

**TAMILNADU GENERATION & DISTRIBUTION CORPORATION
LIMITED (TANGEDCO)**

2X660 MW UDANGUDI STPP

**TECHNICAL SPECIFICATION
FOR
SINGLE GIRDER EOT CRANE**

SPECIFICATION NO.: PE-TS-435-524-A001 Rev 0



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR- PROJECT ENGINEERING MANAGEMENT
NOIDA
INDIA**



2X660 MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE

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SECTION

REV. 00

DATE: JUNE 2020

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SECTION-I

SPECIFIC TECHNICAL REQUIREMENT

SUB-SECTION IA
SUB-SECTION IB
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SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)
SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)
DATA SHEET A



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SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)



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INTENT OF SPECIFICATION

- 1.1 The specification is intended to cover 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, mandatory spares alongwith spares for erection, startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, alongwith Supervision of Erection and Commissioning at site for project and package specified complete with all accessories for the total scope defined for SINGLE GIRDER EOT CRANE.
- 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.



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- 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.



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1.0.0 SCOPE OF WORK

1.1.0 SUPPLIES

1.1.1 Equipment and services to be furnished by the bidder for the Single Girder EOT crane with accessories as per the details given in data sheet A. Any equipment / accessories not specified in the specification but required to make the crane units complete and efficient shall also be under the bidder's scope of work.

Each EOT crane shall include all necessary items but shall not be limited to the following (as applicable): -

1. Crane girder.
2. End carriages complete with wheels
3. Electric Hoist for EOT crane
4. CT / L T drive arrangement
5. Electrical equipments including pendent push button
6. VVVF drive for all motions
7. PVC Shrouded Conductor (Cu) Bus Bar/ FLEXIBLE TRAILING CABLE (Cu) / CABLE REELING DRUM (Cu) Type DSL with accessories for entire bay length
8. Earthing arrangement.
9. Painting of crane.
10. First fill + one year's topping (not less than 10% of the full charge) of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc.
11. Main isolating switch and power cable from 1.5M above ground / operating floor to down shop lead.
12. Rail and fixing arrangements for semi gantry cranes and gantry cranes
13. Lifting tackles including ropes and shackles
14. Canopy protection for electrical equipments of outdoor cranes including DSL

1.1.2 Maintenance Tools and Tackles

A complete unused new set of 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 it can be easily identified for 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 specially protected against rusting in tropical climate and minimum the following shall be provided.



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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 pliers	1 No.
5	Wrench spanner	1 No.
6.	Grease Gun	1 No.
7.	Oil Gun	1 No.
8.	Hand Lamp	1 No.
9	Line tester	1 No.

Note: All maintenance tools & tackles are to be supplied in a tool box.

1.1.3 Erection and commissioning spares

Erection and commissioning spares, as deemed necessary by the bidder shall be supplied along with each Equipment. List of these commissioning spares shall be furnished by the bidder along with their offer. Any item not quoted by the bidder but found necessary during erection and commissioning shall have to be supplied by the bidder without any cost implication.

TABLE 1

S. No.	Description of equipment/item	Quantity
1	Overload Relay	1 set for each crane
2	Limit Switch	1 set for each crane
3	Fuse Link	1 set for each crane
4	Any other as per manufacture's recommendation	

1.1.4 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 and specially protected against rusting in tropical climate. The minimum requirement of mandatory spare parts is listed in Annexure –II, Section IA of this specification.

1.2.0 Services to be provided by the bidder

1.2.1 Scope of work for delivery & transportation etc shall be as per commercial terms and conditions of NIT.

1.2.2 Supervision of erection and commissioning at site.

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

1.3.0. Inspection and Testing

1.3.1. Inspection and testing at Manufacturer's works



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A. Shop inspection and tests will include but not limited to the following - (In-process)

- i. Identification, co-relation and verification of material test certificates for the important components like girders, major load carrying components, hooks, gears, shafts, wheels, wire rope drum, wire rope, gear box etc. For other components supporting test certificates or random check tests shall be conducted / furnished.
- ii. Qualification of welder and welding procedure as per ASME section IX .
- iii. 100% radiography of tension zone & 25% radiography of compression zone on butt welds of load bearing members shall be carried out with acceptance norms as per ASME Sec VIII Div.1 UW 51. DP test of all butt welds shall be carried out as per ASTM E 165/ ASTM E 109 with acceptance norms as per ASME Sec VIII Div.1
- iv. For fillet welds visual inspection on all welds. Die- penetration test (DPT) for fillet welds in the load bearing members as per ASME-165/ASTME 109 and acceptance norm as per ASME section VIII Div. 1.
- v. Ultrasonic test on forgings and casting of critical components like hook, shafts, axles, gears, wheels, pulleys, etc. Ultrasonic test for casting as per ASME Section III NB 2572 & for forging as per ASTM A388.

Unacceptable defects in forgings are as given below: -

1. Cracks, flaws, seams and laps.
2. Defects giving indication larger than 4mm diameter equivalent flaw.
3. Groups of defects with maximum indication less than that from a 4mm dia, equivalent flaw, which cannot be separated at testing sensitivity if the back echo is reduced by 50%.
4. Defects giving indication of 2 to 4 mm diameter equivalent flaw separated by a distance less than 4 the size of the larger of the adjacent flaws.
- vi. PT/MT on component with surface hardening as per ASTM E -165 and ASTM E 138 respectively with no surface defects.
- vii. Gearbox trial run test as per IS / AGMA standards.
- viii. Acceptance and routine tests (HV and insulation) for all electrical and electromechanical components and system as per governing specification
- ix. Functional and simulated operation test, sequencing, interlocks, safety, protection and alarm system. Test on CRANE / CRAB motors and other mechanical, electrical, electro-mechanical as per BHEL technical specification and or as per applicable code
- x. Cranes shall be completely assembled at manufacturers' works to check the misalignment of gears, shafts and other items. Gear box shall have the idle run for minimum two (2) hours.



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B. Testing At Works (Final)

- i. Deflection test of bridge girder at rated load.
- ii. No load (both hoisting & CT), load (SWL)(both hoisting & CT), Over load test (Hoisting at 125% of rated load.)
- iii. Electrical tests for brakes, panel, electrical equipment etc as per IS - 3177
- iv. Measurement of speed of CT & Hoisting (lowering & raising) at rated load.
- v. All Other tests as per IS-3177.

Note: Refer Annexure-IV, Section-IA, Volume II-B for “Shop test Procedure for Load/Overload testing of EOT cranes at Manufacturer’s Works.

1.3.2 Testing at site

The following tests shall be carried out at site by **BHEL** as a part of Erection and Commissioning:

- a) All the tests as mentioned against S.N. 1.3.1 (B) above, with actual hook and wire rope.
- b) No load, load test (SWL) for LT
- c) Speed test at rated load for hoisting, CT and LT mechanism.
- d) Brake test and working of electric hoist.
- e) Any other test as per IS-3177-1999.

The successful bidder shall furnish their recommended procedure for carrying out the Erection, Commissioning & testing at site as mentioned above.

1.4.0 Surface Preparation, Painting & Colour Scheme

Detailed painting procedure has been attached as Annexure III, Section IA, Volume IIB. Bidder shall follow the same.

1.5.0. Drawing / design document for submission after award of contract

Drawing/ design documents to be submitted as per list & submission schedule attached as Annexure-V Section IA, Volume IIB.

Any other design document/ drawing as required by customer/ BHEL shall be submitted by bidder during detail engineering without any implication.

2.0.0. Works Excluded

2.1.0 Supply of steel gantry girders/ ISMB for crane travel

2.2.0 For EOT crane:

The purchaser shall provide single point 415V, 3 phase, 4 wire and 50Hz power feeder at any point of the bay or in the middle of the bay as specified in the Data sheet A. Vendor shall



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provide main isolating switch at 1.5 M above the ground / operating floor level and cable required from isolating switch to DSL.

Any other supply required by the bidder shall be arranged by the bidder himself by using suitable transformer as per the specification.

3.0.0. Deviations

If the proposal submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the appropriate "Schedule of Deviations- with cost of withdrawal" 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 indicate 'NO DEVIATION' in the deviation schedule.

4.0.0. Make of Sub - Vendor items

Make of bought out items will be as per Annexure-I, section IA, volume II-B of the specification. No other make will be acceptable, until and unless specifically got approved by BHEL/Customer during detail engineering. Acceptance/non acceptance of same shall not have any impact on manufacturing & delivery schedule and on cost of crane.

5.0.0 INFORMATION TO BE FURNISHED BY BIDDER ALONG WITH THE OFFER

As detailed in "List of documents to be submitted with bid", Section III

6.0.0 OTHER REQUIREMENTS

Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract along with supply of concerned equipment / component.

Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.



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QUALITY ASSURANCE PLAN

SL NO.	COMPONENT & OPERATIONS	CHARACTERIST ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	* D	**			
					M	C/ N					M	C	N	
1.0 RECEIVING INSPECTION														
1.1	Structural-Plates/RSJ for Main Girders, End Carriages Trolley, Pulley, Gearbox housing , rope drum (if fabricated) etc.	Physical & Chemical	Major	Lab Analysis	100%		IS:2062 Gr. A or B / As per approved G.A.		MTC / Lab Report	✓	P / V	V	V	
1.2	Rope Drum (Seamless Pipe)	Chemical Mechanical	Major	Lab Analysis	1/pipe		Approved drg/DS ASTM A106 Gr A or B		Lab Report	✓	P	V	V	
		Flattening & Acid etching Test Surface defect	Major	Mech test	1/pipe		no cracks, pitting, rusting, damage ,etc		I.R.	✓	P	V	V	
			Visual		100%									
1.3	Gears, pinions, shafts, axles & wheels (#)	Chemical& Mechanical,	Major	Lab Analysis	1/lot		IS:2004 (45C8/55C8) (Relevant IS/appd drg)		MTC	✓	P	V	V	
			Major	UT	100%		ASTMA388/NOTE 1		I.R	✓	P	V	V	# If wheel, gears, pinions, shafts & axle diameter / thickness is equal to or more than 50 mm UT shall be carried out, ref & acceptance norm at S.no.1.4(UT of hook) to be followed

1.4	Hook	Chemical & Mechanical	Major	Lab Analysis	100%	IS: 15560 Related Std. As per appd. Drg./data sheet		MTC	✓	V	V	V	
		UT (above 50 mm dia)	Major	UT on shank portion only	100%	ASTM A388 / ASME Sec VIII Divn 2 – NOTE:1		MTC/ALC/QCR/UT report	✓	P	V	V	
1.5	Wire Rope	Examination of report of breaking load Dimension & Type, construction	Major	Review of TC Measurement	100% 100%	IS: 2266 Appd G A drg	IS: 2266 Appd G A drg	Mfr's TC QCR	✓	P P	V V	V V	
1.6	Motors & cables. Brakes	Make/Type/Rating/ Routine test Make/ type / rating/ HV/IR functional test	Major	Visual / Measurement	100%	Appd drg/DS/Tech spec/Rel IS		I.R STC	✓	P	V	V	For motor, ref. Note 2
1.7	Sheaves	Mech.		Tensile & Hardness	1/lot	Approved Drg / Mfg drg		MTC	✓	P	V	V	
1.8	Limit switch, SFU, Relays, MCB, Fuses, Push buttons Control transformer, VVVF drives	Make/Type/Rating Functional /continuity Make , type, rating, input/output	Major	Review of TC	100%	Appd drg./DS/Scheme/customer Spec./Manu.Std		QCR Routine TC/CO C of mfr	✓	V	V	V	
1.9	DSL ,Current collector, CRD	Make , type, rating, Dimension.	Major	Review of TC	100%	Appd drg./DS/Scheme / customer Spec./ Manu.Std		QCR Routine TC/CO C of mfr.	✓	V	V	V	
1.10	Rail , sole plate	CHEMICAL& MECHANICAL PROPERTIES	MAJOR	CHEMICAL ANALYSIS, MECHANICAL	1 SAMPLE / HEAT	IS 3443 / SAIL PRODUCT/ APPROVED DATA SHEETS /DRAWINGS		MTC / CHECK TEST	✓	P	V	V	Test to be carried out in absence of Mill T.C

				PROPERTIE S				REPO RT					
		VISUAL & DIMENSIONAL	MAJOR	VISUAL & MEASURE	RANDOM			IR	✓	P	V	V	
2	INPROCESS- INSPECTION												
2.1	WPS,PQR & WPQ	Verification of approval				WPS,PQR & WPQ / Qualified by Customer			✓	P	V	V	Customer approved WPS to be used. Procedure & welders qualified by Customer to be used/ deployed.
2.2	Assembled gear box	No load run test backlash & contact pattern, noise, vibration & oil temp rise (for oil lubrictd)	Major	Performance	100%	Apprvd drg/DS/Mfg std Noise 85dbA max, vibration 75 microns max, oil temp rise – 30 °C above ambient max			✓	P	V	V	
2.3	Welding of end carriage, Main Girder, Trolley , rope drum (if fabricated) etc.,	DPT of Welds(all)	Major	LPI	100% on butt&10% on fillet	ASTM E165 or Eq. / No crack or linear indication		I.R.	✓	P	V	V	@RT-100%, for Butt weld in tension & 25% in compression. 100% RT on butt weld for fabricated rope drum
		RT of Butt weld	Major	RT	100%/10%	ASME Sec.VIII,Div.1, UW 51/52		RT film & report	✓	P	V	V	
2.4	Hook	Dimension	Major	Measurement	100%	Mfr's drg / Related Std. As per appd. Drg./data sheet/ IS: 15560 IS: 15560		QCR	✓	P	V	V	
		Proof Load	Major	Load Test				QCR	✓	P	V	V	
		NDT after proof load	Major	LPI	100%	ASTME 165 or Eq. / No crack or linear indication		I.R.		P	V	V	
2.5	Gears, pinions, shafts, axles & wheels (#)	Hardness Surface Defect (after machining)	Major	DPT	100%	Approved Drg/ Data sheet ASTM E-165 No linear indication		MTC	✓	P	V	V	
3	FINAL												

	INSPECTION											
3.1	Overall dimensions	Dimensions (span) level, alignment	Critical	Measurement	100%	Appd GA drg & IS: 3177/IS:3938	I.R.	✓	P	W	W	FUNCTIONAL CHECK OF PENDENT &
3.2a	Assembled Crane along with individual control panel & pendant station	Current & speed for Cross Travel & Hoisting, interlocking sequencing, inching operation, Limit switch operation	Critical	Measure /Verify	100%	Appd GA drg & IS: 3177/Appd data sheet	I.R.	✓	P	W	W	PANEL FOR SPECIFIC CRANE
		Deflection at SWL Holding capacity of brakes		Measurement				✓	P	W	W	
3.2b	Overload test at 125% of SWL			Lifting from mid Air	100%	Appd GA drg & IS: 3177/ IS:3938/ Appd data sheet	I.R.	✓	P	W	W	
3.3	Control Panel & Pendant station	1. Make/type/rating of Bois. 2.IR-HV functional & interlocks 3.DOP by paper insertion for panel	Major	Visual, Operational & Functional Measurement do	100%	Approved drawing / Data sheet / is: 3177 Paper should not go easily.	I.R.		P	W	W	HV of power circuit at 2kV and control circuit at 1kV. IR of power & control circuit with 500V Meggar with acceptance norm of 0.5 Mega Ohm.
			Major do		100% 100%				P	W	W	
3.4	Painting	Examination – shade	Minor	Visual & measurement	100%	Customer's / Approved Painting Procedure			P	V	--	
		Dry Film Thickness	Major	Measurement	Sample				P	V	--	
3.5	Mandatory spares	Quantity/rating/ make	Major	Verification	100%	Approved document		_ /	P	W	V	

NOTE1:*** When back wall echo is set to 100% in sound area then,
a) defect echo shall not exceed 20%
b) Back echo shall be minimum 80% in any area

Note 2:- Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of customer specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between center of stud and gland plate and tested in accordance with approved drawing/data sheet.

LEGENDS:

*RECORDS, IDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M:** SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C:** MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N:** CUSTOMER,

P: PERFORM, **W:** WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI:** MINOR, **CR:** CRITICAL



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CUSTOMER SPECIFICATION



VOLUME II
SUB-SECTION - 2.19.0
CRANES & HOISTS

1.0.0 GENERAL

This part of the specification covers the requirements for Cranes and Hoists.

This section of the specification shall be read in conjunction with other sections of the specification as appropriate and the equipment offered shall meet the requirements as spelt out therein. The system shall comprise of cranes and hoists.

2.0.0 SCOPE OF SUPPLY

The scope of supply shall have to meet all the requirements to make the system complete as per specification and for satisfactory performance guarantee of the complete crane and hoist.

Crane and Hoist shall be provided in the following area considering the design requirement of crane and hoist.

Crane:

REFER PRICE SCHEDULE AND TECHNICAL SPECIFICATION FOR SCOPE OF CRANES.



2.1.0 Crane

Crane shall be provided complete with all accessories as specified under, but not limited to the following:

- a)
- 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)
- 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.
- 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, ~~Anti collision switch for TG hall EOT crane~~ 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. ~~TG hall EOT crane shall be operated from cabin as well as 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) ~~Lifting beam, loose slings and cradle shall be provided as required.~~
- l) 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~~
- Pendant controller (where specified)
- ~~Wireless remote control (where specified)~~
- Indicating lamps, push buttons.
- ~~Lighting panel, lighting fixtures, Cabin fan, 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.
- ~~Electronic Anti-collision device~~

2.3.0 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.

3.0.0 DESIGN REQUIREMENTS

- a)
- b) The cranes and hoist designed to operate at 100% safe working load and subjected to over load test at 125% of rated load.
- c)
- d) Cranes and hoist shall be designed considering the ambient temperature of 50 °C.
- e) The cranes and hoist would be designed considering for hazardous area or non hazardous classification as required.
- f) Crane and hoist control shall be from Variable Voltage and Variable Frequency (VVVF) drive. Creep speed shall be achieved through VVVF drive for cranes.
- g) The hoists shall be provided with flexible trailing cable system.

**4.0.0 DOCUMENTATION****4.1.0 Drawings, data / documents to be submitted along with bid**

- 4.1.1 Completely filled up technical schedules and data sheets of tender documents
- 4.1.2 Crane clearance diagram showing various dimensions/data. (Including highest crane hook position, safe working load etc.)
- 4.1.3 General Arrangement Drawing of the E.O.T. crane assembly.
- 4.1.4 Wheel Loading Diagram.
- 4.1.5 Detailed drawing showing the features of the components of the Crane Bridge and trolley.
- 4.1.6 A detailed write-up on the crane control system. Drawings and data sheets showing the particulars of the controllers, switches, contactors, relays, other control devices and limit switches.
- 4.1.7 General arrangement drawing of protection, control and lighting panels.
- 4.1.8 Electrical /Control Schematic diagrams.
- 4.1.9 Equipment arrangement drawing.
- 4.1.10 Quality Assurance Plan /Inspection and Test Plan (ITP).
- 4.1.11 Field Quality Plan
- 4.1.12 List of tests to be conducted at shop and at site.
- 4.1.13 Testing procedures.
- 4.1.14 A comprehensive write-up and /or brochure on the details of the manufacturing facilities and the test facilities in the shop of the supplier..
- 4.1.15 Detailed engineering, manufacturing, delivery, erection and commissioning schedule and PERT chart.
- 4.1.16 Details of similar job executed in last five years.
- 4.1.17 Lubricants list (with quantities for initial fill and make-up).
- 4.1.18 List of erection and commissioning spares for each crane.
- 4.1.19 List of recommended O&M spares for 3 years normal operation.
- 4.1.20 List of Special Tools & Tackles.
- 4.1.21 List of makes of bought out items.
- 4.1.22 End user certificates.

