u>Protective & Control panel</u>	Refer Section IA-Customer specification, Clause no. 2.1.8.31	
	Size	*	
	Material		
	Numbers and location	One no. Protective panel & One no. each for MH, CT and LT located on bridge platform	
	Degree of Protection	Refer Section IA-Customer specification, Clause no. 2.1.8.31	
	Illumination		
	Other requirements		
3.20.0	<u>Cable</u>	Power	Control
	Material	All cables shall have stranded copper conductors	All cables shall have stranded copper conductors
	Size	minimum size of power cable shall be 6.0 mm ² .	Control wiring shall be with 2.5 mm ² copper;
	Type	FRLS-insulated, multi strand Copper PVC sheathed armoured cable(for fixed cable) and EPR insulated CSP sheathed cable (for flexible cable)	
	Voltage grade	1100 V	
	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to VVVF drive shall be so sized that the voltage drop does not exceed 3% of rated voltage.	
3.21.0	Earthing		
a.	Material of earthing	GI	
b.	Earthing as per specification	Yes (refer electrical scope matrix for earthing)	



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3.22.0	Contactors	AC 4 duty for reversing application. AC 3 duty for non-reversing application`
a.	Safety Switches	AC 23 for motor application, AC 22 for other application. For other details, refer Section IA-Customer specification, Clause no. 2.1.8.32
b.	Fuses	Refer Section IA-Customer specification, Clause no. 2.1.8.33
c.	Overload relay	Yes
3.23.0	Fire Extinguisher	
a.	Type and size	4.5 kg , CO ₂ type
b.	Numbers per crane & Location	Two nos. on bridge
3.24.0	Power Supply	415 V, 3 phase, 4 wire supply at operating floor at centre of bay length
a.	No. of conductors for LT motion	4 (3+1) nos.
3.25.0	Transformer	
a.	Quantity	2 X 100 % - 415/110V (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
d.	Operation	Stand-by control transformer should be able to come in to operation in case of failure of working transformer
3.26.0	Illumination, Socket outlet, bells etc.	Refer Section IA-Customer specification, Clause no. 2.1.8.35
	Over Bridge	
	Under bridge	
	For inspection of crane components	
	Other details	Branch circuits for lighting and receptacles shall be individually protected by MCB. All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.
3.27.0	Type of control for Hoists/ CT/LT operation	Through VVVF drive
a.	Speed control	Thru' VVVF with minimum 6 pulse design



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b.	Starting torque of VVVF	Up to 200 % typical with encoder
c.	Starting current	Less than 150 % of rated torque.
d.	Temperature	VVVF system shall be capable of withstanding up to 50 ° C without derating
3.28.0	Sweep	Sweep shall be attached to the end carriages and to the trolley to remove foreign materials from the rails.
3.29.0	Painting & Color Coding	As per Annexure IV of Section IA
3.30.0	Main Isolating switch	At the center of bay-length
3.31.0	Additional features on pendant push button	-Emergency Push Button (two nos. on bridge platform with easy reach) -Switches for lights and bells -Lamps for Power 'ON' indication and emergency corner switch operation

Note: Other requirements for the system.

- Centralized grease lubrication with hand operated grease pump for all bearings.
- 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 special treatment of insulation and metal against fungus, insects and corrosion.
- DSL phase indicating lamps to be provided.



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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



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

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.



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- 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%.
- 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.



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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 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.



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- 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.
- 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.



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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

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



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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.

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.



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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 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



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half can be removed for inspection and repair with out 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 which ever in 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.

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



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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 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.

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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.

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



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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.

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



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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.

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.



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- 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.
- 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



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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 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



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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

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.



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- 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)



TITLE

TECHNICAL SPECIFICATION
FOR VVVF DRIVE

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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:-
- Input Voltage
 - Input Frequency
 - Output Frequency
 - Output Power
 - Output Current

	TITLE	SPECIFICATION NO. PE-TS-XXX-501-A002	
	<u>TECHNICAL SPECIFICATION</u> <u>FOR VVVF DRIVE</u>	VOLUME II - B	
		SECTION -D	
		Rev 00	
		5 OF 5	

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

ANNEXURE - VI

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				

SITE STORAGE AND PRESERVATION GUIDELINES FOR MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



**PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA**

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

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.

