TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD.

2X660 MW UDANGUDI TPP STAGE I

TECHNICAL SPECIFICATION FOR DOUBLE GIRDER EOT CRANES UPTO 100T

SPECIFICATION NO.: PE-TS-435-501-A102

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

A. SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles fill of lubricants & consumables along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, trial run at site and carrying out performance guarantee/Functional/Demonstration tests at site (As applicable) for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. **Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection & commissioning and load testing of the cranes and its accessories**.

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification **within 10 days of receipt of tender documents.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

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

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

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

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

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

Note:

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

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor’s internal proxy setting should not block DMS application’s link.

http://dms-server.bhelpem.com/Wrench%20Web%20Access/Login.aspx

B. PROJECT INFORMATION

Refer NIT

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 double girder EOT Cranes as mentioned in technical specifcation 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. Box type steel bridge girder complete with bridge rails, end stoppers, walkway platforms across the span of either side of crane and access ladders for double girder crane,

b. End carriage complete with minimum two (2) nos. of wheels for each end carriage and access ladders from gantry platforms, spring buffers etc.

c. Service cage with all protections and access ladder, for maintenance of DSL's.

d. Crab (trolley) with wheels and drive equipment for hoists and trolley complete with motors, gear reducers with Suitable arrangement for collection of oil spillage, brakes, limit switches, couplings, rope drums, wire ropes, main hook, auxiliary hook, end stoppers etc. (trolley)

e. Set of crane longitudinal drive equipment complete with motor, gear reducers with Suitable arrangement for collection of oil spillage, brakes, shaft bearings, gear pinions, and limit switches.

f. EOT crane runway gantry rails complete with fixtures comprising of fixing clamps (machined to suit rail flange contour), bolts, nuts etc for effective crane longitudinal runway length, end stoppers specified.

g. Brakes for all motion and limit switch for over hoisting/ lowering, CT and LT motion.

h. Runway conductors & bridge cross conductors with accessories

i. Crane shall be operated through Pendant Push Button station.

j. Crane buffer stops shall include the buffers on the crane itself. The stoppers to be fixed on the building frame and wheel stoppers shall be provided at either end of the crane runway.

k. The complete electrical equipment basically including:

□□Load break changeover switch mounted on the building structure.

• Cabling between the load break switch and the down shop leads.

• Down shop leads and current collector for crane.

• Load break switch on the crane bridge walkway

• Protective and control switch gear

• Motors

• Festoon cable system for crab

• Master controllers

• Pendent controller (where specified)

• Wireless remote control (where specified)

• Indicating lamps, push buttons.

- Lighting panel, lighting fixtures, light, alarm/bell, socket outlets etc.
- All power and control cables.
- Cable trays & supports, Conduits, Cable glands, lugs & clamps etc.
- Crane earthing system
- Variable Voltage and Variable Frequency (VVVF) control for speed control of crane motors.

l. Fill of lubricants till handing over.

m. Painting of cranes and accessories including touch up painting at site.

n. Maintenance tools & Tackle (As per Annexure III, section-IA of this specification)

o. Erection & Commissioning spares

p. Mandatory Spares

1.1.4 **Lifting tackles**

The crane installations shall be supplied with all the ropes (slings), lifting beam (if required), chains, shackles etc. needed for maintenance of the plant equipment/component.

The minimum scope of supply per handling equipment (crane & hoist) for each lifting tackle includes the following items:

- Two (2) nos. single ropes each with 2 eyes at the ends, each rope 2 m long
- Two(2) nos. single ropes each with 2 eyes at the ends, each rope 4 m long
- Four (4) nos. shackles.

The load-bearing capacity of the ropes and shackles must be suitable for the relevant crane & hoist.

The maximum tension in the rope shall not exceed 1/8 of the calculated braking capacity of the rope. The ropes shall be of the stranded type, and galvanized wires shall be used.

The eyes of the single ropes must be secured with compression fittings. The length of the eyes must be at least 15 times the nominal diameter of the rope.

In special cases, where safe lifting of the relevant component is not certain, specially-made devices shall be provided. At least two (2) of these shall be provided in each individual case.

For each installation a list shall be submitted, showing the number, type, nominal load carrying capacity and strength characteristics of the materials used. In addition, factory and acceptance certificates shall be submitted for all ropes (slings) and materials.

1.1.5 **Mandatory Spares**

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

1.1.6 **Erection and Commissioning spares**

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at

site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. Fill of lubricants; oil etc. till commissioning of the cranes shall also be supplied by the bidder.

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

1.2.0 **Services to be provided by the bidder**

1.2.1. Packing, forwarding and transportation to site

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

1.2.3 Unloading, storage and handling at site.

The Bidder shall provide means for all unloading and reloading for all consignments of plant; both during transport to Site and on the Site. Consignments shall be unloaded immediately on arrival at Site. The Bidder is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc. The following parts shall be stored inside enclosed warehouses:

Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices attached, electric motors and excitation equipment, instruments, welding material and equipment, all small parts and all parts of the crane which already have been finally painted. If large parts are stored in the open air, they shall be provided with weather resistant and fire & resistant covers. Electrical parts, which are not packed in heavy duty polyethylene foil and those so packed, but whose packing has been damaged shall be kept in suitable places from the moment of storage to the moment of installation. All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity. All the equipment shall be stored as per standard storage and preservation instructions etc. of the suppliers.

1.2.4 Arranging test load at site for load/overload test

Completion of erection & commissioning activity and final hand over to customer shall be in vendor's scope. For load/over load test at site, collecting the test load at site within a radius of 1-2 KM from owner's storage to final testing bed of crane shall be under bidder's scope of work. Test load in the form of rolled steel, plates, girder, angle etc., as available at the site shall be made available by the BHEL. 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, mobile cranes for test load handling and any other item required by the vendor during the load testing shall be arranged by the vendor at no extra cost to the BHEL. Slings & cradles will be allowed to be taken back by the vendor, after completion of the test at site.

1.2.5 Demonstration / Load test at bidder's Works and at site.

1.2.6 Obtaining clearance and acceptance certificate from the concerned competent

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

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

1.2.8 Any service mentioned in GCC & SCC as relevant to the package.

1.3.0. **PAINTING & COLOUR SCHEME**

As per Annexure IV, section-IA of this specification

2.0.0. **Works Excluded**

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

Gantry girder

Dead load for load/ overload testing at site

Space for storage.

Exclusion, if any, mentioned in GCC, SCC.

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 to be followed.

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

7.0.0. Performance Test requirement

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

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

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

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

7.1.0 Testing at site

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

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

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

8.0 Consumables

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

QUALITY ASSURANCE AND INSPECTION REQUIREMENT

1.1.0. Inspection and Testing

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

1.2.0. Inspection and testing at Manufacturer's works

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

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

STAGE INSPECTION

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

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

Unacceptable defects in forgings are as given below:

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

5. 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.
6. 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).
7. Acceptance and routine tests (HV and insulation) for all electrical and electro-mechanical components and system as per governing specification

FINAL INSPECTION- Testing At Works.

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

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**.**

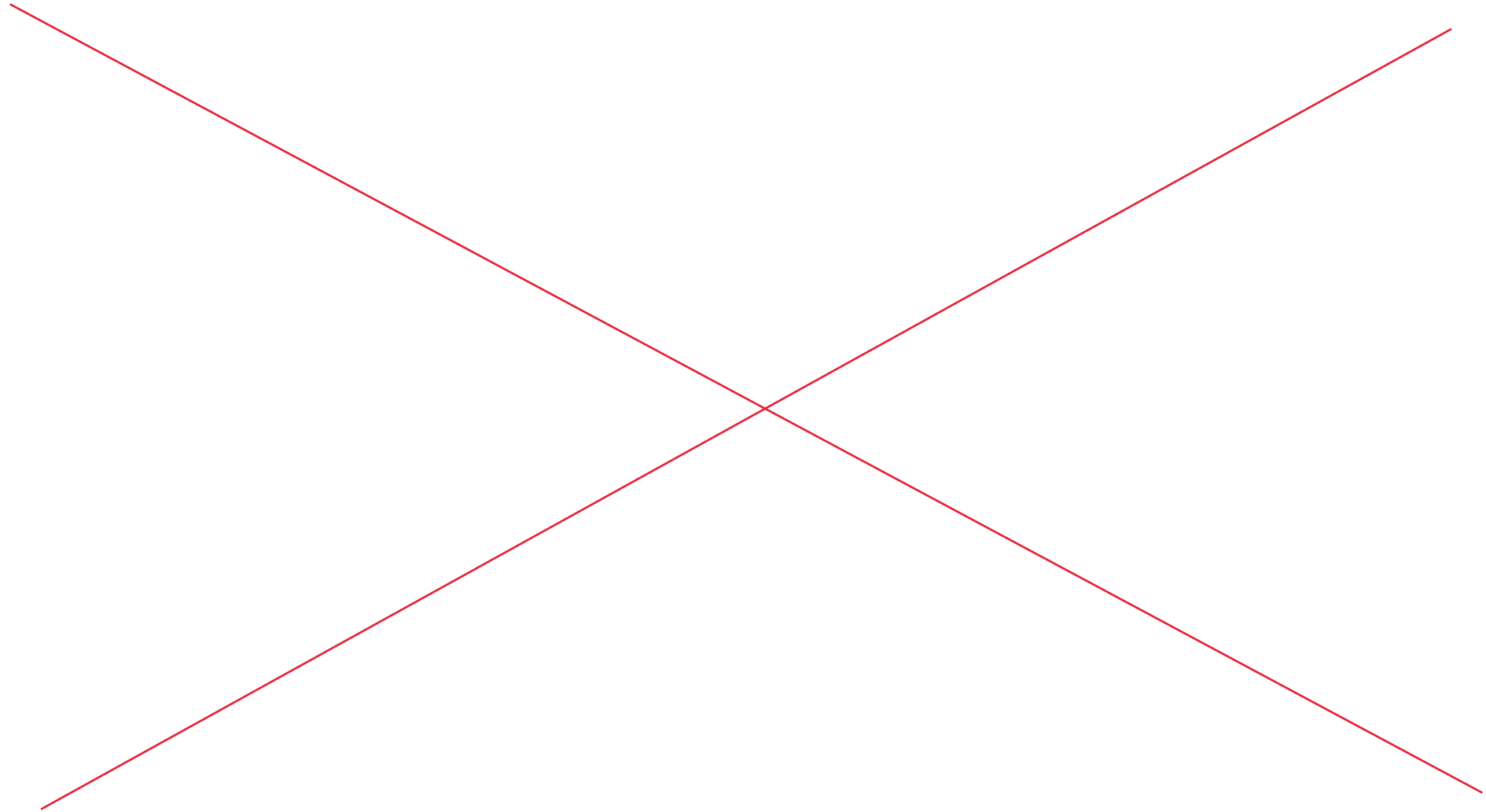
Procedure for Load/Overload testing of EOT cranes at Manufacturer's Works & Site

Refer Testing requirement as mentioned at ANNEXURE-VII.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO.



JOB NO.	435
STATUS	CONTRACT
DISTRIBUTION	
TO	
No. OF	

REV.	DATE	ALTD	CHD	APPD

PROJECT: 2x660 MW UDANGUDI TPP–STAGE I

OWNER: TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED
5TH Floor,Western Wing,NPKRR Maaligai
144,Anna Salai,Chennai–600002.

OWNER'S CONSULTANT:
TATA CONSULTING ENGINEERS LIMITED
BENGALURU

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
	DRN		-sd-	
	DESN		-sd-	
	CHD		-sd-	
	APPD		-sd-	

TITLE
MANUFACTURING QUALITY PLAN FOR DOUBLE GIRDER EOT CRANE UP TO 100MT
AREA- CWPH, BFP, STORE, SWI PH, SWO PH, WORKSHOP)

DEPT.	SCALE:	DRAWING NO.
SIGN		PE-V0-435-501-A151
DATE		SHEET OF REV. 2

FORMAT SIZE A1

Manufacturer's Name and Address:	MANUFACTURING QUALITY PLAN		CLIENT : TANGEDCO
M/S. MANGLA HOISTS PVT LTD. 3C/2,ECOTECH II,UDYOG VIHAR,GREATER NOIDA - 201306	ITEM : DOUBLE GIRDER EOT CRANE CAPACITY UP TO 100 MT QNTY-7 nos. (1 no. CWPH 65/18T, 2 no. BFP 35T, 1 no. HEAVY STORE 15T, 1 no. SWO PH 18T , 1 no. SWI PH 15T , 1 no, WORKSHOP 10T	MQP NO: MHPL/QAP/DG/CRANE/1544 BHEL DOC NO.: PE-V0-435-501-A151 DATE : 17.06.2021 REV: 02 PAGE NO Page 1 of 6	PROJECT : 2X660 MW UDANGUDI STPP CONSULTANT : TATA CONSULTING ENGG. LTD MAIN SUPPLIER : BHEL PEM

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	Format of RECORD		AGENCY			REMARKS
					M	C/B					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D	10.			11.
A.	RAW MATERIAL													
A.1	STEELS PLATES (BOX GIRDER, END CARRAIGE, TROLLEY & GEAR BOX CASING , ROPE DRUM (IF FABRICATED)	CHEMICAL & PHYSICAL	MAJOR	CHEMICAL & PHYSICAL	1 SAMPLE / HEAT		APPRD GD DRG./DATA SHEET /TECH SPEC/IS 2062-2011 GR E250BR		MTC/ LAB REPORT	√	P	V	V	#In the absence of correlated TC check testing shall be done at NABL approved lab.
		NDT	MAJOR	UT (20 MM & ABOVE THICKNESS) 1	100%	100%	ASTM A 435/A 578 LEVEL B	ASTM A 435/A 578 LEVEL B	UT REPORT	√	P	V	V	
A.2	ROUND BAR (FOR PINION, GEARS, AXLE & SHAFTS	CHEMICAL & PHYSICAL	MAJOR	CHEMICAL & PHYSICAL	1 SAMPLE / HEAT/SIZE		APPRD GD DRG./DATA SHEET		MTC /LAB TC	√	P	V	V	
		NDT	MAJOR	UT (40 MM & ABOVE DIA/THIK)	100%	100%	ASTM A 388	NOTE A	UT REPORT	√	P	V	V	
A.3	FORGINGS (FOR GEARS, WHEELS)	CHEMICAL & PHYSICAL	MAJOR	CHEMICAL & PHYSICAL	1 SAMPLE / HEAT		APPRD GD DRG./DATA SHEET		MTC /LAB TC	√	P	V	V	
		NDT	MAJOR	UT	100%	100%	ASTM A 388	NOTE A	UT REPORT	√	P	V	V	
A.4	STEEL CASTING PULLEY	CHEMICAL & PHYSICAL	MAJOR	CHEMICAL & PHYSICAL	1 SAMPLE / HEAT		APPROVED DRAWING/DATA SHEET		LAB REPORT	√	P	V	V	
		NDT	MAJOR	UT(ON BOSS AREA)	100%	100%	ASME SECV ARTICLE 23, SA 609	SA-609 LEVEL II	UT REPORT	√	P	V	V	
A.5	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL & PHYSICAL	MAJOR	CHEMICAL & PHYSICAL	1 SAMPLE / HEAT/SIZE		APPRD GD DRG./DATA SHEET ASTM A 106 GR B		MTC /LAB TC	√	P	V	V	
			MAJOR	, MICRO ETCHING /FLATTENING TEST	100%	100%	APPRD GD DRG./DATA SHEET ASTM A 106 GR B/ASTM E381		IR	√	P	V	V	
		NDT	MAJOR	UT (ABOVE 25MM PIPE THICKNESS)	100%	100%	ASTM E 213	ASTM E 213	UT REPORT	√	P	V	V	

MANUFACTURER/SUB-SUPPLIER

SIGNATURE

Bharat Heavy Electricals Limited PPEI Sector-16A NOIDA 201 301 PEM/Mech. Aux.

LEGEND: * D RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION
** **M:** MANUFACTURER/SUB-SUPPLIER **C:** MAIN SUPPLIER, **N:** TANGEDCO
P: PERFORM, **W:** WITNESS AND **V:** VERIFICATION. AS APPROPRIATE,
CHP: TANGEDCO SHALL IDENTIFY IN COLUM "B" AS "W"
NOTE A: WHEN BACK ECHO (BWE) SET TO 100% FULL SCREEN HIGHT (FSH) IN SOUND AREA OF MATERIAL A DEFECT ECHO>20% IS NOT ACCEPTABLE. ALSO LOSS OF BWE>20% IS NOT ACCEPTABLE.

FOR CLIENT USE	REVIEWED BY	APPROVED BY	APPROVED SEAL

DOC NO.: REV: CAT:

Manufacturer's Name and Address:	MANUFACTURING QUALITY PLAN	CLIENT : TANGEDCO
M/S. MANGLA HOISTS PVT LTD. 3C/2,ECOTECH II,UDYOG VIHAR,GREATER NOIDA - 201306	**ITEM :** DOUBLE GIRDER EOT CRANE CAPACITY UP TO 100 MT QNTY-7 nos. (1 no. CWPH 65/18T, 2 no. BFP 35T, 1 no. HEAVY STORE 15T, 1 no. SWO PH 18T , 1 no. SWI PH 15T , 1 no, WORKSHOP 10T	**MQP NO: MHPL/QAP/DG/CRANE/1544** **BHEL DOC NO.: PE-V0-435-501-A151** **DATE : 17.06.2021 REV:** 02 **PAGE NO** Page 2 of 6	**PROJECT** : 2X660 MW UDANGUDI STPP **CONSULTANT** : TATA CONSULTING ENGG. LTD **MAIN SUPPLIER** : BHEL PEM

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	Format of RECORD		AGENCY			REMARKS
					M	C/B					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D	10.			11.
B.	BOUGHT OUT ITEMS (MECHANICAL)													
B.1	HOOK	CHEMICAL TEST	MAJOR	CHEMICALINTEGRAL PIECE	1 SAMPLE / HEAT/BATCH		APPD DRG/TECH SPEC/IS 1875 CLASS II	APPD DRG/TECH SPEC/IS 1875 CLASS II	MTC	√	P	V	V	
		PHYSICAL TEST	MAJOR	TENSILE TEST ON INTERGRAL TEST PIECE AFTER HEAT TREATMENT	1 SAMPLE / HEAT/BATCH		APPD DRG/ IS 1875 1992 CLASS II	APPD DRG/ IS 1875 1992 CLASS II	MTC	√	P	V	V	
		△1 HARDNESS	MAJOR	HARDNESS TEST	100%	100%	APPD DRG/ IS 1875 1992 CLASS II	APPD DRG/ IS 1875 1992 CLASS II	MTC	√	P	V	V	
		NDT BEFORE PROOF LOAD TEST	MAJOR	UT (ONLY ON SHANK PORTION)	100%	100%	ASTM A 388 2007	NOTE A	MTCIR	√	P	V	V	
			MAJOR	DPT	100%	100%	ASME SEC V	ASME SEC VIII , DIV.1 APPENDIX-8	IR	√	P	V	V	
		PROOF LOAD TEST	MAJOR	PROOF LOAD TEST	100%	100%	DRG/IS5749/ IS15560/DS	DRG/IS5749/ IS15560/DS	IR	√	P	V	V	△1 FROM RECOGNISED TEST HOUSE.
		NDT AFTER PROOF LOAD TEST	MAJOR	UT (ONLY ON SHANK PORTION)	100%	100%	ASTM A 368 2007	NOTE A	MTCIR	√	P	V	V	
			MAJOR	DPT	100%	100%	ASME SEC V	ASME SEC VIII , DIV.1 APPENDIX-8	IR	√	P	V	V	
		INDENTIFICATION PUNCH	MAJOR	VISUAL	100%	100%	--	--	--	--	P	V	V	
B.2	WIRE ROPES	VISUAL& BREAKING STRENGTH	MAJOR	TYPE, CONSTRUCTION, GRADE, BREAKING STRENGTH & VISUAL, DIAMETER	100%	100%	APPROVED GA DRAWING/IS 2266-2006/DS		MTC	√	P	V	V	
B.3	RAILS	CHEMICAL & MECHANICAL PROPERTIES	MAJOR	CHEMICAL & MECHANICAL, HARDNESS	1 SAMPLE / HEAT/SIZE		APPROVED GA DRG/IS 3443-1980/APPD DS		MTC/LAB REPORT	√	P	V	V	
		VISUAL & DIMENSIONS	MAJOR	VISUAL & MEASURE	100%	100%	APPROVED GA DRG/DS		IR	√	P	V	V	

MANUFACTURER/SUB-SUPPLIER

SIGNATURE

Bharat Heavy Electricals Limited PPEI Sector-16A NOIDA 201 301 PEM/Mech. Aux.