4.2.0 Drawings, data / documents to be furnished by the successful bidder

	Description	Approval Category
4.2.1	Technical data sheets	A
4.2.2	Crane clearance diagrams showing various dimensions.	A



Description		Approval Category
4.2.3	Drawings showing general arrangement, clearance requirement, assembly, cross sectional data and material of construction for : a. E.O.T. Crane Unit b. Bridge Assembly and Components c. Bridge and long travel and Wheel Assembly d. Trolley e. Trolley Wheel Assembly f. Drive and Transmission Unit for Bridge Travel, Trolley Travel, and Hoist g. Suspension Unit for Hook Block h. Main Hook Block i. Protection, control and lighting panels. j. Electric hoist	A
4.2.4	Drawings on runway rails, fixtures to fix runway rails with the runway main girder and stops etc.	A
4.2.5	Design calculations of the following : Bridge girder, Rope drum, Machinery Shafts, Gearbox excluding proprietary items, Motor rating, Brake capacity, Bearing life, Wheel loading and current collector, angle iron conductor sizing.	A
4.2.6	Leaflets on proprietary items such as motors, brakes, gear box, coupling etc.	A
4.2.7	Electrical documents as listed in respective sections.	A
4.2.8	Material test certificates, including those for the Hooks and wire rope.	I
4.2.9	Report on various tests at shop and at site and certificates of approval by authorised authority for all flame proof components and test reports for the same if required.	I
4.2.10	Quality plans/ Inspection test plan and Field Quality Plan	A
4.2.11	Erection Manual	I
4.2.12	Operation and Maintenance Manuals	I

4.3.0 To be submitted after the award of contract:

- Completely filled in technical Schedules.
- Dimensional General arrangement drawing for Panels, Main Switch, Master controller etc.
- Schematic wiring diagram for Panels.
- Dimensional General arrangement drawing for Motors, Brakes etc
- Characteristic curves for Motors.
- Load requirement for each crane / hoist
- VVVF Control Features.
- Control write-up for tandem operation.
- Catalogues for the all the electrical items such as cables, brakes, limit switches, relays, meters, etc.
- Quality Plans for agreed list of equipments.



- Type test certificates.
- Sizing calculation for DSL.
- Sizing calculation for Motors & Brakes
- Sizing calculation for Cables.
- Lighting arrangement.
- Earthing layout drawing.
- Cable routing drawing.

4.4.0 Any other drawings required for review during the detailed engineering stage, same shall also be submitted by contractor.



VOLUME II
SUB-SECTION - 2.19.2
SINGLE GIRDER EOT CRANE

1.0.0 CODES AND STANDARDS

The design, manufacture, erection and testing of the crane shall conform to the latest edition of the following codes and standards along with their amendments:

IS 3177	Code of Practice for Electric overhead travelling cranes and gantry cranes other than steel works cranes.
IS 800	Code of practice for use of structural steel in general building construction.
IS 807	Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.
IS 2266	Steel wire ropes for general engineering purposes.
IS 3443	Crane rail sections.
IS 15560	Point hooks with shank up to 160 tonne specification
IS 4029	Guide for testing three phase induction motors
IS 5749	Forged ramshorn hooks.
IS 4164	Specification for lifting 'C' Hooks with eye - capacity up to 25 tonnes
IS 12162	Specification for lifting hook
IS 3832	Specification for hand-operated chain pulley blocks
IS 3938	Specification for electric wire rope hoists
IS 1835	Specification for Round steel wire for ropes
IS 7847	General Characteristic of Lifting hook.
IS 3815	Specification for point hook with shank

Any other International standards such as ASTM / ASME / ISO / DIN / JIS for design of coal handling system shall be followed.

Under slung crane / over head crane are required to be installed for handling various equipments during maintenance.

- a) EOT cranes conforming to M5 for Mechanical, Structural and M7 for Electrical of IS:3177 – 1999 and Class II of IS 3938 shall be designed, manufactured, inspected, shop tested, erection, site testing and commissioning to well established engineering practices, safety codes and other relevant codes and standards.
- b) The crane shall be a complete unit with bridge girder, end carriages for long travel, travelling for cross travel, rope drums, wire ropes, sheaves, drive units, brakes, rails and fixtures, rail clamps (if applicable), end stops, buffers, conductors, all electrical etc. to



make the equipment complete in all respects. The steel used for the crane construction shall be of standard quality. All materials used shall be of recent manufacture, free from defects, mill scales, laminations, pitting, flakes, rust etc. All welds shall be free from defects like blowholes, lack of penetration, slag intrusions etc.

c) Bridge Girder

The crane bridge shall consist of single girder. In case of overhead crane, bridge girder shall be mounted on runway rails. In case of under slung crane, bridge girder shall be mounted on the bottom flanges of I-section. The trolley shall move on the bottom flange of the girder.

The bridge girder shall have enough strength to carry the rated load without causing undue stress or deflection.

d) Wheel

The LT wheel arrangement for overhead crane shall have double flanged wheel and CT wheel arrangement shall have single flanged wheel. The under slung crane shall single flanged wheel arrangement for both LT & CT. The wheels shall be machined on their tread to match the runway rail section for overhead crane and profile of the I-section for under slung crane.

e) The ratio between wheelbase and crane span shall be as stipulated in IS 807.

f) Trolley frames shall be fabricated from rolled structural steel section and not from re-rolled structural steel section.

g) Design shall provide for easy maintenance of all parts, particularly the wheel bearings on end carriage.

h) Platforms/walkways shall be provided for maintenance of crane components with access ladder to access the platforms from operating floor/maintenance area.

•
i) Deflections and Camber

i. 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.

ii. 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.

2.0.0 ELECTRICAL REQUIREMENTS

a) Electrical equipment shall be adequately rated to permit simultaneous operation of any combination of motions of the crane for its duty service.

b) 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) 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.

d) All motors shall be capable of the following :



- Operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
 - Withstand 120% of rated speed for two minutes.
 - Current shall not exceed 6 times full load current for creep speed motor.
 - Withstanding the stresses imposed if started at 110% rated voltage.
 - Start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.
 - The locked rotor motor withstand time under hot condition at 110% rated voltage shall be more than motor starting time at minimum permissible voltage by at least 3 seconds for motors upto 20 seconds starting time.
 - Maximum torque shall not be below 200% of full load torque.
- e) Each motor more than 30 KW rating shall be provided with space heater. All electrical equipment accessories and wiring shall have tropical protection.
- f) The crane(s) shall be furnished complete with all electrical equipment, accessories, like drive motors with VVF drives, conductors, insulators, protective & operating devices, cables, current collectors, all protective devices, anti collision limit switches, mechanical overload and protection for electrical faults etc.
- g) The limit switches shall be totally enclosed type IP-55.
- h) Each hoist shall be furnished with two (2) limit switches meeting the following requirements:
- 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.
- i) Track type limit switches shall be provided on the bridge and trolley to prevent over travelling in either direction.
- j) Trailing cable shall be 1100 V grade, tinned copper, heat resistant, with EPR insulation and as per Class – 5 of IS-8130. Also should have inner PCP sheath and outer CSP sheath with nylon chord reinforcement & heat resistant, oil resistant and flame retardant heavy duty FRLS type.
- k) 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

l) Down Shop Leads (DSL)

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. Minimum 20% allowance for wear and tear shall be provided over the calculated size.



m) VVVF control

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



ANNEX 2.19.2.1
SPECIFIED DESIGN DATA FOR SINGLE GIRDER EOT CRANE

	Description	Unit	Data
1.0	GENERAL		
1.1	Type of control proposed		Pendant
2.0	HOISTING SYSTEM		
2.1	Rope		As per IS 2266, Rope grade 1770
a)	Rope construction		IS 2266 / 6 x 36 multi strand construction Fibre core.
b)	Rope quality (material)		Extra flexible plough steel
c)	Factor of safety		As per IS
2.2	Rope drum		Hoist drum length shall be such that each lead of wire rope has a minimum of two full turns on the drum when the hook is at its lowest position not taking into consideration turns covered by wire rope anchorage and one spare groove for each lead of wire rope on the drum when the hook is at its highest position.
a)	Drum material		Fabricated from carbon steel as per IS 2062, Grade B and stress relieved or seamless pipe as per ASTM A 106 Grade A or B.
b)	Whether stress relieved		Yes (if fabricated)
2.3	Bearing type		Antifriction ball or roller
2.4	Hook		
a)	Hook type		Swivel "C" type single shank of suitable grade of either circular or standard trapezoidal section, point hook suitably heat treated with adequate lifting capacity. Swivel lock pin shall be provided.
b)	Hook material		Forged steel
c)	Safety latches provided		Yes
d)	Hook suspension		Thrust Bearing
2.5	Sheave material		Fabricated from cast steel / steel plate IS 2062 Gr A or B / CS Gr 280-520 IS 1030
2.6	Hoist Brake		
a)	Type		DCEM "fail to safe"



	Description	Unit	Data
b)	Torque		150% of rated torque or greater than the torque transmitted to the brake drum from the suspended load up-to the test load.
2.7	Gear box		Fabricated Fe 410w IS:2062 Gr A/B & stress relieved
a)	Material of gears		EN 9 / 55C8
b)	Material of pinions		EN 19 /EN 24
c)	Type of gears & pinions		Spur / helical
2.8	Limit Switch type		Rotary geared + gravity type
3.0	CROSS TRAVEL		
3.1	CT brake		
a)	Type		DCEM “ fail to safe”
b)	Torque	Nm	150% of rated torque
3.2	Gear box		Fabricated Fe 410w IS:2062 Gr A/B & stress relieved
a)	Material of gears		EN 9 / 55C8
b)	Material of pinion		EN 19 / EN 24
c)	Type of gears & pinion		Spur / Helical
3.3	Wheels		
a)	Materials		Forged steel
b)	Hardness	BHN	Not more than 200BHN
c)	Type		Single flanged
d)	Wheel bearing type		Antifriction Ball/Roller
3.4	Type of limit switches		Lever
4.0	LONG TRAVEL		
4.1	CT brake		
a)	Type		DCEM “ fail to safe”
b)	Torque	Nm	150% of rated torque
4.2	Gear box		Fabricated Fe 410w IS:2062 Gr A/B & stress relieved
a)	Material of gears		EN 9 / 55C8



	Description	Unit	Data
b)	Material of pinion		EN 19 / EN 24
c)	Type of gears/pinion		Spur / Helical
4.3	Wheels		
a)	Materials		Overhead Crane – C55 Mn 75 for overhead crane & Steel used for wheel shall not contain more than 0.06% of Sulphur or Phosphorous. Under slung Crane – Forged steel
b)	Hardness	BHN	Overhead crane – 300 to 350 BHN for under slung crane – Not more than 200BHN
c)	Type		overhead crane – Double flanged under slung crane – Single flanged
d)	Wheel bearing type		Antifriction Ball/Roller
4.4	Type of limit switches		lever
5.0	Type of Buffer Stoppers		Rubber / spring
6.0	Electrical		
6.1	Power supply		Shrouded type down shop leads (copper) shall be provided to supply power to crane. Power supply to Crab shall be through flexible trailing conductors.
6.2	Rating		S4, 60% CDF
6.3	Number of starts/hour		300 starts /hour



**2X660 MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE**

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-I

SUB-SECTION-IB

REV 00

DATE : JUNE 2020

SUB SECTION-IB

SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)



TITLE:

**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
SINGLE GIRDER CRANES****2 X 660 MW UDANGUDI STPP STAGE-I**

SPECIFICATION NO.

VOLUME NO. : **II-B**SECTION: **C**REV NO. : **00** DATE: 04/07/2018

SHEET: OF

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



TITLE:

**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
SINGLE GIRDER CRANES**

2 X 660 MW UDANGUDI STPP STAGE-I

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION: **C**

REV NO. : **00** DATE: 04/07/2018

SHEET: OF

- 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 Datasheets & quality plan for motors.
 - 4.4 Load Data Format. (Annexure –II)
 - 4.5 BHEL Cable listing format (Annexure –III)

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: SINGLE GIRDER CRANE
 SCOPE OF VENDOR: SUPPLY
 PROJECT : 2X660 MW UDANGUDI STPP

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



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 : ($\pm$) 10%
- Voltage variation for HT motors : ($\pm$) 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 60034-15. The coil inter-turn insulation shall withstand steep front impulse withstand voltage as per IEC 60034-15.
- For HT motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, 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 °C 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°C and 40 °C 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



4.0.0 TECHNICAL REQUIREMENTS OF LOW VOLTAGE VFDS

- 4.1.0 VFDS shall be rated for 415 V supply voltage. If isolation transformer is required at input, the same shall be provided.
- 4.2.0 VFDS shall be sized for the specific application with a design margin of atleast 10% over the motor rating. The drive shall be rated to operate at a design ambient of 50°C. It shall be ensured that harmonics are filtered and not reflected at source.
- 4.3.0 Variable speed drives shall be provided for better speed response, range ability, control stability and for ease of control, and smooth, efficient and optimum speed operation of the machine drives.
- 4.4.0 The drive shall be housed in sheet steel enclosure of IP-42 degree of protection. The unit shall be complete with ACB/MCCB at incomer, contactor, semiconductor fuses, meters, indication lamps, annunciations, protections, redundant cooling fans etc.
- 4.5.0 VFDS shall be at-least 12 Pulse type with active front end rectifiers with total harmonic current distortion limited to less than 4%.
- 4.6.0 For VFDs controlled LT motors, it shall be IE2 class as per IS 12615.
- 4.7.0 VFDS system shall have the following features:-
 - High input line-side power factor throughout the speed range.



- Low harmonics on the input line-side, with the total and individual harmonic contents not exceeding the limits established in IEEE-519.
- Low load side harmonics with near sinusoidal current in the drive circuit.
- Suitable for regenerative operation as may be required for the drive application.
- Input and output side choke
- Soft start and soft stop, with capability for bi-directional operation of the drive as may be required.
- Reduced shoot through faults.
- High starting torque as may be required for the drive application.
- Suitable for various drives operating with driven equipment having constant torque, constant power, or load torque varying with square or cube of speed.
- Faster response and have a wide speed range.
- Greater tolerance to load side drive machine parameter variations.
- Wide range of low frequency and super synchronous speed frequency range of operation as may be required.
- Low torque pulsations throughout the lowest & highest frequency range.
- Stability throughout the lowest and highest load range.
- Reduced voltage spikes inflicted on the motor / VFDS equipment that can occur during commutation.
- VFDS shall be capable of flying restart.
- VFDS shall have dynamic braking unit and resistor feature.
- By pass arrangement.

4.8.0 VFDS will comprise frequency converter having following features:

- Voltage or Current Source DC link Pulse Width Modulated (PWM) Converter configuration suitable for operation at automatically produced fixed ratio of Voltage / Frequency (V / F) throughout the complete speed range of the motor; and for operation in constant torque and constant power mode as appropriate. The converter will comprise line commutated power converter connected to AC mains either directly or by a suitably rated converter transformer.
- For the Voltage Source Inverter Configuration, the DC link voltage output by the power supply converter will be smoothened by an L-C circuit and the constant voltage output that will be fed to a forced commutated three phase inverter output system. The system will be complete with shunt capacitors selected to cater to the reactive power requirements of the motor.
- For the Current Source Inverter Configuration, the DC link voltage output by the power supply converter will be by a smoothing choke in series with the converter and the constant current output of the choke will be fed to a suitably commutated three phase inverter output system. The smoothing reactor will be sized to avoid conditions of discontinuous current operation of the converter at its lowest frequency of operation and will be uniformly insulated and protected against voltage surges that could occur during load throw-off.
- Provided with suitable input transformer if required to transform the input system network voltage to the optimal voltage of the converter and to reduce the short circuit capacity and to reduce 'line notching' that can occur during commutation. The Input transformer will have appropriate phase shifting multiple windings to eliminate the 5th & 7th harmonics and their multiples.
- Suitable regulating equipment that will be so designed as to enable the drive motor system to respond to load change with good dynamic accuracy, excellent speed holding accuracy and fine speed setting resolution. From the instrumentation control system, isolated 4-20 mA dc controller output signal will be made available as a set point for the speed controller in the regulation system. The system will include as part of the speed controller any transducer/ converter that may be required to interface with the above signal. Facility for signal measurement at important points in the regulating system will also be provided.



- Independently adjustable voltage boost for VFDS start up and operation at the lower end of the frequency.
 - Separately adjustable ramp up and ramp down time facilities.
 - Complete features for drive soft start and soft or extended stop as required with features required for bi-directional operation of the drive as may be required for the particular application.
 - Close loop control to keep output voltage unaffected by system voltage and load changes. Regulation of output voltage will not be more than plus 2% to minus 2% under steady state (zero to full load) and 8% under transient conditions.
 - Maximum drift in set frequency will be plus 1% to minus 1%.
 - All facilities as required for onsite adjustments of current limits, trip time, maximum frequency, minimum frequency, start compensation, voltage boost, slip compensation, accuracy rate, deceleration rate and others as required.
 - Comprehensive protection and fault display circuit including under / voltage (supply, over current, short circuit / earth fault due to inverter and / or motor fault , internal / external fault provisions for tripping unit. covering as a minimum Over current protection, fast acting short circuit & transient suppression circuits, Overload protection, Phase sequence monitoring and protection, Single phase protection, Mains & Internally generated Transient Over Voltage Protection, Under Voltage and mains supply failure protection, Control supply failure, IGBT fuse failure, Gate suppression for output circuit faults, Thermistor protection relay for protection of windings of motors greater than or equal to 75 kW, necessary di/dt & dv/dt protection, Device / Cubicle overheating protection, Ventilation failure, and any other protection as required for the type of scheme provided.
 - Where closed loop dynamic and fast speed response is required for drives, necessary multi loop control system will be provided complete with tachometers provided in the drive shaft.
- 4.9.0 The control system will consist of a multi loop system having two internal loops. One loop is for speed control and the other is for the control of current. Each loop will have its own controller, along with an acceleration ramp function, which sets the desired value of the speed in accordance with a linear ramp function and thus prevents sudden variation in the controller input.
- 4.10.0 The primary controlled variable will be speed which will be measured by means of a tachometer, which will be provided on the drive shaft and compared with the reference speed input. The error in speed will actuate a speed controller to establish the reference current input. This reference value will be subtracted from the actual current value and the error signal actuates the current controller, the output of this should be connected to the gate control unit, which controls the firing of the IGBT.
- 4.11.0 The inner current loop is made more active than the speed control loop. The speed and current controllers will be capable of accepting the form and type of feedback signal provided by the error detector and must provide at its output a signal of the proper type to operate the IGBT.
- 4.12.0 All necessary indication and monitoring equipment that will as a minimum include speed indicator for motors with a provision for repeat indication signal for use with DCS instrumentation system, speed reference, speed feedback, current reference, current feedback, regulated power supply voltages; voltmeter, ammeter, frequency, power factor meter, kW meter at mains input supply side, pulse output meter; voltmeter, ammeter, frequency, kW meter torque meter kW meter and speed indicator on the load side.
- 4.13.0 Audio visual Alarm annunciation (with visual and audio alarm acknowledge facilities) as required that will as a minimum include drive in monitoring mode, drive in regenerating mode, control electronic power supply, over temperature, motor over current, rectifier over current, motor overload, any other motor / converter faults.



- 4.14.0 Necessary Input and output Filters will be provided at appropriate locations to suppress harmonics at the input and the output of the VFDS converter system and to improve the input power factor.
- 4.15.0 The VFDS panel will be located indoors inside electrical rooms. The VFDS panel will have self-ventilating & cooling fans fed with power drawn from within the VFDS panel complete with fan motor starters including switch & HRC fuses, contactors & overload relays as per details given for MCC in the previous sections of this report.
- 4.16.0 VFDS unit will be controlled from following 3 different locations
- VFDS panel
 - Local Operator Panel or Local Control Station
 - DCS
- 4.17.0 Following minimum control facilities will be provided on each of the VFDS Panel and the Local Operator Panel:-
- Incoming switch and HRC fuses.
 - Start / Stop PBs to switch ON / OFF of the drive.
 - All necessary contactors and switch with HRC fuses or current limiting circuit breakers for the drive control and protection along with overload protection.
 - Raise / Lower PBs for speed variation of the drive.
 - Auto / Manual Selector Switch for selection of the mode of operation.
- 4.18.0 In Auto mode, frequency will be controlled from the instrument control PLC / DCS system by a 4 to 20 mA signal. For ON / OFF control of the motor in the Auto mode, 4-20 mA interlock signal from instrumentation PLC system will be wired to the VFDS panel.
- 4.19.0 In the Manual mode, the Selector Switch will be provided to select the motor control either from VFDS Panel or from the field.
- Drive Ready Indication and
 - Speed Indicator
 - DCS interface covering :-
 - Wiring of 4-20 mA signal input from DCS/PLC for speed variation.
 - Wiring of DCS / OFF input signal / contact for motor Start / Stop.
 - Wiring of 4-20 mA signal output to DCS/PLC for speed indication.
 - Wiring of contacts to remote for Drive Ready Indication

5.0.0 PAINTING

Painting shall be carried out by approved process. After preparation of the under surface the equipment shall be painted with epoxy based paint by powder coating. The final thickness of paint film on steel shall not be less than 85 microns. Final shade shall be RAL-7035.