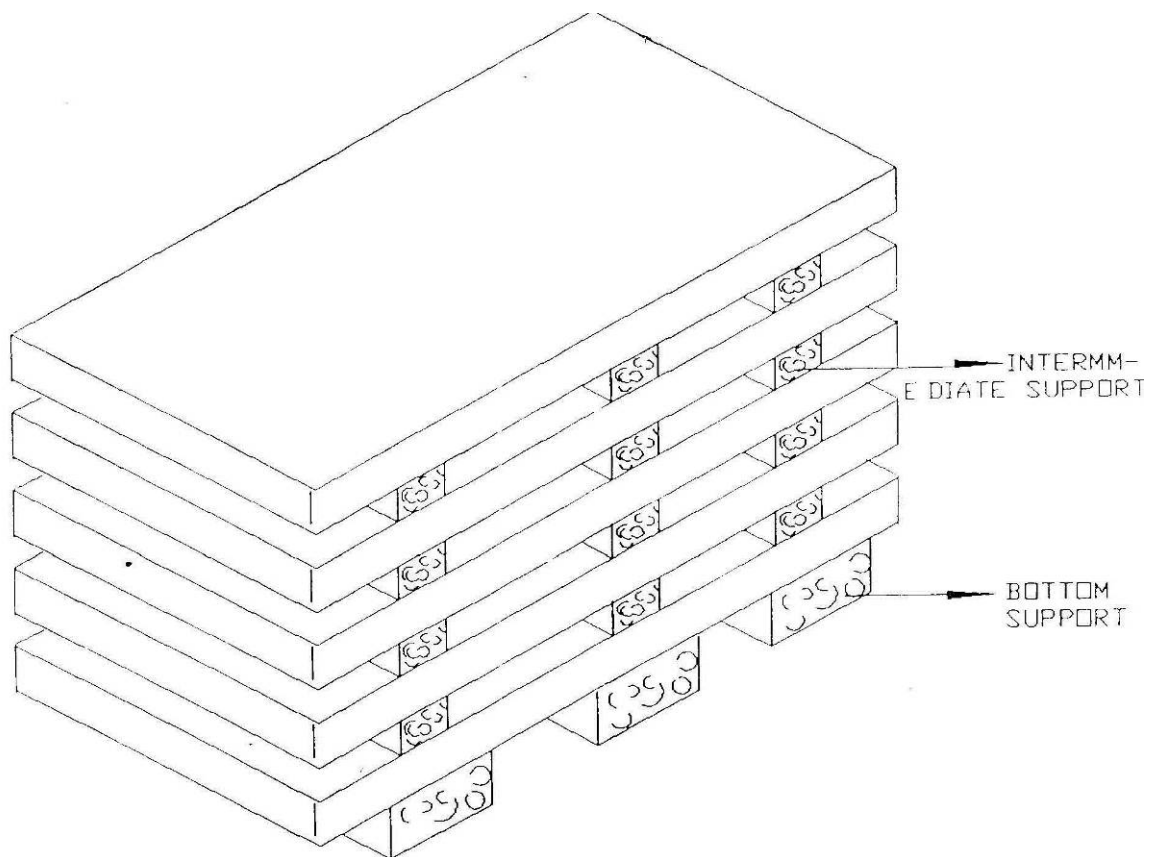


Figure – 1 – PLATE STACKING ARRANGEMENT

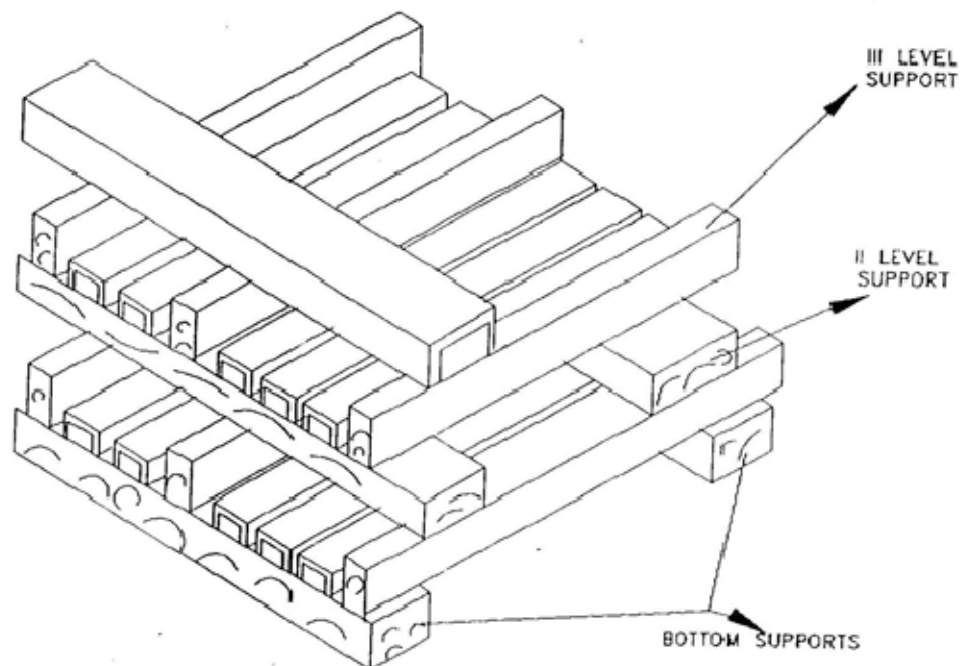


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



TITLE
1X800 MW NORTH CHENNAI TPP STAGE III
DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
SRANDARD TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-423-501-A101

REV 00

Section IIB Date NOV'16

SECTION – II

STANDARD TECHNICAL SPECIFICATION

SUB-SECTION IIA – Standard Technical Requirement (Electrical)



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : II-B
SECTION : D
REV NO. : 00 DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

बी एच ई एल 	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 1 OF 4

1.0

INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0

CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0

DESIGN REQUIREMENTS

3.1

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2

Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3

Starting Requirements

3.3.1

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

3.3.2

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

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4
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 as per Data Sheet - A during the starting period of motors.		
3.3.3 The following frequency of starts shall apply i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature. ii) 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) iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor		
3.4 Running Requirements		
3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.		
3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.		
3.5 Stress During bus Transfer		
3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.		
3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.		
3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.		
3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.		
4.0 CONSTRUCTIONAL FEATURES		
4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy		
4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.		
Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled		
4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.		

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	Terminals and Terminal Boxes	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.	