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NOTE A: WHEN BACK ECHO (BWE) SET TO 100% FULL SCREEN HIGHT (FSH) IN SOUND AREA OF MATERIAL A DEFECT ECHO>20% IS NOT ACCEPTABLE. ALSO LOSS OF BWE>20% IS NOT ACCEPTABLE.

DOC NO.:	REV:	CAT:
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Manufacturer's Name and Address:	MANUFACTURING QUALITY PLAN		CLIENT : TANGEDCO
M/S. MANGLA HOISTS PVT LTD. 3C/2,ECOTECH II,UDYOG VIHAR,GREATER NOIDA - 201306	**ITEM :** DOUBLE GIRDER EOT CRANE CAPACITY UP TO 100 MT QNTY-7 nos. (1 no. CWPH 65/18T, 2 no. BFP 35T, 1 no. HEAVY STORE 15T, 1 no. SWO PH 18T , 1 no. SWI PH 15T , 1 no, WORKSHOP 10T	**MQP NO: MHPL/QAP/DG/CRANE/1544** **BHEL DOC NO.: PE-V0-435-501-A151** **DATE : 17.06.2021 REV:** 02 **PAGE NO** Page 3 of 6	**PROJECT** : 2X660 MW UDANGUDI STPP **CONSULTANT** : TATA CONSULTING ENGG. LTD **MAIN SUPPLIER** : BHEL PEM

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	Format of RECORD		AGENCY			REMARKS
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1.	2.	3.	4.	5.	6.		7.	8.	9.	D	10.			11.
C.	**BOUGHT OUT ITEMS (ELECTRICAL ITEMS)**													
C.1	TRANSFORMER(CONTROL/LIGHT)	MAKE, RATING	MAJOR	VISUAL	100%	100%	APPROVED BOI LIST/SLD/DRG/BOM/DS		IR		P	V	V	
		ROUTINE TEST	MAJOR	REVIEW	100%	100%	MFG CATLOG/DS/IS 12021 FOR CONTROL TRANFORMER		MFG TC		P	V	V	
C.2	SFU,MCCB,MCB,CONTRACTORS,DSL,RELAYS,FUSES,RESISTANCE BOX,HOOTER,PUSH BUTTONS, JUNCTION BOX LIMIT SWITCHES	MAKE/TYPE/RATING/SIZE	MAJOR	VISUAL	100%	100%	APPROVED BOI LIST/SLD/DRG/BOM/DS		IR		P	V	V	
		FUNCTIONAL/CONTINUITY CHECK / IR (AS APPLICABLE)	MAJOR	DOCUMENT REVIEW	100%	100%	DRAWING/DS/ RELEVANT STD	DRAWING/DS/ RELEVANT STD	IR/COC		P	V	V	
C.3	MOTOR	MAKE/TYPE/RATING, ROUTINE TEST	MAJOR	VISUAL, REVIEW	100%	100%	APPROVED BOI LIST/SLD/DRG/BOM/DS		MTC	√	P	V	V	TYPE TEST FOR MOTORS > 30KW (1)
C.4	BRAKES	MAKE/TYPE/RATING	MAJOR	VISUAL, REVIEW	100%	100%	APPROVED BOI LIST/SLD/DRG/BOM/DS		MTC	√	P	V	V	
		HV/IR FUNCTIONAL CHECK	MAJOR	MSMT	100%	100%	MFG STD	MFG STD	MTC	√	P	V	V	
C.5	VVVFD DRIVE	MAKE/TYPE/RATING	MAJOR	VISUAL	100%	100%	APPROVED BOI LIST/SLD/DRG/BOM/DS		MTC/COC		P	V	V	
		ROUTINE TEST	MAJOR	REVIEW	100%	100%	MFG STD	MFG STD	MTC	√	P	V	V	
C.6	CABLES(POWER/CONTROL/ TRAILING/FLEXIBLE)	MAKE/TYPE/SIZE	MAJOR	VISUAL	100%	100%	APPROVED BOI LIST/SLD/DRG/BOM/DS		MTC		P	V	V	
		ROUTINE TEST	MAJOR	REVIEW	100%	100%	TS/IS 9963/IS1554/IS7098	TS /IS 9963/IS1554/IS7098	MTC	√	P	V	V	
C.7	RADIO REMOTE, MASTER CONTROLLER, PENDANT STATION, SWITCHES	MAKE/TYPE/RATING/ FUNCTIONAL	MAJOR	VISUAL	100%	100%	APPROVED BOI LIST/SLD/DRG/BOM/DS		MTC/IR/ COC		P	V	V	
C.8	ANTI-COLLISION DEVICE, CABLE GLAND & LUGS, RECTIFER, LAMPS, LOAD CELL	MAKE/TYPE	MAJOR	VISUAL	100%	100%	APPROVED BOI LIST/SLD/DRG/BOM/DS		MTC/IR/ COC		P	V	V	

MANGLA HOIST PVT LTD. 3C/2, Ecotech-II G. Noida

Bharat Heavy Electricals Limited PPEI Sector-16A NOIDA 201 301 PEM/Mech. Aux.

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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	Format of RECORD	AGENCY			REMARKS
					M	C/B				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D	10.		11.
D	IN PROCESS INSPECTION (FABRICATION COMPONENTS)												
D.1	WELDING	WPS,PQR & WPQ	MAJOR	REVIEW OF DOCUMENTS	100%	100%	ASME SEC IX 2007		QW 481-484	√	P	V	V	WPS/PQR/WPQ APPROVED/REVEIWED BY NPCIL/BVI.LLYODS/SGS/ TUV
D.2	WELD FIT UP & EDGE PREPARATION	DIMENSIONS	MAJOR	DIMENSIONS	100%	100%	MFG DRG	MFG DRG	IR		P	V	V	
D.3	WELD SOUNDESS	NDT	MAJOR	DPT ON FILLET WELD & BUTT WELD JOINTS	100% FOR BUTT WELD JOINTS & 100% FOR FILLET WELD		ASME SEC V △1	ASME SEC VIII DIC 1 APPEND 8	IR	√	P	V	V	
D.4	BUTT WELD (GIRDER, END CARRAIGES, TROLLEY & FAB. ROPE DRUM IF APPLICABLE	NDT	MAJOR	RT	100% IN TENSION ZONE /25% IN COMPRESSION ZONE & 100% FOR ROPE DRUM SEAM WELD		ASME SEC V	ASME SEC VIII CL UW 51 & 52	IR	√	P	V	V	
D.5	HEAT TREATMENT (SR) OF ROPE DRUM & GEAR BOX CASING	--	MAJOR	REVIEW OF SR CHART/TEST REPORT	100%	100%	ASME SEC VIII DIV I (UCS-56)		IR	√	P	V	V	IF FABRICATED
D.6	CABIN, PLATFORM,HAND RAIL	DIMENSIONS	MAJOR	MEASUREMENT	100%	100%	MFG DRG	MFG DRG	--	—	P	V	V	
D.7	FINAL INSPECTION OF FABRICATED COMPONENT (GIRDER, END CARRAIGES, TROLLEY)	VISUAL & DIMENSIONAL	MAJOR	VISUAL & DIMENISONAL CHECK	100%	100%	APP. GA DRG/CRAB	APP. GA DRG/CRAB	IR	√	P	W	W	AT THE TIME OF FINAL INSPECTION OF CRANE
E	IN PROCESS INSPECTION (MACHINED COMPONENTS)												
E.1	ROPE DRUM	NDT & DIMENSIONAL CHECK	MAJOR	DPT TEST ON FILLET WELD & DIMENSIONS	100%	100%	ASME SEC VIII DIV 1/MFG DRG	NO RELEVANT INDICATION	IR	√	P	V	V	
		NDT	MAJOR	DPT ON GROOVE AFTER MACHINING	100%	100%	IS 3658-1981/ASME E 165	NO RELEVANT INDICATION	IR	√	P	V	V	
E.2	PULLEY & BRAKE DRUM	VISUAL & DIMENSIONS	MAJOR	VERIFICATION	100%	100%	MG DRG	MFG DRG	IR	√	P	V	V	
		NDT	MAJOR	DPT (ONLY ON GROOVE OF PULLEY & RADIUS OF BDC)	100%	100%	IS 3658-1981/ASME E 165	NO RELEVANT INDICATION	IR	√	P	V	V	
E.3	DSL GUARD	DIMENSIONAL	MAJOR	MEASERUMENT	100%	100%	MFG DRG	MFG DRG	IR		P	-	-	
E.4	FASTENERS	VISUAL & DIMENSIONS	MAJOR	VISUAL & DIMENISONAL CHECK	100%	100%	MFG STD /DRG	MFG STD /DRG	IR		P	-	-	

MANUFACTURER/SUB-SUPPLIER

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Bharat Heavy Electricals Limited PPEI Sector-16A NOIDA 201 301 PEM/Mech. Aux.

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1.	2.	3.	4.	5.	6.		7.	8.	9.	D	10.			11.
E.5	GEAR BOX	VISUAL, DIMENIONAL, MAKE,TYPE,RATING, NO LOAD RUN TEST FOR 4 HOURS, BACKLASH	MAJOR	REDUCTIONRATIO, TEMP RISE, NOISE,VIBRATION , OIL LEAKAGE	100%	100%	APPRD. DRG/DS/MFG STD	APPRD. DRG/DS/MFG STD	IR	√	P	V	V	
E.6	PINIONS,GEARS, WHEELS	VISUAL & DIMENSIONS	MAJOR	MEASUREMENT	100%	100%	APPRD. DRG/DS/MFG STD	APPRD. DRG/DS/MFG STD	IR		P	V	V	
		HARDNESS	MAJOR	MEASUREMENT	100%	100%	APPRD. DRG/DS/ IS 3177	APPRD. DRG/DS/ IS 3177	IR	√	P	V	V	DIFFERENCE B/W GEAR & PINION HARDNESS SHALL BE MIN 20 BHN AS PER IS 3177
		NDT	MAJOR	DP ON TEETH	100%	100%	IS 3658-1981/ASME E 165	NO RELEVANT INDICATION	IR	√	P	V	V	
F	FINAL INSPECTION													
F.1	CONTROL PANEL WITH VVVF DRIVE (AS APPLICABLE)	IDENTIFICATION OF ALL ELE. COMPONENTS, CABLE LAYING/DRESSING /FERULLING/TERMINATION DIMENSIONALFUNCTIONAL, HV/IR/ INTERLOCKS/DOP	MAJOR	VISUAL,DIMENSIONAL, OPERATIONAL & FUNCTIONAL CHECK,HV/IR	100%	100%	IS 3177-1999/APP DRG/DATASHEET	IS 3177-1999/APP DRG/DATASHEET	TC	√	P	W	W	HV AT 2.5 KV FOR POWER CKT & AT 1.5KV FOR CONTROL CKT, DOP BY PAPER INSERTION METHOD,
		PAINT SHADE/THIK/ADHESION	MAJOR	VISUAL/DFT	100%	100%	PAINTING SPECIFICATION /APP GA DRG	PAINTING SPECIFICATION /APP GA DRG	TC		P	V	V	7 TANK PROCESS SHALL BE DONE BEFORE PAINTING PANELS
F.2	EOT CRANE ASSEMBLY WITH CONTROL PANEL, MASTER CONTROLLER/REMOTE CONTROLLER PENDANT STATION	VISUAL & DIMENSIONAL	MAJOR	DIMENSIONAL,SPAN, DIAGONAL, WATER LEVEL & WHEEL BASE	100%	100%	APP DRG/DS/ IS 3177	APP DRG/DS/ IS 3177	IR	√	P	W	W	CRANE SHOULD BE OPERATED BY RRC MEANT FOR THAT CRANE
		OPERATIONAL	MAJOR	1.SPEED & CURRENT MEASUREMENT AT NO LOAD FOR HOIST & CT MOTION 2.SPEED & CURRENT MEASUREMNT AT SWL FOR HOIST & CT MOTION 3.OVERLOAD TEST (125% OF SWL) HOIST MOTION (ONLY FOR WATCHING MOTIONS) 4. DEFLECTION TEST AT SWL. 5. OPERATION CHCK OF BRAKE AT SWL 6. INTERLOCK & FUNCTIONAL TEST	100%	100%	APP DRG/DS/ IS 3177	APP DRG/DS/ IS 3177	IR	√	P	W	W	FUNCTIONAL & INTERLOCK TEST AS PER APPROVED ELECTRICAL SCHEMATIC DRAWING

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1.	2.	3.	4.	5.	6.		7.	8.	9.	D	10.			11.
F.3	SURFACE PREPARATION AND PAINTING	PAINT SHADE / DFT / NAME PLATE DETAILS CHECK	MAJOR	VISUAL / DFT CHECK	100%	100%	PAINTING SCHEDULE/DS/TS	PAINTING SCHEDULE/DS/TS	IR	√	P	R		
F.4	INSPECTION RELEASE NOTE (IRN)	SCOPE OF COMPLETION	MAJOR	REVIEW OF QA DOSSIER	100%	100%	AS PER APPROVED QAP/GA/DS	AS PER APPROVED QAP/GA/DS	DOSSIER/ IRN	√	P	-	H	

NOTES:

1. BOUGHT OUT ITEMS SHALL BE OF TANGEDCO/TCE APPROVED MAKE PROJECT SPECIFIC LIST OF BOI IS ATTACHED.
2. ALL MATERIAL SHALL BE AS PER APPROVED DRG./DATA SHEET OF EOT CRANE, IN CASE OF ANY COMPONENT IS NOT INDICATED IN APPROVED DRG/DATASHEET THE SAME SHALL BE AS PER RELEVANTIS/MANUFACTURER DRG.
3. IN ADDITION TO ABOVE IF ANY NEW REQUIREMENT APPEARS DURING CONTRACT EXECUTION PHASE, THE SAME HAS TO BE COMPLIED BY VENDOR.
5. BOX GIRDER WELDING TO BE DONE BY CO2 PROCESS WITH FULL PENTRATION BEVEL FILLET JOINTS.WPS/PQR/WPQ SHALL BE SUBMITTED FOR REVIEW DURING FINAL INSEPCTION.
6. STATUTORY REQUIREMENTS WILL BE COMPLIED.
7. INSTURMENTS USED FOR TESTS SHALL HAVE VALID CALIBRATION CERTIFICATE WITH TRACEABILITY TO NATIONAL LEVEL.
8. WITNESS POINTS SHALL BE AS PER APPROVED INSPECTION CATEGORIZATION PLANS.

Ref drawing-

1.PE-V0-435-501-A105 General arrangement with CT DSL details

2. PE-V0-435-501-A117 Schematic circuit diagram

3. PE-V0-435-501-A127 Data sheet of DG EOT Crane with painting details

TATA CONSULTING ENGINEERS LIMITED	UDANGUDI SUPER CRITICAL THERMAL POWER PROJECT (2 X 660 MW)	TANGEDCO
☑	CAT-1	Drawing/documents approved for final distribution. BHEL will proceed with manufacturing/ fabrication/construction.
☐	CAT-2	Drawing/documents cleared for manufacturing/ fabrication/construction subject to incorporating the comments given. BHEL to resubmit the drawing for Approval in Category – 1. Comments will be marked on the drawing documents.
☐	CAT-4	Drawing document of this category are for information only and not for approval. Information furnished on the document is noted.

Approval conveyed herein neither relieves the Vendor/Contractor of his contractual obligations and his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits conforming to the relevant codes and standards as per the specification and performance requirements nor does it limit the purchaser's rights under the contract.

NOTE:

1. It is mandatory to close documents with Code 2 / 3 to Code 1 in agreed contract period or 2 weeks, whichever is earlier
2. Any design changes / modification required to be carried out in Code 4 Drawings / Documents shall be the responsibility of BHEL. BHEL to resubmit reflecting the Design Changes for information.

ENGINEER, TATA Consulting Engineers Ltd.	PROJECT MANAGER, TATA Consulting Engineers Ltd.	CHIEF ENGINEER PROJECTS-II, TANGEDCO, CHENNAI-02
Date Jan 05, 2022	Date Jan 05, 2022	Date

MANUFACTURER/SUB SUPPLIER

SIGNATURE

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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.

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.

1. Procedure for Load / Overload testing:

Checklist:

Crane shall be assembled in all respect and shall be placed on load stands in the testing bay. All fasteners shall be ensured in tightened condition.

Proper oil/grease lubrication shall be checked and ensured at all gear boxes, bearing housings etc.

BOIs components of crane shall be verified for make/rating etc. as per approved documents.

Visual and dimensional checks as per approved GA.

Visual inspection of hoist ropes to see if there are any defects.

With SWL:

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 for maximum 1 minute.

- 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. Resisters in the circuit will be checked for any overheating of the element. For checking the cross travel, raise the load up to 500mm approx. 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.

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.

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

With Overload (hoisting motion only)

The load will be 125 percent of the rated capacity (SWL) with actual hook.

The load will be lifted upward to about 500mm 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.

Brake test: Brakes shall be checked while hoisting/ lowering / travelling of the load. There should not be any unwanted motion after the brakes have been applied.

Check the hoist brake when the first load is lifted a short distance off the ground.

Lubrication test- Visual checking shall be done for any leakage of lubrication.