6.0.0 TESTS

All the equipment supplied shall be of type tested quality. Type test reports shall be submitted for each voltage class and current rating.



7.0.0 DRAWINGS & DOCUMENTS

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

- Technical data sheet
- General arrangement and section drawing
- Single line diagram & Schematic wiring diagrams
- Metering and protection drawing
- Foundation Plan & loading details
- VFDS sizing calculation
- Test reports
- Manufacturing 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	
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 requirement if any in the datasheet (Add extra row).
- 3 For details which is not applicable please write "NA"

	TITLE MOTORS DATA SHEET – C 2 x 660MW UDANGUDI STPP	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 21.05.18
		SHEET 1 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTORS DATA SHEET – C 2 x 660MW UDANGUDI STPP	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 21.05.18
		SHEET 2 OF 2

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

		QUALITY PLAN SHEET 1 OF 2		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION			
SYSTEM		NUMBER PED-506-00-Q-006, REV-01			TITLE			SECTION			VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./MFG. SPEC.	MFG. DRG./MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

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

SUB-VENDOR LIST FOR ELECTRICAL ITEMS

ITEM DESCRIPTION	SL NO.	VENDOR NAME
CABLE GLANDS	1	ALLIED TRADERS & EXPORTERS
	2	ARUP ENGG & FOUNDRY 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

ANNEXURE III

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

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

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

(A) SYSTEM VOLTAGE CODES:

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

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

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

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

(C) CABLE CODES

PVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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



SECTION-3.28: EARTHING & LIGHTNING PROTECTION SYSTEM

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Earthing & Lightning protection system.

2.0.0 SCOPE OF WORK

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

- a) Buried earth mat for the main plant, auxiliary plants, non plant buildings and switchyard
- b) Embedded earth mat in the concrete floor of buildings, electrical rooms including GIS building.
- c) Equipment enclosure earthing for all electrical equipment
- d) Earthing of all metallic structures including cable racks
- e) Electronic earthing for all DCS/Respective control system/SAS/EMS and other electronic equipment
- f) Earthing for communication system
- g) Lightning protection for GIS building, Switchyard and transformer yard
- h) Lightning protection for main plant building, Boiler, ESP
- i) Lightning protection for Chimney
- j) Lightning protection for Cooling tower
- k) Lightning protection for Ash silo structure
- l) Lightning protection for CHP buildings and structures
- m) Lightning protection for Ash buildings and structures
- n) Lightning protection for all auxiliary plant buildings/structures and outdoor equipment/structures
- o) Lightning protection for all non-plant buildings and structures

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 version of the following Standards except where modified and /or supplemented by this specification.

- a) IS: 3043 Code of Practice for Earthing
- b) IS: 2309 Protection of building and allied structures against lightning - Code of practice
- c) IS: 1079 Specification for hot rolled carbon steel sheet and strips
- d) IS: 2629 Recommended practice for hot dip galvanizing on iron & steel
- e) IS: 4759 Specification for hot-dip zinc coatings on structural steel and , allied products
- f) IS: 6745 Methods for determination of weight of zinc-coating on zinc coated articles.
- g) IEEE 80 IEEE Guide for safety in AC substation grounding
- h) IEEE 142 Grounding of industrial & commercial power system.
- i) CBIP manual on AC earthing system
- j) Indian Electricity Rules

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Earthing System

- 4.1.1 Earthing system shall be provided for complete power station including switchyard.



4.1.2 Earthing system shall comprise the following:

- Neutral earthing to establish the ground reference of the electrical system
- Safety ground connections for protecting personnel from injury and property from damage
- Equipment earthing to ensure a low impedance return path for ground current should an electrical fault occur between the live conductors and the equipment enclosure

4.1.3 Various system earthing envisaged in the power project are as follows:

S. No.	System Voltage	Neutral	Maximum earth fault current
1.	400 kV system	Solidly earthed	63 kA
2.	33 kV system	Solidly earthed	25 kA
3.	Generator	High impedance earthed	10 A
4.	11 kV system	Medium resistance earthed	300 A
5.	6.6 kV system	Medium resistance earthed	300 A
6.	415 V system	Solidly earthed	65/50 kA

The safety and equipment earthing systems should meet the following requirements:

- a) All metallic enclosures on equipment and exposed noncurrent-carrying conductive materials capable of becoming energized due to either insulation failure, inadvertent contact with an energized conductor, or building up of a static or induced voltage should be earthed.
- b) The earthing arrangement should ensure a deliberate earth fault current return path, so that the (overcurrent or earth fault) protection shall sense the fault and either trip the faulty circuit or provide an alarm to the station operator.
- c) The earthing should limit the step and touch voltage to acceptable limits during an earth fault.
- d) The earthing conductors and connections should withstand the earth fault current for the duration of the fault, without being damaged by thermal, thermo-mechanical or electromechanical stresses.
- e) The earthing conductors should be continuous; no switching device should be inserted in the earthing conductors (except where the operation of the switching device shall also automatically disconnect all power sources to the equipment earthed by that conductor). Equipment enclosures should not be used as part of the earthing conductor.
- f) The earthing conductors should be mechanically reliable or protected in order to withstand any possible mechanical stress imposed on them. The exposed connections of earthing conductors should be accessible for inspection.
- g) The earthing system should be designed to minimize corrosion to adjacent structures, equipment and enclosures.

4.1.4 The earth mat design for GIS building , switchyard and transformer yard shall be designed as per IEEE 80. The earthing system of Switchyard shall meet the following requirements:

- Ensure adequate earth fault current for operation of earth fault protection
- Limit step and touch voltages to acceptable limits during earth fault
- Earthing conductors and connections shall withstand earth fault current for the duration of the fault



- 4.1.5 The earth mat shall be designed with grid spacing such that safe voltage gradients are maintained. Earth conductors shall be installed below ground shall be spaced in a grid pattern to provide the earthing mesh grid throughout the site. Switchyard earth mat shall be interconnected with main plant earth mat by a minimum of two parallel conductors.
- 4.1.6 The mild steel earth grid shall be designed to withstand 40 years of corrosion and still retain safe touch and step potentials in accordance with IEEE 80. Corrosion rate shall be arrived at as per soil resistivity report.
- 4.1.7 The earth mat of the station shall be designed such that the total ground resistance does not exceed 0.5 ohm.
- 4.1.8 Earth mat and all earthing conductors for GIS building earthing shall be of copper. The earthing conductor material for other locations shall be corrosion resistant steel.
- 4.1.9 400 kV system earth fault current of 63 kA shall be considered for earthing design. The earthing design shall consider the following:
- Earth fault current duration for conductor sizing : 1 sec
 - Shock duration for mesh sizing : 0.5 sec
 - Depth of buried earthing conductor : minimum 600 mm
 - Human body weight for step / touch voltage calculation : 70 kg
 - Resistivity of concrete : 500 ohm m
- 4.1.10 Contractor shall carry out earth resistivity test of power project site and shall establish homogeneous soil resistivity for earthing design. Number of earth resistivity test locations shall be not less than 10. The test locations shall be subject to Owner's approval.
- 4.1.11 For Gas insulated switchyard the following aspects shall be considered:
- All metallic enclosures should normally operate at ground voltage level.
 - When grounded at the designated points, the bus enclosure design should ensure that no significant voltage differences exist between individual enclosure sections and that neither the supporting structures nor any part of the grounding systems is adversely influenced by the flow of induced currents.
 - To avoid the circulation of enclosure currents beyond regular return path within the GIS assembly, power cable sheath grounds should be tied to the grounding system via connections that are separated from the GIS enclosures. Very fast transients generated by switching or by faults in the GIS may cause these insulation elements to flashover. In such cases, the consequences of such flashovers on current distribution within the grounding system should be considered.
 - Enclosure return currents also cannot be permitted to flow through any mounted current transformers.
 - In GIS building, earth mat of copper flat shall be embedded in the concrete floor in grid / mesh form. Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
- 4.1.12 The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences. The following shall be ensured.
- The grounding system shall ensure safe touch & step voltages in all the enclosures
 - All GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. shall be connected to the ground bus of GIS.
 - The enclosure of the GIS shall be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections



should be provided for each of circuit breaker, transformer terminals, cable terminals, surge arrestors, earth switches and at each end of the bus bars.

- The grounding continuity between each enclosure shall be effectively interconnected with copper bonds of suitable size to bridge the flanges.
- Suitable measure shall be provided to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrestor, phase/ earth fault and discharges between contacts during switching operation. Suitable barrier of non-linear resistor at SF6/ Air termination, cable bushing etc. to mitigate transient enclosure voltage shall be provided.

- 4.1.13 Earthing terminal of each lightning arrester and capacitor voltage transformer shall be directly connected to earth electrode which in turn, shall be connected to station earthing grid.
- 4.1.14 Isolation of main plant earth mat and GIS Switchyard earth mat shall be provided by test link.
- 4.1.15 All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it.
- 4.1.16 Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
- 4.1.17 Earthing conductor shall be buried 2000 mm outside the Switchyard fence. All the gates and every alternate post of the fence shall be connected to earthing grid.
- 4.1.18 For the power house building involving turbine hall, boiler and ESP, earthing conductor shall be buried in ground in mesh form to enable earthing of all major steel structures, electrical equipment etc.
- 4.1.19 For auxiliary plants, earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. Earth risers shall be extended to the building interior for equipment earthing.
- 4.1.20 In all the electrical rooms, earth mat (galvanized steel flat) shall be embedded in the concrete floor in grid / mesh form. Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
- 4.1.21 Earth pit shall be constructed as per approved drawing. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 6000 mm. Earth pits shall be treated with salt and charcoal.
- 4.1.22 Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, etc., it shall be laid minimum 300 mm below them and shall be circumvented in case it fouls with equipment / structure foundations. Earthing conductors crossing the road / rail tracks shall be laid at 600 mm depth.
- 4.1.23 All earth electrodes shall preferably be driven to a sufficient depth to reach permanently moist soil. Electrodes shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.
- 4.1.24 Earth pits shall be located avoiding interference with road, building foundation, column, equipment foundation etc. The disconnect facility shall be provided for individual earth pits to check their earth resistance periodically. Proper symmetry and distance between earth pits shall be maintained as per applicable standards and procedures. Treated earth pits shall conform to relevant standard.



- 4.1.25 Construction of trench for earthing conductor shall include excavation, laying of conductor, back filling and compacting. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench / foundation / underground pipes at crossings.
- 4.1.26 HV Neutral point of the following transformers shall be directly connected to earth through two numbers treated earth pit.
- Generator transformers
 - Standby transformer
 - 33 kV winding of Auxiliary transformer
- 4.1.27 LV Neutral point of the following transformers shall be directly connected to earth through two numbers treated earth pit.
- LT Service transformers
- 4.1.28 LV Neutral Points of the following transformers shall be connected to Neutral Grounding Resistors (NGRs). NGR shall be connected to earth through two numbers treated earth pit.
- Unit transformer
 - Station Transformer
 - Unit auxiliary transformer
 - Station auxiliary transformer
 - Other auxiliary transformers
- 4.1.29 Earth pits/earth electrodes shall be interconnected to near by station earthing grid.
- 4.1.30 For equipment earthing, earthing conductor shall be sized to withstand earth fault current of the system for the duration permissible by the protection device. Thickness of galvanising shall be atleast 610 gm/sq.m for all steel conductors.
- 4.1.31 Size of the earthing conductor shall be not less than the following:

Sl. No.	Equipment	Size/ type of Earthing material
1)	Main earthing conductor / Earth mat	40 mm dia corrosion resistant steel rod
2)	Earth risers from earth mat	40 mm dia corrosion resistant steel rod or 65X8 mm size GS flat
3)	Rod earth electrode	40 mm dia corrosion resistant steel rod
4)	Earth conductor embedded in concrete in GIS building	Copper flat
5)	Earth conductor embedded in concrete	50X6 mm GS flat
6)	Treated earth pit for power circuit	Minimum 65 mm dia galvanized steel pipe electrode as per IS:3043
7)	Electronic earthing	Chemical earth pit with copper electrode
8)	EHV Equipment	
	a) Equipment earth pad to structure, Structure to earth mat	2 nos. 75X8 mm galvanized steel (GS) flat
	b) Control cubicle, Mechanism box	2 Nos. 50X6 mm GS flat



Sl. No.	Equipment	Size/ type of Earthing material
	c) Lightning arrester Insulating base to surge counter	50 mm ² copper cable
	d) Lightning arrester Surge counter to earth (without touching structure)	75X8 mm GS flat
	e) CVT neutral to earth electrode	75X8 mm GS flat
	f) Earth switch rod to isolator frame	2 nos. copper flexible
9)	Switchyard Towers	
	a) Tower peak to test link	7/3.66 mm galvanized steel shield wire
	b) Test link to main earth mat	50X6 mm GS flat
	c) Structure to earth mat	75X8 mm GS flat
10)	HT transformers (enclosure and neutral)	65X8 mm GS flat
11)	LT transformers (enclosure and neutral)	75X8 mm GS flat
12)	DG set (enclosure and neutral)	50X6 mm GS flat
13)	Generator, LAPT, NGT, NGT neutral	50X6 mm GS flat
14)	HT Switchgear, HT motors, HT busducts	50X6 mm GS flat
15)	LT Switchgear (PCC & MCC), LT busduct	75X8 mm GS flat
16)	All distribution boards	50X6 mm GS flat
17)	LT motors of 75 kW and above	50X6 mm GS flat
18)	LT motors of 30 kW to <75 kW	32X5mm GS flat
19)	LT motors of 9.3 kW to <30 kW	25X3mm GS flat
20)	LT motors of 5.5, 7.5 kW	4 SWG GS wire
21)	LT motors of <5 kW	6 SWG GS wire
22)	Charger / UPS	50X6 mm GS flat
23)	Lighting panels	25X6 mm GS flat
24)	Relay panels / SAS panel	25X6 mm copper flat
25)	Cable trays	50X6 mm GS flat
26)	CT junction box / PT junction box	50X6 mm GS flat
27)	Lighting / Control junction boxes	14 SWG GS wire
28)	Lighting poles/masts	20 mm dia, mild steel earth electrode
29)	Local push button stations	8 SWG GS wire

4.1.32 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity. Steel columns, metallic stairs, hand rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing.

4.1.33 Metallic conduits shall not be used as earth continuity conductor.



- 4.1.34 Flexible earthing connectors shall be provided for moving parts.
- 4.1.35 50 mm x 6 mm galvanized steel flat shall run all along the cable tray routes and the same shall be welded / connected to each of the tray /rack. Further, this flat shall be earthed at both ends and at an interval of 30 m.
- 4.1.36 Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making earth connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint / compound.
- 4.1.37 Connection between earthing conductors shall be welded type. For rust protection, the welds shall be treated with red lead and coated with two layers bitumen compound.
- 4.1.38 Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- 4.1.39 Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
- 4.1.40 Earthing conductors along their run on cable trench, ladder, walls etc. shall be supported by suitable welding / cleating at intervals of 1000 mm. Wherever it passes through walls, floors etc., pipe sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- 4.1.41 Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations.
- 4.1.42 Electronic panels and equipment shall be grounded utilising an insulated copper ground wire terminated at separate earth electrode.
- 4.1.43 For electronic equipment such as DCS, Respective control system, SAS, EMS etc., chemical earthing pit shall be provided. The earth pit shall be tested and proven type and shall be guaranteed for service life of 40 years. The chemical earth pit shall comprise pipe electrode, crystalline conductive mixture, bentonite etc. constructed in a pit of not less than 4000 mm depth. The pit shall be effective in all weather conditions and offer medium resistance. For electronic earthing system, earthing conductor shall be of copper.
- 4.1.44 **Earthing of chimney:** Earthing shall be carried out by routing 50x6 mm galvanised steel strip earthing conductor from chimney top up to ground. Each earthing conductor shall be earthed by using 40 mm dia 4 metre mild steel rod and shall also be interconnected with the power station earthing grid.
- 4.1.45 Earthing of cabling system
- Armour of the HT cables and LT single core cables shall be earthed only at one end of cable.
 - Armour of other cables shall be earthed at both ends of cable.
 - Screen of HT power cables shall be earthed at one end only.
 - Screen of C&I screened control cables shall be earthed at one end.
 - Screen of electronic earthing system cables shall be earthed as per the requirements.
- 4.1.46 After completion of grounding system installation, the measurement of ground resistance shall be performed by the Contractor. continuity of earth conductors and efficiency of all bonds and joints shall be checked. Before measurement, the overhead ground wires shall be disconnected from the GIS Switchyard. The method of measurement shall be as per relevant standards / codes. The ground resistance of GIS Switchyard grounding system shall be not more than 0.5



ohm. Earth resistance at earth terminations shall be measured in presence of Owner's representatives

5.0.0 LIGHTNING PROTECTION SYSTEM

- 5.1.0 Direct stroke lightning protection (DSLPP) shall be provided in the GIS Switchyard by lightning masts and shield wires including connections, earth pits etc. to make the lightning protection complete for the outdoor GIS Switchyard including reactors. The arrangement shall be based on DSLPP calculations. Contractor shall furnish necessary design calculation for approval by Owner.
- 5.2.0 The lightning protection system in the transformer yard shall cover the following equipment in the protection zone.
- Generator transformers
 - Station transformers
 - Standby transformers
 - Auxiliary transformers
- 5.2.0 All areas of the power station shall be provided with lightning protection. The lightning protection system for buildings shall consist of air termination network, down conductors, test link and earth electrodes.
- 5.3.0 Air termination network consisting of vertical or horizontal conductors or combination of both shall be provided for the building. Down conductors shall follow the most direct path possible between the air terminal network and the earth termination network. Each down conductor shall be provided with a test link for testing. An earth electrode shall be connected to each down conductor.
- 5.4.0 For Lightning protection, material & sizes shall be as follows:
- Vertical air termination : 20 mm dia galvanised steel rod
 - Horizontal air termination : 25X6 mm Galvanised steel Strip
 - Down conductor : 25X6 mm Galvanised steel Strip
 - Test link : 150x50x6 mm Galvanised steel Strip with Box
 - Earth Electrodes : Treated earth pit with rod electrode as per IS:3043
- 5.5.0 Thickness of galvanising shall be atleast 610 gm/sq.m for all galvanised steel conductors.
- 5.6.0 The lightning protection system shall not come in direct contact with other equipment/systems such as cables, conduits, electrical equipment, underground metallic ducts etc. All metallic structures within vicinity shall be bonded to the lightning protection system.
- 5.7.0 All welded/brazed joints shall be coated with anti- corrosive paint for rust protection.
- 5.8.0 Lightning conductor when used above ground level and shall be connected through test link with earth electrode/earthing system. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth. Down conductor shall not be connected to other earthing conductors above ground level.
- 5.9.0 Each down conductor shall be provided with a test link at 1500 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. All joints in the down conductors shall be of welded type.
- 5.10.0 Down conductors shall be cleated on outer side of building wall/ welded to outside building columns at 750 mm interval.



- 5.11.0 Lightning conductor on roof shall be cleated on surface of roof using insulated clamps/saddles for conductor fixing at an interval of 1000 mm for horizontal run and 750 mm for vertical run..
- 5.12.0 Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
- 5.13.0 Installation of lightning conductors on the roofs of buildings shall include construction of support, laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / welding of the down comers on the walls / columns of the building and connection to the test links to be provided above ground level.