4.7.2	unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.	
4.7.3	Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.	
4.7.4	Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	General	

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

	TITLE LV MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		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 LV MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		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			



TITLE
1X800 MW NORTH CHENNAI TPP STAGE III

DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
DOCUMENTS TO BE SUBMITTED ALONG WITH BID

SPECIFICATION NO. PE-TS-423-501-A101

REV 00

Section III Date NOV'16

Page 1 of 2

SECTION-III

DOCUMENTS TO BE SUBMITTED ALONG WITH BID



1X800 MW NORTH CHENNAI TPP STAGE III
TECHNICAL SPECIFICATION FOR
DG EOT 50T TO 150T
DOCUMENTS TO BE SUBMITTED ALONG
WITH BID

SPECIFICATION NO. PE-TS-423-501-A101

VOLUME II - B

SECTION -III

REV 00

DATE NOV 2016

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid

a) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format given under Vol-III

OR

No Deviation Certificate

b) Un priced copy of price format indicating quoted/ not quoted against each row/column

c) Copy of pre-bid clarifications, if any, duly signed & stamped

d) Signed/ Stamped copy of Compliance cum Confirmation Certificate (Vol-III)

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 ACCORDINGLY WILL NOT BE CONSIDERED FOR BID EVALUATION.



TITLE
1X800 MW NORTH CHENNAI TPP STAGE III
DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
COMPLIANCE CUM CONFIRMATION CERTIFICATE

SPECIFICATION NO. PE-TS-423-501-A101

REV 00

Section III Date NOV'16

Page 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) The EQUIPMENT'S functional guarantees shall stand valid till at least eighteen (18) months from PERFORMANCE GUARANTEE test of equipment as per technical specification or commercial terms and conditions, whichever is later.
- 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 BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.



TITLE
1X800 MW NORTH CHENNAI TPP STAGE III
DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
COMPLIANCE CUM CONFIRMATION CERTIFICATE

SPECIFICATION NO. PE-TS-423-501-A101

REV 00

Section III Date NOV'16

Page 2 of 2

- 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.