Deflection test – Deflection shall be measured and recorded with dial gauge during load test. Deflection of the girder should not exceed span/ 900 as per customer specification.

i.e. Deflection < span /900

Emergency stop operation to be checked.
Limit switch operation to be checked.

2. Control Panel Testing :

Interlocking Functional check : Two motions will not simultaneously work same shall be shown by pressing push buttons for any two motions.

HV & IR : Control panel shall be isolated from VVVF drives & other electronic parts.

Insulation resistance test by using megger(Digital Insulation Tester) & follow the following steps
Connect red test lead to '+' terminal & connect black test lead to ' – ' terminal.
Short the red & black test lead and press the test switch, Zero MΩ should be indicated on the display
Connect the test leads to circuit under test and press test switch
Display indicates the reading in MΩ, Insulation resistance should be within the range of the instrument, '1' or '-1'.

HV test at 2 KV for Power & 1.0 KV for control circuit will check for the continuity for 1 minute time(value should be stable in HV tester & zero reading will confirm the short/continuity) followed by IR test again

Sheet Thickness : Will verify the sheet thickness of the control panel by physical measurement

Cable lying, Dressing, Ferruling, Components fixing, Overall dimensions, Painting Shade, Surface finish thickness: By Visually verified against approved Electrical drawing

Adhesive Test : Will Scratch(X-cut) approx. 20x40mm area by scratch tool & apply adhesion tape over the scratch area & will peel-off the tape. No paint peel-out should be there outside the scratch area.

DOP Test : By Paper Insertion method by following below steps.

Paper shall be insert at three area around the panel door(Top, Bottom & opening side)

Will lock the panel door

Pull-out the inserted papers one by one & Paper should not come out.

3. SAFETY POINTS:

Following points shall be ensured during inspection of the crane-

- ✓ When carrying out operational checks, do so slowly and carefully from a safe position with the crane positioned so that no person is under the block or in an area of danger. Be prepared to stop quickly should the system being tested fail to operate.
- ✓ Previous entry in the log sheet for outstanding actions shall be checked.
- ✓ Loading bay exclusion zone is in place shall be ensured and all barriers and signs are correct.
- ✓ No persons are located on or near the crane where the possibility of an entrapment, collision or striking accident could occur.
- ✓ No persons have had permission to access the crane rail track area (where appropriate) or that scaffolding has been erected that could collide with the crane or load.
- ✓ If required a banks man is in attendance for difficult lifts shall be ensured. If work involves 'guiding' then the banks man must stay outside of the exclusion zone.
  NOTE, Banks man is only allowed into exclusion zone if the area is restricted and totally under the instruction of the crane operator.
- ✓ During lifting operations, do not attempt to steady the load by hand, use hand lines and seek assistance. If the lift involves using guide ropes only those instructed to participate in the lift can access the exclusion zone.
- ✓ Clear lines of communication must be in place so that the crane operator has total control of the load and unloading area.
- ✓ Mobile phones and hand-held radio communications are not to be used when operating cranes. In the event that the lift cannot be completed safely without the use of radio communications then a risk assessment must be undertaken and a safe method of radio contact is to be established before the lift commences.
- ✓ Clear operator route for controlling of the crane shall be ensured prior to lifting load.
- ✓ Crane movement area shall be clear of personnel and equipment shall be ensured.
- ✓ On no account, there should not be any lifting operations over essential or rotating equipment.
- ✓ When the load is about to be released that the area around the load shall be clear, and that the load is well supported before releasing it from the crane. Same shall be ensured.
- ✓ Do not use the crane to drag loads.
- ✓ Correct operator position at the start and during the lift shall be ensured. The operator must be able to see the load and the lift hook clearly at all times.
- ✓ Do not stand under any load being lifted. Same shall be ensured.
- ✓ Do not exceed the Safe Working Load of the crane. Overload test shall be done for a while only.
- ✓ Keep the load as close to the ground as possible during the lift.
- ✓ Keep pendant control and pendant cable well clear of the load and hoist ropes during the lift.
- ✓ All signs are in good order and securely fixed in place.
- ✓ Secure pendant control where appropriate.

PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS	STANDARD FIELD QUALITY PLAN	
		SYSTEM : EOT Crane AREA : TG HALL	QP NO. : REV. No. : 00 PAGE No. : 1 of 4

SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS
1	RECEIPT & STORAGE EOT Crane after arrival at site.							
	a. Check manufacturers dispatch documents at site, MDCC, CHP etc. for completeness, identification.	Record Verification	Visual	B	100%	Drawings / Tech. Spec.	Protocol	
	b. Check for coating condition of rust inhibitor check and any transit damage	Visual	Visual	B	100%	Drawings/Tech. Spec/ No. Damage	Protocol	
	c. Storage condition of parts, rails, crane girders and structural parts shall be placed on the elevated surface. * Gear box, fasteners and wire ropes shall be stored in closed covered shed.	Physical	Visual	B	100%	Storage & Preservation Procedure.	Protocol	
	d.Electrical items like panel, cables, motor, controls & resistance block in closed, covered shed.	Physical	Visual	B	100%	Storage & Preservation Manual	Protocol	
2	PRE-ERECTION CHECK							
	a. For Gantry at every 5.0 M i.e. span, level, diagonals before taking over from Client	Measurement	Tape, Water level	A	100%	Drawings	Protocol	
	b. Web axes of gantry girders in a raw are aligned.	Measurement	Water level	B	100%	Drawings/ER Manual	Protocol	
	c. Center to center distance of gantry girders.	Measurement	Measuring Tape	B	100%	Drawings/ER Manual	Protocol	

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PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS	STANDARD FIELD QUALITY PLAN	
		SYSTEM : EOT Crane AREA : TG HALL	QP NO. : REV. No. : 00 PAGE No. : 2 of 4

SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
3	Check for Alignment of Rails							
	a. Straightness of gantry rails	Measurement	Piano Wire/ Twine	B	100%	Drawings/Erection Manual	Protocol	
	b. Level and Elevation of Gantry rails (top level of girder)	Measurement	Water level/ Measuring Tape	A	100%	Drawings/Erection Manual	Protocol	
	c. Distance between rails(every 5 M) (Tolerance.±. 6mm) including diagonal of gantry rails (Tolerance±. 5 mm)	Measurement	Measuring Tape	A	100%	Drawings/Erection Manual	Protocol	
	d. Bolting of rails and tightening	Measurement	Torque wrench	C	100%	Drawings	Protocol	
	e. End Stopper Arrangement	Physical	-	A	100%	Drawing	Protocol	
4	ERECTION CHECK FOR							
	a. Joining of Girders i.e. splice joints	Physical	-	B	100%	Tech. Spec.	Protocol	
	b. Placement of girder assembly on the gantry.	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	
	c. Movement of wheels	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	
	d. Placement and positioning of electrical panel & trolley.	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	

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PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS	STANDARD FIELD QUALITY PLAN	
		SYSTEM : EOT Crane AREA : TG HALL	QP NO. : REV. No. : 00 PAGE No. : 3 of 4

SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCETANCE STANDARD	FORMAT OF RECORD	REMARKS
	e. Movement of crab trolley on the crane girder	Physical	-	B	100%	Drawings/Tech Spec.	Protocol	
	f. Deviation in the crane rail level at any point from true level tolerance ± 10 mm	Measurement	Piano Wire / Twince	A	100%	Drawings/ Erection Manual	Protocol	
5	D.S.L.							
	a. Fixing arrangement	Visual	-	C	100%	Drawing	Protocol	
	b. Location with respect to gantry rail, spacing & alignment.	Measurement	Measuring Tape	B	100%	Drawing	Protocol	
	c. Continuity check & insulation Resistance	Measurement	Megger	A	100%	Minimum 5 Mega Ohms	Protocol	
6	Cable laying connections	Physical	-	B	100%	Drawing	Protocol	
7	Crab Clearances							
	a. Headroom, end clearance, hook approaches and height of lift and record.	Visual & Measurement	Measuring Tape	B	100%	Drawing	Protocol	
8	Gear Box							
	a.Check oil level	Measurement	Dip stick	B	100%	Drawing	Site log Book	
9	LT Machinery, Platform, cabin, Electrical equipment, other structural components, limit switch & Mechanical stopper.							
	a. Fit up	Visual	-	B	100%		Protocol	
	b. Alignment	Visual	-	B	100%	Drawing	Protocol	
10	Storm braker arrangement	Physical	-	A	100%	Drawing	Protocol	
11	COMMISSIONING CHECKS							

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PSSR-QUALITY	SUPPLIER'S NAME & ADDRESS	STANDARD FIELD QUALITY PLAN	
		SYSTEM : EOT Crane **AREA : TG HALL**	QP NO. : REV. No. : 00 PAGE No. : 4 of 4

SL.NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS	QUANTUM / FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
	a. Power & control cable connections Insulation Resistance	Visual	Megger	A	100%	Min 5 Mega Ohms	Protocol	
	b. Control panel earthing Insulation resistance	Measurement	Megger	A	100%	Min 5 Mega Ohms	Protocol	
	Function & sequential operation	Physical		B				
	c. Resistance box earthing							
	IR value	Measurement	-	B	100%	Min 5 Mega Ohms	Protocol	
	Resistance	Measurement		B	100%	Drawing	Protocol	
	d. Operation of Brakes (Hoist motion, L.T. Motion & C.T. motion)	Physical	-	A	100%	O&M Manual	Protocol	
	e. Operation of limit Switch (Hoist & traveling motion brakes)	Physical	-	A	100%	O&M Manual	Protocol	
	f. Motors.		-					
	IR value	Measurement		B	100%	Min 5 Mega Ohms	Protocol	
	Earthing							
	g. At no load check							
	Motor Current	Measurement	-	A	100%	As per procedure	Protocol	
	Crane Speed (only watching all motion)	Measurement		A	100%			
	h. At full load check / Load testing of crane (SWL):							
	Motor Current	Measurement		A	100%	As per procedure	Protocol	
	Crane Speed	Measurement		A	100%			
	Deflection.	Measurement		A	100%			
	i.At 25% Overload		-				Protocol	
	(only watching all motion)	Visual		A	100%	As per procedure		
	j. Storm braker arrangement	Physical	-	A	100%	Drawing	Protocol	
	k. Touch Up Painting.	Visual	-	C		As per approved shade	Records	

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ANNEXURES

1. ANNEXURE-I- MAKES OF SUB-VENDOR ITEMS

SR. NO.	ITEM	SUPPLIERS
1	STEEL	SAIL/ESSAR/JINDAL
2	HOOKS	SMRITI FORGING /EE KARACHIWALA /STEEL FORGING
3	MOTORS	MARATHON/BBL/CGL/LHP/KEC/ABB/SIEMENS
4	WIRE ROPE	USHA MARTIN
5	BRAKES	S ELECTROMAG/SOC/KAKKU/ EMCO/ BCH/PETHE
6	BEARING	SKF/FAG/ZKL/NBC
7	GEAR BOX, WHEELS, COUPLING	OEM
8	CONTROL PANELS	OEM
9	VVVF DRIVES	SCHNEIDER/YASKAWA /SIEMENS/FUJI
10	DBR	IRESCO/SOC/BEADFLEX/SURE/ENAPROS
11	SHROUDED DSL	SUSHIL ENGG/STROMAG/SOC
12	RAIL	JSPL, SAIL
13	OVERLOAD RELAYS	SIEMENS/L&T/C&S/SCHINEIDER/ABB
14	MCB, MCCB, MPCB	SIEMENS/L&T/C&S/SCHNEIDER
15	TIME RELAYS	MINILEC/SIEMENS/C&S/SELECTRON
16	AUX.RELAY (COUPLING)	SIEMENS/SCHNEIDER/AREVA/PLA/OEN/JYOTI/OMRON
17	LIMIT SWITCHES	ELECTROMAG/SOC/OMEGA CONTROL/AVON/JAI BALA JI/BCH/SIEMENS/KEYCEE/SCHENIDER (TELEMECHANIC)
18	ELECTRICAL ISOLATORS/SFU	SIEMENS/L&T/ABB/SCHNEIDER/C&S
19	HRC FUSES	GE/ABB/SIEMENS/L&T/C&S
20	PUSH BUTTONS	SIEMENS/L&T/TEKNIK/SCHNEIDER/ VAISHNO
21	PENDENT STATION	IES MAKE / TELEMECHANIQUE/VAISHNO/OEM
22	RRC	ACROPOLIS/SNT CONTROL
23	TRANSFORMER	INDCOIL/AE/PRAGATI/KAPPA/LOGICSTAT/PRECISE/ SILKAANS/PRAYOG
24	LINE CHOKE	SERCON
25	INDICATING LAMPS	SIEMENS/L&T/TEKNIK/VAISHNO/SCHNEIDER
26	LIGHTS	CGL/PHILIPS/BAJAJ (BIS MARKED)
27	INDICATING METER	MECO/AE/RISHAB
28	SELECTOR SWITCH	KAYCEE/L&T/VAISHNO/SALZER
29	TERMINAL BLOCK	CONNECT WELL/PHOENIX/ELELEX
30	LOAD CELL	IPA/SARTORIOUS
31	CABLE LUGS (HEAVY DUTY)	DOWELLS, UML ENGINEERS -Kolkata, JAINSON
32	HOOTERS	BEACON, OSC, TARGET, KHERAJ

NOTE:

1. THE SUB VENDOR LIST ABOVE IS FINAL
2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CCONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BBIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL.

ANNEXURES

2. ANNEXURE-II MANDATORY SPARES

Sl. No.	DESCRIPTION	QUANTITY
A)	**MANDATORY SPARES FOR 18T SEA WATER OUTFALL PUMP HOUSE CRANE**	
1	***Spares for long travel unit***	
i	Set of axle bearings	1 set
ii	Set of gearbox bearings with sleeves	1 set
iii	Long travel end shaft bearings	1 set
iv	Coupling	1 set
v	Seals for travel gear box	1 set
vi	Long travel brake shoes	1 set
vii	Long travel brake springs	1 set
viii	Long travel brake shoe liners	1 set
2	***Spares for cross travel unit***	
i	Axle bearings	1 set
ii	Set of gearbox bearings with sleeves	1 set
iii	Set of seals for gearbox	1 set
iv	Cross travel end shaft bearing	1 set
v	Coupling	1 set
vi	Cross travel brake shoes	1 set
vii	Cross travel brake springs	1 set
viii	Cross travel brake shoe liners	1 set
3	***Spares for main hoist***	1 Set
i	Main hoist pulley bearings	1 set
ii	Set of bearings for rode drum	1 set
iii	Set of bearings for gear box	1 set
iv	Set of seals for main hoist	1 set
v	Main hoist brake shoes	1 set
vi	Main hoist brake springs	1 set
vii	Main hoist brake shoe liners	1 set
viii	Disc pad	1 set
4	***Electrical: control panels/motors***	
i	Power contactor of each rating	2 nos.
ii	Over load relays of each rating	2 nos.
iii	MCCB/MPCB of each rating	2 nos.
iv	Push button of each type	2 nos.
v	VVVF drive of each type & rating	1 no.
vi	Set of bearings for main hoist motor	1 set
vii	Set of bearings for aux hoist motor	1 set
viii	Set of bearings for cross travel motor	1 set
ix	Set of bearings for long travel motor	1 set

ANNEXURES

B)	**MANDATORY SPARES FOR 15T SEA WATER INTAKE PUMP HOUSE CRANE**	
1	***Spares for long travel unit***	
i	Set of axle bearings	1 set
ii	Set of gearbox bearings with sleeves	1 set
iii	Long travel end shaft bearings	1 set
iv	Coupling	1 set
v	Seals for travel gear box	1 set
vi	Long travel brake shoes	1 set
vii	Long travel brake springs	1 set
viii	Long travel brake shoe liners	1 set
2	***Spares for cross travel unit***	
i	Axle bearings	1 set
ii	Set of gearbox bearings with sleeves	1 set
iii	Set of seals for gearbox	1 set
iv	Cross travel end shaft bearing	1 set
v	Coupling	1 set
vi	Cross travel brake shoes	1 set
vii	Cross travel brake springs	1 set
viii	Cross travel brake shoe liners	1 set
3	***Spares for main hoist***	1 Set
i	Main hoist pulley bearings	1 set
ii	Set of bearings for rode drum	1 set
iii	Set of bearings for gear box	1 set
iv	Set of seals for main hoist	1 set
v	Main hoist brake shoes	1 set
vi	Main hoist brake springs	1 set
vii	Main hoist brake shoe liners	1 set
viii	Disc pad	1 set
4	***Electrical: control panels/motors***	
i	Power contactor of each rating	2 nos.
ii	Over load relays of each rating	2 nos.
iii	MCCB/MPCB of each rating	2 nos.
iv	Push button of each type	2 nos.
v	VVVF drive of each type & rating	1 no.
vi	Set of bearings for main hoist motor	1 set
vii	Set of bearings for aux hoist motor	1 set
viii	Set of bearings for cross travel motor	1 set
ix	Set of bearings for long travel motor	1 set
C)	***LIST OF ITEMS COMMOM FOR ALL CRANES***	
	LT Motors of each type and rating	

ANNEXURES

a)	Driving end bearing	1 set
b)	Non driving end bearing	1 set
c)	Terminal block for motors up to 30 Kw each rating	10 Nos.
d)	Motors of each type & rating	1 no.

Notes:-

1. One (1) Set 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.
3. Unless stated otherwise a 'Set', it will include the total requirement of the item for a unit module or the station as specified. Also, set for the particular equipment e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example a set of bearing shall include all hardware normally required while replacing the bearings. It is further, intended that the assembly/sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly/sub-assembly, these shall be considered as different types of assembly/sub-assembly.
4. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.
5. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.
6. Any item which is quoted as “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the
purpose of evaluation.
7. Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
8. Interchangeability and Packings: All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be pre set and/or preprogrammed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre setting/pre programming before putting them in to service. The spare shall be treated and properly packed for long term storage.
9. Identification: Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.
10. Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification, same shall be deemed to have been covered in bidders scope of supply.

ANNEXURES

3. 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.
10.	Hydraulic Jack	2 Nos. of suitable capacity

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.