5.14.0 Lightning protection system for chimney

- 5.14.1 The lightning protection system for chimney shall be installed in accordance with IS 2309. Pointed vertical air terminal rods shall be provided at the top and these shall be equally spaced at 120 degree around the circumference of the top flue cane. Air terminals shall project not less than 1000 mm above the highest part of the flue cane. Air terminals shall be mechanically and electrically connected to a continuous circumferential conductor.

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

- Vertical air termination : 20 mm dia lead coated steel rod
- Horizontal air termination (top 12 metre): 25X3 mm lead coated copper strip
- Horizontal air termination (remaining portion): 50X6 mm Galvanised steel Strip
- Down conductor (top 12 metre) : 25X3 mm lead coated copper strip
- Down conductor (remaining portion) : 50X6 mm Galvanised steel Strip
- Coronal band (top) : 70 sq.mm lead coated copper conductor
- Coronal band (mid-height) : 70 sq.mm copper conductor
- Test link : 150x50x6 mm Galvanised steel flat in steel enclosure
- Earth Electrodes : Treated earth pit with rod electrode as per IS:3043

- 5.14.2 Two cable collars, , shall encircle the chimney; one at the top, interconnecting the lower ends of the air terminals and the down conductors, and one approximately mid-height of the chimney, connecting the down conductors. Not less than four down conductors along shell shall be located along the exterior wall of the shell, shall extend to the chimney base to earth electrode pit, and shall be connected to the plant grounding grid.

- 5.14.3 Air terminals, connections, conductors, clamps, fixtures, anchors, etc., exposed within 12000 mm of the top of the chimney shall have a continuous lead covering of a sheath of commercially pure lead not less than 2 mm in thickness.

- 5.14.4 During construction, temporary lightning protection should be maintained by connecting the concrete reinforcement to two permanent electrical grounding conductors. After the top lift of the chimney shell has been completed, temporary air terminals which may consist of reinforcing bars, should be installed at the top to serve as a temporary protection until the lining and cap are completed and permanent air terminals are installed.

5.16.0 Lightning Protection System for cooling tower and Ash Silo

- 5.15.1 Pointed vertical air terminal rods shall be provided at the top and these shall be spaced around the circumference of the top. Air terminals shall consist of galvanized steel conductors, each not less than 20 mm diameter galvanized steel rod, projecting not less than 1000 mm above the highest part structure. Air terminals shall be mechanically and electrically connected to a continuous circumferential conductor. Number of down conductors as per IS: 2309, shall be located along the exterior wall, shall extend to the base to earth electrode pit, and shall be connected to the power station earth grid.



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

- Vertical air termination : 20 mm dia lead coated steel rod
- Horizontal air termination : 50X6 mm Galvanised steel Strip
- Down conductor : 50X6 mm Galvanised steel Strip
- Coronal band (at top)) : 70 sq.mm copper conductor
- Test link : 150x50x6 mm Galvanised steel flat in steel enclosure
- Earth Electrodes : Treated earth pit with rod electrode as per IS:3043

5.15.2 During construction, temporary lightning protection should be maintained by connecting the concrete reinforcement to two permanent electrical grounding conductors.

5.16.0 On completion of lightning installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured in presence of Owner. Resistance of individual earth electrode shall be measured after disconnecting it from the grid. Tests shall be carried out as per IS : 3043 for earthing installation including the following:

- a) Earth continuity checks
- b) Earth resistance of the complete system, sub-system and earth pits

6.0.0 DRAWINGS & DOCUMENTS

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

- Soil resistivity report
- Design basis report for earthing and lightning protection system
- Earthing design calculation
- Typical installation drawings for earthing and lightning protection
- Electronic earthing layout and details
- Earthing layout for Transformer Yard
- Earthing layout for Power house building, Boiler and ESP
- Earthing layout for Chimney
- Earthing layout for Cooling tower
- Earthing layout for all auxiliary plant buildings
- Earthing layout for all non-plant buildings
- Earthing layout for GIS building and Switchyard
- Lightning protection design calculation
- Lightning protection layout for Power house building, Boiler and ESP
- Lightning protection layout for transformer yard
- Lightning protection layout for all auxiliary plant buildings
- Lightning protection layout for all non-plant buildings
- Lightning protection layout for GIS building and Switchyard
- Lightning protection layout for Chimney
- Lightning protection layout for Cooling tower
- Field quality plan



**2X660 MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE**

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-I

SUB-SECTION-IC

REV 00

DATE JUNE 2020

SUB SECTION-IC

DATA SHEET A

TABLE-A							
S No.	Location	Type of Crane	Qty (Nos.)	Capacity (T)	Span (m)	Lift (m)	Travel (m)
1	Compressor house	Underslung EOT/ Indoor Duty	1	7.5 T	13.8	5.9	35
2	Desalinated cum fire water pump house	Underslung EOT/ Indoor Duty	1	6 T	5.5	4.5	70.05
3	Diesel Generator Room	Underslung EOT/ Indoor Duty	1	7.5 T	13.25	6.2	23.7
4	Fuel Oil Pump House (suitable for hazardous area)	Underslung EOT/ Indoor Duty	1	3 T	11.7	8.35	51
5	Sea Water Intake Pump House Gate/Screens handling	Semi Gantry/ Outdoor Duty	1	7.5 T	11.6	18.7	35.7
6	CW pump house Screen and Gates handling	Semi Gantry/ Outdoor Duty	1	7.5 T	4.98	14.5	80
7	Sea Water outfall Pump House Gate/Screens handling	Gantry /Outdoor Duty	1	5 T	3.775	14	20



**2X660 MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE**

SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-I

SUB-SECTION-IC

REV 00

DATE JUNE 2020

Sr. No.		DESCRIPTION	TECHNICAL PARTICULARS	
1.0.0		Design, fabrication and testing of the crane confirm to standard / code number	Mechanical and Electrical as per IS: 3177-1999 (Reaffirmed 2006), IS 3938 & Structure design in accordance to IS 807:2006.	
1.1.0		Area of installation and quantity of cranes	As per TABLE A	
1.2.0		Crane classification	M5 for Mechanical, Structural & M7 for Electrical.	
1.3.0		Suitable for outdoor or indoor duty	Indoor duty	
1.4.0		Capacity and lift		
1.4.1		Main hoist	(SWL = Safe working load)	
	a.	Rated capacity (SWL) – tonnes	As per TABLE A	
	b.	Test load- 125% of Rated capacity (SWL)– tonnes	Over load test: 125% of Rated capacity (SWL)	
1.4.2		Deflection test of crane	Shall be carried out at SWL	
1.5.0		Span	Shall be suitable as per approved layout	
1.6.0		Operation from	Fixed type pendent push button station	
2.00		CRANE PERFORMANCE		
2.1.0		Crane speed with full load	Full speed M/Min	Creep speed M/Min
	a.	Main hoist	2.5	10% of main speed (thru' VVVF drives)
	b.	Trolley travel (CT)	10	10% of main speed (thru' VVVF drives)
	c.	Longitudinal bridge travel (LT)	15	10% of main speed (thru' VVVF drives)
2.2.0		Acceleration values	LT motion (bridge travel)	CT motion (trolley travel)
			As per IS: 3177	As per IS: 3938
2.3.0		Lift in Metres	The lifting rope shall be of sufficient length to permit the main hook to reach the zero level.	
	a.	Main Hoist	As per Annexure A	
2.4.0		Hook Approaches		
	a.	Main hook (DSL end)	To suit the lifting requirement.	
	b.	Main hook (Other end)		
3.0.0		COMPONENT DETAILS		
3.1.0		Trolley		
	a.	Type	Fabricated	
	b.	Material	Rolled Structural steel.	
	c.	Whether jacking pads for lifting trolley provided or not	Yes	
3.2.0		Rope drums	Drum shall have minimum one spare groove when this hook is at its highest position.	
	a.	Material (Indicate IS)	Fabrication from carbon steel as per IS: 2062, GR B and stress relieved / seamless pipe as per ASTM A106 GR A/B.	
	b.	Flange / flangeless	Flanged	
	c.	Numbers provided	One	



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	d.	Type of grooves	Machined grooved identical Right hand and Left hand. Machined grooved identical right hand and left hand. One no. spare groove.	
3.3.0		Rope details		
	a.	Construction	Extra flexible plough steel, 6 x 36 or 6 x 37 construction (galvanised), Right Hand Ordinary (RHO) lay construction.	
	b.	Standard conforming to	IS: 2266	
	c.	Tensile designation (Rope Grade)	1770 (in N/sq. mm)	
	d.	Type of core	Fiber	
3.4.0		Sheaves details		
	a.	Material	Fabricated from cast steel/ steel plate IS: 2062 GR A or B/ CS GR 280-520 IS: 1030.	
	b.	Type of guards provided	Fabricated from Sheet steel	
3.5.0		Gear box details		
3.5.1		Hoist Motions		
	a.	Type of mounting of gear box	Horizontal / Vertical	
	b.	Classification	Suitable for M5 duty	
	c.	Type of gears	Helical / spur	
	d.	Type of lubrication	Grease / splash	
	e.	Materials (gear/pinions)	Gear: EN9/ 55C8 Pinion: EN19/ EN24	
	f.	Difference in gear & pinion hardness	Min 20 BHN	
	g.	Type of bearing	Antifriction ball / roller	
3.5.2		Travel Motions	CT	LT
	a.	Type of mounting gear box	Horizontal / Vertical	
	b.	Classification	M5 duty	
	c.	Type of gears	Helical / spur	
	d.	Type of lubrication	Grease / splash	
	e.	Hardness (BHN) – gear	568+/-20BHN for alloy steel.	
	f.	Hardness (BHN) – pinion	568+/-20BHN for alloy steel.	
	g.	Difference in Gear and pinion hardness	Min 20 BHN	
	h.	Materials (gear / pinions)	All gears shall be forged from low or medium carbon alloy steel and suitably heat treated. Gears and pinions shall be hardened, ground finished, machine cut and profile ground.	
	i.	Casings	Fabricated steel gear boxes which shall be dust proof and firmly sealed to prevent oil leakages. Gearboxes shall have covers split horizontally and arranged such that top half can be removed for inspection. The gear boxes shall be fitted with bolted type machined inspection covers.	
	j.	Standard conforming to	IS: 4460	
3.6.0		Wheels details	Cross travel	Long travel
	a.	Material	Gantry/ semi gantry Crane: C55Mn75 & steel used for wheel shall not contain more than 0.06% of Sulphur or phosphorous. Under slung Crane: Forged Steel	
	b.	Hardness	300-350 BHN Underslung crane: not more than 200 BHN.	



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	c.	Type	Single flanged taper/ straight tread (for underslung crane) and double flange for overhead crane.				
	d.	Numbers provided	As per manufacturer's standard.				
	e.	Specification conforming to	In case of gantry/ semi-gantry cranes the long travel wheels shall confirm to IS 3177. However in case of cross travel of gantry and semi - gantry cranes, all travel wheels of underslung cranes shall be as per IS 3938.				
	f.	Arrangement of lubrication	Grease				
3.7.0		Lifting hooks					
	a.	Type	'C' type (Trapezoidal section with swivelling Type)				
	b.	Safe lifting capacity	As per SWL				
	c.	Material	Solid, forged, heat treated alloy steel /carbon steel of rugged construction and provided with a standard depress type safety latch.				
	d.	Standard conforming to	IS: 15560				
	e.	Hook can swivel	Yes				
	f.	Safety latch on hook provided	Yes				
	g.	Locking device on swivelling hook	Provided				
3.8.0		Buffers	Cross travel		Long travel		
	a.	Type	Spring or rubber buffers shall be provided on the trolley & end carriage				
	b.	Numbers provided	4		4		
	c.	Details of end stop	Suitable end stops welded to the bridge girder shall be provided to contact the buffers.				
3.9.0		Brakes					
3.9.1		Hoist Motions					
	a	Type of brake (ac / dc / thruster)	DCEM				
	b.	Number provided per motor	1				
	c.	Braking capacity (% of full load torque)	150%				
3.9.2		Travel Motions	CT		LT		
	a.	Type of brake (ac / dc / thruster)	DCEM				
	b.	Number provided per motor	1		1		
	c.	Braking capacity (% of full load torque)	150%		150%		
3.10.0		Drive system for hoisting					
	a.	Arrangement of drive from motor to rope drum (main)	Through geared steel coupling and gear box				
3.11.0		Bearings	Crane hook	Trolley wheels	Rope drum	Gear box	Any other assembly
	a.	Type	Antifriction ball / roller bearings				
	b.	Lubrication	Grease lubrication				



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	c.	Bearing life	10,000 working hours.
3.12.0		Bridge girder	
	a.	Type & Quantity	Rolled sections. One no for each crane.
	b.	Vertical Deflection and Camber	Span / 900 (maximum) As per IS 807, clause 21, "Girders shall be cambered to an amount approximately equal to the dead load deflection plus one-half the live load deflection."
	c.	Type of connection to end carriage	As per manufacturer's standard.
3.13.0		End carriage span material	Structural steel.
3.14.0		Motors	
3.14.1		Hoist Motions	MH
	a.	Type	Three phase squirrel cage induction motors operated from VFD system and suitable for speed range and torque without exceeding temperature rise limits. Micro speed shall be thru' VVVF drive. Pull out torque shall be minimum 275% of rated torque.
	b.	Enclosure	TEFC
	c.	Numbers furnished	One
	d.	Voltage, phase and frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +/-5% occurring separately or combined voltage and frequency variation of 10%.
	e.	Class of protection	IP – 55
	f.	Rated capacity (KW)	Motor nameplate rating at 50°C shall have Motor rating will be calculated keeping margin of at least 25% over the maximum power requirement in the duty condition specified. Further, the hoist motors will be rated to lift 125% of the design load on the hook at the rated speed.
	g.	Duration factor/duty	60 % CDF / S-4
	h.	Class of insulation	Minimum Class F or better insulation materials with additional phase insulating material, extra end-turn bracing and Class H spike resistant wire.
	i.	Number of starts/ hour	300 starts / hr
	j.	Overload protection for motors provided	In built feature of VVVF drives.
	k.	Space heater requirements	Not required
3.14.2		Travel Motions	CT & LT
	a.	Type	Three phase squirrel cage induction motors operated from VFD system and suitable for speed range and torque without exceeding temperature rise limits. Micro speed shall be thru' VVVF drive.
	b.	Enclosure	TEFC
	c.	Numbers furnished	Minimum One (1)



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	d.	Voltage, phase and frequency	Suitable for rated frequency of 50 Hz with a voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$ occurring separately or combined voltage and frequency variation of 10%.		
	e.	Class of protection	IP – 55		
	f.	Rated capacity (KW)	The motor shall be suitable for 300 starts / hr and 60% CDF. Motor nameplate rating at 50°C shall have Motor rating will be calculated keeping margin of at least 25% over the maximum power requirement in the duty condition specified.		
	g.	Duration factor/duty	60 % CDF / S-4		
	h.	Class of insulation	Class 'F' for sq. cage motors with temp rise limited class B.		
	i.	Number of starts/ hour	300 starts / hr		
	j.	Overload protection for motors provided	In built feature of VVVF drives		
		Space heater requirement	Not Required		
3.15.0		Limit switches	Main hoist	Cross Travel	Long Travel
	a.	Type	Rotary + Gravity type hand reset	Two way lever type/ One way lever type	
	b.	Number provided	1 + 1	1/2	1/2
	c.	Material of contacts	Limit switch shall be provided with 2 NO & 2 NC contacts. Material of contact shall be high grade silver cadmium plated with high conductivity and non-corrosive type. DOP-IP55		
	d.	Control voltage	110V		
	e.	Confirm to code	All limit switch shall confirm to IEC-60947-5-1		
3.16.0		Power conductors (DSL)			
	a.	Type	a. PVC Shrouded Conductor (Cu) Bus Bar Type DSL with accessories for entire bay length (with current collector & mounting brackets) (for all cranes except gantry crane). b. Cable Reeling Drum (CRD) along LT travel for gantry crane. c. Flexible cable with Taut wire / Festoon cable arrangement for CT motion for all cranes.		
	b.	Size	Shall be sized with a margin of 20% over load requirement. Voltage drop at motor terminal shall be limited to 3% at extreme positions of cranes. Protective cover over DSL shall be provided.		
	c.	Length	Suitable for entire bay length.		
3.17.0		Isolation switch & Control Panel	A 14 SWG thick corrosion resistant sheet steel weather proof, water shedding, dust and vermin proof control panel/cabinet conforming to degree of protection IP55 with 16 SWG thick sheet steel water tight hinged and padlocked doors, fully wired, shall be provided for terminating all wiring for control, protection and alarm circuits of each transformer. Suitable stiffeners shall be provided wherever required.		



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	a.	Material & size	Rolled sheet steel 1.6mm size		
	b.	DOP	IP 55		
3.18.0		Control for Hoisting /CT/LT operations			
	a.	Creep speed	Thru' VVVF		
	b.	Temperature	VVVF system shall be capable of withstanding upto 50° C without derating.		
3.19.0		Cable	Power	Control	Trailing
	a.	Material	Copper	Copper	Copper
	b.	Type	XLPE insulated	PVC / XLPE insulated	Heat resistant with EPR insulation and as per class -5 of IS:8130. Trailing cable: Inner PCP sheath and outer CSP sheath with nylon chord reinforcement, oil resistant and flame retardant heavy duty FRLS Type.
	c.	Size	Min. 2.5 mm ² for Copper & 6 mm ² for Aluminium (up to 10 A Current only Cu cable shall be used)	Min. 1.5 mm ² with 20% spare core.	Power Cable: Min. 2.5 mm ² for Copper. Control Cable: Min. 1.5 mm ²
	d.	Voltage grade	1100 V		
	e.	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 15% of rated voltage during starting and 3% of rated voltage at full load running condition with cranes at extreme position. However, the voltage drops from transformer secondary to motor terminals during full load running of motors shall be limited to 6% of rated voltage.		
3.20.0		Earthing	Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be effectively earthed. Electrical system shall be designed for a fault level of 50 kA. Earthing system adopted shall be type TN-CS.		
	a.	Material of earthing	G.I / Copper		
3.21.0	a.	Contactors	AC 4 duty for reversing application. AC 3 duty for non -reversing application. In case the feature of reversing no reversing is inbuilt in VVVF drives then the contactors shall not be required.		
	b.	Switches	AC 23 for motor application, AC 22 for other application.		
	c.	Fuses	HRC		



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	d.	Overload relays	Overload protection inbuilt in VVVF drives.
3.22.0		Power supply	415 V, 3 phase, 3 wire supply at 1.5m above operating floor. Power supply shall be at operating floor at centre of bay length.
3.23.0		Transformer	Dry type, with insulation class B or better.
	a.	Quantity	2 X 100 % for control
	b.	Voltage Rating	Control 415/110V
	c.	KVA rating	Min. 20% over loading to be considered while sizing the rating

- Ambient Temperature - Crane and its components shall be designed /selected for ambient temperature of 50° C.
 - All materials / components will be new and of tested quality and will conform to the specification requirements and standards mentioned.
 - The crane will be furnished with required components comprising the following.
 - Rolled steel sections shall be used for the crane main girders having adequate strength.
 - Wheelbase for end carriage will as per IS.3177:1999
 - The hoist design shall be as per IS 3938.
 - Hook shall be as per IS 15560.
 - Cranes shall be operated through fixed type pendent push button station.
 - Crane shall be complete with trolley, tracks, wheels, axles, drive mechanism etc.
 - The side plates of the trolley shall extend beyond wheel flanges, thus providing bumper protection for the wheels. The two side plates shall be connected by means of an equalising pin. The wheels shall be machined on their treads to match the profile of the monorail.
 - Drums shall be machine grooved right and left with grooves of a proper shape for the rope used.
 - All material, castings and forgings will be of tested quality & certificates shall be made available as per approved QAP.
- Final inspection and load testing of cranes shall be carried out at manufacturer's works. Further the cranes shall also be successfully erected and load testing at site.
- All load test shall be as per IS 3177/ IS 3938.