PROJECT:-1X800 MW NORTH CHENNAI STPP III

PACKAGE:- DOUBLE GIRDER EOT CRANES

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE	
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NOTES:

- | |
|---|
| 1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only. |
| 2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight. |
| 3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format. |
| 4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of. |
| 5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. |
| 6. Bidder shall furnish price copy of above format along with price bid. |
| 7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser. |
| 8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered. |

9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	Nos				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
BC BAY EOT CRANE	40 kW		S	1	0	D	S	N	I	-								
NOTE:-Signed and stamped copy of this electrical load data shall be furnished by bidder along with bid. In event of ordering, above load data shall be considered as final and inputs for switchgear sizing shall be furnished to concerned electrical agency based on this electrical load data. Hence, no change in this load data shall be accommodated during detail engineering.																		
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 (CONTACTOR CONTROLLED)																		
	LOAD DATA (ELECTRICAL)	JOB NO.	423			ORIGINATING AGENCY			PEM (ELECTRICAL)									
		PROJECT TITLE	1X800 NORTH CHENNAI STPP III			NAME			DATA FILLED UP ON									
		SYSTEM	DG EOT Crane above 50 T upto 150 T			SIGN.			DATA ENTERED ON									
		DEPTT. / SECTION	ELECTRICAL			SHEET 1 OF 1		REV. 00		DE'S SIGN. & DATE								



TITLE
1X800 MW NORTH CHENNAI TPP STAGE III
DOUBLE GIRDER EOT CRANES ABOVE 50T
UPTO 150T
PRE BID CLARIFICATION SCHEDULE

SPECIFICATION NO. PE-TS-423-501-A101

REV 00

Section III Date NOV'16

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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: _____