ANNEXURES

4. ANNEXURE IV - PAINTING SPECIFICATION

- Surface Prep – SA 2-1/2
  Primer – Solvent Based IZS – VS of 60%, n Dust – 1.77 kg/ltr minimum, Zn dust by weight – minimum 85%, Pot life of 12 hours/ 21 Deg. Paint to meet compositional & performance specifications for SSPC Paint 20, Level 1. 1 Coat total DFT 75 Microns

- Touch up - Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level 2. 1 Coat total DFT 75 Microns
- Mid Coat - 2 pack High build High Solid Lamellar MIO based Epoxy Mid coat 1 Coat Total DFT 200 microns
- Finish - 2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs. 1 coat Total 75 microns
- Total DFT shall be 350 Microns

Motors

- Surface Prep – SA 2-1/2
- Primer - Catalysed Zn rich Primer with a VS of 60% min, complying to SSPC Paint 20 level 2. 1 coat Total DFT 75 microns
- Finish - Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%. 2 Coats Total DFT 100 Microns
- Total DFT 275 Microns

Panels

- Surface Prep – SA 2-1/2
- Primer - Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment. Total DFT 75 microns
- Mid Coat - Two component High Build Surface Tolerant Epoxy coating pigmented with Aluminium and Lamellar Micaceous iron oxide 1 coat total DFT 100 microns
- Top Coat - Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%. 1 Coats Total DFT 100 Microns
- Total DFT 275 Microns

Color Shade-

1. Crane Structure- Golden yellow, shade 356 as per IS-5
2. Bottom block assembly - Golden yellow, shade 356 as per IS-5 with black strip
3. Hooks - Golden yellow, shade 356 as per IS-5 with 100 mm wide black zebra strip
4. End carriage, sweep- Golden yellow, shade 356 as per IS-5 with black strip
5. Panels and motors- Steel grey, shade 631 as per IS-5

ANNEXURES

5. 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	Schedule date of submission from date of LOI. (in weeks)
1	PE-V0-435-501-A201	Manufacturing Quality Plan with sub vendor list For SWIPH & SWOPH crane	2
2	PE-V0-435-501-A203	Data sheet of motors for SWIPH & SWOPH crane	5
3	PE-V0-435-501-A107	GA and Mechanism Sizing Calculation for SWIPH	2
4	PE-V0-435-501-A109	GA and Mechanism Sizing Calculation for SWOPH	2
5	PE-V0-435-501-A205	Crab sub assembly for SWIPH & SWOPH crane with CT wheel assembly	3
6	PE-V0-435-501-A206	Main hook block assembly with details of hook, nut and check plate For SWIPH & SWOPH crane	2
7	PE-V0-435-501-A207	Long travel Machinery Assembly with LT wheel assembly For SWIPH & SWOPH crane	4
8	PE-V0-435-501-A208	General arrangement for PVC shrouded DSL for SWIPH & SWOPH crane	3
9	PE-V0-435-501-A212	Structural calculations For SWIPH & SWOPH crane	3
10	PE-V0-435-501-A217	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 along with GA of panels, Pendent, Remote Radio Control along with control write up for SWIPH crane	5
11	PE-V0-435-501-A218	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 along with GA of panels, Pendent, Remote Radio Control along with control write up for SWOPH crane	5
12	PE-V0-435-501-A219	Cable Sizing and cable schedule For SWIPH & SWOPH crane	6
13	PE-V0-435-501-A227	Data sheet of SWIPH & SWOPH crane with painting details	3
14	PE-V0-435-501-A232	Gantry Rail installation for SWIPH & SWOPH crane	3
15	PE-V0-435-501-A250	Crane lubrication drawing For SWIPH & SWOPH crane	6
16	PE-V0-435-501-A514	O & M Manual For SWIPH & SWOPH crane	9
17	PE-V0-435-501-A523	Mandatory spare parts list For SWIPH & SWOPH crane	8

ANNEXURES

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.

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. BHEL will comment in 14 days

iii. 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.

ANNEXURES

6. 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.

ANNEXURES

7. ANNEXURE-VIII -Format for Operation & Maintenance Manual

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**Cover page**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	**Index**				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	**Description of Plant/System**				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	**Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)**				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**Operation Guidelines for plant personal/user/operator**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				

ANNEXURES

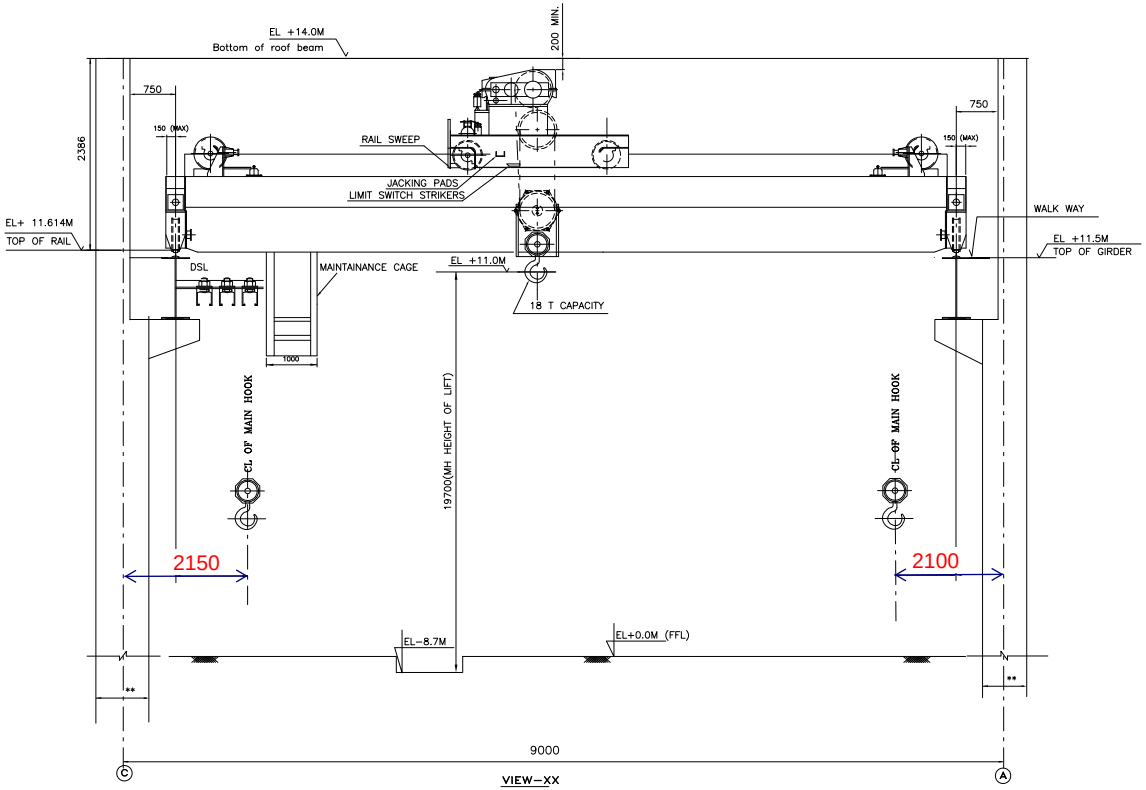
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	**Maintenance guidelines for plant personal**				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble 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**				

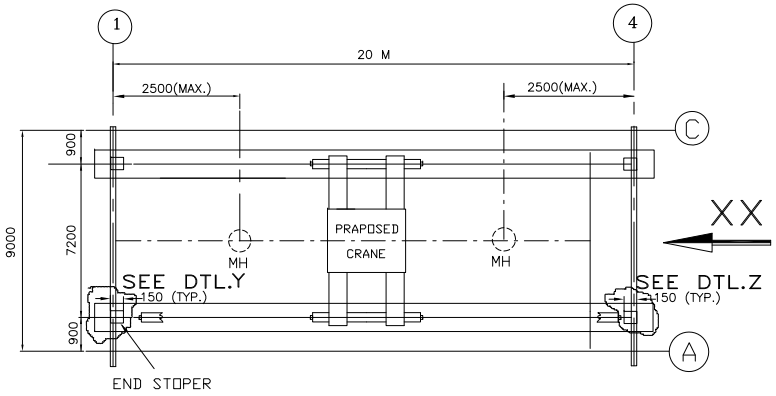
COMPUTER FILE NAME : TAL5

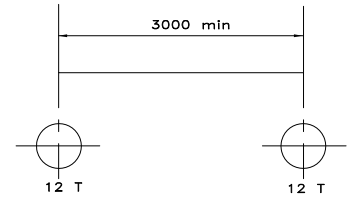
ALL DIMENSIONS ARE IN MM FIRST ANGLE PROJECTION

DRAWING NO. PE-DG-435-501-A005

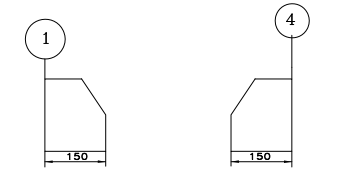
CUSTOMER'S DRAWING NO.







LT WHEEL LOAD DIAGRAM (WITHOUT IMPACT).



Approx. crane weight = 15 T
(including crab weight)

Approx. crab weight = 3.5 T

NOTES

1) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
2) SPAN , LIFT , HOOK APPROACHES & BAYLENGTH ARE SUBJECT TO CHANGE AS PER CHANGE IN FINAL CIVIL STRUCTURE.
3) BOTH 'A' ROW and 'C' ROW COLUMNS ARE ASSUMED TO BE OF 800 mm
4) FACE OF COLUMN IS 150MM OFFSET TOWARDS INSIDE FROM CENTRE LINE OF COLUMN

Ref drawing: PE-DG-435-172-N005 (MECHANICAL GA OF SEA WATER OUTFALL P/H

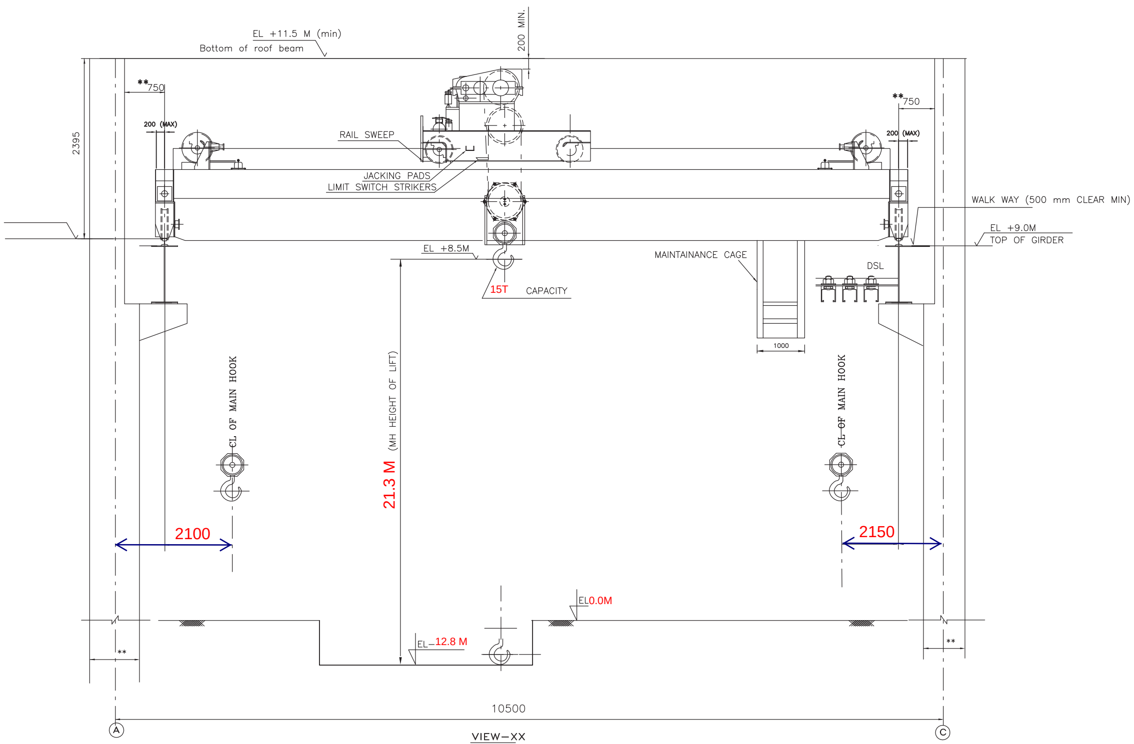
CUSTOMER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED TANGEDCO HEAD QUARTERS, 1ST FLOOR, NEW EB QTRS., 144,Anna Salai,Chennai-600002.					
CONSULTANT NAME	TATA CONSULTING ENGINEERS LIMITED BENGALURU					
PROJECT NAME	2x660 MW UDANGUDI TPP-STAGE I					
BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA	DEPT CODE: M	DRN	NAME	SIGN Sd/-	DATE	
		DESN	BHASKAR	Sd/-	JAN 2019	
		CHD	PKK	Sd/-	JAN 2019	
		APPD	GB	Sd/-	JAN 2019	
TITLE: CRANE CLEARANCE DIAGRAM OF 18T EOT CRANE (1) SEA WATER OUTFALL PUMP HOUSE						
	DEPT.	SCALE 1:3000	DRAWING NO. PE-DG-435-501-A005			
	SIGN					
	DATE		SHEET 1 OF 1		REV. 1	

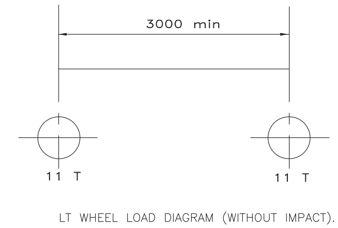
ALL DIMENSIONS ARE IN MM

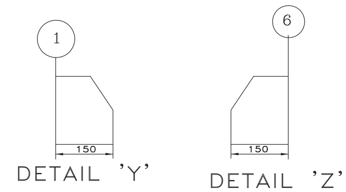
FIRST ANGLE PROJECTION

DRAWING NO. PE-DG-435-501-A004

CUSTOMER'S DRAWING NO.

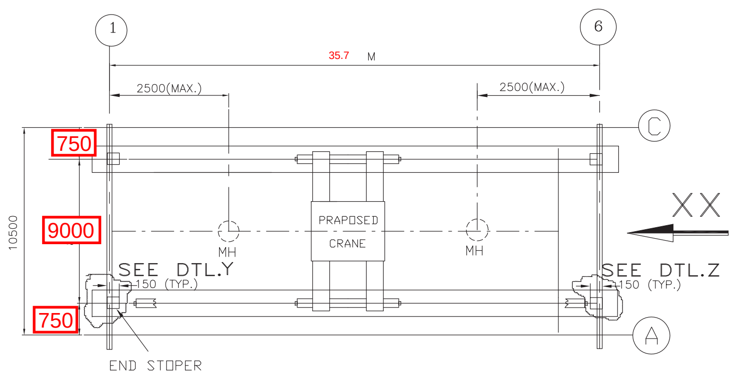






NOTES

1) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
2) SPAN , LIFT , HOOK APPROACHES & BAYLENGTH ARE SUBJECT TO CHANGE AS PER CHANGE IN FINAL CIVIL STRUCTURE.
3) DISTANCE BETWEEN CENTRE LINE OF COLUMNS AND FACE OF COLUMNS HAVE BEEN ASSUMED AS 150MM



PROJECT: 2x660 MW UDANGUDI SUPERCRITICAL TPS-STAGE I

CUSTOMER: TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)

OWNER's CONSULTANT: DESEIN PRIVATE LIMITED
DESEIN HOUSE, GREATER KAILASH-II, NEW DELHI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN		Sd/-	
	DESN	BHASKAR	Sd/-	JAN 2019
	CHD	PKK	Sd/-	JAN 2019
	APPD	GB	Sd/-	JAN 2019

TITLE: CRANE CLEARANCE DIAGRAM OF 15T EOT CRANE
SEA WATER INTAKE PUMP HOUSE

DEPT. SCALE 1:3000
SIGN
DATE

DRAWING NO. PE-DG-435-501-A006
SHEET 1 OF 1 REV. 0

COMPUTER FILE NAME :

SUB SECTION-IB

SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)

TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD.

2 X 660 MW UDANGUDI STPP STAGE-I

DOUBLE GIRDER EOT CRANE

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

CONTENTS

SPECIFIC TECHNICAL REQUIREMENTS:

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

The equipment and services to be provided by bidder under this specification shall be as detailed here below but shall not be limited to the following:

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 bidder without any extra charge shall provide the same.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Electrical load requirement for DG EOT 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 including GA drg, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc. shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL.

h) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.

i) Motors shall meet minimum requirement of Electric motor specification.

j) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.

k) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

l) 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 DG EOT CRANE and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
b) Electrical load requirement.

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

4.1 Electrical scope between BHEL & vendor
4.2 Technical specification – Specification for Electric Motors/Actuators
4.3 Standard Technical specification – LV Motors
4.4 Datasheets & quality plan for motors.
4.5 Load Data Format. (Annexure –II)
4.6 BHEL Cable listing format (Annexure –III)

REV: 00 DATE: 11.03.2015

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

PACKAGE: DOUBLE GIRDER EOT CRANES

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

PROJECT :

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 3W) 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	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

SECTION–3.16: MOTORS

1.0.0 INTENT OF SPECIFICATION

This section covers the technical requirements of HT motors, LT Motors and DC motors.

2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and /or supplemented by this specification.

a)	IS: 325	Three phase induction motors
b)	IS: 12615	Energy efficient induction motors
c)	IS: 900	Code of practice for installation and maintenance of induction motors
d)	IS: 996	Single-phase AC induction motor for general purpose
e)	IS: 1231	Dimensions of three-phase foot-mounted induction motors
f)	IS: 2223	Dimensions of flange mounted AC induction motors
g)	IS: 4029	Guide for testing three-phase induction motors
h)	IS: 8789	Values of performance characteristics for three-phase induction motors
i)	IS: 13555	Guide for selection and application of 3-phase AC induction motors for different types of driven equipment
j)	IS: 5571	Guide for selection of electrical equipment for hazardous areas
k)	IS: 12065	Permissible limits of noise level for rotating electrical machines
l)	IS: 12075	Mechanical vibration of rotating electrical machines
m)	IS 60034-5	Degree of protection provided by Integral design of rotating electrical machines
n)	IS 60034-8	Terminal marking and direction of rotation
o)	IS 60079-1	Equipment protection by flame proof enclosure
p)	IS 60034-1	Rotating electrical machines.
q)	IS 60079	Explosive atmospheres
r)	IS/IEC 60529	Degrees of protection provided by enclosures (IP code)
s)	IEC 60034	Rotating electrical machines.
t)	IS 3177	Code of practice for Design, Manufacture, Erection and testing of Cranes and Hoists

3.0.0 TECHNICAL REQUIREMENTS

3.1.0 Design ambient temperature

Motors shall be suitable for an ambient temperature of 50 degree C and relative humidity of 95% and shall deliver the rated output without exceeding its guaranteed temperature limits.

3.2.0 Supply voltage

Motors rated up to and including 415 V are termed as LT motors and the motors rated higher than 415 V are termed as HT motors.

Motors shall be capable of delivering the rated output under following voltage and frequency variations without exceeding its guaranteed temperature limits.

- Frequency variation : (+) 3% and (-) 5%
- Voltage variation for LT motors : (±) 10%
- Voltage variation for HT motors : (±) 6%
- Combined variation of voltage and frequency : 10% (absolute sum)

All the motors shall be so designed that maximum inrush currents, locked rotor torque and pullout torque developed at extreme voltage and frequency variations do not endanger the motor and the driven equipment.