SPECIAL HAZARDOUS AREA REQUIREMENT FOR 3T CAPACITY CRANE FOR FOPH AREA:

1. All wheels shall be provided with phosphor bronze type.
2. Any other mechanism where two non-lubricated parts mate, one of them shall be for non-ferrous material like phosphor bronze aluminum bronze.
3. All electrical components/ equipment for EOT cranes shall meet the requirements of hazardous area & shall be explosion proof type/ flame proof type. Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equivalent.
4. Coupling guards shall be non-sparking (i.e. non-ferrous/non-metallic) type.
5. LT DSL shall be flexible trailing cable type.
6. Cranes shall be suitable for hazardous area (i.e. Zone-2) for gas group IIA,IIB

SPECIAL REQUIREMENT FOR GANTRY/SEMI GANTRY CRANES:

1. All semi gantry/ gantry cranes shall be outdoor type.
2. Wheel stops to be provided for outdoor cranes.
3. Anchoring system to be provided for outdoor cranes
4. All electric equipments i.e. motor, panels to be provided with canopy. Push buttons, cables, isolators , junction box , panels , motors , etc shall be weather proof, rain proof.



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5. For semi gantry cranes & gantry cranes DSL/cable reeling drum (CRD) shall be of suitable protection class for outdoor duty. Additionally canopy arrangement shall be provided for protection against rain water.
6. For outdoor cranes, Wind loads to be considered based on the design wind speeds arrived at based on IS : 875 (Part -3) – Latest Edition. Basic wind speed to be considered as 39 m/sec as per IS:875 -1987 Part-3 .Probability factor,(k1 risk coefficient), terrain, height and structure size factor, k2 and topography factor, k3 shall be as per IS:875.

Note:

- Bidder to confirm the compliance of technical details as mentioned against each item. Deviation, if any shall be brought out clearly.
- In case of discrepancy between the Data sheet and requirement given elsewhere in the technical specification, the more stringent of the two as per the interpretation of purchaser shall be applicable



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MAKES OF SUB VENDORS ITEMS

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



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		SCHNEIDER (Earlier TELE MACHANIQUE)		
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
16.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	



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		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
17.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DELTON CABLES LTD	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		ELKAY TEELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES	NOIDA	



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		COMPANY LTD		
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
		UNIVERSAL CABLES LTD	SATNA	
18.	TRAILING CABLES	NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
		SUYOG ELECTRICALS LTD	VADODARA	
19.	XLPE POWER CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	



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		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
20.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
21.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
22.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
23.	LIMIT SWITCHES	SPEED-O-CONTROL		
		ELECTROMAG		
24.	PENDENT PUSH BUTTON STATION	OEM		
25.	INDICATING LAMPS	TECKNIC		
		BCH		
		SIEMENS		
		STANDARD		
26.	MCB	MDS		
		INDO COPP		
		STANDARD		
		SIEMENS		
		L&T		
		ABB		
27.	PANELS	SCHNEIDER		
		OEM		
		RITTAL		
		PYROTECH		
28.	RESISTANCE BOXES	ENAPROS		
		OEM		
		SAFEX FIRE SERVICES LTD		
		UNITED FIRE EQUIPMENTS PVT. LTD		
		ZENITH FIRE SERVICES (INDIA) PVT LTD		
29.	VVVF	YASKAWA		
		ABB		
		SIEMENS		
		SCHNIEDER		
		FUJI ELECTRIC		
		MITSUBISHI ELECTRIC		
		CG POWER & INDUSTRIAL SOLUTIONS LTD		
30.	SHROUDED DSL	SUSHEEL		
		STROMAG		
31.	LOAD CELL	IPA		
		SARTORIUS		
32.	GEAR BOX	OEM		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		
33.	RAIL	BONGFILIOLI*		
		JSPL		



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		SAIL		

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.
2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.



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ANNEXURE II

MANDATORY SPARES LIST FOR SINGLE GIRDER EOT CRANE (FOR EACH CRANE)

Sl. No.	DESCRIPTION	QUANTITY
1	<i>Spares for long travel unit</i>	
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	<i>Spares for cross travel unit</i>	
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	<i>Spares for main hoist</i>	1 Set
i	Main hoist pulley bearings	1 set
ii	Set of bearings for rope drum	
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	<i>Electrical: control panels/motors</i>	
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 cross travel motor	1 set
viii	Set of bearings for long travel motor	1 set
5	<i>Motors of each type and rating</i>	



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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. or 10% of installed quantity whichever is higher

NB: Items at sl no. 1 to 4 shall be 1 lot applicable for each crane (i.e. 7 set is required). For items at sl no. 5, items are common for all cranes. (refer unpriced schedule for detail)

NOTES

- Set for the particular equipment, 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. One (1) set means 100% requirement for one crane.
- Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.
- 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.
- 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.
- 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.
- 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.
- Identification:*



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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.

- 8 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 bidder's scope of supply.



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ANNEXURE III
PAINTING SPECIFICATION

Structural

- 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:

SL. No	Item Description	Color Shade	Remarks
1	Crane Structure	Golden Yellow shade 356 as per IS-5	
2	Trolley and hook	Golden Yellow shade 356 as per IS-5	
3	Motors	Light Gray shade 631 as per IS-5	
4	Control Panels	Light Gray as per IS-5	



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ANNEXURE IV

Procedure for Load/Overload testing of Single Girder EOT Underslung crane at Manufacturer's Works

Objective: To demonstrate final No load, Load, Overload, Deflection & Functional tests of assembled Crane for the purpose of acceptance in line with IS 3177.

Basic Assumptions / Inputs for testing at Works:

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

Procedure for Load / Overload testing:

- The cranes shall be tested for no load and load /overload test at works generally in conformance with the IS – 3177 (1999). Specifically with respect to the load / overload testing of crane, the following tests as per the outlined procedures shall be done at works.
- Deflection of the girder will be measured at SWL when the trolley with load is at the middle of the girder.
- No load and full load current of the motors will be measured to verify whether it is as per the approved data sheet of the motor. Resistors in the circuit will be checked for any overheating of the element.
- The load will be gradually raised to 125 percent of the rated capacity (SWL) with actual hook. The load will be lifted upward to about 1 meter height above its support and stop again. Check for any undue drift in the load. If load drifts, check the adjustment of brakes and repeat the above procedure. Then lower the load to rest on support/ground.
- For checking the cross travel, raise the load up to one (1) meter height above supports and then move the trolley with load about one (1) meter in either direction of the bridge. Then lower the load to rest on support/ground.
- Creep speed motions shall be checked over a distance of about 500 mm.



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ANNEXURE – V

A.0 DRAWINGS/DESIGN DOCUMENTS FOR SUBMISSION (during detailed engineering)

Sl. No.	BHEL DRG.NO	DRAWING TITLE	PRIMARY/ SECONDARY	SUBMISSION SCHEDULE - FROM DATE OF P.O.
1	PE-V0-435-524-A001	Manufacturing Quality Plan with sub vendor list for single girder EOT crane	PRIMARY	R-0 WITHIN 21 DAYS FROM PO & SUBSEQUENT REVISIONS WITHIN 10 DAYS OF COMMENTS RECEIVED FROM BHEL.. BHEL SHALL FURNISH COMMENTS/ APPROVAL ON EACH SUBMISSION WITHIN 18 DAYS FROM RECEIPT
2	PE-V0-435-524-A002	Data sheet of Single Girder Crane with painting details	PRIMARY	
3	PE-V0-435-524-A003	G.A. of Single Girder CRANE with CT DSL arrangement OF SG CRANE	PRIMARY	
4	PE-V0-435-524-A004	Mechanism Sizing Calculation OF SG CRANE	PRIMARY	
5	PE-V0-435-524-A008	Schematic Circuit Diagram for a) Main Protective panel & BOM b) Main hoist panel & BOM c) Cross Traverse and Long Travel panel & BOM d) Pendant and earthing.	PRIMARY	
6	PE-V0-435-524-A005	G.A. drg of Hoist with trolley wheel assembly	SECONDARY	R-0 WITHIN 30 DAYS FROM PO & SUBSEQUENT REVISIONS WITHIN 10 DAYS OF COMMENTS RECEIVED FROM BHEL.. BHEL SHALL FURNISH COMMENTS/ APPROVAL ON EACH SUBMISSION WITHIN 18 DAYS FROM RECEIPT
7	PE-V0-435-524-A006	Bottom Block assembly	SECONDARY	
8	PE-V0-435-524-A007	General arrangement for LT cable trailing for Single Girder crane	SECONDARY	
9	PE-V0-435-524-A009	Long travel Machinery Assembly with LT wheel assembly	SECONDARY	
10	PE-V0-435-524-A010	Detailed BOM/BOQ for crane	SECONDARY	
11	PE-V0-435-524-A011	General arrangement of panel & pendant push button	SECONDARY	
12	PE-V0-435-524-A012	Cable sizing calculation and schedule.	SECONDARY	
13	PE-V0-435-524-A014	Mandatory spare parts list OF SG CRANE	SECONDARY	
14	PE-V0-435-524-A016	Erection procedure of SG crane	SECONDARY	
15	PE-V0-435-524-A019	O & M Manual	SECONDARY	

Notes:

INCOMPLETE DRAWINGS/DOCUMENTS SHALL NOT BE TREATED AS SUBMITTED.



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B.0 NO.OF DRAWINGS/DOCUMENTS FOR SUBMISSION

Distribution of documents

The source, distribution, no. of copies etc shall be as per the following document distribution schedule.

Document Distribution Schedule - After Placement of Order

Sl.No.	Document	Total Copies	Distribution		
			Owner		Consultant
			HQ	SITE	
1.	PERT Network, work schedules, Bar charts, Layout drawings in 2D & 3 D of all building, plant, pump house, control room etc	12	4	6	2
2.	Data, drawings, documents, write-ups, calculation				
	- Preliminary	12	5	5	2
	- Revised	12	4	6	2
3.	Approved drawings, documents etc.	12	4	6	2
4.	Instruction manuals for erection and O&M	12	5	6	1
5.	As built drawings including O &M manual				
	- Hard Copy	12	5	6	1
	- Soft Copy	5	2	2	1

Note:

- a) Bidder to note that all the drawings and documents shall also be submitted on CD's (compact disc) in following software.
 - I. All the drawings shall be prepared in AutoCAD.
 - II. All the documents shall be prepared MS word / EXCEL.
 - III. PDF files for all drawings/documents shall also be submitted.

C.0 DOCUMENT MANAGEMENT SYSTEM

1.0 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://124.124.36.198/wrenchwebaccess/login.aspx>)



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ANNEXURE -VI

Check List for Operation & Maintenance Manual

0Project name :
 1Project number :
 2Package Name :
 3PO reference :
 4Document number :
 5Revision 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				



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



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	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				

Checked by
Dealing Engineer

Key Resource Person

Section Head



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ANNEXURE –VII

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.



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ANNEXURE –VIII

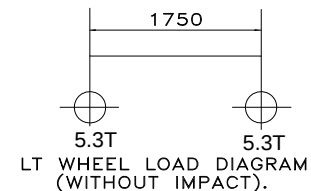
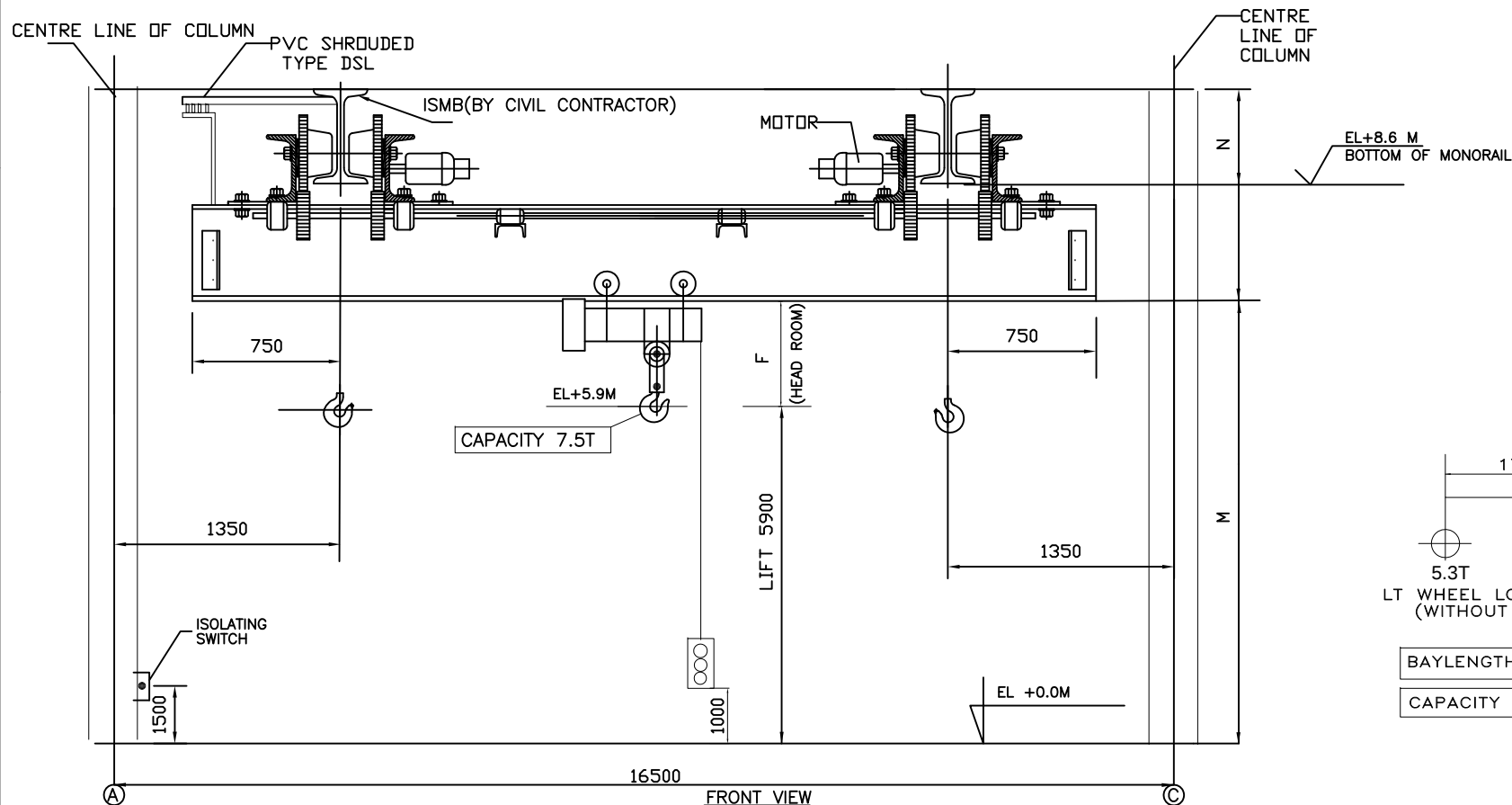
CRANE CLEARANCE DIAGRAMS

ALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

PE-DG-362-524-A001
DRAWING NO.

CUSTOMER'S DRAWING NO.



BAYLENGTH = 35 M

CAPACITY = 7.5 T

NOTES:

1. DIMENSIONS MARKED (*) SHALL BE FURNISHED DURING DETAIL ENGG.
2. ALL DIMENSIONS ARE IN MM.
3. 4/2 FALL ROPE DRUM TO BE USED (IF REQ.) TO MEET THE HOOK APPROACH

PROJECT				
2x660 MW UDANGUDI SUPERCRITICAL TPS-STAGE I				
CUSTOMER				
TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)				
CONTRACTOR				
BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI				
COPY RIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICAL LIMITED it must not be used directly or indirectly in any way detrimental to the interest of the company.				
DEPT. CODE	DESIGN	NAME	SIGN	DATE
M	CHD	PK	SM/-	
TITLE				
CRANE CLEARANCE DIAGRAM OF COMPRESSOR HOUSE 7.5T SINGLE GIRDER UNDERSLUNG CRANE				
DEPT. SCALE 1:3000		DRAWING NO.		
SIGN		PE-DG-435-524-A001		
DATE		REV. 0		

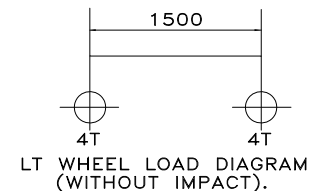
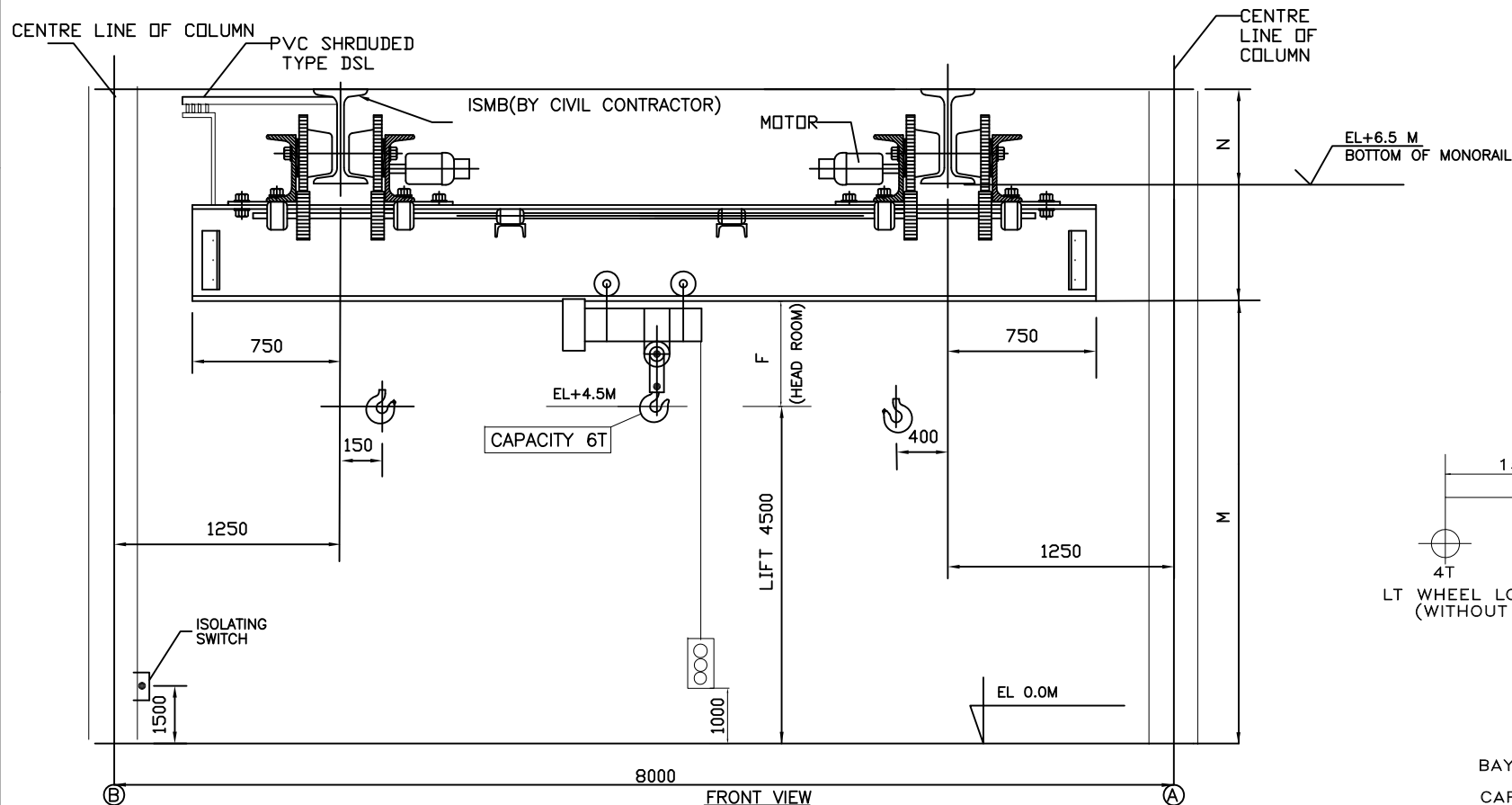
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ALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

PE-DG-362-524-A002
DRAWING NO.