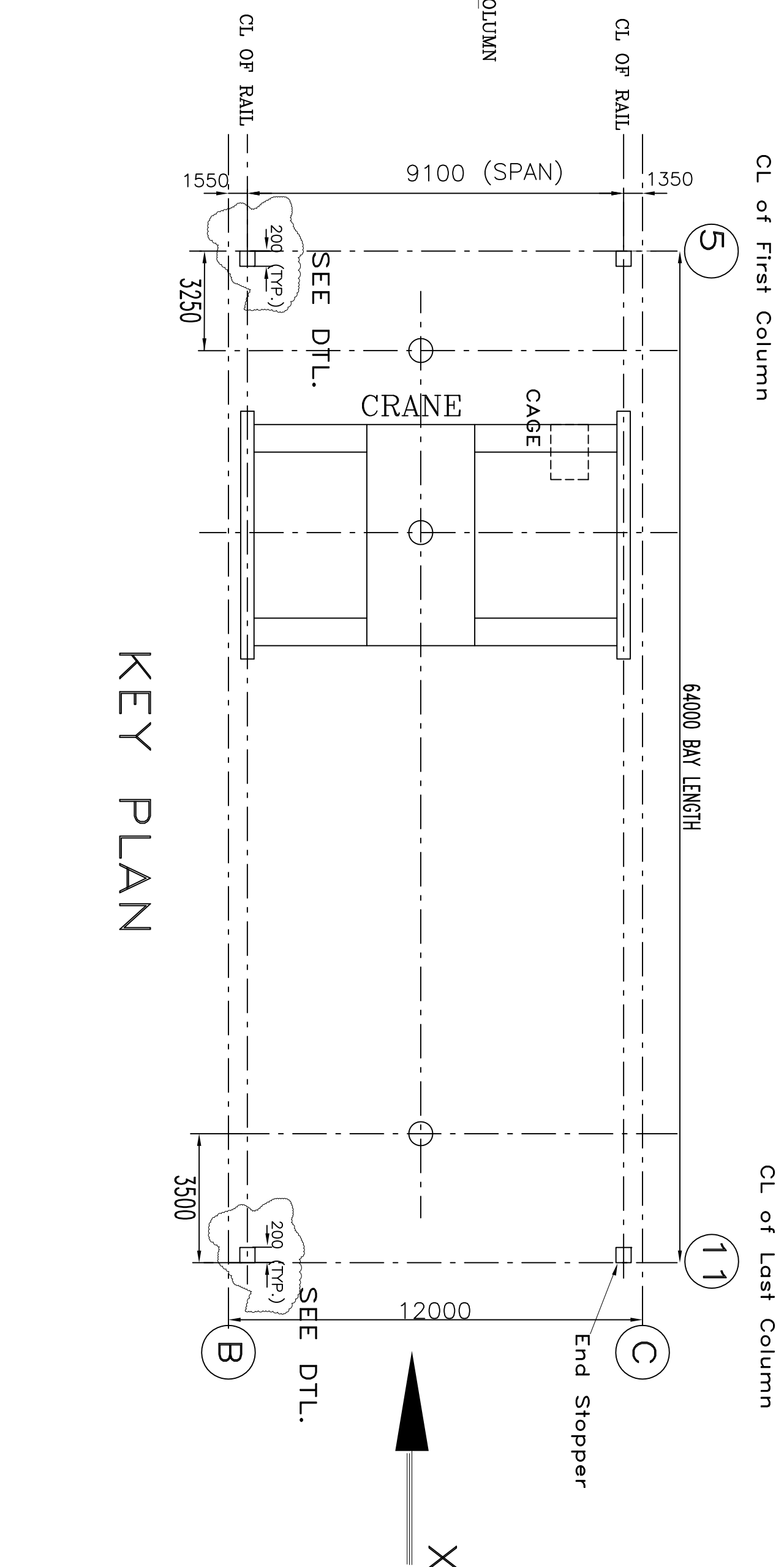
NAME: _____

DESIGNATION: _____

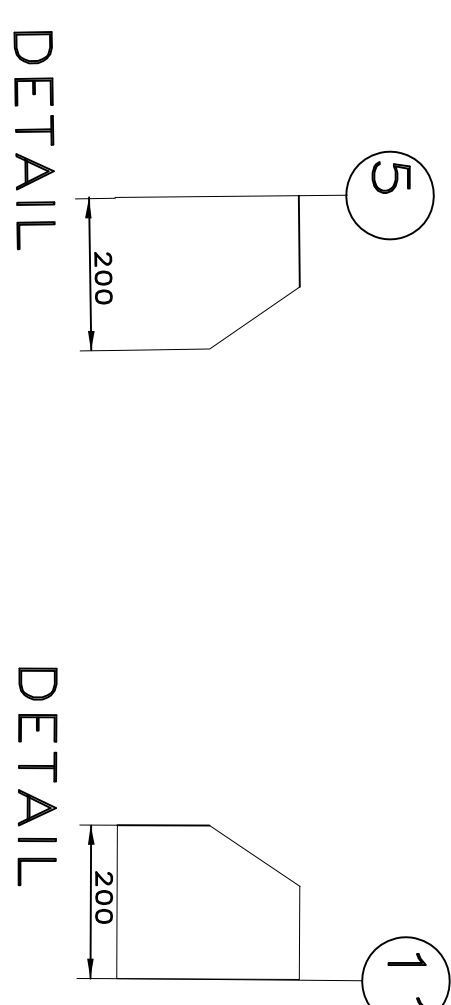
COMPANY: _____

DATE: _____

COMPANY SEAL



KEY PLAN



NOTES:

- Diagram illustrating the LT Wheel Load Diagram (Without Impact). The diagram shows a horizontal line representing the span, with two circles representing wheels. The distance between the centers of the wheels is labeled "5100 MIN". Below each wheel is a vertical line labeled "33 T". The left wheel is labeled "CL of First Column" and the right wheel is labeled "CL of Last Column".

CUSTOMER		TAMILNADU GENERATION & DISTRIBUTION CORPORATION									
		5th Floor, Western Wing, MPKRI Matligal, 144, Anna Salai, Chennai-600002									
PROJECT		1X800 MW TANGEDCO NORTH CHENNAI TPP STAGE III-BTGS									
		BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT NOIDA									
JOB NO.		423									
STATUS		CONTRACT									
DISTRIBUTION											
The following is OFF REPORT AND CORRESPONDENCE. BHARAT HEAVY ELECTRICALS LIMITED is not to be used directly or indirectly in any way detrimental to the interest of the Company.											
REV / DATE		A / 15		CHD		APRD					
TITLE											
CRANE CLEARANCE DIAGRAM FOR 60T DOUBLE CRANE FOR BC BAY											
DEPT. SCALE		DRAWING NO.									
		REVISION		REVISION		REVISION		REVISION		SIGN	
		DATE		DATE		DATE		DATE			
		20/11/2018		20/11/2018		20/11/2018		20/11/2018			
		20/11/2018		20/11/2018		20/11/2018		20/11/2018			