3.3.0 System Parameters

Sl. No.	Description	11 kV and 6.6 kV System	LT System
1.	Voltage level	6.6 kV : Above 200 kW and upto 2000 kW 11 kV: Above 2000 kW	240 V : up to 0.2 kW 415 V: >0.2 kW and up to 200 kW.
2.	System earthing	Earthed through resistance, limiting earth fault current to 300 Amps	415 V system solidly grounded.
3.	Fault withstand rating of motor terminal box (Breaker operated)	50 kA for 0.2 sec for 11 kV and 31.5 kA for 0.2 sec for 6.6 kV	415 V system : 50/65 kA for 0.2 second

3.4.0 Type

AC Motors shall be squirrel cage induction type unless otherwise it is specified.

3.5.0 Duty

- All AC motors shall be squirrel cage three phase/single phase induction motors. All the motor shall be designed for bi-directional rotation.
- All the motors shall be rated for S1 duty for continuous operation. Motors of crane and hoist application shall be intermittent duty.
- DC motor shall generally be of shunt wound type rated for 220 V DC.
- Motors shall be suitable for installation in hot, humid and tropical atmosphere and polluted at places with coal ash and or fly ash.
- The motors shall be suitable for bus transfer schemes provided on the 11 kV/6.6 kV/415 V systems without any injurious effect on its life.

3.6.0 Design margin

Whenever the basis for motor rating are not specified in the corresponding mechanical specification section 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.

The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating; pull up, breakdown and full load torques are available for the intended service.

Service shall be considered as 1.0 only.

3.7.0 Method of Starting

- All the motors shall be suitable for direct on-line starting on full load. Where variable voltage and variable frequency (VVFD) operation is envisaged through VVFD drives, motors shall be specially designed for such application.
- LT motors rated up to 125 kW shall be controlled through MPCB/MCCB and contactor. LT motors rated more than 125 kW shall be controlled through air circuit breaker.
- HT Motors shall be controlled through vacuum circuit breaker.

3.8.0 Efficiency

All the duty motors shall be energy efficient type. For HT and LT motors, it shall be IE3 class as per IS 12615. For VFD controlled HT and LT motors, it shall be IE2 class as per IS 12615.

3.9.0 Temperature rise

- Winding Insulation shall be Class F.
- Temperature rise of air cooled motors shall not exceed 70°C over air temperature of 50°C by resistance method, while delivering its maximum rated output.
- Temperature rise of water cooled motors shall not exceed 80°C over inlet cooling water temperature by resistance method, while delivering its maximum rated output.

3.10.0 Starting voltage

a) Motors shall be capable of starting and accelerating the load at following starting voltage, with direct on-line starting, without exceeding specified winding temperatures.

- HT Motors (up to 1000 kW) : 85% of rated voltage
- HT Motors (> 1000 kW up to 4000 kW) : 80% of rated voltage
- HT Motors (> 4000 kW) : 75% of rated voltage
- LT motors : 80% of rated voltage

b) During fast changeover of power supply source, vector difference between the motor residual voltage and the incoming supply voltage shall be about 150% of the rated voltage and the motors shall withstand voltage stress and torque stress developed during that time, which may last for a period of one (1) second.

c) The motor shall be capable of operating at full load at a supply voltage of 75% of the rated voltage for 5 minutes.

3.11.0 No. of Starts

Continuous duty motors shall be suitable for the following starting requirements under the specified conditions of load, torque and inertia.

- No. of consecutive hot starts shall be 2 (with initial temperature of the motor at full load operating level).
- No. of consecutive cold starts shall be 3 (with initial temperature of the motor at ambient temperature).
- For conveyor motors, no. of consecutive hot starts shall be 3 (with initial temperature of the motor at full load operating level).

3.12.0 Starting current

- Locked rotor current of HT motors for applications other than listed below shall be limited to 600% of the full load current, and is subject to IS tolerance.
- For energy efficient LT motors, locked rotor current shall be as per IS: 12615.
- Locked rotor current of the VFD controlled AC motors shall be limited to 300% of the full load current, and is subject to IS tolerance.
- Locked rotor current of the BFP motors shall be limited to 450% of the full load current of the motor, and is subject to IS tolerance.

3.13.0 Locked rotor withstand time

- The locked rotor withstand time for HT motors under hot conditions at 110% rated voltage shall be more than the starting time at minimum permissible voltage specified above by atleast three seconds or 15% of the accelerating time whichever is greater. Provision of speed switch shall be avoided to the extent possible. In case the speed switch is required, it shall be indicated by the bidder in his offer
- For the LT motors having starting time up to 20 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 seconds more than the starting time.
- For the motors having starting time more than 20 seconds and up to 45 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.
- For motors having starting time more than 45 seconds at minimum permissible voltage, 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.
- Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
- When a speed switch is mounted on the motor shaft, the same shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% over speed in either direction of rotation.

3.14.0 Torque Requirements

- Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
- Pull out torque at rated voltage shall not be less than 205% of full load torque.
- Motors subjected to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% of rated speed in reverse direction.

3.15.0 Enclosure

a) Motors shall have IP 55 degree of protection.

b) For hazardous location, the enclosure of motors shall following have flame proof construction conforming to applicable standard.
   - Fuel oil area Group – IIB
   - Hydrogen generation plant area : Group – IIC)

3.16.0 Cooling

- LT motors shall be totally enclosed fan cooled (TEFC), type IC411. The cooling shall be effected by self-driven bi-directional centrifugal fan protected by fan cover.
- HT motors can be totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA-IC6A1A1) type.
- Motors rated >3000 kW can be closed air circuit water cooled (CACW).
- Motors with CACA/CACW heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate the following:

  -Hot and cold air temperatures of the closed air circuit for CACA motors.

  -Hot and cold, air and water temperatures for CACW motors.
- The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.

3.17.0 Winding

- Winding shall be class F insulation with temperature limited to class B. Insulation shall be Non-hygroscopic, oil resistant, and flame resistant. Winding, fittings and hardware shall be corrosion resistant. Winding shall be tropicalized and suitably varnished, baked and treated for operating satisfactorily in humid and corrosive atmosphere.
- For the VFD operated drives, insulation shall be designed to take care of stresses due to high DV/DT. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages.
- Space heaters rated for 240 V AC, 50 Hz supply shall be provided for motors rated 30 kW and above to maintain windings in dry condition when motor is standstill.
- For HT motors, insulation shall be Vacuum Impregnated (VPI).
- HT motors shall withstand one minute power frequency voltage test or 1.2/50 micro sec lightning impulse Voltage wave of 4U+5 kV (U=Line voltage in kV) test on main insulation as per IEC 600034-15. The coil inter-turn insulation shall withstand steep front impulse withstand voltage as per IEC 600034-15.
- For HT motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0℃, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the ETD's shall be platinum.

3.18.0 Bearings

- Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- Sleeve bearings shall be split type, ring oiled with permanently aligned, close running shaft sleeves. Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with grease nipple and relief holes. For sleeve bearings, the bearing housing shall be preferably in end shield itself.
- Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. However, if anti-friction bearings can take vertical thrust, thrust and guide bearings are not required.

- Lubricant shall not deteriorate under all service conditions. The lubricants shall be limited to normally available types. For motors rated 30 kW and above re-lubrication facility shall be provided.
- For motor with forced lubrication, a shaft driven oil pump shall be provided along with an electrical auxiliary pump. Alternatively, two motor driven pumps may be provided, one working and one standby. All necessary auxiliaries and accessories shall be provided to complete the system. A pressure gauge and pressure switch for low oil pressure warning and to start the standby oil pump automatically shall also be provided. A motor driven jacking oil pump may be provided, for heavy shaft loads.
- 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.
- For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box.
- Each bearing shall be provided with dial type thermometer.
- For all VFD operated motors shall have insulated bearings to prevent flow of shaft currents.
- For motors rated above 1000 KW having shaft length more than 1.5 M shall have insulated bearings to prevent flow of shaft currents.
- All the motors rated <15 kW shall be provided with sealed ZZ bearings.
- Lub oil pressure transmitters shall be provided to DCS for remote monitoring. Lub oil pressure very low trip to HT equipment shall be 2 out of 3 logic.

3.19.0 Terminal Boxes

- Separate terminal boxes of IP 55 degree of protection shall be provided for stator leads. For single core cables, gland plate shall be non-magnetic material. Terminal box of HT motors shall be capable of being turned 360° in steps of 180°. Terminal box of LT motors shall be capable of being turned 360° in steps of 90°. The terminal boxes shall be split type with removable cover with access to connections.
- Terminals for motors shall be stud type, thoroughly insulated from the frame. The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- The terminal box shall be capable of withstanding maximum system fault current for 0.2 sec for all breaker operated motors and shall be provided with explosion vent.
- For contactor operated LT motors, the terminal box shall be capable of withstanding the fault current for 0.2 sec minimum and operating time of MPCB/MCCB.
- Removable gland plates of thickness not less than 2.5 mm sheet steel or 3 mm aluminium (for single core cables) shall be provided for cable boxes.
- Cable spreader box shall be provided for larger cable sizes.
- Cable boxes of HT motors shall be phase segregated type. The terminals of three phases shall be segregated by barriers of metal or fiber glass. For HT motors, cable box design shall be suitable for accommodating cable termination kits.
- Separate terminal box for space heaters shall be provided.
- A separate terminal box of IP 55 degree of protection shall be provided for temperature detectors.
- Motors rated >1000 kW shall be provided with neutral current transformers of PS class on each phase for differential protection in neutral side terminal box. The three phases shall be connected to form the star point after passing through the CTs. The CT details shall be

finalized during detail engineering. Neutral terminal box shall have IP 55 degree of protection.

- The secondary leads of CT shall be wired to separate auxiliary terminal box of IP 55 degree of protection
- All the accessory terminal boxes shall be located on the same side of the main (power) terminal box.
- For LT motors, terminal box shall be located on top, unless otherwise specified.

3.20.0 Earthing Terminals

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

3.21.0 Noise and Vibration

- Motors shall be selected with low noise levels in accordance with IS 12065.
- The peak amplitude of the vibration shall also be within the specified limits of IS: 12075.
- All HT motors shall be provided with vibration pads for mounting vibration detectors.

3.22.0 Name Plates

Motor shall have stainless steel nameplate(s) showing diagram of connections, all particulars as per IS: 325 / IS: 12615 and shall also have 'BEE' marking.

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

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

3.23.0 Canopy

Canopy shall be provided for all the motors located outdoor. For details, please refer Civil section.

4.0.0 DC MOTORS

DC motors shall be provided where specified/required. DC Motors shall be sized for operation with fixed resistance starting for reliability. DC motors shall be shunt wound type. Motors shall be capable of delivering the rated output at 220 V DC with (+) 10% and (-) 15% variations without exceeding its guaranteed temperature limits. 220 V DC system shall be unearthed. Starting current of the DC motors shall be limited to 200% of the full load current of the motor, and is subject to IS tolerance. DC Motors shall be similar to AC Motors with respect to other features like enclosure type, cooling and class of insulation.

5.0.0 INSTALLATION

Installation shall be carried out as per IS: 900.

6.0.0 PAINTING

Painting shall be carried out by an approved process. Pretreatment shall conform to applicable standard. The equipment shall be subject to a coat of red oxide primer paint. All inside and

outside surface shall be painted with epoxy based paint. The final thickness of paint film on steel shall not be less than 100 microns. Finish shade shall be 631 of IS: 5 (smoke grey).

7.0.0 TESTING AND INSPECTION

7.1.0 Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished for the motors rated 30 kW and above.

7.2.0 The following type tests shall be conducted on LT motors.

- Measurement of resistance of windings of stator and wound rotor.
- No load test at rated voltage to determine input current power and speed
- Full load test to determine efficiency power factor and slip.
- Temperature rise test.
- Momentary excess torque test.
- High voltage test.
- Test for vibration severity of motor.
- Test for noise levels of motor
- Test for degree of protection
- Over speed test.

7.3.0 The following additional type tests shall be conducted on HT motors.

- No load saturation and loss curves up to approximately 115% of rated voltage
- Measurement of noise at no load.
- Momentary excess torque test
- Full load test
- Temperature rise test at rated conditions.
- Lightning Impulse withstand test on the sample coil shall be as per IEC-60034, part-15
- Surge-withstand test on interturn insulation shall be as per clause no. 5.1.2 of IEC 60034, part-15
- Degree of protection test for the enclosure followed by IR, HV and no load run test.
- Terminal box-fault level withstand test for each type of terminal box.

7.4.0 The following routine tests shall be carried out for the motors as per applicable standards.

- IR of Winding before and after HV tests
- HV test on main winding space heater, RTD, BTD
- Resistance measurement
- No load run test Major Electrical
- Phase sequence and direction of rotation
- Vibration check Major Electrical
- Reduced voltage running test
- Locked rotor test at reduced voltage
- Record of RTD & BTD resistance at the end of no load test
- Test on space heater & RTD
- Visual Control of terminal box and verification of construction with respect to short tested terminal box

7.5.0 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

- Measurement of vibration.
- Measurement of insulation resistance and polarization index.
- Measurement of full load current.
- Test running of the motors, checking the temperature rise and identifying the hot spot etc.

8.0.0 DRAWINGS & DOCUMENTS

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

- Motor sizing calculation
- Technical particulars
- General arrangement drawings
- Performance curves (Efficiency, power factor, starting current)
- Characteristic curves (Speed torque, Hot/cold with stand time, Negative sequence current)
- Terminal box details
- Test reports
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan

SECTION - 3.24: CABLES

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of cables.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following:

a) 19/33 kV grade XLPE insulated armoured FRLS power cables
b) 11/11 kV grade XLPE insulated armoured FRLS power cables
c) 6.6/6.6 kV grade XLPE insulated armoured FRLS cables
d) 1.1 kV grade XLPE insulated armoured FRLS cables
e) 1.1 kV grade XLPE insulated armoured FRLS control cables
f) Trailing cables
g) Shielded cables
h) Telephone cables
i) Fiber optic cables

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and / or supplemented by this specification.

a)	IS: 3975	Mild steel wires formed wires and tapes for armouring of cables.
b)	IS: 4905	Methods for random sampling.
c)	IS: 5831	PVC insulation and sheath of electric cables.
d)	IS: 7098 Part-I	Cross-linked polyethylene insulated PVC sheathed cables (LV)
e)	IS: 7098 Part-II	Cross-linked polyethylene insulated PVC sheathed cables (HV)
f)	IS: 8130	Conductors for insulated electric cables and flexible cords.
g)	IS: 10418	Drums for electric cables.
h)	IS: 10810	Methods of tests for cables.
i)	IS: 3961	Recommended current ratings for cables

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Power cables shall be provided for the following systems:

- 33 kV earthed system having phase fault current and earth fault current of 25 kA.
- 11 kV unearthed system having phase fault current of 50 kA and earth fault current of 300 A.
- 6.6 kV unearthed system having phase fault current of 31.5 kA and earth fault current of 300 A.
- 415 V earthed system having phase fault current and earth fault current of 65/50 kA.
- 220 V DC unearthed system having fault current of not less than 25 kA.

4.2.0 Power cables shall be sized to withstand the system fault current for the fault clearing time indicated below:

- Breaker operated Motor feeders and transformer feeders: 0.16 second.
- Breaker operated outgoing feeders: 0.5 second.
- Tie between two switchgear: 0.5 second.
- Incomers: 1 second.

4.3.0 Power cables shall be sized to satisfy the following Criteria:

- To withstand specified system short circuit current for the specified fault clearing time.
- To carry full load current under applicable installation conditions considering Site ambient temperature & site installation (Grouping) conditions based on Manufacturer's recommendation.
- To limit the voltage drop under steady state/transient state conditions to permissible values.

4.4.0 Cables shall be armoured type only.

4.5.0 Power cables shall be XLPE insulated. Control cables shall be PVC / XLPE insulated.

4.6.0 PVC insulation shall be suitable for continuous conductor temperature of 70°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90 °C and short circuit conductor temperature of 250 °C.

4.7.0 Cables for 33 kV system shall be rated for 19/33 kV earthed grade, cables for 11 kV system shall be rated for 11/11 kV unearthed grade and Cables for 6.6 kV system shall be rated for 6.6/6.6 kV unearthed grade. Cables for 415/230 V AC and 220 V DC shall be rated for 1.1 kV grade.

4.8.0 To minimize the damage that can be caused by a fire, conductors installed in electrical cable tray systems shall have jackets which have non-propagating, and self-extinguishing flame retardant, low smoke (FRLS) characteristics. Outer sheath shall be of PVC black in colour. These cables shall meet the following test requirements.

- Oxygen index of minimum 29 when tested as per IS 10810 Part-58
- Temperature index of minimum 250°C when tested as per IS 10810 Part-64
- Acid gas emission of maximum 20% when tested as per IS 10810 Part-59 Average light transmission of 40% minimum when tested as per IS 10810 Part-63 (average smoke density is maximum 60%)
- Flame test requirements as per IS 10810 Parts-53 and 62
- Flame retardant test requirements as per IS 10810 Part-61

4.9.0 For power cables, copper conductor shall be used for current rating of up to 10 A. For higher current rating, conductor can be aluminium/copper. Minimum size of copper conductor shall be 2.5 sq.mm and aluminium conductor shall be 6 sq.mm.

4.10.0 Conductor of control cables shall have plain annealed copper. The minimum size of control cable shall be of 1.5 sq.mm. For CT circuit minimum size shall be 2.5 sq.mm copper. Control cables shall have 20% spare cores.

4.11.0 Current transformers leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity and knee point voltage. Minimum 2.5 sq.mm copper cables shall be used for connection of CT to load. In case 2.5 sq.mm size impose unacceptably high burden on CTs, 4 sq.mm copper shall be used. Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq.mm copper conductor exceeds this value, higher conductor sizes shall be used.

4.12.0 Power cables shall carry the full load current of the circuit continuously under site conditions considering the various derating factors like thermal resistivity of soil, ambient air/ground temperature, grouping, method of laying, etc.

4.13.0 Design ambient air temperature and ground temperature shall be considered at 50℃ and 40℃ respectively for cable sizing.

4.14.0 For 11 kV & 6.6 kV cables, screen of each core shall be sized to withstand 300 A for 1 sec. For 33 kV cables, screen of each core shall be sized to withstand system earth fault current for 0.16 sec.

4.15.0 For HT motors the voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 2.5% of the rated voltage. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5% of rated voltage

4.16.0 For LT motors the voltage drop in the cable, during motor starting condition, shall be limited to 15% and during full load running condition, shall be limited to 3% of the rated voltage. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 6% of rated voltage.

4.17.0 Cables for the following systems shall be fire survival type.

- DC emergency lube oil pumps
- DC seal oil pump
- DC emergency lighting cables for main building.
- Batteries to chargers and DC distribution boards
- Turbine lub oil pumps
- Jacking oil pumps
- Emergency turbine trip by push button in control room
- Inter trip cables between Boiler master fuel trip and turbine trip relays
- Inter trip cables between Generator trip relays and turbine trip relays/400 kV circuit breaker/generator field breaker/UT breakers

4.18.0 Method of curing for HT XLPE insulation shall be **gas/steam curing**.

4.19.0 Conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied with XLPE insulation in one operation through triple extrusion.