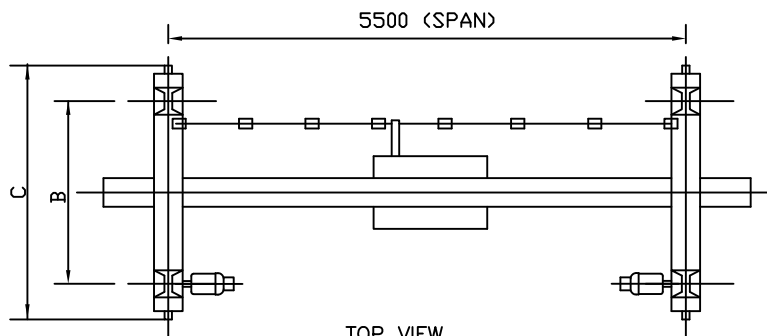
CUSTOMER'S DRAWING NO.



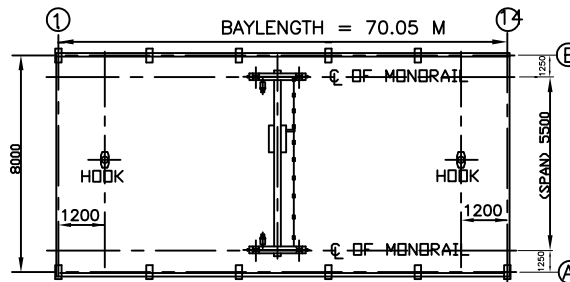
BAYLENGTH = 70.05 M
CAPACITY = 6 T

NOTES:

1. DIMENSIONS MARKED (*) SHALL BE FURNISHED DURING DETAIL ENGG
2. ALL DIMENSIONS ARE IN MM.



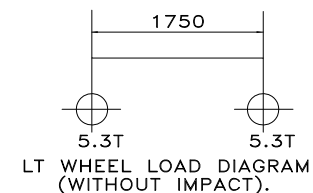
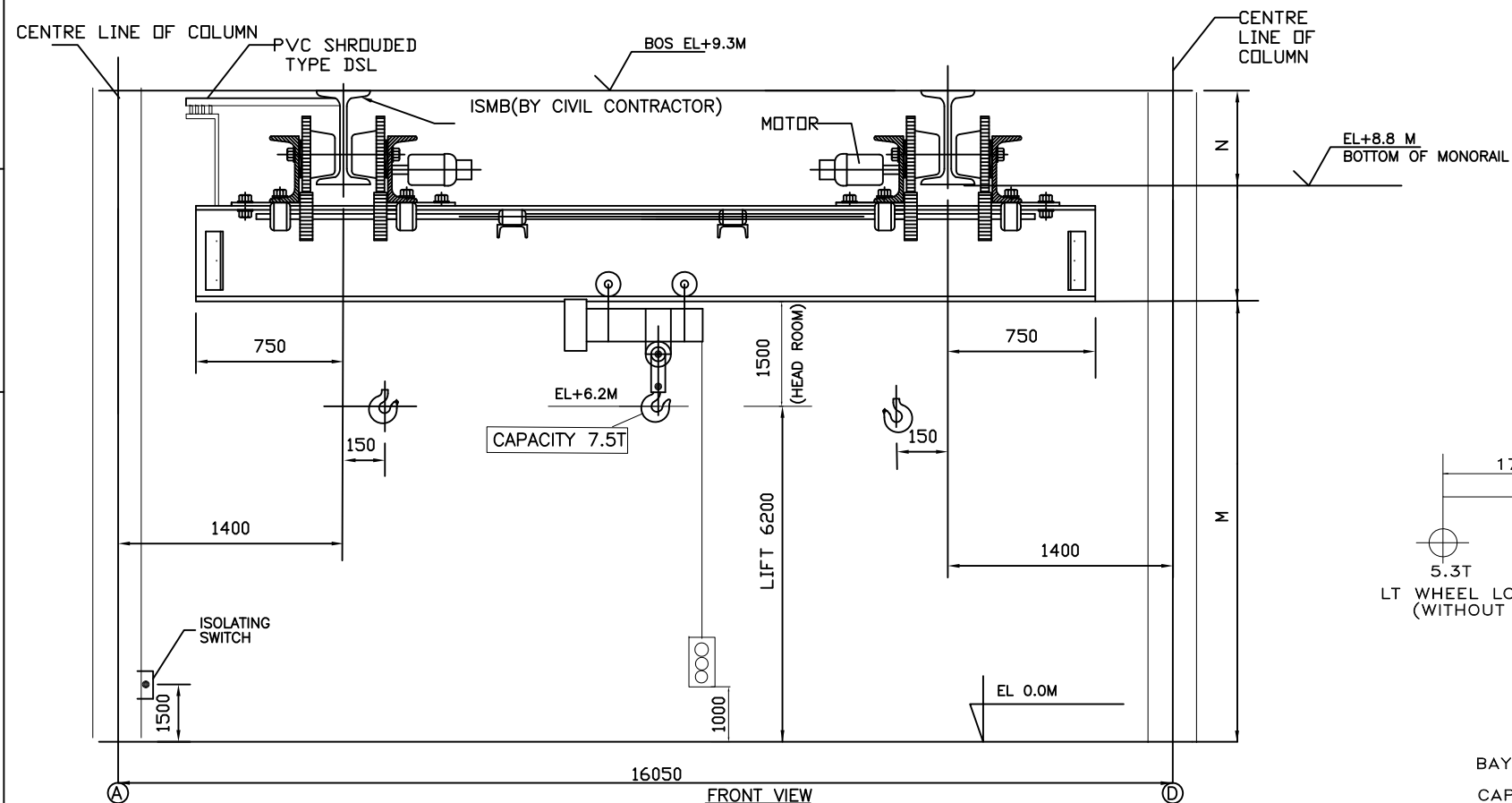
TOP VIEW



KEY PLAN

PROJECT																			
2x660 MW UDANGUDI SUPERCRITICAL TPS-STAGE I																			
CUSTOMER																			
TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)																			
CONTRACTOR																			
BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI																			
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DEPT	DES	NAME	SIGN	DATE															
CHD	OP		SA/-																
APPD	PK		SA/-																
TITLE																			
CRANE CLEARANCE DIAGRAM OF DESALINATED CUM FIRE WATER PH 6.0T SINGLE GIRDER UNDERSLUNG CRANE																			
DEPT. SCALE 1:3000		DRAWING NO.																	
SIGN		PE-DG-435-524-A002																	
DATE		SHEET 1 OF 1																	
		REV. 0																	

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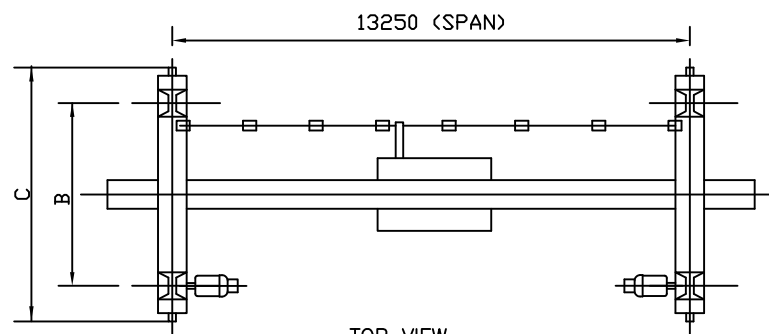


BAYLENGTH = 23.7 M

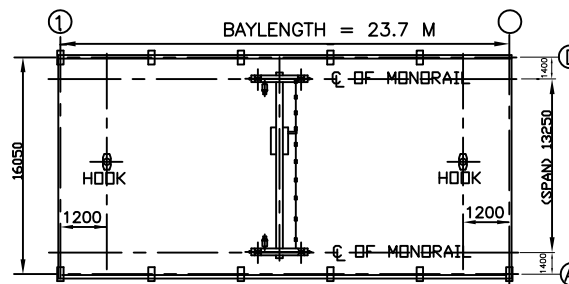
CAPACITY = 7.5 T

NOTES:

1. DIMENSIONS MARKED (*) SHALL BE FURNISHED DURING DETAIL ENGG
2. ALL DIMENSIONS ARE IN MM.
3. TOTAL CRANE WT. 5.5T(INCDG HOIST WT OF 1T)

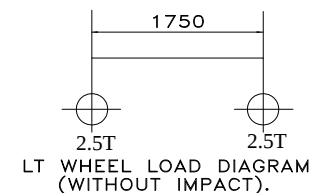
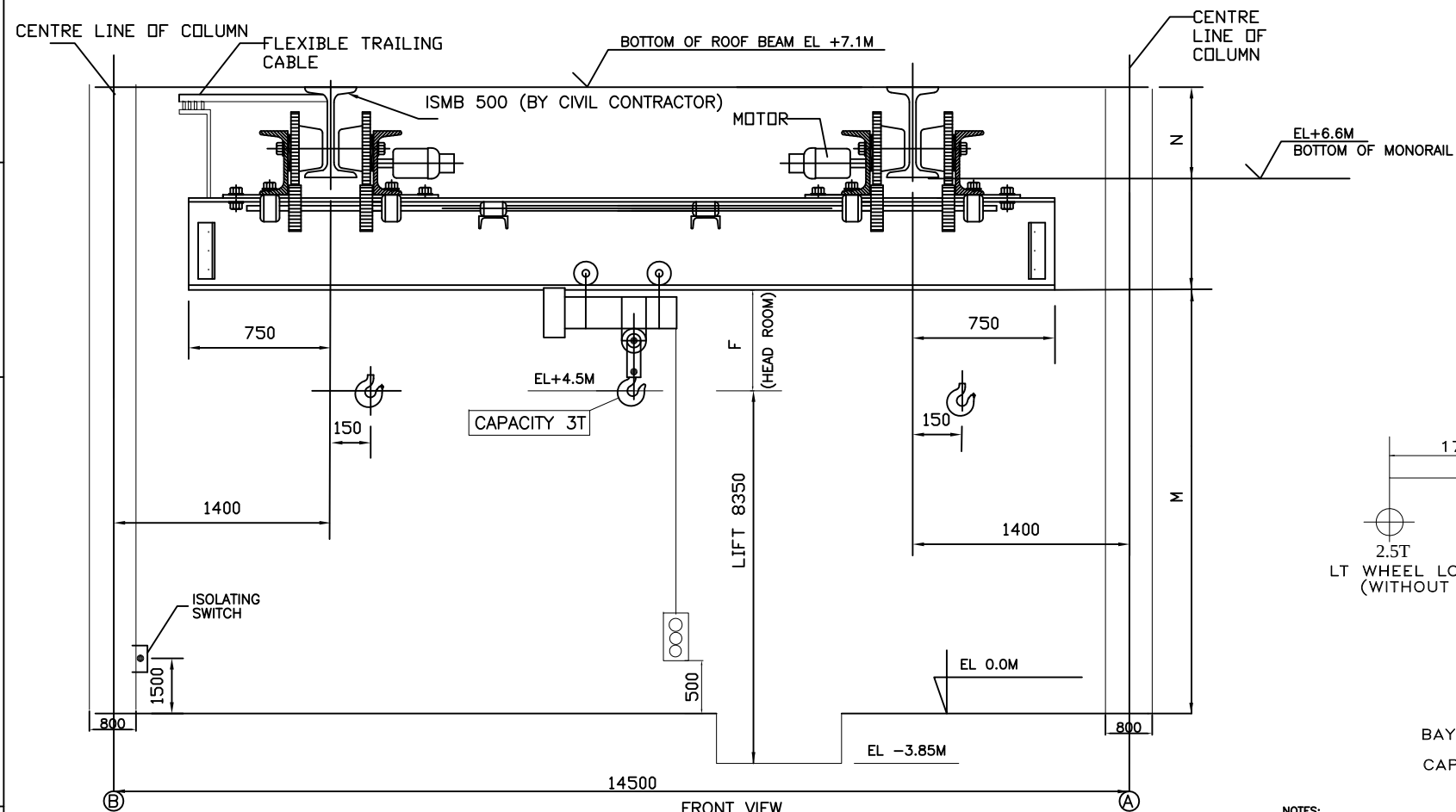


TOP VIEW



KEY PLAN

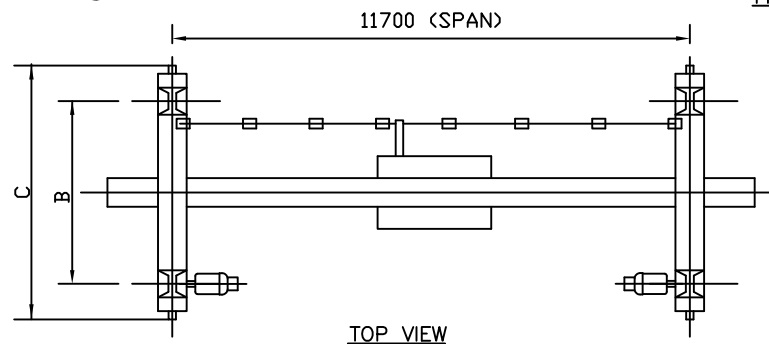
PROJECT	2x660 MW UDANGUDI SUPERCRITICAL TPS-STAGE I				
	CUSTOMER: TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)				
CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD				
	POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI				
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TITLE	CRANE CLEARANCE DIAGRAM OF DG BUILDING HOUSE 7.5T SINGLE GIRDER UNDERSUNG CRANE				
	DEPT.	SCALE	DRAWING NO.		
	SIGN	1:3000	PE-DG	435-524-A00	
	DATE		10.06.20	REV. 0	



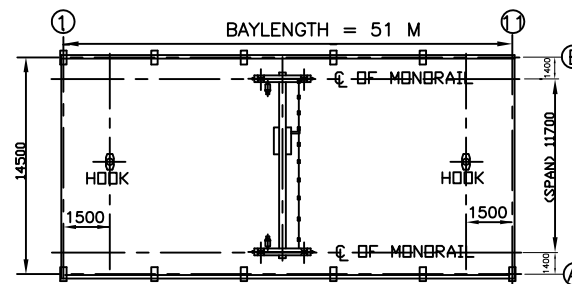
BAYLENGTH = 51 M
CAPACITY = 3 T

NOTES:

1. DIMENSIONS MARKED (*) SHALL BE FURNISHED DURING DETAIL ENGG.
2. ALL DIMENSIONS ARE IN MM.
3. CRANE SHALL BE SUITABLE FOR HAZARDOUS AREA
4. LT DSL SHALL BE FLEXIBLE TRAILING CABLE TYPE



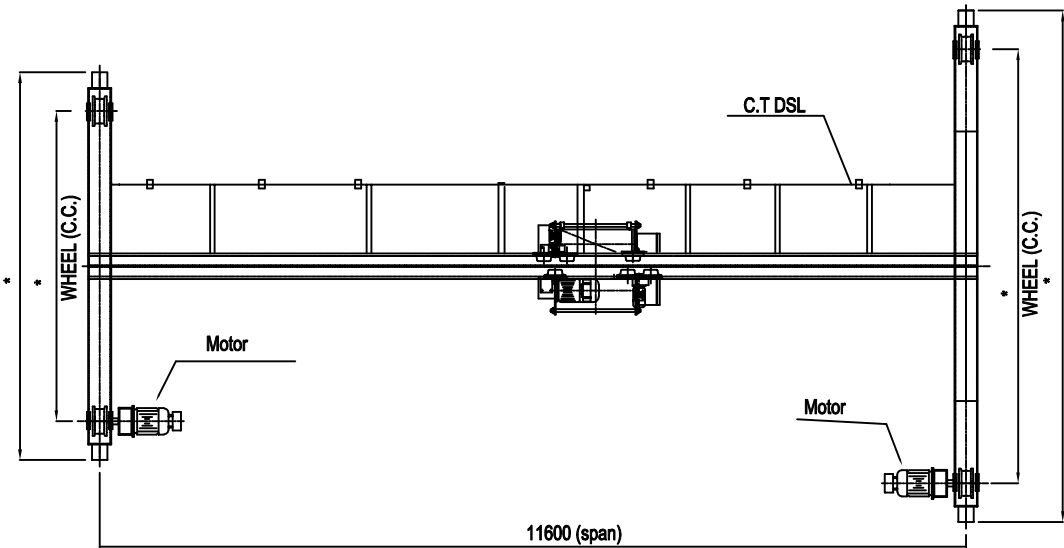
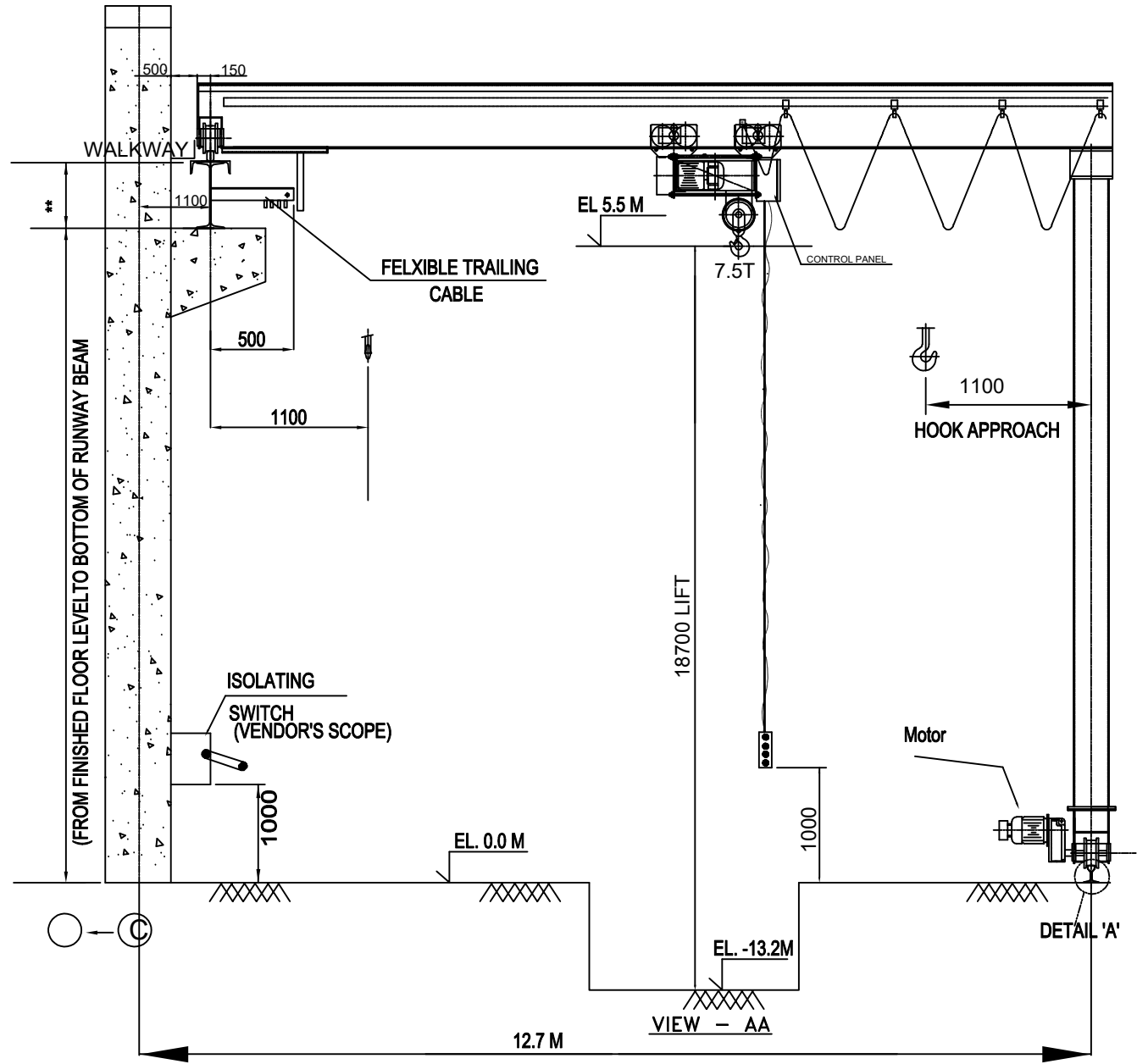
TOP VIEW



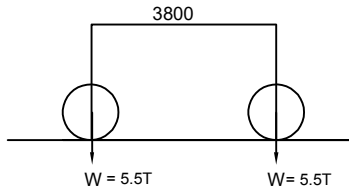
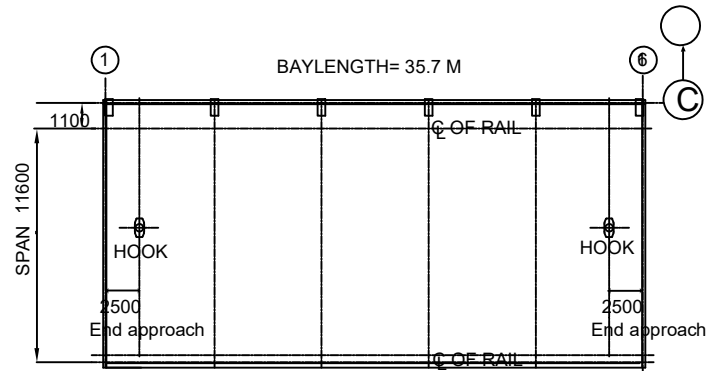
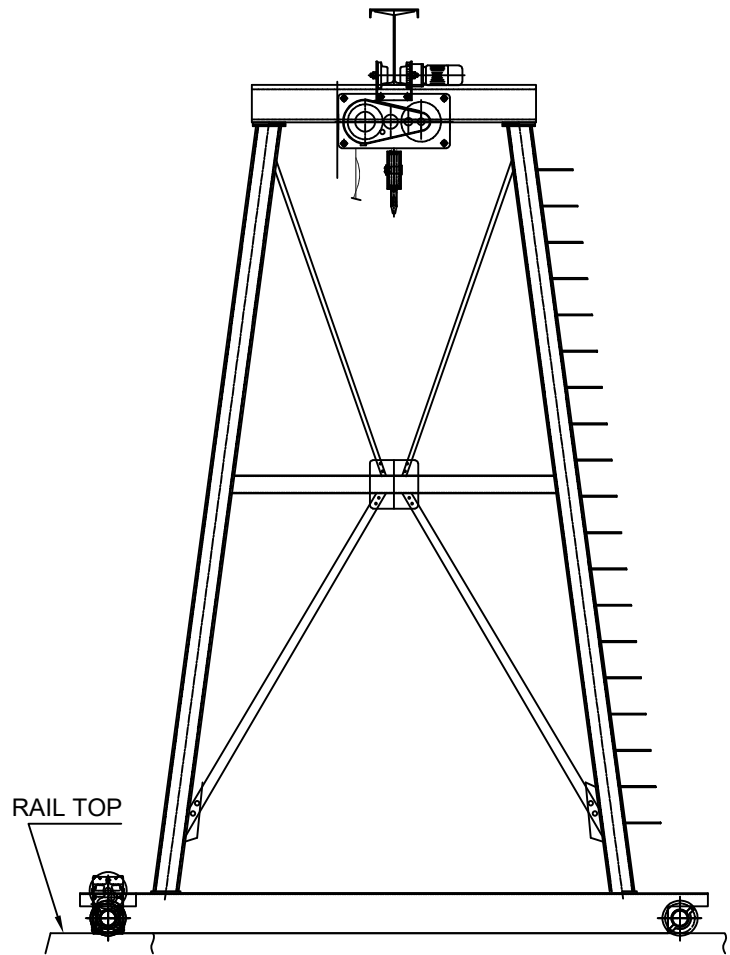
KEY PLAN

PROJECT		2x660 MW UDANGUDI SUPERCRITICAL TPS-STAGE I							
CUSTOMER		TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)							
CONTRACTOR		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI							
									
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				DESIGN	GP	SM/-			
				CHK	PK	SM/-			
				APPR	GS	SM/-			
TITLE		CRANE CLEARANCE DIAGRAM OF F.O. PUMP HOUSE 3.0T SINGLE GIRDER UNDERSLING CRANE							
		DEPT.		SCALE 1:8000		DRAWING NO.			
		SIGN				PE-DG-435-524-A004			
		DATE				 15.06.2010			
						REV. 0			

FE-DG-435-524-A005
DRAWING NO.



TOP VIEW



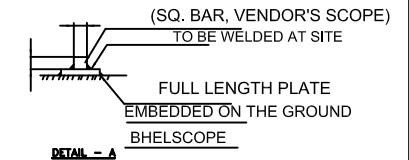
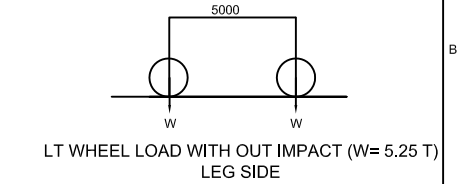
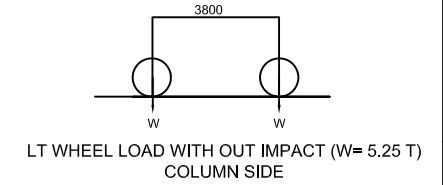
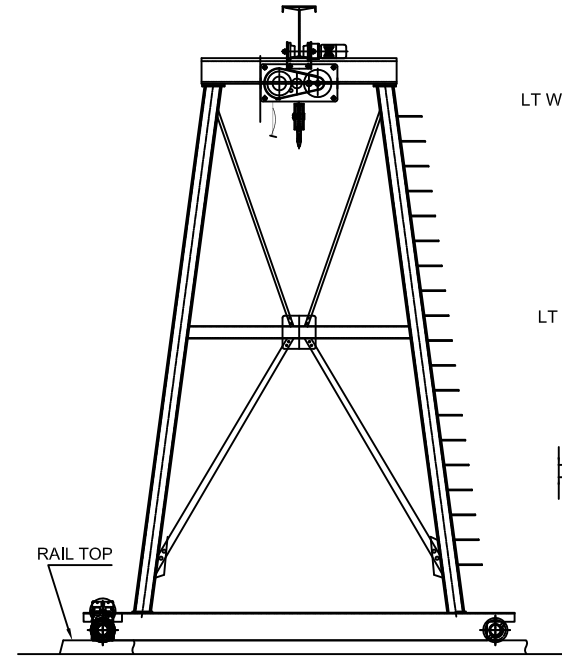
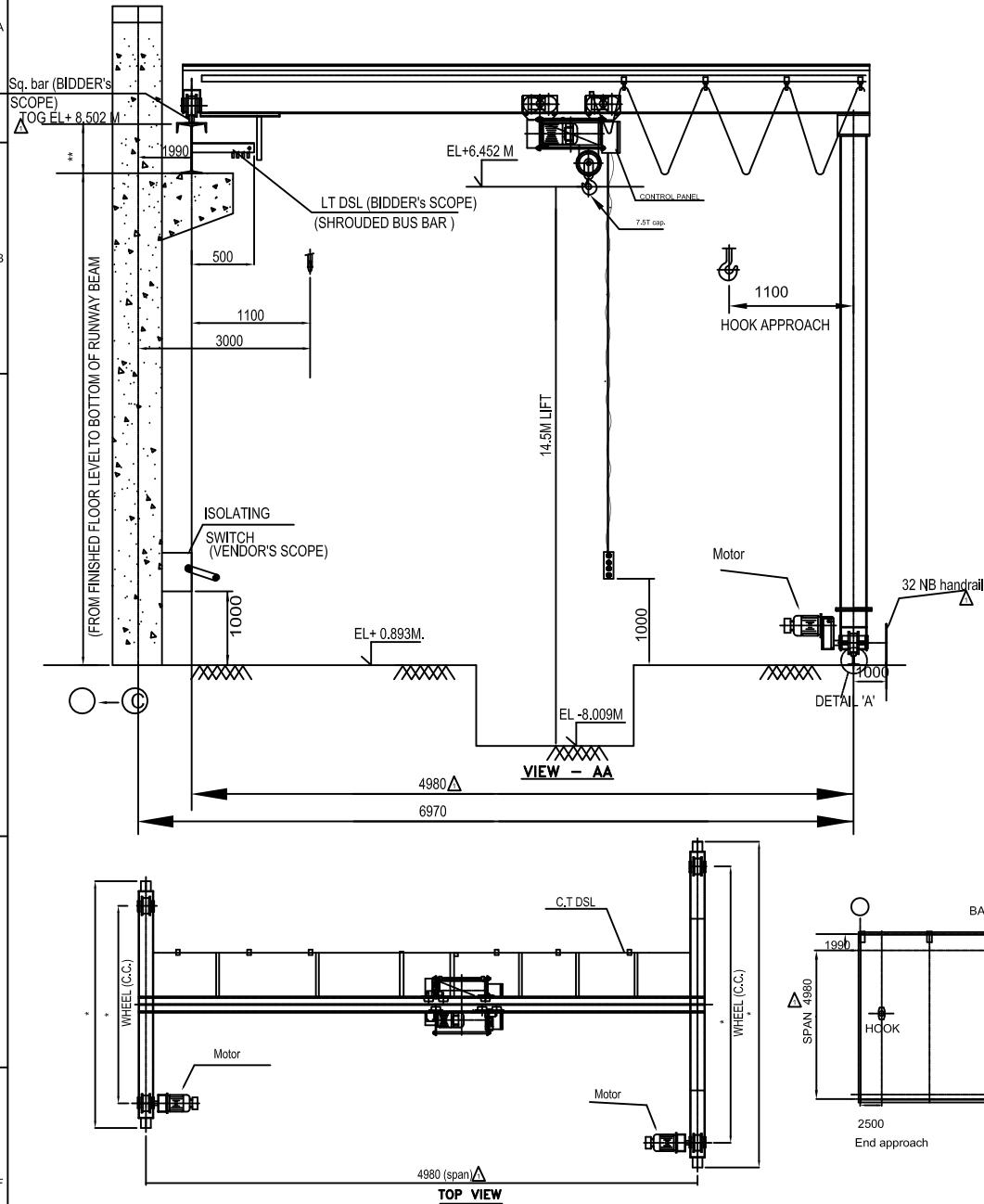
LT WHEEL LOAD WITH OUT IMPACT

- NOTE-
- 1 - ALL DIMENSIONS ARE IN MM.
 - 2 - DSL(LT) => SHROUDED BUS BAR CONDUCTOR
 - 3 - ** SUBJECT TO FINALISATION OF STRUCTURE
 - 4 - DIMENSION MARKED AS(*) IS TO BE GIVEN BY THE VENDOR
 - 5 - CRANE SHALL BE OUTDOOR TYPE
 6. 4/2 falls to be provided for rope drum i.e. hook to be lifted centrally.

CUSTOMER: 	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO) 2X660 MW UDANGUDI STPP																				
	OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED, BENGALURU																				
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA																				
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TITLE	CRANE CLEARANCE DIAGRAM FOR 7.5 T CAPACITY SINGLE GIRDER SEMI GANTRY CRANE FOR SEA WATER INTAKE PH SCREEN & GATE HANDLING																				
<table border="1"><tr><td></td><td>DEPT.</td><td>SCALE</td><td>DRAWING NO.</td><td>REV</td></tr><tr><td></td><td>DESIGN</td><td>GP</td><td>PE-DG-435-524-A005</td><td>1</td></tr><tr><td></td><td>CHECK</td><td>PPR</td><td></td><td></td></tr><tr><td></td><td>APPROVE</td><td>SEP</td><td></td><td></td></tr></table>		DEPT.	SCALE	DRAWING NO.	REV		DESIGN	GP	PE-DG-435-524-A005	1		CHECK	PPR				APPROVE	SEP			 Page 11 of 130 REV 0
	DEPT.	SCALE	DRAWING NO.	REV																	
	DESIGN	GP	PE-DG-435-524-A005	1																	
	CHECK	PPR																			
	APPROVE	SEP																			

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- NOTE-
- 1 - ALL DIMENSIONS ARE IN MM.
 - 2 - DSL(LT) = PVC SHROUDED DSL
 - 3 - ** SUBJECT TO FINALISATION OF STRUCTURE
 - 4 - DIMENSION MARKED AS(*) IS TO BE GIVEN BY THE BIDDER
 - 5 - CRANE SHALL BE OUTDOOR TYPE

PROJECT 		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	DATE
					DESIGN	BHASKAR	Sd/-	FEB 2020
					CHD	PKK	Sd/-	FEB 2020
			APPD	GB	Sd/-	FEB 2020		
TITLE		CRANE CLEARANCE DIAGRAM OF 7.5T CAPACITY SINGLE GIRDER SEMI GANTRY CRANE FOR CWPB SCREENS & GATES HANDLING						
					DEPT.	SCALE 1:3000	DRAWING NO.	
					SIGN		PE- DG- 435- 524- A006	
					DATE		Page 112 of 130	
							REV. 1	

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COMPUTER FILE NAME : TAL5

F

B

A

DRAWING No. PE-DG-435-524-A007

Fold-2

Fold-3

Fold-2

Fold-1

6

5

4

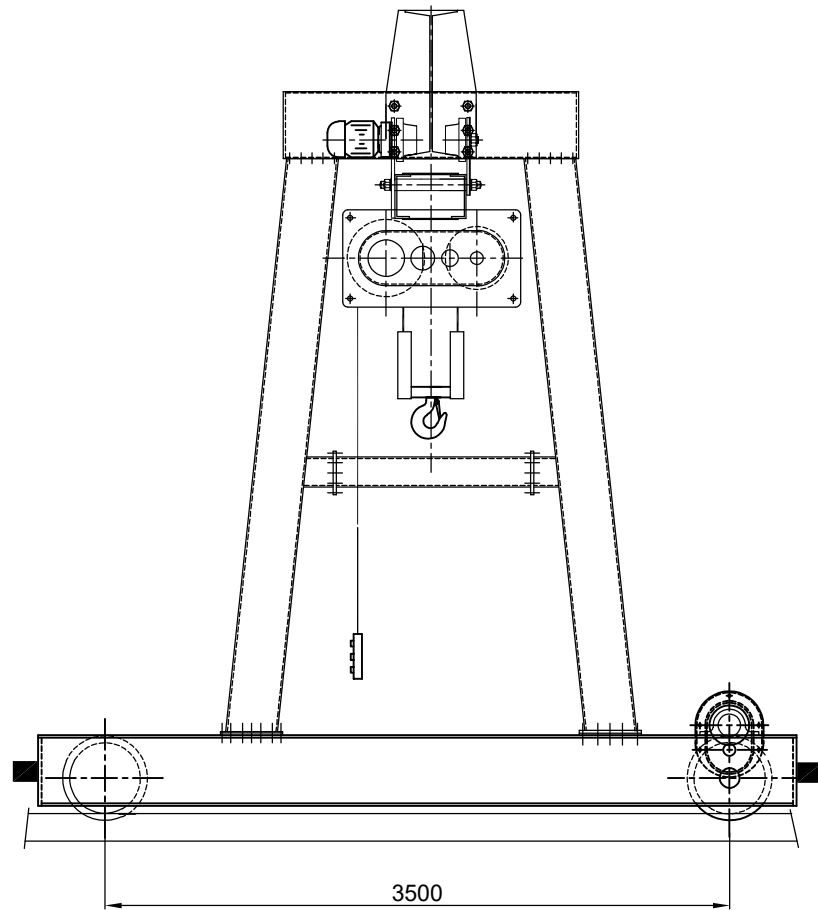
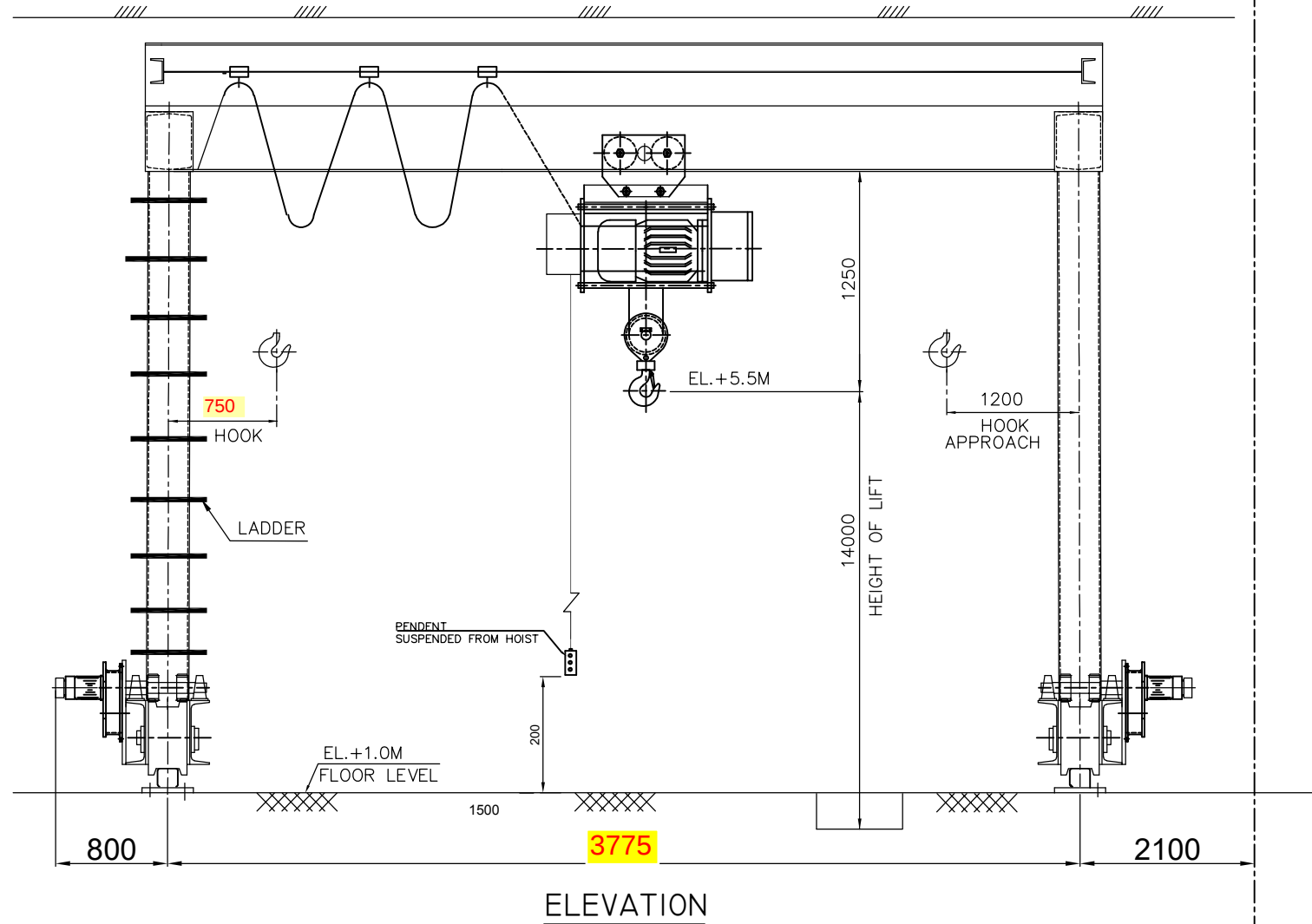
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CUSTOMER'S DRAWING No.