4.20.0 For armoured cables, armouring shall be of aluminium for single core cables. For multicore armoured cables, armouring shall be of galvanised steel.

4.21.0 All the cables shall be protected against rodent and termite attack. Necessary chemicals shall be added into the PVC compound of the outer sheath. The sheath shall be resistant to water, UV radiation, fungus, etc.

4.22.0 Multi-core cable color coding shall be as follows:

- Red, yellow, blue, black and gray for five core cables
- Outer sheath shall be of black in colour.
- For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.

4.23.0 Three core 19/33 kV earthed grade, 11/11 kV unearthed grade, 6.6/6.6 kV unearthed grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded semi conducting compound as conductor screen
- Extruded XLPE insulation
- Extruded semi conducting compound as insulation screen
- Copper tape as metallic screen for each core
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.24.0 Single core 19/33 kV earthed grade,11/11 kV unearthed grade, 6.6/6.6 kV unearthed grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded Semi conducting compound as conductor screen
- Extruded XLPE insulation
- Extruded Semi conducting compound as insulation screen
- Copper tape as metallic screen
- Hard drawn aluminium wire armour
- Extruded FRLS PVC outer sheath

4.25.0 Multicore 1.1 kV earthed grade cables shall constitute the following:

- Circular / shaped, stranded aluminium conductor (compacted for >10 sq.mm)
- Extruded XLPE insulation
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.26.0 Single core 1.1 kV earthed grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded XLPE insulation
- Hard drawn aluminium wire armour
- Extruded FRLS PVC outer sheath

4.27.0 **Trailing power and control cables for mobile equipment shall constitute the following:**

Unearthed grade HT power cables, earthed grade LV power cables and control cables shall be flexible trailing with annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed. For HT cables, insulation screen shall be provided. Cables shall conform to applicable IS/IEC standard requirements.

4.28.0 **Fire survival cables**

Fire survival cable shall be of copper conductor and comply with IEC-60331 (withstanding 750 degree C temperature for 3 hours). Also the halogen acid contents in outer sheath shall not be more than 2% when tested as per IEC-60754 and the smoke density in percent light absorption shall not exceed 20% when tested as per ASTM-D-2843. 1.1 kV earthed grade fire survival cables shall constitute the following:

- Circular/shaped stranded and compacted annealed copper conductor
- Elastomeric materials (XLPE, EPR, SR, or LSOH) insulated
- Glass mica tapped
- Extruded FRLS compound or LSOH material as inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS compound or LSOH material as inner sheath

4.29.0 Multicore 1.1 kV earthed grade control cables shall constitute the following as per IS:1554-1 / 7098-1:

- Multi stranded annealed copper conductor
- Extruded PVC / XLPE insulation
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.30.0 Multi pair 1.1 kV earthed grade, overall screened signal cables shall constitute the following as per BS EN 50288-7:

- Multi stranded annealed copper conductor
- Extruded PVC insulation
- Twisted pair
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.31.0 Multi pair 1.1 kV earthed grade, individual and overall screened signal cables shall constitute the following as per BS EN 50288-7:

- Multi stranded annealed copper conductor
- Extruded PVC insulation
- Twisted pair

- Individual polyester taped, Al-mylar screened with ATC drain wire
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.32.0 **Cable drums**

Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. All wooden parts shall be manufactured from durable quality wood duly seasoned and treated with copper nepthenates or zinc nepthenates for preserving the wood. The surface of the drum and the outer most cable layer shall be covered with waterproof layer. 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.

4.33.0 **Cable identification system**

a) In addition to manufacturer's identification on cables as per IS, following marking shall also be embossed/printed on the outer sheath at an interval of one metre throughout the length of cables.

- BIS mark
- Manufacturer's name and or trade mark.
- Year of manufacture
- Cable code
- Type of cable and voltage class.
- Nominal cross section area of conductor and no.of cores.
- Progressive sequential length making.

b) Cables shall be marked as having FRLS outer sheath at every 5 meters.

c) The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible.

d) Multi-core cable color coding shall be as follows:

- Red, yellow and blue for three core cables
- Outer sheath shall be of black in colour.
- For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.
- For multi pair cables, each pair shall be coloured and numbered.

5.0.0 **TESTS**

Cables offered shall be type tested and proven type. Routine tests shall be carried out on 100% drums. Type tests, special tests and acceptance tests shall be carried out on 1 drum selected on random basis, out of every 10 or less number of drums of each type and size of cable of each lot. Size shall mean area of cross section in sq.mm read in conjunction with the number of cores. Type shall mean type of insulation, sheath, volt grade FRLS/FS etc.

5.1.0 **Type Test**

a) Tests on conductor

i) Annealing Test (for copper)
ii) Tensile test (for aluminium)
iii) Wrapping test (for aluminium)
iv) Resistance test

b) Tests for armour wires/strips
c) Tests for thickness of insulation and sheath
d) Physical tests for insulation

i) Tensile strength and elongation at break
ii) Ageing in air oven
iii) Shrinkage test
iv) Hot test
v) Water absorption (gravimetric)

e) Physical test for outer sheath

i) Tensile strength and elongation at break
ii) Ageing in air oven
iii) Shrinkage test
iv) Hot deformation
v) Heat shock test
vi) Loss of mass test in air oven
vii) Thermal heat stability test (as per IS : 5831)
viii) Bleeding and blooming test

f) Anti-termite and anti-rodent test (on outer sheath).
g) Partial discharge test
h) Bending test
i) Dielectric power factor test

i) As a function of voltage
ii) As a function of temperature

j) Insulation resistance (volume resistivity) test
k) Heating cycle test
l) Impulse withstand test
m) High voltage test
n) Flammability test
o) Cold impact test

5.2.0 **Acceptance Test**

a) Annealing test (for copper)
b) Tensile test (for aluminium)
c) Wrapping test (for aluminium)
d) Conductor resistance test
e) Test for thickness of insulation and sheath
f) Hot set test for insulation
g) Tensile strength and elongation at break test for insulation and outer sheath
h) Partial discharge test (for screened cables)
i) High voltage test
j) Insulation resistance (volume resistivity) test

5.3.0 **Routine Test**

a) Conductor resistance test
b) Partial discharge test

c) High voltage test

5.4.0 **Special Test**

a) Oxygen index test as per IS 10810 Part-58
b) Temperature index test as per IS 10810 Part-64
c) Acid gas generation test as per IS 10810 Part-59
d) Smoke generation test as per IS 10810 Part-63
e) Flammability tests as per IS 10810 Parts-53 and 62
f) Flame retardant test as per IS 10810 Part-61

5.5.0 **Site Test**

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) Insulation resistance test
b) High voltage test

6.0.0 DRAWINGS & DOCUMENTS

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

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan

DATA SHEET-A		
SL NO.	DESCRIPTION	**2X660 MW UDANGUDI SUPERCRITICAL STPP**
A	**General**	
1	Manufacturer & country of origin	
2	Motor type	Squirrel cage induction AC motors
3	Efficiency class	For all LT motors, it shall be IE3 class as per IS 12615 except for VFD controlled LT motors, it shall be IE2 class as per IS 12615
4	Type of starting	DOL
5	Maximum acceptable kW rating of LV motor	>0.2 kW and up to 200 kW. LT motors rated up to 125 kW shall be controlled through MPCB/MCCB and contactor. LT motors rated more than 125 kW shall be controlled through air circuit breaker.
6	Rating up to which Single phase motors permitted.	up to 0.2 Kw
7	Installation (Indoors/ Outdoors)	indoor/outdoor
8	Degree Of Protection	IP 55
9	Name of the equipment driven by motor & Quantity	
10	Maximum Power requirement of driven equipment	
11	Rated speed of Driven Equipment	As per system requirement
12	Design ambient temperature	50 deg C
B	**Design and Performance Data**	
1	Frame size & type designation	DURING DETAILED ENGINEERING
2	Type of duty	All the motors shall be rated for S1 duty for continuous operation. Motors of crane and hoist application shall be intermittent duty. The motors shall be suitable for bus transfer schemes provided on the 11 kV/6.6 kV/415 V systems without any injurious effect on its life.
3	Rated Voltage	240/415 V
4	Rated Frequency	50 Hz
5	System fault level at rated voltage	50 kA for 1 sec.
6	LV System grounding	solidly grounded
7	Permissible variation for	
a	Voltage	±10%
b	Frequency	+3% to -5%
c	Combined voltage & frequency	10%
8	Rated output at design ambient temp (by resistance method)	As per system requirement
9	Synchronous speed & Rated slip	As per system requirement
10	Minimum permissible starting voltage	80% of rated voltage During fast changeover of power supply source, vector difference between the motor residual voltage and the incoming supply voltage shall be about 150% of the rated voltage and the motors shall withstand voltage stress and torque stress developed during that time, which may last for a period of one (1) second. c) The motor shall be capable of operating at full load at a supply voltage of 75% of the rated voltage for 5 minutes.

11	TYPE OF STARTER PROVIDED IN MCC	DOL
12	Starting time in sec with mechanism coupled	
a	At rated voltage	As per manufacturers standard
b	At min starting voltage	
13	Locked rotor current as percentage of FLC (including IS tolerance)	For energy efficient LT motors, locked rotor current shall be as per IS: 12615. Locked rotor current of the VFD controlled AC motors shall be limited to 300% of the full load current, and is subject to IS tolerance
14	Torque	
a	Starting	
b	Maximum	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. • Pull out torque at rated voltage shall not be less than 205% of full load torque. • Motors subjected to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% of rated speed in reverse direction.
15	Permissible temp rise at rated output over ambient temp & method	Winding shall be class F insulation with temperature limited to class B
16	Noise level at 1.0 m (dB)	Motors shall be selected with low noise levels in accordance with IS 12065.
17	Amplitude of vibration	The peak amplitude of the vibration shall also be within the specified limits of IS: 12075.
18	Efficiency & P.F. at rated voltage & frequency	
a	At 100% load	Premium efficiency (IE3) IS: 12615 .
b	At 75% load	
c	At starting	
C	**Constructional Features**	
1	Method of connection of motor driven equipment	As per system requirement
2	Applicable Standard	as per relevant standard
3	DOP of Enclosure	IP55
4	Method of cooling	LT motors shall be totally enclosed fan cooled (TEFC), type IC411. The cooling shall be effected by self-driven bi-directional centrifugal fan protected by fan cover. The Alarm switch contact rating shall be minimum 0.5 A at 220 V DC and 10 A at 230 V AC.
5	Class of insulation	All motors shall have class F insulation but limited to class B temperature rise
6	Main terminal box	

a	Type	Separate terminal boxes of IP 55 degree of protection shall be provided for stator leads. For single core cables, gland plate shall be non-magnetic material. Terminal box of LT motors shall be capable of being turned 360° in steps of 90°. The terminal boxes shall be split type with removable cover with access to connections.
b	Power Cable details (Conductor, size, armour/unarmour)	DURING DETAILED ENGINEERING
c	Cable Gland & lugs details (Size, type & material)	DURING DETAILED ENGINEERING The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer. The terminal box shall have a separate grounding terminal.
d	Permissible Fault level (kArms & duration in sec)	Fault withstand rating of motor terminal box (Breaker operated): 415 V system : 50/65 kA for 0.2 second
7	Earth Conductor Size & Material	DURING DETAILED ENGINEERING
8	Space heater details (30KW & ABOVE) (Voltage & watts)	Space heaters rated for 240 V AC, 50 Hz supply shall be provided for motors rated 30 kW'and above to maintain windings in dry condition when motor is standstill.
9	Flame proof motor details (if applicable)	For hazardous location: the enclosure of motors shall following have flame proof construction conforming to applicable standard. • Fuel oil area Group – IIB • Hydrogen generation plant area : Group – IIC)
a	Enclosure	
b	suitability for hazardous area	
i	Zone O / I / II	
ii	Group IIA / IIB / IIC	
c	Degree of Protection	
9	No. of Stator winding	As per manufacturers standard
10	Winding connection	As per system requirement
11	Kind of rotor winding	As per manufacturers standard

12	Kind of bearings	Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area. • Sleeve bearings shall be split type, ring oiled with permanently aligned, close running shaft sleeves. Grease lubricated bearings shall be pre-lubricated and shall have provisions for inservice positive lubrication with grease nipple and relief holes. For sleeve bearings, the bearing housing shall be preferably in end shield itself. • Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. However, if anti-friction bearings can take vertical thrust, thrust and guide bearings are not required. • Lubricant shall not deteriorate under all service conditions. The lubricants shall be limited to normally available types. For motors rated 30 kW and above re-lubrication facility shall be provided. For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box. • Each bearing shall be provided with dial type thermometer. • For all VFD operated motors shall have insulated bearings to prevent flow of shaft currents. Lub oil pressure transmitters shall be provided to DCS for remote monitoring. Lub oil pressure very low trip to HT equipment shall be 2 out of 3 logic.
13	Direction of rotation when viewed from NDE	motor shall be bi-directional
14	Paint Shade & type	Painting shall be carried out by an approved process. Pretreatment shall conform to applicable standard. The equipment shall be subject to a coat of red oxide primer paint. All inside and outside surface shall be painted with epoxy based paint. The final thickness of paint film on steel shall not be less than 100 microns. Finish shade shall be 631 of IS: 5 (smoke grey).
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	DURING DETAILED ENGINEERING
D	**Characteristic curves/ drawings**	
1	(To be enclosed for motors of rating >55KW)	
2	Torque speed characteristic	
3	Thermal withstand characteristic	
4	Current vs time	
5	Speed vs time	
E	**Tests on motors**	

NOTE:

1 Please write "As per manufacturers standard" where data is not defined in the project specification.

2 Please mention any project specific requirrement if any in the datasheet (Add extra row).

3 For details which is not applicable please write "NA"

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	

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 ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

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

Legends for Inspection agency

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

SUB-VENDOR LIST FOR ELECTRICAL ITEMS

ITEM DESCRIPTION	SL NO.	VENDOR NAME
CABLE GLANDS	1	ALLIED TRADERS & EXPORTERS
	2	ARUP ENGG & FOUNDARY WORKS
	3	BALIGA LIGHTING EQPT.PVT.LTD.
	4	COMMET BRASS PRODUCTS
	5	DOWELLS
	6	ELECTROMAC INDUSTRIES
	7	INCAB
CABLE LUGS	1	DOWELLS
	2	UNIVERSAL MACHINES LTD.
LV MOTORS (NON FLAME PROOF)	1	ABB
	2	BHARAT BIJLEE LTD.
	3	CROMPTON GREAVES
	4	GE-POWER
	5	KIRLOSKAR ELECTRIC CO LTD.
	6	LAXMI HYDRAULICS PVT. LTD
	7	MARATHON
	8	NGEF
	9	RAJINDRA ELECT INDUSTRIES
	10	SIEMENS

CABLE SCHEDULE FORMAT **ANNEXURE III**

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

SECTION - 3.24: CABLES

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of cables.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following:

a) 19/33 kV grade XLPE insulated armoured FRLS power cables
b) 11/11 kV grade XLPE insulated armoured FRLS power cables
c) 6.6/6.6 kV grade XLPE insulated armoured FRLS cables
d) 1.1 kV grade XLPE insulated armoured FRLS cables
e) 1.1 kV grade XLPE insulated armoured FRLS control cables
f) Trailing cables
g) Shielded cables
h) Telephone cables
i) Fiber optic cables

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and / or supplemented by this specification.

a)	IS: 3975	Mild steel wires formed wires and tapes for armouring of cables.
b)	IS: 4905	Methods for random sampling.
c)	IS: 5831	PVC insulation and sheath of electric cables.
d)	IS: 7098 Part-I	Cross-linked polyethylene insulated PVC sheathed cables (LV)
e)	IS: 7098 Part-II	Cross-linked polyethylene insulated PVC sheathed cables (HV)
f)	IS: 8130	Conductors for insulated electric cables and flexible cords.
g)	IS: 10418	Drums for electric cables.
h)	IS: 10810	Methods of tests for cables.
i)	IS: 3961	Recommended current ratings for cables

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Power cables shall be provided for the following systems:

- 33 kV earthed system having phase fault current and earth fault current of 25 kA.
- 11 kV unearthed system having phase fault current of 50 kA and earth fault current of 300 A.
- 6.6 kV unearthed system having phase fault current of 31.5 kA and earth fault current of 300 A.
- 415 V earthed system having phase fault current and earth fault current of 65/50 kA.
- 220 V DC unearthed system having fault current of not less than 25 kA.

4.2.0 Power cables shall be sized to withstand the system fault current for the fault clearing time indicated below:

- Breaker operated Motor feeders and transformer feeders: 0.16 second.
- Breaker operated outgoing feeders: 0.5 second.
- Tie between two switchgear: 0.5 second.
- Incomers: 1 second.

4.3.0 Power cables shall be sized to satisfy the following Criteria:

- To withstand specified system short circuit current for the specified fault clearing time.
- To carry full load current under applicable installation conditions considering Site ambient temperature & site installation (Grouping) conditions based on Manufacturer's recommendation.
- To limit the voltage drop under steady state/transient state conditions to permissible values.

4.4.0 Cables shall be armoured type only.

4.5.0 Power cables shall be XLPE insulated. Control cables shall be PVC / XLPE insulated.

4.6.0 PVC insulation shall be suitable for continuous conductor temperature of 70°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90 °C and short circuit conductor temperature of 250 °C.

4.7.0 Cables for 33 kV system shall be rated for 19/33 kV earthed grade, cables for 11 kV system shall be rated for 11/11 kV unearthed grade and Cables for 6.6 kV system shall be rated for 6.6/6.6 kV unearthed grade. Cables for 415/230 V AC and 220 V DC shall be rated for 1.1 kV grade.

4.8.0 To minimize the damage that can be caused by a fire, conductors installed in electrical cable tray systems shall have jackets which have non-propagating, and self-extinguishing flame retardant, low smoke (FRLS) characteristics. Outer sheath shall be of PVC black in colour. These cables shall meet the following test requirements.

- Oxygen index of minimum 29 when tested as per IS 10810 Part-58
- Temperature index of minimum 250°C when tested as per IS 10810 Part-64
- Acid gas emission of maximum 20% when tested as per IS 10810 Part-59 Average light transmission of 40% minimum when tested as per IS 10810 Part-63 (average smoke density is maximum 60%)
- Flame test requirements as per IS 10810 Parts-53 and 62
- Flame retardant test requirements as per IS 10810 Part-61

4.9.0 For power cables, copper conductor shall be used for current rating of up to 10 A. For higher current rating, conductor can be aluminium/copper. Minimum size of copper conductor shall be 2.5 sq.mm and aluminium conductor shall be 6 sq.mm.

4.10.0 Conductor of control cables shall have plain annealed copper. The minimum size of control cable shall be of 1.5 sq.mm. For CT circuit minimum size shall be 2.5 sq.mm copper. Control cables shall have 20% spare cores.

4.11.0 Current transformers leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity and knee point voltage. Minimum 2.5 sq.mm copper cables shall be used for connection of CT to load. In case 2.5 sq.mm size impose unacceptably high burden on CTs, 4 sq.mm copper shall be used. Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq.mm copper conductor exceeds this value, higher conductor sizes shall be used.

4.12.0 Power cables shall carry the full load current of the circuit continuously under site conditions considering the various derating factors like thermal resistivity of soil, ambient air/ground temperature, grouping, method of laying, etc.

4.13.0 Design ambient air temperature and ground temperature shall be considered at 50℃ and 40℃ respectively for cable sizing.

4.14.0 For 11 kV & 6.6 kV cables, screen of each core shall be sized to withstand 300 A for 1 sec. For 33 kV cables, screen of each core shall be sized to withstand system earth fault current for 0.16 sec.

4.15.0 For HT motors the voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 2.5% of the rated voltage. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5% of rated voltage

4.16.0 For LT motors the voltage drop in the cable, during motor starting condition, shall be limited to 15% and during full load running condition, shall be limited to 3% of the rated voltage. However, the voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 6% of rated voltage.

4.17.0 Cables for the following systems shall be fire survival type.

- DC emergency lube oil pumps
- DC seal oil pump
- DC emergency lighting cables for main building.
- Batteries to chargers and DC distribution boards
- Turbine lub oil pumps
- Jacking oil pumps
- Emergency turbine trip by push button in control room
- Inter trip cables between Boiler master fuel trip and turbine trip relays
- Inter trip cables between Generator trip relays and turbine trip relays/400 kV circuit breaker/generator field breaker/UT breakers

4.18.0 Method of curing for HT XLPE insulation shall be **gas/steam curing**.

4.19.0 Conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied with XLPE insulation in one operation through triple extrusion.

4.20.0 For armoured cables, armouring shall be of aluminium for single core cables. For multicore armoured cables, armouring shall be of galvanised steel.

4.21.0 All the cables shall be protected against rodent and termite attack. Necessary chemicals shall be added into the PVC compound of the outer sheath. The sheath shall be resistant to water, UV radiation, fungus, etc.

4.22.0 Multi-core cable color coding shall be as follows:

- Red, yellow, blue, black and gray for five core cables
- Outer sheath shall be of black in colour.
- For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.

4.23.0 Three core 19/33 kV earthed grade, 11/11 kV unearthed grade, 6.6/6.6 kV unearthed grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded semi conducting compound as conductor screen
- Extruded XLPE insulation
- Extruded semi conducting compound as insulation screen
- Copper tape as metallic screen for each core
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.24.0 Single core 19/33 kV earthed grade,11/11 kV unearthed grade, 6.6/6.6 kV unearthed grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded Semi conducting compound as conductor screen
- Extruded XLPE insulation
- Extruded Semi conducting compound as insulation screen
- Copper tape as metallic screen
- Hard drawn aluminium wire armour
- Extruded FRLS PVC outer sheath

4.25.0 Multicore 1.1 kV earthed grade cables shall constitute the following:

- Circular / shaped, stranded aluminium conductor (compacted for >10 sq.mm)
- Extruded XLPE insulation
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.26.0 Single core 1.1 kV earthed grade cables shall constitute the following:

- Circular stranded and compacted aluminium conductor
- Extruded XLPE insulation
- Hard drawn aluminium wire armour
- Extruded FRLS PVC outer sheath

4.27.0 **Trailing power and control cables for mobile equipment shall constitute the following:**

Unearthed grade HT power cables, earthed grade LV power cables and control cables shall be flexible trailing with annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed. For HT cables, insulation screen shall be provided. Cables shall conform to applicable IS/IEC standard requirements.

4.28.0 **Fire survival cables**

Fire survival cable shall be of copper conductor and comply with IEC-60331 (withstanding 750 degree C temperature for 3 hours). Also the halogen acid contents in outer sheath shall not be more than 2% when tested as per IEC-60754 and the smoke density in percent light absorption shall not exceed 20% when tested as per ASTM-D-2843. 1.1 kV earthed grade fire survival cables shall constitute the following:

- Circular/shaped stranded and compacted annealed copper conductor
- Elastomeric materials (XLPE, EPR, SR, or LSOH) insulated
- Glass mica tapped
- Extruded FRLS compound or LSOH material as inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS compound or LSOH material as inner sheath

4.29.0 Multicore 1.1 kV earthed grade control cables shall constitute the following as per IS:1554-1 / 7098-1:

- Multi stranded annealed copper conductor
- Extruded PVC / XLPE insulation
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.30.0 Multi pair 1.1 kV earthed grade, overall screened signal cables shall constitute the following as per BS EN 50288-7:

- Multi stranded annealed copper conductor
- Extruded PVC insulation
- Twisted pair
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.31.0 Multi pair 1.1 kV earthed grade, individual and overall screened signal cables shall constitute the following as per BS EN 50288-7:

- Multi stranded annealed copper conductor
- Extruded PVC insulation
- Twisted pair

- Individual polyester taped, Al-mylar screened with ATC drain wire
- Overall polyester taped, Al-mylar screened with ATC drain wire
- Extruded PVC inner sheath
- Galvanised steel formed wire/strip
- Extruded FRLS PVC outer sheath

4.32.0 **Cable drums**

Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. All wooden parts shall be manufactured from durable quality wood duly seasoned and treated with copper nepthenates or zinc nepthenates for preserving the wood. The surface of the drum and the outer most cable layer shall be covered with waterproof layer. 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.

4.33.0 **Cable identification system**

a) In addition to manufacturer's identification on cables as per IS, following marking shall also be embossed/printed on the outer sheath at an interval of one metre throughout the length of cables.

- BIS mark
- Manufacturer's name and or trade mark.
- Year of manufacture
- Cable code
- Type of cable and voltage class.
- Nominal cross section area of conductor and no.of cores.
- Progressive sequential length making.

b) Cables shall be marked as having FRLS outer sheath at every 5 meters.

c) The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible.

d) Multi-core cable color coding shall be as follows:

- Red, yellow and blue for three core cables
- Outer sheath shall be of black in colour.
- For more than 5 cores, core identification shall be by alpha numerical numbering system at an interval of one meter.
- For multi pair cables, each pair shall be coloured and numbered.

5.0.0 **TESTS**

Cables offered shall be type tested and proven type. Routine tests shall be carried out on 100% drums. Type tests, special tests and acceptance tests shall be carried out on 1 drum selected on random basis, out of every 10 or less number of drums of each type and size of cable of each lot. Size shall mean area of cross section in sq.mm read in conjunction with the number of cores. Type shall mean type of insulation, sheath, volt grade FRLS/FS etc.

5.1.0 **Type Test**

a) Tests on conductor

i) Annealing Test (for copper)
ii) Tensile test (for aluminium)
iii) Wrapping test (for aluminium)
iv) Resistance test

b) Tests for armour wires/strips
c) Tests for thickness of insulation and sheath
d) Physical tests for insulation

i) Tensile strength and elongation at break
ii) Ageing in air oven
iii) Shrinkage test
iv) Hot test
v) Water absorption (gravimetric)

e) Physical test for outer sheath

i) Tensile strength and elongation at break
ii) Ageing in air oven
iii) Shrinkage test
iv) Hot deformation
v) Heat shock test
vi) Loss of mass test in air oven
vii) Thermal heat stability test (as per IS : 5831)
viii) Bleeding and blooming test

f) Anti-termite and anti-rodent test (on outer sheath).
g) Partial discharge test
h) Bending test
i) Dielectric power factor test

i) As a function of voltage
ii) As a function of temperature

j) Insulation resistance (volume resistivity) test
k) Heating cycle test
l) Impulse withstand test
m) High voltage test
n) Flammability test
o) Cold impact test

5.2.0 **Acceptance Test**

a) Annealing test (for copper)
b) Tensile test (for aluminium)
c) Wrapping test (for aluminium)
d) Conductor resistance test
e) Test for thickness of insulation and sheath
f) Hot set test for insulation
g) Tensile strength and elongation at break test for insulation and outer sheath
h) Partial discharge test (for screened cables)
i) High voltage test
j) Insulation resistance (volume resistivity) test

5.3.0 **Routine Test**

a) Conductor resistance test
b) Partial discharge test

c) High voltage test

5.4.0 **Special Test**

a) Oxygen index test as per IS 10810 Part-58
b) Temperature index test as per IS 10810 Part-64
c) Acid gas generation test as per IS 10810 Part-59
d) Smoke generation test as per IS 10810 Part-63
e) Flammability tests as per IS 10810 Parts-53 and 62
f) Flame retardant test as per IS 10810 Part-61

5.5.0 **Site Test**

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) Insulation resistance test
b) High voltage test

6.0.0 DRAWINGS & DOCUMENTS

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

- Design basis report
- Cable sizing calculation
- General arrangement drawings
- Technical data sheet
- Test reports
- Catalogues
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan

DATA SHEET FOR DG EOT CRANE WITH VVVF DRIVES

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

scope-1							
Sl no.	Area	Type	Qnty	Cap.	Span	Lift	Travel
1	Sea water outfall pump house	DOUBLE GIRDER EOT CRANE	1 no.	18T	7.2M	19.7M	20M
2	Sea water intake pump house	DOUBLE GIRDER EOT CRANE	1 no.	15T	9 M	21.3M	35.7M

Sr. No.		DESCRIPTION	TECHNICAL PARTICULARS
1.0.0		**Design Requirements**	• The cranes and hoist designed to operate at 100% safe working load and subjected to over load test at 125% of rated load. • Cranes and hoist shall be designed considering the ambient temperature of 50 °C.
1.1.0		**Name of manufacturer**	*
	a.	EOT Crane	*
	b.	Crane motors	*
	c.	Runway conductors	*
1.2.0		**Weight of equipments**	
	a.	Bridge assembly	*
	b.	Trolley assembly	*
	c.	Total crane weight	*
	d.	Total weight of the gantry rail	*
	e.	Total weight of DSL	*
	f.	Total weight of all the equipments under this specification	*
1.3.0		**Design, fabrication and testing of the crane confirm to standard / code number**	Mechanical M5 and Electrical M7 as per IS: 3177-1999 & Structure design in accordance to IS 807:2006 / IS 800:1984. For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8 mm thick.
1.4.0		**Suitable for outdoor or indoor duty**	Indoor
1.5.0		**Crane Parameter**	
	a.	Rated SWC – tonnes	*
	b.	Test load SWC – tonnes	Rated SWC and over load test : 125% of SWC
	c.	Span	*
	d.	Lift	*
	e	Travel	*

	g.	Hook Approaches (DSL end)	*	
	h.	Hook Approaches (Non-DSL end)	*	
1.6.0		**Operation from**	Pendent Push Button+ Radio remote control	
2.00		**CRANE SPEED WITH FULL LOAD**	**Full speed M/Min**	**Creep speed M/Min**
	a.	Main hoist	**2.0**	0.2 (10% of main speed thru' VVVF drives)
	b.	Trolley travel (CT)	**10.0**	1.0 (10% of main speed thru' VVVF drives)
	c.	Longitudinal bridge travel (LT)	**15.0**	1.5 (10% of main speed thru' VVVF drives)
3.0.0		**COMPONENT DETAILS**		
3.1.0		**Trolley**		
	a.	Type	Fabricated	
	b.	Method of fabrication	Fusion welded	
	c.	Material	Mild Steel (Fe410) Gr-B IS: 2062	
	d.	Centre to centre distance of wheels (on the same rails)	*	
	e.	Mountings	Mountings shall be designed to facilitate easy removal of the wheels, bearings and journals.	
	f.	Whether jacking pads for lifting trolley provided or not	Yes	
3.2.0		**Bridge girder**	**Qnty & Size (*)**	
	a.	Type & Quantity	Box type – 2 nos. Material: IS 2062 gr B	
	b.	Vertical Deflection	The total maximum vertical deflections of the girders for the safe weight of working load plus the weight of the crab in central position (without taking into consideration the impact factor) shall not exceed limit of span/900 as specified by the relevant IS 807 or any other code whichever is having higher deflection shall be taken for limit.	
	c.	Camber	The girder shall be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.	
	d.	Type of connection to end carriage	By fitted bolts	
	e.	Mountings	Mountings shall be designed to facilitate easy removal of the wheels, bearings and journals.	
3.3.0		**End carriage**	**Qnty & Size (*)**	
	a.	Material	IS 2062 gr B	
	b.	Sweeping plates	shall be fixed to both ends of the end carriages.	

	c.	End carriage span (wheel base)	Wheel bases for end carriage shall not be less than 1/5 of the span or as per IS.3177	
3.4.0		**Rope drums**	Rope-drums shall be grooved and welded steel conforming to IS 3177. Drum shall haveminimum one spare groove when this hook is at its highest position.	
	a.	Dimensions in mm length and diameter (PCD)	*	
	b.	Material (Indicate IS)	Seamless pipe ASTM -106 Gr. B or fabricated rolled section to IS: 2062 Gr. B & stress relieved	
	c.	Flange / flangeless	Flanged	
	d.	Numbers provided	One for each hoist	
	e.	Type of grooves	Identical Right hand and Left hand	
	f.	Diameter on bottom of grooves	*	
3.5.0		**Rope details**	The rope shall be of flexible plough steel with lubricated hemp (fibre) core construction. Attachment to the rope shall be provided for fastening to the drum. Rope shall be of sufficient length so that drum has two full turns when hook is at the lowest position.	
	a.	Construction	Extra flexible plough steel , 6 x 36 construction	
	b.	Grade	Min 1770	
	c.	Standard conforming to	IS: 2266 (latest edition)	
	d.	Diameter in mm	*	*
	e.	Breaking strength	*	*
	f.	Tensile designation	*	*
	g.	Factor of safety	5.25 as per IS	5.25 as per IS
	h.	Type of core	Fibre	Fibre
	i.	Number of falls	*	*
	j	Length of rope	*	*
3.6.0		**Sheaves details**		
	a.	Material	Rope sheaves shall be of cast steel or fabricated steel with anti-friction bearings. Fe 410 WA IS: 2062 Gr. A or B / CS Gr. 280-520 IS:1030 Design as per IS:3177-1999	
	b.	Diameter of main sheaves in mm on Root	* *	
	c.	Diameter of Equalizing sheaves (in mm) on Root	Should not be less 62% of calculated main sheave diameter	
	d.	Type of guards provided	Fabricated from rolled steel plate	

3.7.0		Shafts, Axles, coupling, and Keys	Shafts and axles shall be made of forged steel and shall have ample strength, rigidity and adequate bearing surface for intended duties. Shafts and axles shall be accurately machined and properly supported. Shafts shall, as far as possible, be furnished straight. If shouldered, these shall be provided with fillets of ample radius or shall be tapered to avoid loss of strength and stress concentration. These shall be designed considering allowances for keys and splines.			
3.7.1		Coupling details (between motor and gear box)	Main hoist	Aux. Hoist	Cross Travel	Long Travel
	a.	Type	All couplings shall be of steel. Flexible gear type coupling shall be provided			
	b.	Size & Torque rating	*			
	c.	Guards and enclosures	Provided			
3.7.2		Coupling details (between gear box and wheels)	Cross Travel (CT)	Long Travel (LT)		
	a.	Type	All couplings shall be of steel. Flexible gear type coupling shall be provided			
	b.	Size & Torque rating	*			
	c.	Guards and enclosures provided	Yes			
3.7.3		Coupling details (between gear box and rope drum)	Main hoist	Aux. Hoist		
	a.	Type	All couplings shall be of steel. Flexible gear type coupling shall be provided			
	b.	Size	*			
	c.	Guards and enclosures provided	Yes			
3.7.4		**Shafting (Output)**	**Cross Travel**	**Long Travel**		
	a.	Diameter in mm	*	*		
	b.	Factor of Safety	As per IS: 3177-2020			
	c.	Number of support bearings	*	*		
	d.	Type of support bearing	*	*		
	e.	Arrangement of lubrication	Grease cups / Nipple			
	f.	Type of lubricant	Grease			
	g.	Max unsupported length of shaft in mm	*	*		
3.7.5		Keys and keyways	Shall conform to IS 2048 / 2291 / 2292 / 2293 as applicable.			

3.8.0		**Gear box details**	Gears shall be cut from solid cast or forged steel blanks or shall be of stress relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Split gears shall not be used. Gears and pinions shall be totally enclosed for all motions and must be dust proof and prevent oil leakage. Gear boxes shall have oil bath type for lubrication. Gear boxes shall have covers split horizontally for inspection. Necessary oil level indicator, Drain plugs, Lifting lugs and guards shall be provided. Creep motion shall be controlled through VVVF drive.		
		Motion	**MH**	**CT**	**LT**
	a.	Type of mounting of gear box	Horizontal / Vertical	Vertical	Horizontal / Vertical
	b.	Type of gears	Helical / Spur	Helical / Spur	Helical / Spur
	c.	Type of lubrication	Splash Lubrication		
	d.	Classification	Suitable for M5 duty		
	e.	Total number of reductions	*	*	*
	f.	Reduction ratio	*	*	*
	g.	Difference in Gear and pinion hardness	Min 20 BHN		
	h.	Materials (gear/pinions)	Main Gears En 9/ 55C8/ IS2707 Gr. 1or 2. Pinions En 19/EN 24. Hardness conforming to IS: 3177 (latest edition) Gears to be hardened, tempered & heat treated as per IS 4460		
	i.	Casings	Fabricated Fe 410w IS: 2062 Gr A/B & stress relieved		
3.9.0		**Wheels details**	**Cross travel**	**Long travel**	
	a.	Material	Forged Steel / C 55 Mn 75		
	b.	Hardness	300 – 350 BHN		
	c.	Depth of hardness	10 mm (min)		
	d.	Tread diameter in mm	*	*	
	e.	Tread width in mm	*	*	
	f.	Process of hardening	Volume hardening		
	g.	Type	Double flanged		
	h.	Numbers provided	*	*	
	i.	Specification conforming to	IS: 3177		
	j	Arrangement of lubrication	Grease		
	k.	Bearing/ bearing life	Anti-friction bearing / 10,000 working hours		
3.10.0		**<u>Lifting hooks</u>**			
	a.	Type	C type as per IS: 15560		

	b.	Safe lifting capacity	*		
	c.	Material	Class 2 as per IS 1875		
	d.	Standard conforming to	IS: 15560		
	e.	Hook can rotate	Yes		
	f.	Safety latch on hook provided	Yes		
	g.	Locking device on swiveling hook required or not	Provided		
3.11.0		**Buffers**	**Cross travel**	**Long travel**	
	a.	Type	Spring loaded type. To be designed to bring the loaded crane (In calculation crane is considered to be loaded with SWL) to rest from speed of 50% of the rated speed.		
	b.	Numbers provided	4	4	
3.12.0		End stoppers	**Cross travel**	**Long travel**	
	a.	Numbers provided	4	4	
	b.	Material	Mild steel, grade 'A/B' of IS 2062	Mild steel, grade 'A/B' of IS 2062	
3.13.0		**Brakes**			
		Motion	**MH**	**CT**	**LT**
	a	Type of brake	AC EHT + DCEM	AC EHT + DCEM	AC EHT + DCEM
	b.	Number provided per motor	1+1	1+1	1+1
	c.	Braking capacity (% of torque transmitted to the brake drum with full load.)	150%	125%	125%
	d.	Diameter of brake in mm	*	*	*
	e.	Torque rating Kg. M	*	*	*
	f.	Braking torque actually required	*	*	*
	g.	Braking distance in mm	*	*	*
	h.	Material			
		• Brake liners	Ferrodo liners		
		• Drum	CS IS : 1030 / CL 4 IS : 1875		
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)	Pony motor NA as creep speed through VVVF drive		

3.14.0		Bearings	Crane hook	Trolley wheels	Rope drum	Gear box	Any other assembly
	a.	Type	Bearings shall be of ball or roller type only. All anti-friction bearings shall be of approved make, which are interchangeable with corresponding size bearings of other make. Bearing housings shall be of split type or so designed to permit easy removal of the shaft. The design shall be such that there is no ingress of dust and oil or grease does not leakout. Drip pans shall be provided to accept accidental leakage and drippings.				
	b.	Number provided for each	As per assembly requirements				
	c.	Method of lubrication	Centralised grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice.				
	d	Bearing life	10,000 working hours.				
3.15.0		**Rails**					
	a.	Type / section	Rails sections as per IS: 3443 Grade 50 C 12. Joint to be butt-welded by thermit welding & fusion welding or by end clamping welded by thermit welding & Fusion welding or by end clamping arrangement.				
	b.	Standard conforming to	IS: 3443				
	c.	Weight per metre	*				
	d.	Material	50C12				
	e.	Top width in mm	*				
	f.	Height in mm	*				
	g.	Rail stops	Steel made rail stops shall be provided at ends of rails for bridge and trolley welded to crane girders to prevent creeping of rails and running off of trolley. Stops shall match wheel radius for double/single girder overhead crane and buffers shall be provided as required.				
3.16.0		**Platform and Walkways**	Chequered plate platform 6mm thick over plain as per IS : 3502				
	a.	Bridge platform Length	Full span length provided at both side				
	b.	Walkways	Access walkways of not less than 750 mm (clear) side of bridge girder and cross over walkways. Min 500 mm (clear) required around the crab for maintenance.				
	c.	Type of access from gantry girder level to crane bridge	Rung ladder				
	d	Type of access to crab from crane bridges walkway	Rung ladder				
	e	Type of access to maintenance cage from crane bridges walkway	Rung ladder				

	f	Handrail	The hand railings shall consist of 32 mm NB pipe Medium class of IS : 1161 in two (2) tiers. Top pipe shall be at about one (1) m and middle pipe shall be at about 450 mm height from the walkway platform level. vertical post spacing not exceeding 1500mm with provision of kick plate(100mm high and 6 mm thick).		
3.17.0		**Motors**	Creep motion shall be controlled through VVVF drive.		
		Motions	MH	CT	LT
	a.	Type	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. Motor shall have class F insulation temperature rise limited to class B and enclosures shall conform to the degree of protection IP-55.		
	b.	Rated capacity (KW)	Motor ratings shall be 25% (at least) over the maximum power requirement. The hoist motors shall be rated to lift 125% of the design load at rated speed.		
	c.	Enclosure	TEFC		
	d.	Numbers furnished	1	1	2
	e.	Safety arrangements	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		
	f.	Voltage, phase and frequency	415V ± 10%, 3 Ph., 4 wire, 50 Hz, +3/-5 % Combined voltage & frequency variation = 10% absolute		
	g	Overload protection for motors provided	Yes		
	h	Space heater requirements	For motors of rating 30 KW and above		
	i	Specific requirement	• 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.		
3.18.0		**Limit switches**	**Main hoist**	**Cross Travel**	**Long Travel**
	a.	Type	A screw type limit switch with self resetting features which will act in case of over hoisting.+ A gravity operated hand reset type limit switch as a back up protection against over hoisting.	Track type limit switches shall be provided on the bridge and trolley to prevent over travelling in either direction.	

	b.	Number provided	1+1	2	2
	c.	Rating of contacts	*		
	d.	Material of contacts	Double break Silver Cadmium		
	e.	Control voltage / Enclosure	110 V/ IP 55		
3.19.0		**Power conductors (DSL)**			
	a.	Type	LT: PVC shrouded Cu conductor bus bar. CT: EPR insulated, copper conductor trailing cables, as per IS: 9968, on the bridge.		
	b.	Size	Shall be sized with a margin of 10% over load requirement. Minimum 20% allowance for wear and tear shall be provided over the calculated size.		
	c.	Material	*		
	d.	Numbers	3CU + 1 GI		
	e.	Length	Suitable for bay length		
	f.	Guard provided	Guard shall be provided on crane to prevent the hoist ropes coming in contact with down shop leads. Suitable guards shall be provided to revolving shafts, coupling etc.		
3.20.0		**CABLES**	Power cable	Control cable	
	a.	Material	Cu	Cu	
	b.	Type	FRLS – PVC, XLPE INSULATED TYPE	FRLS – PVC, XLPE INSULATED TYPE	
	c.	**Voltage grade**	1100 V		
	d.	Trailing cable	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 chord reinforcement & heat resistant, oil resistant and flame retardant heavy duty FRLS type.		
3.21.0		**Protective Panel**			
	a.	Material	CRCA Sheet steel 2 mm size		
	b.	Numbers and location	One number located in bridge		
	c.	DOP	IP 55		
3.22.0		**Control panel**			
	a.	Material	CRCA Sheet steel 2 mm size		
	b.	Numbers and location	One each for MH, CT and LT located on bridge platform with space heaters.		
	c.	DOP	IP 55		

3.23.0		**Pendent Station**	The push button station shall be supported independently, earthed separately independent of suspension and shall comprise the following push buttons and indicating lamps i.'Start' and 'Stop' ii.Long travel - 'Right' and 'Left' iii.Cross travel - 'To' and 'Fro' iv.Hook - 'Hoist' and 'Lower' Red lamp shall indicate supply 'ON'. All push buttons shall be hold-to run' type.
3.24.0		**Warning gong**	Operated from pendant. Suitable for 240V AC of noise level 95 dBA at 3.5 m
3.26.0		**Earthing**	
	a.	Material of earthing	G.I / Copper
	b.	Earthing as per specification	Yes
3.27.0	a.	**Contactors**	AC 4 duty for reversing application. AC 3 duty for non-reversing application
	b.	**Switches**	AC 23 for motor application, AC 22 for other application.
	c.	**Fuses**	HRC
	d.	**Overload relay**	Temperature compensated bimetallic with single phasing preventor.
3.28.0		**Power supply**	BHEL shall provide One (1) no.. 415 V, 3 phase, 4 wire supply at isolator switch at operating floor.
3.29.0		**Transformer**	(Dry type, With Insulation Class B or Better)
	a.	Quantity	2 X 100 % for control, 1 no for lighting & 1 no for hand lamp.
	b.	Voltage Rating	Control 415/110V, Lighting 415/240V and hand lamp 415/24V.
	c.	KVA rating	20% over loading to be considered while sizing the rating
3.30.0		**Illumination**	
	a.	Over Bridge	4 no. 40W LED, 4 nos.24V 20A -3 pin Industrial socket
	b.	Under bridge	4 nos. 125 W LED lamps along with shock absorbing and anti swing suspension arrangement
	c.	For inspection of crane components	One (1) portable 40W hand lamp with min. half span length flexible cable for inspection of crane components
3.31.0		**Fire Extinguisher**	Three nos. on bridge, 4.5 kg CO_2 type
3.32.0		**Maintenance cage**	Suitable inspection cages to accommodate two persons to facilitate inspection of down shop lead covered by wire mesh
3.33.0		**Type of control for Hoists/ CT/LT operation**	Through VVVF drive

3.34.0		**VVVF Drive**	The VVF drive shall be equipped at least with 1024 pulse incard, 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 derated at 50 Deg C ambient temperature. VVVF system shall be rated for continuous duty as per IEC 146 (clause II). Output frequency range shall be minimum 0 to 50 Hz at constant torque and 0 to 100 Hz at constant power. Efficiency of VVVF shall be minimum 97%. Individual converters shall be provided for each vector drive. The harmonic content reflected on incoming line is to be limited to 5% THD and 3% for individual harmonics. Harmonics filters preferably along with 12 pulse converter/IGBT based converter shall be used to achieve this.
	a.	**Rating & Qnty**	*
3.35.0		Overload protection system	To be considered for the Hoist with additional operational limit switches.
3.36.0		**Isolating switch**	One no. at operating floor
3.37.0		**Painting**	As per Annexure- IV

Note: Other requirements for the system.

1. No cast iron part shall be used on the crane except for electrical equipment. However, in case of gear boxes casing only, use of cast iron of grade not less than 25, IS: 210 -1962 is recommended. Similarly, no wood or other combustible material shall be used in any part of the crane.
2. Parts requiring replacement or lubrication shall easily be accessible without dismantling the other equipment and structures.
3. Defects in the material like fractures, cracks, blow holes, pitting etc. are not allowed. Rectification /Replacement of any such flow are permissible only with the approval of the owner.
4. Crane shall be complete with trolley, tracks, wheels, axles, drive mechanism, hoisting drum brakes, horns, warning, lights, limit switches etc.
5. Access ladder shall be provided for access the crane from building walkway. And ladder shall be provided for access the maintenance cage from crane walkway.
6. Platforms / walkways in crane shall be provided for maintenance with 750 mm clear inside width. Non skid steel plate of thickness 6 mm with toe guards of 100 mm height above the floor level and safety hand railing shall be provided along the full span length on either side of the crane bridge girders.
7. The brakes shall be located on input shaft / extension of input shaft of gear reducer. Coupling halves shall not be used as brake drums.
8. Upper pulley block to be placed above crab platform level for ease in approach during maintenance.

ELECTRICAL REQUIREMENTS:

1. Electrical equipment shall be adequately rated to permit simultaneous operation of may combination of motions of the crane for it duty service.
2. 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, mechanical overload and protection for electrical faults etc.
3. Necessary start/stop and emergency controls shall be provided. Automatic reset type limit switches shall be provided to prevent over-travel for:
   • Over hoisting and lowering motions of the hook.
   • Long travel motion
   • Cross travel motion
4. One (1) set of shrouded type down shop leads (DSL) with copper conductor for the crane runway length shall be provided. Conductor shall be colour coded for R, Y, B phases and ground. Current

carrying capacity of Runway conductors shall be designed for simultaneous operation of the two cranes as applicable.

The shrouded copper bus bar conductor system shall comprise of 4 wire suitable for single power feed to mid point. The material of shroud shall be PVC suitable for 70 deg. C. The continuous current rating of the conductors shall be so chosen that the voltage drop from load break switch to the motor terminal is restricted to 3 % based on maximum derated current and 10% based on peak current

5. Power supply to Crab shall be through flexible trailing conductors
6. All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion.
7. DSL phase indicating lamps to be provided.
8. Emergency Switch-Mushroom type emergency STOP push buttons to open the main contactor shall be furnished at least two on bridge platform within easy reach.
9. Additional features on pendant push button:

   Emergency Push Button
   Switches for lights and bells
   Lamps for Power ‘ON’ indication and emergency corner switch operation

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL 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

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_2SO_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.

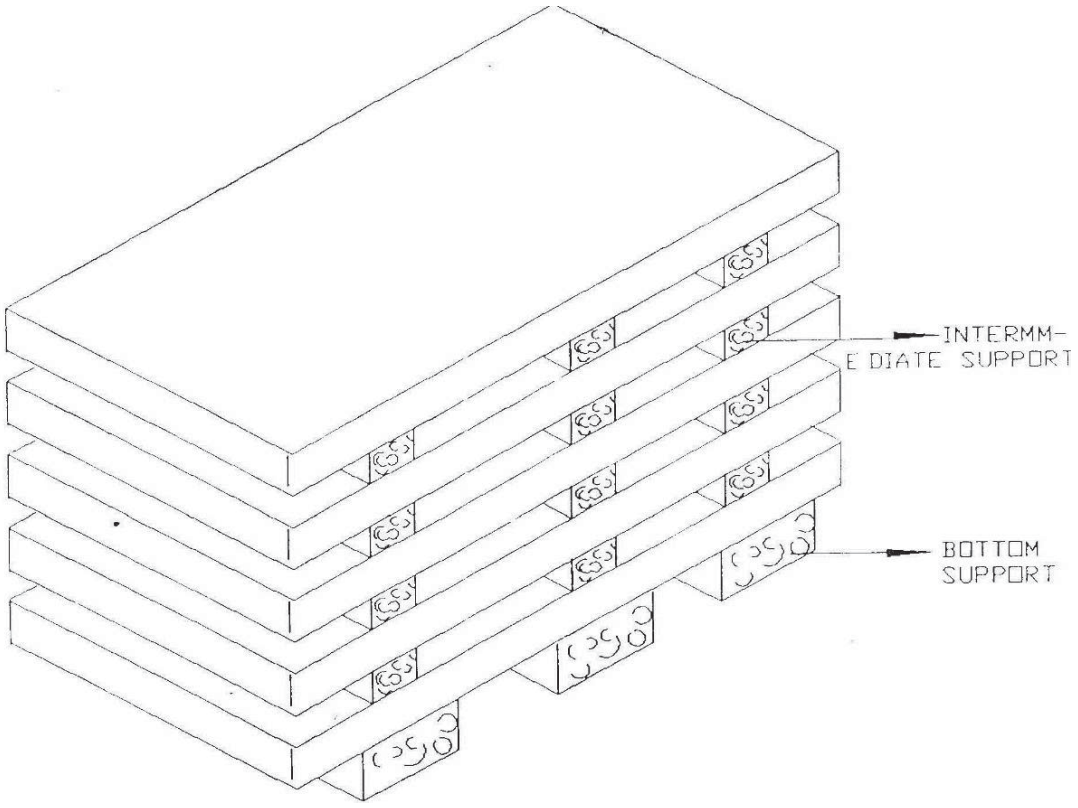


Figure – 1 – PLATE STACKING ARRANGEMENT

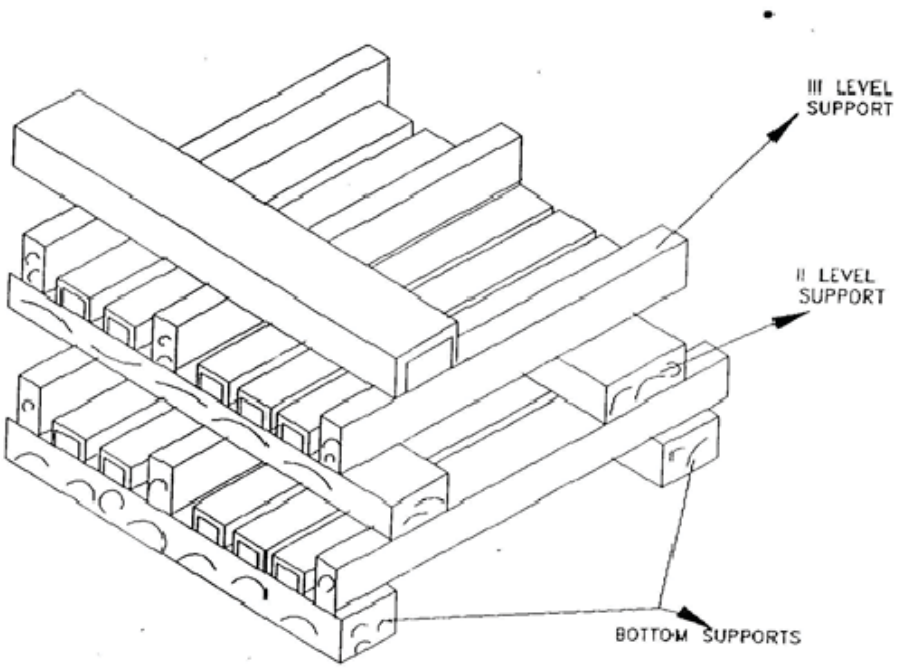


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION III

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

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

a. Signed and Stamped copy of Compliance cum Confirmation Certificate

b. Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format attached in the tender

   Or

   No deviation certificate

c. Un priced copy of price format indicating quoted/ not applicable against each row/column

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.

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', 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 is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. 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.

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.

m) Regarding commercial documents / deviations, BHEL clarified that commercial documents / deviations shall not been considered during technical evaluation. However if any issue in the commercial documents / deviation related to technical requirements needs to be highlighted and resolve in technical evaluation only. No aspect of commercial issues needs to be highlighted / resolved in technical evaluation and their offer is strictly in compliance with technical specification. BHEL also clarified to the bidder any technical deviations (e.g. related to MDL, required documentation etc. for completion of the project) raised by them in commercial deviation either explicit or implicit shall be considered null and void even if agreed by BHEL during commercial evaluation stage. Bidder agreed to confirm and compliance with technical specification and subsequent clarification on bids during pre- award discussion.

LOAD TITLE	RATING (KW / A)		FULL LOAD CURRENT FLC(A)	UNIT (U)/STN. (S)	Nos.		VOLTAGE CODE*	FEEDER CODE*	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME> 5 SEC (Y)	LOCATION (Tag. No.)	RATING & FLC CHECKED FROM MOTOR/VALVE APPROVED DATASHEET (Y/N)	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	KKS NO.
	NAME PALTE	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	20	21	22
Sea water intake PH		15 kW		S	1	0	D	S	N	I		sea water intake PH									
Sea water outfall PH		18 kW		S	1	0	D	S	N	I		sea water outfall PH									

NOTES: 1. COLUMN 1 TO 14 & 20 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATTIONS : * 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 (DC) : G =220V, H = 110 V, J = 48 V, K = +24V, L= -24V

: **FEEDER CODE (8) :- U = UNIDIRECTIONAL STARTER, B = BIDIRECTIONAL STARTER, S = SUPPLY FEEDER, D = SUPPLY FEEDER (CONTACTOR CONTROLLED)

BHEL	LOAD DATA (ELECTRICAL)		JOB NO.	435		ORIGINATING AGENCY		PEM (ELECTRICAL)	
			PROJECT TITLE	2X660 MW UDANGUDI STPS		NAME		DATA FILLED UP ON	
			SYSTEM / S	D/G EOT (UPTO 100T)		SIGN.		DATA ENTERED ON	
			DEPTT. /SECTION	MAUX		SHEET 1/2	REV. R0	DE'S SIGN. & DATE	

	2X660 MW UDANGUDI STPS **DOUBLE GIRDER EOT CRANE UPTO 100T**	SPECIFICATION NO. PE-TS-435-501-A102 SECTION: III REV 00 DATE AUG 2023

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