Fold-3

A

B

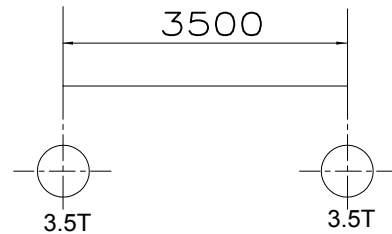


SIDE VIEW

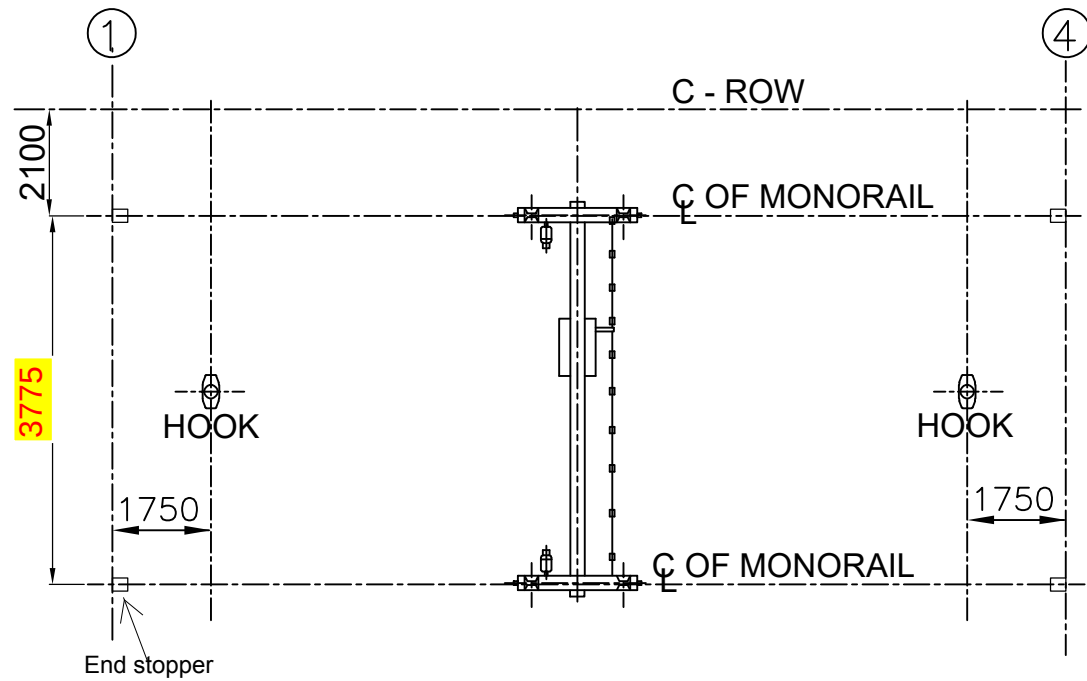
CRANE CAPACITY = 5 TONS
CRANE BAY LENGTH = 20 M

NOTE

- 1 - ALL DIMENSIONS ARE IN mm
- 2 - QTY.- 1 NO.
3. 4/2 falls to be provided for rope drum i.e. hook to be lifted centrally.
4. To meet indicated hook approach, if girder is required to extend outside, same to be done by bidder.
5. Crane shall be outdoor type & power supply shall be through CRD



LT WHEEL LOAD DIAGRAM
(WITHOUT IMPACT).



KEY PLAN

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									
 Maharatna Company	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA					DEPT CODE	DRN	NAME PC	SIGN Sd/-	DATE 21.04.20
						M	DESIGN	BHASKAR	Sd/-	21.04.20
						CHD	PK	Sd/-	21.04.20	
						APPD	GB	Sd/-	21.04.20	
TITLE CRANE CLEARANCE DIAGRAM FOR 5T CAPACITY GANTRY CRANE FOR SEA WATER OUTFALL PH SCREENS AND GATES										
						DEPT.	SCALE	NTS	DRAWING NO.	
						SIGN			PE-DG-435-524-A007	
					DATE	SHEET			Page 113 of 130. 0	



2X660 MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE

STANDARD TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-II

REV. 00

JUNE 2020

SECTION-II

STANDARD TECHNICAL REQUIREMENT

SUB-SECTION IIA

STANDARD TECHNICAL REQUIREMENT (MECHANICAL)



2X660MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE
STANDARD TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-II

SUB-SECTION-IIA

REV 00

DATE JUNE 2020

SUB SECTION-IIA

STANDARD TECHNICAL REQUIREMENT (MECHANICAL)



2X660MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE
STANDARD TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-II

SUB-SECTION-IIA

REV 00

DATE JUNE 2020

SINGLE GIRDER EOT CRANE

1.0.0 SCOPE

This specification covers the design, material, manufacture, assembly, inspection and testing at manufacturer works for single girder EOT crane. The equipment shall include all the accessories required for the trouble free operation.

The crane shall be complete with trolley and truck, wheels and axles, Drive mechanisms, Hoisting Drums, Brakes, Creep Speed Arrangement, Lifting tackles, Buffers, Electric Motors, Controls, Switch Board and cabling, horns, warning lights, Limit switches etc. Any item not mentioned herein but required to make the system complete for the satisfactory performance of the crane shall also be included.

2.0.0 CODES AND STANDARDS

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

- | | | |
|----|------------------|---|
| a) | IS 807 | Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists |
| b) | IS: 3177 | Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes |
| c) | IS: 2266 | Specification for steel wire ropes for general Engineering purposes. |
| d) | IS: 4029 | Guide for testing induction motor (for temperature rise) |
| e) | IS: 15560 | Steel hooks for standard shank design |
| f) | IS: 1554 Part I | PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts. |
| g) | IS: 325 | Three phase induction motors. |
| h) | IS: 900 | Code of practice for installation and maintenance of induction motors |
| i) | IS: 694 (Part-I) | Copper conductors PVC insulated cables for voltage up to 1000 V. |
| k) | IS: 434 (Pt I) | Copper conductors rubber insulated cables for voltage up to 1000V. |
| m) | IS: 691 | Flexible trailing cables rubber insulated. |
| n) | IS 3043 | Code of practice Earthing. |



2X660MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE
STANDARD TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-II

SUB-SECTION-IIA

REV 00

DATE JUNE 2020

- | | | |
|----|----------|--|
| o) | IS: 3938 | Electric Wire Rope Hoists. |
| p) | IS: 2147 | Degree of protection provided by enclosures for Low voltage switchgear and control gear. |
| q) | IS: 1554 | Polyethylene insulated PVC sheathed cables. |

Indian electricity rules - 1956.

In the event of any conflict between the specification and standards mentioned above, the specification shall govern.

3.0.0 SINGLE GIRDER EOT CRANE

3.1.0 DESIGN REQUIREMENTS

3.1.1 The crane shall be designed in accordance with the latest edition of IS-3177/IS-807 & hoist block shall be as per IS-3938 and any other standard as referred there in and subject to any modification and requirement as specified herein after.

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

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

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

3.1.4 For welded construction such as bridge girders, end carriages, rope drum, gearboxes etc; steel shall be conforming to IS-2062 quality.

3.1.5 No cast iron part shall be used on the crane.

3.1.6 Guard shall be provided on crane to prevent the hoist ropes coming in contact with down shop leads. Guards of an approved design, which will push forward or off the track any object such as a person foot or arm, placed across it. Guards shall be attached to each end of the end carriages. Suitable guards shall be provided to revolving shafts, coupling etc.

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

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

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

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

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

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

3.1.13 The crane shall be manufactured as per the tolerances specified below



**2X660MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE
STANDARD TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-II

SUB-SECTION-IIA

REV 00

DATE JUNE 2020

- | | | |
|----|---|------------------------------------|
| a) | Span over LT wheels | ± 3mm |
| b) | Diagonal on wheels | ± 3mm |
| c) | Long travel wheel alignment | ± 1mm |
| d) | Tilt of wheels or balancer axle | ±1/1000mm(horizontal and vertical) |
| e) | Permissible variation in Speeds at full notch with rated load, voltage and frequency shall be as follows. | |
| | i) Travelling and traversing | ±10% |
| | ii) Hoisting Lowering | ±10% |

3.1.14 Proper allowance shall be made for impact and wear in the design of the crane and in no case shall the factor of safety in any part be less than six (6), as per IS: 3177 based on the ultimate strength of the materials used at design duty.

3.2.0 STRUCTURAL DETAILS

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

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

3.2.1.2 The calculated strength of riveted joint or joints made by friction grip bolts in structure members shall be not less than the calculated net strength of the member.

3.2.1.3 Bolts used in shear shall be fitted in to reamed hole.

3.2.1.4 Transverse filled welding on load carrying member shall be avoided.

3.2.1.5 All butt welds on structural members subjected to tensile stress shall be X - rayed.

3.2.1.6 Fillet welding on load carrying members shall be avoided.

3.2.1.7 Plates, angles and other rolled section used in the load bearing members of the structure shall not be less than 6mm thick.

3.2.1.8 The cranes working out door or in corrosive environment, an allowance of 1.5 mm shall be added to the calculated thickness.

3.2.1.9 Minimum thickness of chequered plates for platform shall be over 5mm over plain. Chequered plates shall not be considered for strength calculations of load carrying member.

3.1.1.10 The material of construction of the major components shall be as specified in the specification/data sheet. Manufacturer are however free to use alternate material which are superior for the intended service. But in all the cases, prior concurrence of the purchaser is must.

3.2.2 Girder / Beam



2X660MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE
STANDARD TECHNICAL REQUIREMENT

SPECIFICATION No: PE-TS-435-524-A001

VOLUME: II B

SECTION-II

SUB-SECTION-IIA

REV 00

DATE JUNE 2020

3.2.2.1 The girder / beam shall be fabricated from rolled steel (Box section/ I-section) and shall be of adequate strength to withstand the rolling loads and other stresses it is subjected to. The design of the girder shall be in accordance with latest edition of IS- 807 with the following deletion / addition as applicable.

3.2.2.2 The maximum vertical deflection of the girder produced by the dead load, the weight of the trolley and the rated load shall not exceed 1/750 of the span of the crane (if the span of the cranes is more than 12m), and 1/600 of the span (if the span of the crane is less than 12m) as per IS 807 (latest edition). Girders shall be cambered to an amount approximately equal to the dead load maximum deflection plus one-half the live load deflection.

3.2.3 End carriage

3.2.3.1 End carriages shall be fabricated from rolled steel section or plates or as the case may be. End carriage shall be of ample strength to resist all stresses likely to be imposed on them under service conditions including collision with other cranes or stops.

3.3.0 MECHANICAL

3.3.1 Rope drums

Rope drums shall be of mild steel plate fabricated/ of seamless pipe or of cast steel. Seamless pipe shall be procured from BHEL approved makes & TC shall be furnished. All fabricated rope drums shall be stress relieved. The drum shall be so designed to take full length of hoisting rope in single layers. The end of the rope shall be anchored to the drum in such a way that the charger is readily accessible. Each rope shall have not less than two (2) full turns on the drum when the hook is at lowest position not taking into consideration the turns covered by the rope in charge. There shall be one spare groove for each rope lead when the hook is at the highest position. Each rope end shall be clamped with minimum two clamping wedges with at least two bolts on each clamping arrangement.

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

3.3.2 Hoist ropes

Ropes of steel core as specified in Data Sheet – A/B shall be of right hand lay, of 6x36 construction of best plough steel having minimum tensile strength as 160-180 kg/mm². Left hand lay wire ropes shall not be used (Reverse bend ropes shall be avoided as far as possible).

3.3.3 Rope sheaves



**2X660MW UDANGUDI STPP
SINGLE GIRDER EOT CRANE
STANDARD TECHNICAL REQUIREMENT**

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Sheaves shall be of cast steel. All sheaves shall be identical, however, exception may be made for equalizer sheave. Sheave groove shall be ground finished for getting increase rope life. Equalizer sheave shall be arranged to turn and swivel in order to maintain rope alignment under all circumstances.

3.3.4 Wheels

LT wheels shall be single flanged for underslung EOT crane and double flanged with tread (to suit the rail) for overhead EOT cranes. The wheels shall be capable of taking up misalignment in span as specified. Solid wheel shall either be of forged steel or as specified. The wheel shall be with hardness of BHN 300-350 for overhead EOT cranes and BHN 200 (max) for underslung EOT cranes. Contact stresses between wheels and rails should be within permissible limits.

3.3.5 Buffer

Each End carriage shall be provided with buffer as per data sheet 'A'. Buffers should be so located that removal is not required while changing wheels or bogies. Buffers shall have sufficient tension on energy absorption capacity to bring the unloaded crane to rest from the speed of 50% of the rated speed to zero speed.

3.3.6 LT drive

One pair of wheels in each end carriage shall be driven by motor through reduction gear.

3.3.7 CT drive

The CT mechanism of the electric hoist shall consist of 2pairs of wheels which shall be driven by motor through reduction gear.

3.3.8. Gearing

Spur and helical gearing shall normally be used for all motions. Worms and bevel gears shall not be used. First high-speed reduction shall be through helical gears. All gears shall be hardened and tempered and of alloy steel with machine cut teeth. Surface hardening of teeth is not acceptable. Gear teeth shall preferably be cut in metric module system. Gears shall be designed to meet requirement of crane duty as per IS: 3177. The ratings of gears shall be established as per IS: 4660.

3.3.9 Gear Box

3.3.9.1 All gears shall be completely covered and enclosed in oil tight casing & sealed with gasket.

3.3.9.2 The gearboxes shall be of mild steel or cast steel. All fabricated gearboxes shall be stress relieved.



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3.3.10 Bearing

3.3.10.1 Ball and roller antifriction bearing of FAG, SKF, NBC, NORMA make shall be used throughout, except where specified otherwise. Rated life of ball and roller bearing shall be not less than total working life as per relevant codes. Life of bearing shall be calculated in accordance with manufacturers recommendations.

3.3.10.2 Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as possible to exclude dirt and prevent oil leakage.

3.3.11. Couplings

3.3.11.1 Motor shafts shall be connected to gear box input extension shafts through flexible gear coupling. Solid coupling shall be used for connecting intermediate lengths of long travel shafts, if applicable.

3.3.12 Lifting hook

Standard hooks shall be used unless otherwise specified. These hooks shall conform to the latest edition of IS 15560 as specified in the data sheet "A".

3.3.13 Brakes

3.3.13.1 Selection and design of brakes shall be such as to meet the requirement. Electro mechanical brakes shall be provided for each motions. Brakes shall be designed to suit 150% FLT of motor for the hoist motion and 125 % FLT of motor for LT/CT motion. Brakes shall be provided as specified in Data Sheet 'A'

3.4.0 ELECTRICAL

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

3.4.1.1 Main isolating Switch fuse unit shall be provided at 1.5M above the operating floor level at one end of bay length or in the middle as specified in the data sheet A. Supply of cable from switch to down shop leads shall be included in the bidder's scope of work.. The switch shall be provided with Power ON Red indication lamp.

3.4.1.2 Run way conductors (Down shop leads) shrouded conductor as specified in the data sheet A shall have four conductors. One of the conductors shall be connected to earth grid for earthing connections of all electrical equipments on the crane and shall be connected to suitable collecting gear of earth conductor. Voltage drop across the down shop leads shall be less than 2%. Maintenance cradle for DSL shall be provided on crane if asked in Data Sheet 'A'. Sufficient allowance of min. 10% for wear & tear shall be considered while sizing the conductor. The runway conductors shall be supported on brackets and insulators.

3.4.1.3 The current collectors shall be of adequate current carrying capacity and shall maintain adequate contact pressure. Spacing between current collectors shall be such as to provide



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sufficient quenching area for sparks coming out of collectors surface. The collector system per conductor shall be top-running type having spring loaded CI/carbon metallic shoes to maintain adequate contact pressure.

3.4.1.4 The cable, supplying power to crane trolley / electric hoist shall be flexible trailing cable as per IS-9968 Part I (latest edition) and mounted on retracting supports (festoon type)

3.4.2 DRIVE MOTORS

3.4.2.1 Crane motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The break down torque of the motors shall not be less than 225 percent of the full load torque with rated voltage and frequency applied and pull out torque shall not be less than 250% of the rated full load torque of motor.

3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending upon the ambient temperature and voltage /frequency variation shall be applied to derate the motors. The minimum margin of 10% or as specified in the section C of specification shall be considered over the calculated rating of the motor. The protection class of the motors shall be as per data sheet A. Motors shall be tested at manufacturer's works in accordance with IS-325/as per agreed Quality plan & Reports shall be submitted for approval. Motors shall comply with the requirement of IS-325-1978 or as per the motor specification if enclosed here with.

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

3.4.3 Limit Switch

The hoist mechanism of the crane shall be provided with rotary/gravity/snap action type limit switch to open the control circuit and in order to prevent the crane hook from over hoisting and over lowering. One gravity type back-up limit switch of hand-reset type shall be provided. This switch shall operate in the event of failure of main limit switch if called for in data sheet "A".

Lever operated limit switches shall be provided at both ends of longitude travel and cross traverse. These limit switches shall be self-reset type.

3.4.8 Protective Panel / Controls

3.4.8.1 The electrical protective panel shall be a cubicle fabricated from 2 mm thick sheet steel with lockable-hinged door. It shall be dust and vermin proof with degree of protection as IP-55 or as specified in data sheet A. All the equipment inside the panel shall have permanent identification. The panels shall be front connected type with front-hinged door for access to wiring and terminals. Engraved nameplate shall be furnished for all panels and also for the equipments and devices mounted there on.



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The following minimum equipments shall be provided.

- a) One triple pole air break type main contactor with thermal overload relay.
- b) One triple pole main line connecting/disconnecting switch.
- c) Switch fuse unit with D.O.L. starter for each motion.
- d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.
- e) Contactors, timer and auxiliary contactors.
- f) Control transformer with fuses.
- g) Indicating lamps to indicate the live condition of all three phases.
- h) Other equipments as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The contactor drop off voltage shall be between 45-50% of rated voltage.
- i) All internal wiring shall be identified with numbering ferrules at both ends as per the relevant wiring diagram.

3.4.9 Pendent Push button station

It shall be suspended by wire rope to prevent pull on the cables. The following minimum push buttons key operated type.

- a) Main "ON", "OFF" push button key operated and lockable in "OFF" position.

This push button will operate the main contactor.

- b) Hoist and lower directions. (2Nos.)
- c) Trolley travels both directions. (2 Nos.)
- d) Bridge travels both directions. (2 Nos.)
- e) Inching speed for hoisting & lowering
- f) Inching speed for bridge motion.
- g) Inching speed for trolley motion.
- h) Creep speeds
- i) Emergency stop push button (mushroom type).
- j) Alarm bell push button.

3.4.10 Grounding

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

3.4.10.2 The equipment fed by flexible cables shall be grounded by means of fourth core provided in the flexible trailing cable. Pendent push button station shall be earthed separately.



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

3.4.11 WIRING SYSTEM

The supplier shall furnish all power, control and auxiliary circuit wiring of the equipment and the panel located on the trolley or bridge.

The wiring shall be complete in all respect to ensure the proper functioning of the equipment.

Power wiring to any motor shall be done with 1100V grade Cu conductor, PVC insulated / armoured / FRLS cable of suitable sizes as specified in Data Sheet A.

- d) For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.
- e) All control and auxiliary external circuit wiring shall be done with PVC insulated FRLS type 2.5mm stranded copper conductor.
- f) Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.
- g) Each motor shall be wired independently. Power and control wiring shall be effectively separated.
- h) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.
- i) All wire termination to the panels shall be provided with clamp type connections screw. Type terminals with screw directly impinging on conductors are not acceptable.
- j) Multi-way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring and outgoing.
- k) Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points
- l) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

4.0.0 LOAD INDICATION:

The crane shall have a permanent inscription of English on each side, readily visible from the ground level, stating the safe working loads in tonnes, year of manufacture, crane serial number and manufacturer's name.



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DOCUMENTS TO BE SUBMITTED BY BIDDER

- | | |
|------|---|
| IIIA | LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH
BID |
| IIIB | COMPLIANCE CUM CONFIRMATION CERTIFICATE |
| IIIC | PRE BID CLARIFICATION SCHEDULE |



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**SUB SECTION-IIIA
LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID**



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DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID:

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

- a) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format given in GCC. In case of no deviation, bidder to mention "No deviation" on signed and stamped copy of Deviation sheet.
- b) Copy of pre-bid clarifications, if any, duly signed & stamped
- c) Signed/ Stamped copy of Compliance cum Confirmation Certificate (Vol-III)
- d) Un priced copy of price format indicating quoted/ not quoted against each row/column along with cost of withdrawal / price implication format for deviations.

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.



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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance
- 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.



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- 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) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.



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PRE-BID CLARIFICATION SCHEDULE

S. No.	Section/Clause /Page No.	Statement of the referred clause	Clarification Required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL