TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.
(TANGEDCO)

2X660 MW SEZ ENNORE STPP

TECHNICAL SPECIFICATION
FOR
SINGLE GIRDER CRANES

SPECIFICATION NO.: PE-TS-412-524-A001

BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, U.P
INDIA

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SECTION-I

SPECIFIC TECHNICAL REQUIREMENT

IA	**SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)**
IB	**SPECIFIC TECHNICAL REQUIREMENT (ELECTRICAL)**
IC	**DATA SHEET A**

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

IA – Specific Technical Requirement (Mechanical)

INTENT OF SPECIFICATION

1.1 The specification is intended to cover design, engineering, manufacturing, inspection and testing, painting, supply/ delivery duly packed at FOR site including mandatory spares (as applicable), erection & commissioning spares, maintenance tools & tackles, all accessories (isolating switch and power cable from isolating switch to DSL), DSL, rails (as applicable) including freight in line with drawings/ documents/ test procedures approved by BHEL/ Customer 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 responsibility of providing such facilities to complete the supply, erection and commissioning 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 Vol-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.

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 end customer including their consultant as interpreted by BHEL in the relevant context.

ANNEXURE-A

SCOPE OF SINGLE GIRDER CRANES

Sl No	Area/Equipment Description	Type	Quantity (Nos.)	Capacity (T)	Lift (m)	Travel (m)	Span (m)
1	Air Compressor Building (Indoor)	Overhead electric operated	1	8T	5	35	10.8
2	DG Building (Indoor)	Underslung electric operated	1	8T	6.5	26	13
3	Filter water pump house (Indoor)	Underslung electric operated	1	5T	4.5	69	8
4	Workshop building (Indoor)	Overhead electric operated	1	10T	5	42	11
5	Sea water intake pump house TWS screen & gates handling (Outdoor)	Gantry Crane (electric operated)	1	10T	18.85	20	12.5
6	CW pump house Screens & gates handling (Outdoor)	Semi-gantry crane (electric operated)	1	8T	14.8	78.87	5.27
7.	Clarified water pump house (Indoor)	Under-slung crane(electric operated)	1	5T	4	15.25	4.5
8	Permanent store (heavy material store) (Indoor)	Under-slung crane(electric operated)	1	10T	5.75	95	9.77
9	Permanent store (Light material store) (Indoor)	Under-slung crane(electric operated)	1	3T	5.75	80	9.77

Note- Bidder to note that there shall be no implication for change in lift and/or span upto (+/-)1000 mm.

PROJECT INFORMATION:

(INCLUDED IN SCC)

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/HOT misc. 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/HOT misc. 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 and buffers.
3. Electric Hoist for EOT crane
4. CT / L T drive arrangement
5. VVVF Drives for all 3 Motions.
6. Electrical equipments (control panel, pendent, power & control cables etc.)
7. Types of DSL:
   a. PVC Shrouded Conductor (GI) Bus Bar Type DSL with accessories for entire bay length (with current collector & mounting brackets) (except for 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.
8. Supports & brackets for LT Trailing cable for gantry crane.
9. Rail (for O/H, Semi gantry, gantry crane only)
10. Limit switches
11. Earthing arrangement.
12. Painting of crane.
13. First fill of lubricant.
14. O & M Manual, drawings and documents.
15. Main isolating switch and power cable from 1.5M above ground / operating floor to down shop lead.
16. Power cable with cable tray, clits & other accessories.
17. Control transformer with standby arrangement.
18. End stoppers (4 nos. for each crane)
19. All fasteners (nuts, bolts, washer required for complete assembly of cranes.
20. Platforms (as applicable)
21. All components of outdoor cranes should be provided with protective cover (canopy).

22. All outdoor cranes shall be provided with anchoring arrangement.

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.

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.

The Bidder shall also supply erection & commissioning spares along with his main equipment as per Table 1 given below, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. In case additional spares/ quantity are required, the same shall also be included if it is deemed necessary for commissioning of Single Girder cranes. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares.

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

"One (1) Set"" is defined as 100% requirement for one crane for the entire cranes of similar size & capacity.

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.

1.1.5 Packing procedure – Refer Annexure-VII of section IA of this specification.

1.2.0 Services to be provided by the bidder

1.2.1. Design, engineering with associated documentation. Erection and commissioning procedure with illustrative drawings shall be submitted by successful bidder for carrying out the erection and commissioning of hoist, sub assembly along with its accessories at site including operation and maintenance manual.

1.2.2. 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.

1.2.3. Packing, forwarding and transportation to site.

1.2.4. Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL.

1.3.0. Inspection and Testing: All testing/inspection related requirement to be included in next sub-section (Quality Assurance)

1.4.0 SURFACE PREPARATION, PAINTING & COLOUR SCHEME

Detailed painting procedure has been attached as Annexure III, Section IA of technical specification. 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 of technical specification.

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 Power supply:

The purchaser shall provide single point 415V, 3 phase, 3 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 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 bid submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the appropriate "Schedule of Deviations- Cost of withdrawal" as attached along with General Condition of contracts (GCC) furnishing full particular of such deviations along with cost of withdrawal of deviation. Unpriced schedule of this schedule shall be submitted along with technical offer. Unpriced format should contain "QUOTED" / "NIL" / "NA" against each deviation. 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. Priced copy of same shall be submitted
along with price schedule.

4.0.0. **Make of Sub - Vendor items**

Indicative list of makes of bought-out items will be as per Annexure V, section II. The same shall be subject to customer/ BHEL approval during detail engineering. Any addition/deletion in the list shall not have any commercial implication. Any additional make proposed by successful vendor shall not be used 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 at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

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.

QUALITY ASSURANCE AND INSPECTION REQUIREMENT

Inspection and Testing shall be as per approved manufacturing quality plan, approved drawings/ documents and relevant IS codes. Reference manufacturing quality plan is included in this specification at Section I, Sub-Section-IA to enable the bidder to understand the extent of inspection and testing requirements to execute the job. The successful bidder has to follow the requirement in the above documents along with the relevant standards. However, the Manufacturing Quality Plan shall be submitted by supplier during detailed engineering for approval by end customer.

A. Inspection and testing at Manufacturer's works

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 ASTME -165 and ASTME 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.

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 I for "Shop test Procedure for Load/Overload testing of EOT cranes at Manufacturer's Works.

B. 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.

	MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: STANDARD TECHNCIAL SPECIFICATION
		ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: SG overhead/underslung EOT/HOT Crane
			DATE	P.O.NO –
		CAPACITY: -	PAGE Page 1 of 5	BHEL NO:
				CONTRACTOR: BHEL

S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Agency				Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
`	***FOR EOT CRANE***												
1.0	**RECEVING 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 Visual	1/pipe 100%	no cracks, pitting, rusting, damage ,etc		I.R.	_/	P	V	V	
1.3	Gears, pinions, shafts, axles & wheels (#)	Chemical& Mechanical,	Major Major	Lab Analysis UT	1/lot 100%	IS:2004 (45C8/55C8) (Relevant IS/appd drg) ASTM A388/NOTE 1		MTC I.R	_/ _/	P P	V V	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/Q CR /UT report	_/	P	V	V	

		LEGEND: CLASS A: Critical, B: Major, C: Minor		DOC. NO.:
		** M: MANUFACTURER / SUB-CONTRACTOR D: Records for Data Fold C: CONTRACTOR /NOMINATED INSPECTION AGENCY, ND: NDT LAB N: Customer R: Test / Dim Report, IR-Inspection Report INDICATE "P" PERFORMS, "W" WITNESS, MTC: Mfr's Test Cert. "V" VERIFICATION, ALC: Approved Laboratory Certificate, QCR: Quality Control Report		
MANUFACTURER	CONTRACTOR			NAME & SIGN OF APPROVING AUTHORITY & SEAL
NAME & SIGNATURE				

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									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
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 Etc Control transformer	Make/Type/Rating Functional /continuity Make , type, rating, input/output	Major	Review of TC	100%	Appd drg./DS/Scheme/NLC Spec./Manu.Std		QCR Routine TC/COC of mfgr	_/	V	V	V	
1.9	DSL	Make , type, rating, Dimension.	Major	Review of TC	100%	Appd drg./DS/Scheme /NLC Spec./ Manu.Std		QCR Routine TC/COC of mfgr.	_/	V	V	V	
2	**INPROCESS- INSPECTION**												
2.1	WPS,PQR & WPQ	Verification of approval				WPS,PQR & WPQ / Qualified by NTPC/ LLOYDS / EIL / TPL			_/	P	V	V	IN CASE OF NTPC/ LLOYDS / EIL / TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED
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	

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MANUFACTURER	CONTRACTOR			
NAME & SIGNATURE				

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	ITEM: EOT CRANES - SINGLE GIRDER CAPACITY: -	REV Rev 00 DATE PAGE Page 3 of 5	PACKAGE: SG overhead/underslung EOT/HOT Crane P.O.NO – BHEL NO: CONTRACTOR: BHEL

S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record		Agency			Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
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 of Butt weld	Major	RT	100%/10%	ASME Sec.VIII,Div.1, UW 51/52		RT film & report	_/	P	V	V	@RT-100%, for Butt weld in tension & 25% in compression. 100% RT on butt weld for fabricated rope drum
2.4	Hook	Dimension	Major	Measurement	100%	Mfr's drg / Related Std. As per appd. Drg./data sheet/		QCR	_/	P	V	V	
		Proof Load	Major	Load Test		IS: 15560	IS: 15560	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		Measurement					_/	P	W	W	
3.2b	Overload test at 125% of SWL	Holding capacity of brakes		Lifting from mid Air	100%	Appd GA drg & IS: 3177/ IS:3938/ Appd data sheet		I.R.	_/	P	W	W	

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MANUFACTURER	CONTRACTOR			
NAME & SIGNATURE				

	MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT: STANDARD TECHNCIAL SPECIFICATION
		ITEM: EOT CRANES - SINGLE GIRDER CAPACITY: -	REV Rev 00 DATE PAGE Page 4 of 5	PACKAGE: SG overhead/underslung EOT/HOT Crane P.O.NO – BHEL NO: CONTRACTOR: BHEL

S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record		Agency			Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
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 Major do	Visual, Operational & Functional Measurement do	100% 100% 100%	Approved drawing / Data sheet / is: 3177 Paper should not go easily.		I.R.		P P	W W	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.
3.4	Painting	Examination – shade	Minor	Visual & measurement	100%	Customer's / Approved Painting Procedure				P	V	-	
		Dry Film Thickness	Major	Measurement	Sample					P	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 specification 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.

		LEGEND: CLASS A: Critical, B: Major, C: Minor		DOC. NO.:
		** M: MANUFACTURER / SUB-CONTRACTOR D: Records for Data Fold C: CONTRACTOR /NOMINATED INSPECTION AGENCY, ND: NDT LAB N: Customer R: Test / Dim Report, IR-Inspection Report INDICATE "P" PERFORMS, "W" WITNESS, MTC: Mfr's Test Cert. "V" VERIFICATION, ALC: Approved Laboratory Certificate, QCR: Quality Control Report		NAME & SIGN OF APPROVING AUTHORITY & SEAL
MANUFACTURER	CONTRACTOR			
NAME & SIGNATURE				

CUSTOMER SPECIFICATION

CHAPTER 17

17.0 CRANES AND HOISTS

17.1 Scope

17.1.1 Cranes and hoists to facilitate the lifting and transporting of various equipment during construction, maintenance or replacement of the plant components shall be provided.

17.1.2 Each crane or hoist shall be complete with its accessories, supporting structure, power supply, safety devices and controls and shall conform to local statutory rules and regulation.

17.1.3 Equipment to be supplied:

- Two (2) nos. Double Girder Turbine Hall EOT Crane with auxiliary hoist. The turbine hall EOT crane shall be extended upto the maintenance bay.
- EOT cranes

  i. CW Pump House (double girder EOT crane)
  ii. Sea Water Intake Pump House (single girder Overhead EOT crane)
  iii. Ash Compressor House (Underslung Crane)
  iv. Ash water Pumphouse (Underslung Crane)
  v. Ash Slurry pumphouse (Overhead Single Girder EOT Crane)
  vi. Ash water recovery Pumphouse (Underslung Crane) (if applicable)
  vii. Clarified Water Pump House (Under Slung Crane)
  viii. Filter water Pump House (RO Stage I Permeate) (Under Slung Crane)
  ix. Air Compressor Room (Overhead EOT Crane)
  x. DG room. (Under Slung Crane)
  xi. Work shop (Single Gider overhead EOT Crane) – Min 10T
  xii. Boiler Feed Pump House (Overhead EOT Crane)
  xiii. Stores
  xiv. GIS (Double Girder Overhead EOT)
  xv. UF Permeate Pumphouse (underslung EOT)
  xvi. Mill Reject compressor room (Underslung EOT)

REFER ANNEXURE-A OF SEC-IA FOR DETAILED SCOPE OF SG CRANES

- Electric hoists/ Manual chain pulley blocks in areas like Boiler area(ID fan, FD fan, PA fan, Boiler circulation pump, coal feeder area, Airpreheater, seal air fan, ESP, Bottom ash silo, fly ash silo and mill reject ash silo, Mill reject compressor, Power house building (Vacuum pumps, CEP, DMCW pumps, ACW pumps, butterfly valves at condenser inlet and outlet, condenser water box, Lube oil unit, control oil unit and central lube oil system), Electro Chlorination building, Desalination building Gravity filtered pipe gallery, Coal Handling System (Crusher House, Transfer towers, Head/Tail end of conveyors, Bunker building, flap gate, flow divider, junction tower, ERH, etc.), Water treatment plant , Effluent treatment plant and Sewage treatment plant, Sea water intake pump house stop-log gates and screens, HVAC Building, AC plant, Fuel Oil Pump House, ETP, Air Washer Room, Chemical house, Hydrogen generation building, AHP(compressor, vacuum pumps, slurry pump house) & any other areas as applicable.
- Gantry Crane (EOT) shall be provided for handling stop log gates & screens in the CW Pumphouse,

17.2 Equipment Sizing and Design Criteria

17.2.1 **EOT Cranes**

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

The CW Pumphouse EOT crane shall be rated for the heaviest component to be handled in the CW Pumphouse.

The lift for the CW Pumphouse EOT crane shall be based on lifting the circulating water pump out of the pump suction flume onto the maintenance floor area.

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

The EOT cranes shall be designed as per Class M5 for mechanical and structural components and Class M5 for all electrical components IS: 807, 1S 3177.

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

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

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

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

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

17.2.4 **Other Features**

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

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

The EOT cranes are designed with a maximum deflection of 1/900 of crane span at rated load.

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

17.2.9 **EOT cranes for other buildings**- The cranes shall be underslung type

17.2.10 **Hoists and Trolleys with Monorails**

REFER ANNEXURE-A OF SEC-IA FOR DETAILED SCOPE OF SG CRANES

For items weighing 300 kg and above, hoists and trolleys along with monorails shall be provided throughout the plant where crane cannot be utilized. For items weighing less than 1000 kg, manual hoists shall be provided. For items weighing 1000 kg and more, electric hoists (lift & travel) shall be provided. In case the lifting height is more than 10m, electric hoist (lift & travel) shall be provided irrespective of the weight. All hoists shall be provided with trolleys.

Apart from above the following fixed chain pulley blocks having 6 m lift shall be supplied by the bidder.

1T capacity – 10 nos.
3T capacity – 10 nos.
5T capacity – 8 nos.
10T capacity – 3 nos.

17.2.11 **Capacity of Cranes & Hoists**

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

17.3 **Electrical Requirements**

17.3.1 Electrical equipment shall be adequately rated to permit simultaneous operation of nay combination of motions of the crane for it duty service.

17.3.2 **Motors**

17.3.3.1 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.

17.3.3.2 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.

17.3.3.3 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 voiltage.
- 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.

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

17.3.3.5 The VVF drive control shall be used for control of each motion. The VVf drive shall be equipped at least with 1024 pulse incard, droop control for synchronization and crane software. The rating of VVF shall be decided considering 250% of full load

current of respective drive motor based on in panel rating with derated at 50 Deg C ambient temperature.

17.3.3.6 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.

17.3.4 **DSL**

17.3.4.1 DSL shall meet the following requirements :

- Shrouded bus bar type.
- Minimum 20% allowance for wear and tear shall be considered during sizing.
- Voltage drop for all conductors and cables/ wires shall be limited to 3% of rated voltage between the main disconnect witch and motor terminals.

17.3.5 **LIMIT SWITCHES**

The limit switches shall be totally enclosed type IP-55.

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. Track type limit switches shall be provided on the bridge and trolley to prevent over travelling in either direction.

17.3.7 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.

17.3.8 For other electrical and specific design requirements of electrical items refer Volume IV of the EPC specification.

17.4 **Control & Instrumentation Requirements**

17.4.1 Necessary start/stop and emergency controls shall be provided. Automatic reset type limit switches shall be provided to prevent over-travel for

a) Over hoisting and lowering motions of the hook.

b) Long travel motion

c) Cross travel motion

17.4 **OPERATING SPEEDS FOR MISCELLANEOUS HOISTS**

a.	Hoist	:	3 m/min
b.	Trolley travel	:	6 m/min
c.	Long travel	:	10 m/min

d.	Creep speed	:	10% of full speed (as applicable)
e.	Crane runway rails	:	Rails to suit

DATA SHEET FOR TG BUILDING EOT CRANE

1.	Number of Cranes			:	Two (2) nos.
2.	Crane Classification			:	Class-II to BS:466-1947 IS:807 & IS:3177
3.	Type of service			:	Indoor
4.	Capacity – Main Hoist				
	a.	Rated	Tonnes	:	By Bidder (Min 125T)
	b.	Test load	Tonnes	:	125% of rated load
5.	Capacity – Auxiliary Hoist				
	a.	Rated	Tonnes	:	By Bidder
	b.	Test load	Tonnes	:	125% of rated load
6.	Type of Hooks				
	a.	Main Hoist		:	Ramshorn type swiveling hook with locking device
	b.	Auxiliary Hoist		:	Standard single swiveling hook with locking device
7.	Number of trolleys			:	One (1)
8.	Number of hoists on trolley			:	Two (2): One (1) Main and One (1) Auxiliary Hoist
9.	Crane structure			:	Bridge Girders of box type and steel fabricated construction
10.	Operating speeds with full load (M/min)				
	a.	Main Hoist		:	1.5
	b.	Auxiliary Hoist		:	6
	c.	Trolley travel		:	15
	d.	Longitudinal bridge travel		:	30

	e.	Creep speeds	:	10 percent of full speed for all motions
11.	a.	Crane runway rails	:	To suit
	b.	Runway Conductors (DSL)	:	as indicated in write up
12.	Operator's cabin :			
	a.	Type	:	Fixed open type
	b.	Location	:	On one (1) side of the bridge (towards B-row)
	c.	Height	:	2 metres
13.	Brakes :			
	a.	Hoists (Main/Aux) operated shoe type brake for each hoist	:	a) Electro-hydraulic thruster b) Electro-magnetic load brake for each hoist
	b.	Bridge travel	:	a) Electro-hydraulic thruster operated shoe type brake (to cater also for foot operation from cabin) b) Electro-magnetic load brake
	c.	Crab travel	:	a) Electro-hydraulic thruster operated shoe type brake b) Electro-magnetic load brake
	d.	Emergency/parking brake	:	Parking brake operable from the operator's cabin

DATA SHEET FOR EOT CRANE FOR OTHER AREAS

1.	Number of Cranes			:	One (1) in each area
2.	Crane Classification			:	Class-II to BS: 466-1947 IS: 807 & IS: 3177
3.	Type of service			:	Indoor
4.	Capacity – Main Hoist				
	a.	Rated	Tonnes	:	As specified
	b.	Test load	Tonnes	:	1.25 times rated load
5.	Capacity – Auxiliary Hoist				
	a.	Rated	Tonnes	:	As specified
	b.	Test load	Tonnes	:	1.25 times rated load
6.	Type of Hooks				
	a.	Hoist		:	Standard single swiveling hook with locking device
7.	Number of trolleys			:	One (1)
8.	Number of hoists on trolley			:	One (1)
9.	Crane structure			:	Bridge Girders of box type and steel fabricated construction
10.	Operating speeds with full load (M/min)				
	a.	Hoist		:	1.5
	b.	Trolley travel		:	15
	c.	Longitudinal bridge travel		:	30
	d.	Creep speeds		:	10 percent of full speed for all motions
11.	a.	Crane runway rails		:	To suit
	b.	Runway Conductors (DSL)		:	As indicated in write up
12.	Brakes for cranes & hoists :				
	a.	Hoists		:	a) Two (2) nos. Electro-hydraulic thruster type brake
	b.	Long travel		:	a) Two (2) nos. Electro-hydraulic thruster type brake

c.	Cross travel	:	a)	Two (2) nos. Electro-hydraulic thruster type brake
			b)	Two (2) nos. hydraulic thruster (foot operated)
			c)	One (1) no. Electro-hydraulic thruster type brak

CHAPTER - 6

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

a. Non-ferrous materials
b. Austentic stainless steel
c. Plastic and / or plastic coated materials
d. Insulated surface of equipment and pipes except color coating wherever required.
e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)

IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.
Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above due point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).
The grade of blasting shall be performed in line with the approved painting scheme.
The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.
Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement pf painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting
(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General
Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5^0C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3^0C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm2, according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this

specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

(i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.

(ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.

(iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.

(iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

(v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m2.

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry fim thickness 75µm.

At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature upto 120^0C as per clause 6.1 & 6.3. However

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry fim thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

6.5 Special Coating

(a) Parts exposed to temperatures above 120^0C, upto 200^0C, not insulated

(i) At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry fim thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.

Intermediate Coat

I pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm.
Total system dry film thickness 145µm.
Final coat according to colour code.

Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat.

In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall confirm to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work.

QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

6.6.2 Rubber Lining of Pipes, Valves and Tanks for DM Water

Pretreatment

Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.7 Painting for Electrical items

6.7.1 All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.

6.7.2 All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.

6.7.3 Painting of I & C equipment : Epoxy coating required for all I & C equipment.

6.8 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark Admirality Grey	632	-	-
2.	Boiler casing, ducting	Nut Brown	413	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
3.	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-
4.	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.	Switchgear	Light grey (Powder coated)		-	-
8.	Control & relay panels	Light grey (Powder coated)	631/70 78 of IS 1650	-	-
9.	Turbines	Light Grey	631	-	-
10.	Generators & Exciter	Light Grey	631	-	-
11.	Transformers	Aluminum	-	-	-
12.	Machinery guards	Signal red	537	-	-
13.	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-

14.00.00 NOISE LEVEL

The equivalent 'A' weighted sound pressure level measured at a height of 1.0 m above floor level in elevation and at a distance of one (1) meter horizontally from the nearest surface of any equipment / machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

(a.) Safety valves and associated vent pipes for which it shall not exceed 105 dBA.

(b.) Regulating drain valves in which case it shall be limited to 90 dBA.

(c.) TG unit in which case it shall not exceed 90 dBA.

(d.) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 85 dBA.

15.00.00 PACKAGING AND TRANSPORTATION

All the equipment & spares 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. Each spare shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer.In case of equipment supplied with grease/lubricants from imported origin, the supplied shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Owner to procure these items from indigenous sources. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & pre-assembly to bare minimum. The Owner's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

16.00.00 ELECTRICAL ENCLOSURE

All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

ANNEXURE-I

S. NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (sets)	NO. OF CD-ROMs (sets)
1.	PLANT DEFINITION MANUAL-	-	3 CD-ROMs
2.	Drawings "FOR APPROVAL"	10	Soft Copy
3.	Drawings "FOR INFORMATION"	10	Soft Copy
4.	Drawings "FINAL APPROVED DRAWING"	8	Soft Copy
5.	Drawings "AS BUILT "	8	3 CD-ROMs
6	DATASHEETS,DESIGNCALCULATIONS,PURCHASE SPECIFICATIONS, etc. and Other type of documents		
	i) For Approval	10	SOFT COPY
	ii) FINAL	8	3 CD-ROMs -
	iii) Analysis reports of equipment/ piping/ structures components/ systems employing software packages as detailed in the specifications		
	a) Input	10	SOFT COPY
	b) Output	10	SOFT COPY
	c) Drawings/ Sketches	10	SOFT COPY
7	Erection manual "FINAL"	8	3CD ROMS
8	Operation & Maintenance manual	10	3CD ROMS
9	Plant Hand Book "DRAFT"	6	SOFT COPY
10	Plant Hand Book "FINAL"	15	3CD ROMS
11	Commissioning and Performance Procedure manual	10	3CD ROMS
12	Performance and Functional Guarantees test report	6	3CD ROMS
13	Progress Reports	6	3CD ROMS
14	Project completion report	10	3CD ROMS
15	QA programme including	1	

S. NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (sets)	NO. OF CD-ROMs (sets)
	Organization for implementation and QA system manual (with revision-servicing)		
16	Vendor details in respect of proposed vendors including Bidder's evaluation report.	1	
17	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, POR etc.		
	(i) For review/comment	3	
	(ii) For final approval	4	1 set CD ROMS
18	Welding Manual, Heat Treatment Manuals,	4	
	Storage & preservation manuals		
	Final	4	2 CD ROMS
19	Monthly Vendor Approval	2	1 CD ROM
	and QP approval status		
20	QA Documentation Package for items / equipment manufactured and dispatched to site	2	2 CD ROMS
21	QA Documentation Package for field activities on equipment/systems at site	2	2 CD ROMS

m) Safety precautions to be followed in electrical supply distribution during erection

Operation & Maintenance Manuals

i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant / equipment including, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied to the Owner.

ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the Owner for records.

iii. A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings.

iv. The manuals shall include the following :

a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.

b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

c) Where applicable, fault location charts shall be included to facilitate finding the cause of maloperation or break down.

v. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant.

vi. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the Owner indicating lubrication method for each type/category of bearing.

8.03.02 **Plant Handbook**

The Bidder shall submit to the Owner a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipment and systems covering the complete project including

1. Design and performance data.
2. Process & Instrumentation diagrams.
3. Single line diagrams.
4. Sequence & Protection Interlock Schemes.
5. Alarm and trip values.
6. Performance Curves.
7. General layout plan and layout of main plant building and auxiliary buildings.
8. Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Owner's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03 **Project Completion Report**

The Bidder shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **Drawings**

(a.) All documents submitted by the Bidder for Owner's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I. The soft copies to be supplied shall be either in CDs, or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval could be in the Image form.

(b.) Final copies of the approved drawings shall be submitted on CD-ROM along with the requisite number of hard copies as per Annexure-I.

(c.) The completed plant documentation with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. shall be furnished to Owner.

(d.) All documents/text information shall be in latest version of MS Office.

ANNEXURES

ANNEXURE-I

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		

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		L&T		
		ABB		
		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	KOLKATA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		INDUSTRIES		
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
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 TELELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		INCOM CABLES (P) LTD	NEW DELHI	
		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	
		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	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
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	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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		
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		
		SCHNEIDER		
27.	PANELS	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		
30.	SHROUDED DSL	SUSHEEL		

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		STROMAG		
31.	LOAD CELL	IPA		
		SARTORIUS		
32.	GEAR BOX	OEM		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		
		BONGFILIOLI*		
33.	RAIL	JSPL		
		SAIL		

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

ANNEXURE II

MANDATORY SPARES LIST FOR SINGLE GIRDER EOT. CRANE
(Spares to be provided for each crane)

1.0	**SPARES FOR LONG TRAVEL UNIT**	
A	SET OF AXLE BEARINGS	1 SET
B	SET OF GEARBOX BEARINGS WITH SLEEVES	1 SET
C	LONG TRAVEL END SHAFT BEARINGS	1 SET
D	COUPLING	1 SET
E	SEALS FOR TRAVEL GEAR BOX	1 SET
F	LONG TRAVEL BRAKE SHOES	1 SET
G	LONG TRAVEL BRAKE SPRINGS	1 SET
H	LONG TRAVEL BRAKE SHOE LINERS	1 SET
2.0	**SPARES FOR CROSS TRAVEL UNIT**	
A	AXLE BEARINGS	1 SET
B	SET OF GEARBOX BEARINGS WITH SLEEVES	1 SET
C	SET OF SEALS FOR GEARBOX	1 SET
D	CROSS TRAVEL END SHAFT BEARING	1 SET
E	COUPLING	1 SET
F	CROSS TRAVEL BRAKE SHOES	1 SET
G	CROSS TRAVEL BRAKE SPRINGS	1 SET
H	CROSS TRAVEL BRAKE SHOE LINERS	1 SET
3.0	**SPARES FOR MAIN HOIST**	
A	MAIN HOIST PULLEY BEARINGS	1 SET
B	SET OF BEARINGS FOR RODE DRUM	1 SET
C	SET OF BEARINGS FOR GEAR BOX	1 SET
D	SET OF SEALS FOR MAIN HOIST	1 SET
E	MAIN HOIST BRAKE SHOES	1 SET
F	MAIN HOIST BRAKE SPRINGS	1 SET
G	MAIN HOIST BRAKE SHOE LINERS	1 SET
H	DISC PAD	1 SET
4.0	**ELECTRICAL: CONTROL PANELS/MOTORS**	
a	POWER CONTACTOR OF EACH RATING	2 NOS.
b	OVER LOAD RELAYS OF EACH RATING	2 NOS.
c	MCCB/MPCB OF EACH RATING	2 NOS.
d	PUSH BUTTON OF EACH TYPE	2 NOS.
e	SPARES FOR VVVF DRIVE OF EACH RATING	1 SET
f	SET OF BEARINGS FOR MAIN HOIST MOTOR	1 SET
g	SET OF BEARINGS FOR CROSS TRAVEL MOTOR	1 SET
h	SET OF BEARINGS FOR LONG TRAVEL MOTOR	1 SET
	Mandatory spares from Electrical & C&I List (Applicable for total population of SG cranes)	
5.0	**ELECTRICAL ITEMS**	
	Motor of each type & rating	10% of the installed quantity or minimum 1 number whichever

		be higher
6.0	**C&I ITEMS**	
A	Limit switch	2 set of each type & size
B	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more

Note:-

1. "One (1) Set" and "One (1) set of each type & size" is defined as 100% requirement for one crane for the entire cranes of similar size & capacity.
2. "All essential spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is not applicable for particular equipment then suitable applicable alternate spare have been offered / shall be supplied without any financial implication."
3. For quantities indicated in percentage, fractions are to be rounded-off to next higher integer.
4. Any item which is "not applicable" in the above list and is found to be "applicable" at a later date shall be supplied by the Vendor without any extra cost.
5. All mandatory spares to be interchangeable with the original equipment.
6. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
7. Each spare part shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content 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.

ANNEXURE III
PAINTING

Painting of the equipment shall be carried out to protect the same from rusting / corrosion during shipping, long storage at site, erection, and during its normal operation / usage.

Whilst the essential requirements of surface preparation and painting are specified here, these in no way relieve the contractor of his responsibility to carry out his work in accordance with good practices. However, any deviation/modification from the specification shall be referred to the purchaser for approval.

A) Steel structure: -

Surface preparation : Blasting according to SIS 055900 grade Sa 2½

Primer : Two (2) layers of Primer paint shall be Zinc Silicate, total dry firm thickness 120 µm. (60 µm per coat)

Intermediate : Two intermediate MIO Epoxy paint, DFT per coat 90 µm (total 180 µm)

Finish Coat : One (1) finishing coats of Polyurethane coating. 30microns DFT.
Total DFT : 330µm

B) Mechanical Components and Motor: –

Surface preparation : Blasting according to SIS 055900 grade Sa 2½

Primer : Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75 microns

Finish Coat : Two (2) finishing coats of chlorinated rubber at 30-40 microns DFT each coat

Total DFT : 135-155µm

C) Control Panel:

Surface preparation : Seven tank process

Primer : two coats of zinc rich primer paint, total dry film thickness 75µm.

Finish Coat : two coats of finishing epoxy paint shall be applied, 30-40 microns DFT each coat.

Total DFT : 135-155µm
Or powder coating – 75 micron (total DFT)

Color Shade:

SL. No	Item Description	Colour Shade	Remarks
1	Crane/hoist Structure	Golden Yellow Shade 356 as per IS-5	Colour band black
2	Trolley & hook	Crimson shade 540 as per IS-5	
5	Motors	Light grey 631 as per IS 5	
6	Control Panels	Light Grey 631 of IS-5/ RAL 7032	

Bidder to also follow the end customer Technical specification wrt painting requirements, surface preparation & colour coding available at Section-IA of this Technical specification.

ANNEXURE IV

Procedure for Load/Overload testing of Single Girder EOT/Underslung/semigantry/gantry 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. Resisters 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.

ANNEXURE – V

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

Sl. No.	BHEL DRG.NO	DRAWING TITLE	REMARKS	SUBMISSION SCHEDULE - WEEK NUMBER FROM DATE OF P.O
1	PE-V0-412-524-A100	Manufacturing Quality Plan with sub vendor list for single girder EOT crane	APPROVAL	2
2	PE-V0-412-524-A101	Data sheet of Single Girder Crane with painting details	APPROVAL	2
3	PE-V0-412-524-A102	GA.of Single Girder EOT CRANE along with CT festoon cable details	APPROVAL	2
4	PE-V0-412-524-A103	Mechanism Sizing Calculation	APPROVAL	2
5	PE-V0-412-524-A104	G.A. drg of Hoist with trolley wheel assembly	INFORMATION	3
6	PE-V0-412-524-A105	Bottom Block assembly	INFORMATION	3
7	PE-V0-412-524-A106	General arrangement for LT cable trailing for Single Girder crane	INFORMATION	3
8	PE-V0-412-524-A107	Schematic Circuit Diagram for following a) Main Protective panel & BOM b) Main hoist panel & BOM c) Cross Traverse and Long Travel panel & BOM d) Pendent and earthing.	APPROVAL	3
9	PE-V0-412-524-A108	Long travel Machinery Assembly with LT wheel assembly	INFORMATION	4
10	PE-V0-412-524-A109	Detailed BOM/BOQ for crane	INFORMATION	6
11	PE-V0-412-524-A110	General arrangement of panel & pendent push button	INFORMATION	4
12	PE-V0-412-524-A111	Cable sizing calculation and schedule.	APPROVAL	3
13	PE-VO-412-524-A113	Mandatory spare parts list (if applicable)	APPROVAL	6
14	PE-V0-412-524-A112	O & M Manual	INFORMATION	8
15	PE-V0-412-524-A115	Erection procedure	INFORMATION	8

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. Detailed list/ break-up of mandatory spares shall be submitted along with BBU by supplier for approval during engineering.
5. Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.
6. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

    a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

    b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

    c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

    d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

    e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

    f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

    g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

    h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

    i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

    j) Bidder to follow the following the drawing submission schedule:

        i. 1st submission of drawings from date of LOI as per the submission schedule.

ii. Every revised submission incorporating comments – within 7 days.

k) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

B.0 NO.OF DRAWINGS/DOCUMENTS FOR SUBMISSION

A.	Drawing for Approval	No. of prints/copies (hard prints)
i.	For approval	8
ii.	For final distribution (after the vendor obtains final approval from the customer).	12
B.	Certificate, reports etc. (Material test, inspection report and all other type of tests etc.)	6
C.	O&M Manual	
I.	Draft for approval	2
ii.	For final distribution	12

Note:
a) The number of prints/hard copies are indicative and may change on project to project basis.

b) Bidder to note that all the drawings and documents shall also be submitted on CD's (compact dics) 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).

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				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**Operation Guidelines for plant personal/user/operator**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	**Maintenance guidelines for plant personal**				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to				

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

Checked by
Dealing Engineer

Key Resource Person

Section Head

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.

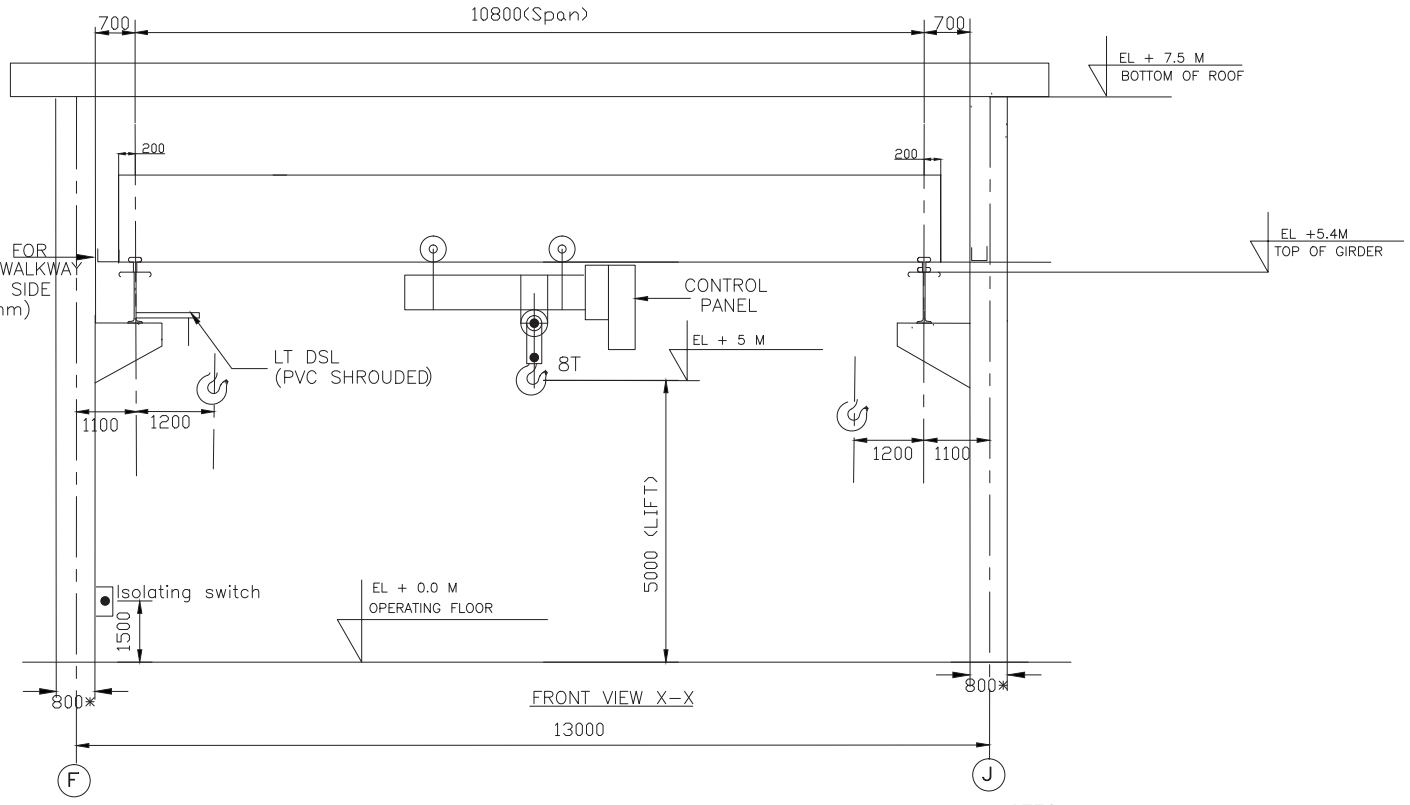
The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition, the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement.

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.

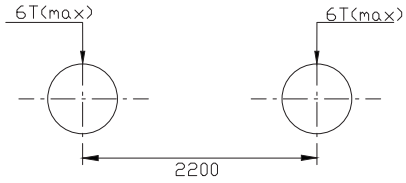
Note: Bidder to follow the end customer Technical specification at Section-IA of this Technical specification for others details wrt Packing Procedure.

ANNEXURE –VIII

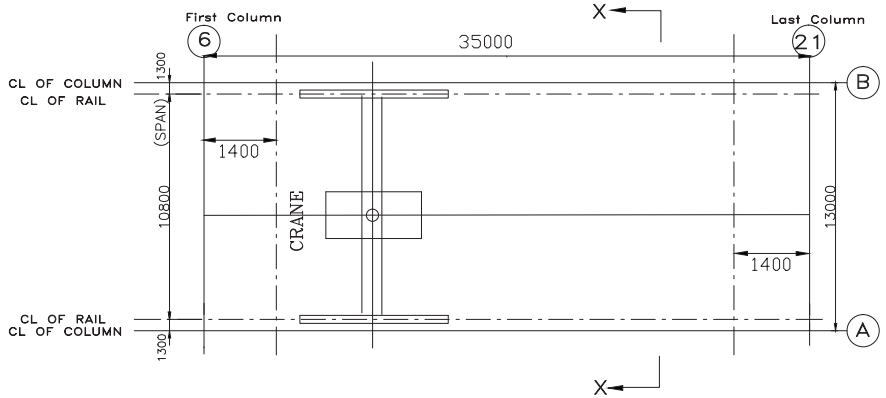
INPUT DRAWINGS



SL NO.	TECHNICAL SPECIFICATIONS PARAMETERS	
9.	CREEP SPEED SHALL BE ACHIEVED THRU' VVVF DRIVES	
8.	CLASS	M5
7.	DUTY	INDOOR DUTY
6.	QTY.	1 NO
5.	BAYLENGTH	35 MTRS
4.	LIFT	5 MTRS
3.	WHEEL LOAD (WITHOUT IMPACT) PER PAIR	6 T
2.	SPAN	10.8 MTRS
1.	SAFE WORKING LOAD	8 T



LT WHEEL LOAD
(WITHOUT IMPACT)



KEY PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. "*"MARKED DIMENSIONS ARE TENTATIVE & ANY CHANGE IN COLUMN SIZE SHALL AFFECT CRANE SPAN & APPROACHES
3. LIFT & SPAN ARE TENTATIVE & MAY VARY BY +/– 1000 MM.

CUSTOMER: TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)
2X660 MW ENNORE SEZ STPP

OWNER'S CONSULTANT: DESEIN PRIVATE LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

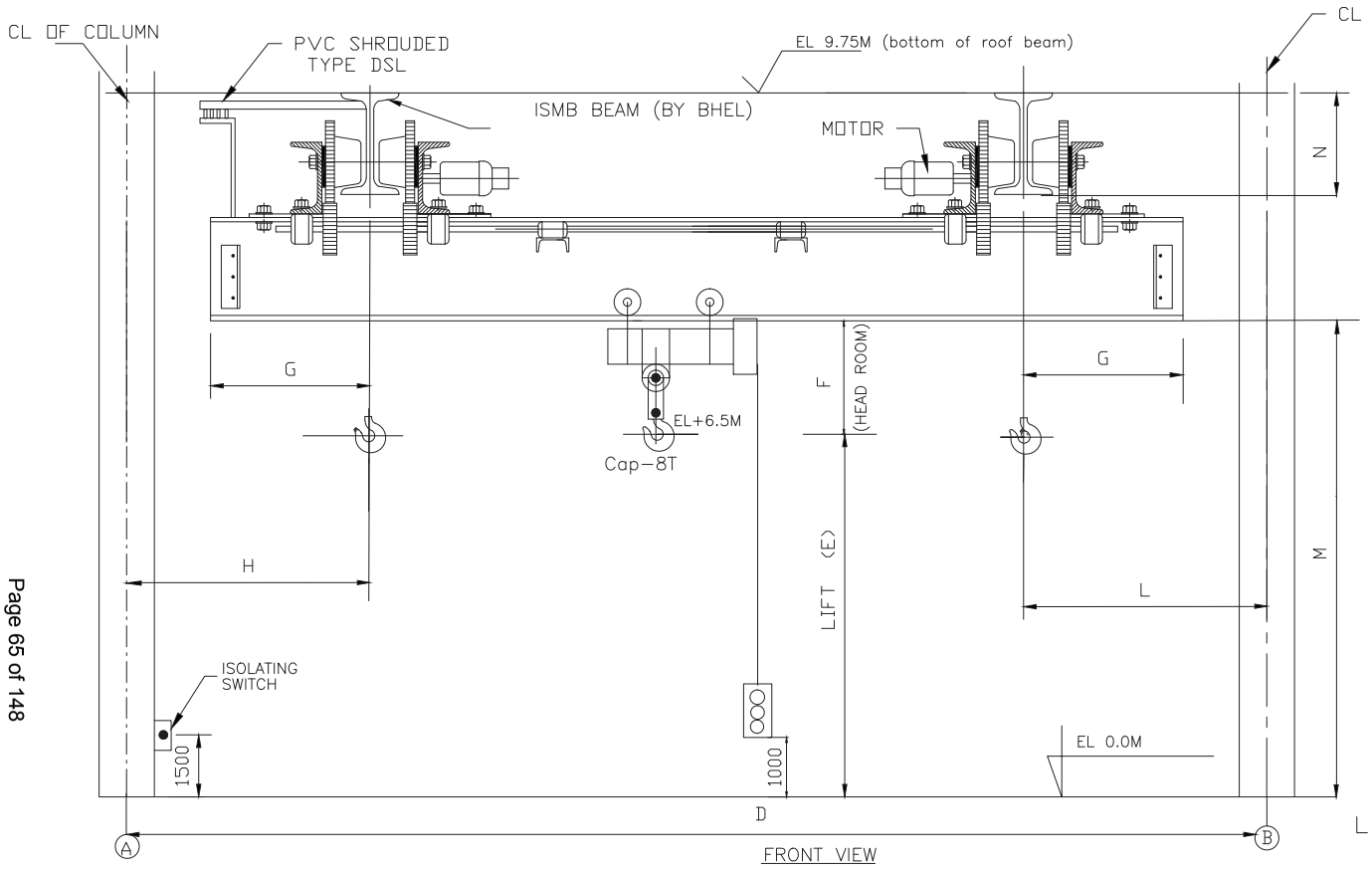
DEPT CODE		NAME	SIGN	DATE
M	DRN	BS		
	DESN	BS		
	CHD	PKK/GB		
	APPD	PK		

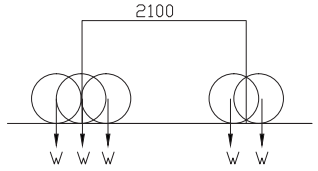
TITLE: CRANE CLEARANCE DIAGRAM FOR 8T CAPACITY SINGLE GIRDER O/H CRANE FOR AIR COMPRESSOR BUILDING

DEPT. | SCALE | DRAWING NO. PE-DG-412-524-A001
SIGN | SHEET 1 | REV. 0

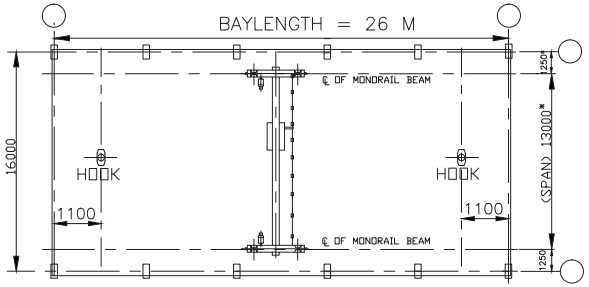
COMPUTER FILE NAME : TAL5

DESIGN PARAMETERS	
A	13000*
B	*
C	*
D	16000
E	6500
F	*
G	750
H	1250*
L	1250*
M	*
N	*

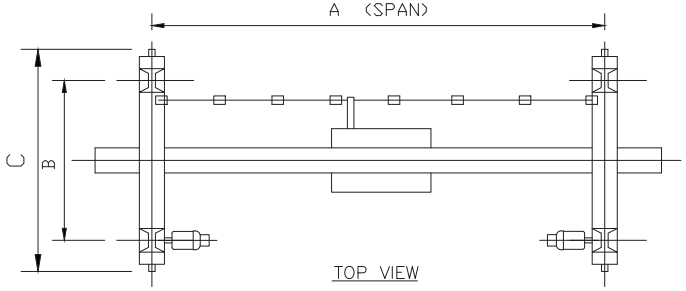




LT WHEEL LOAD WITH OUT IMPACT (W=3.00T APPROX.)



KEY PLAN



TOP VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL '*' DIMENSIONS ARE TENTATIVE & SHALL BE FINALISED DURING DETAILED ENGG.
3. LIFT & SPAN ARE TENTATIVE & MAY VARY BY +/- 1000 MM.

REVIEWED										
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)
2X660 MW ENNORE SEZ STPP

DESEIN PRIVATE LIMITED

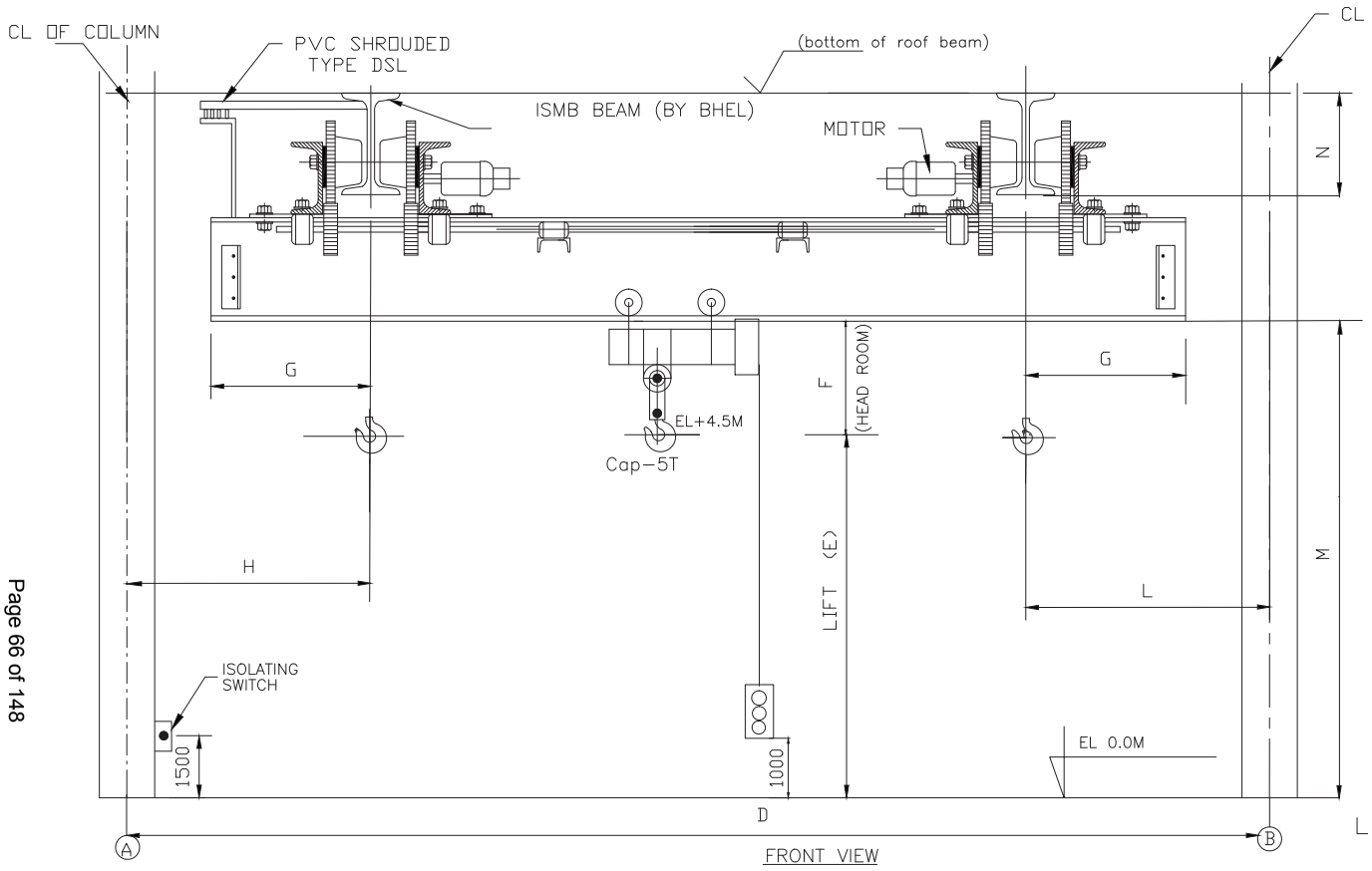
BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

	NAME	SIGN	DATE
DRN.	BS	--SD--	25.05.17
CHD.	PKK/GB	--SD--	25.05.17
APPD.	PK	--SD--	25.05.17

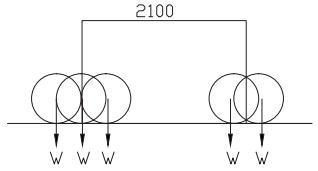
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR DG_BUILDING

UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A002 | REV. R0

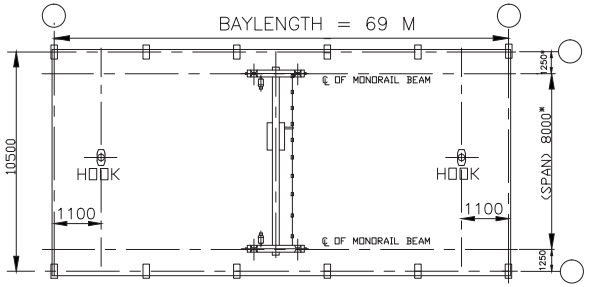
DESIGN PARAMETERS	
A	8000*
B	*
C	*
D	10500*
E	4500
F	*
G	750
H	1250*
L	1250*
M	*
N	*



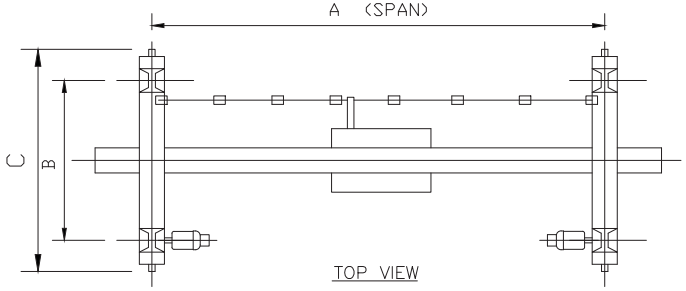
FRONT VIEW



LT WHEEL LOAD WITH OUT IMPACT (W=2.25T APPROX.)



KEY PLAN



TOP VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL '*' DIMENSIONS ARE TENTATIVE & SHALL BE FINALISED DURING DETAILED ENGG.
3. LIFT & SPAN ARE TENTATIVE & MAY VARY BY +/- 1000 MM.

REVIEWED										
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)
2X660 MW ENNORE SEZ STPP

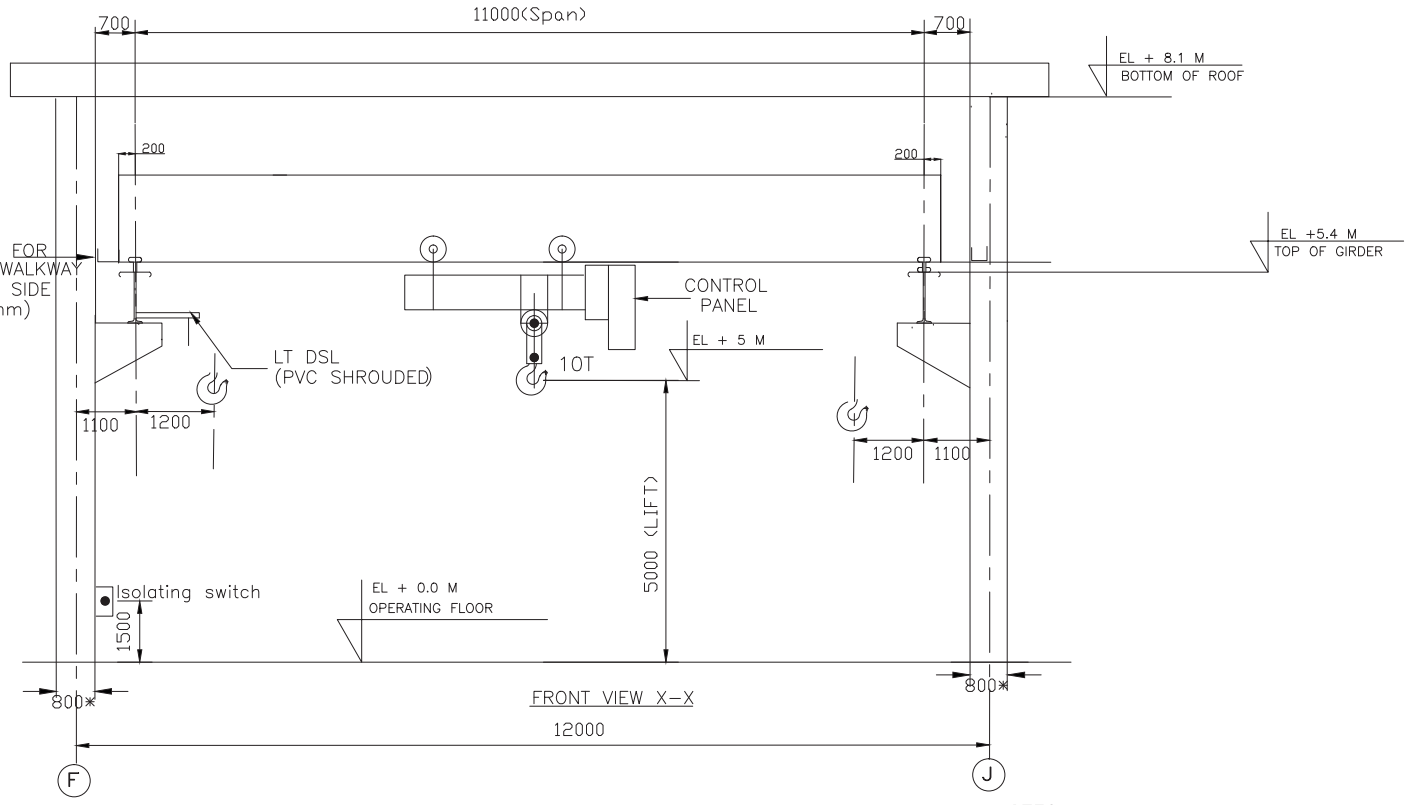
DESEIN PRIVATE LIMITED

BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

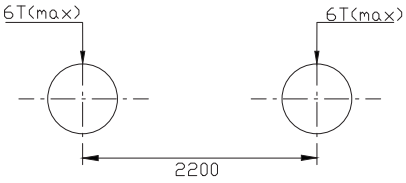
	NAME	SIGN	DATE
DRN.	BS	--SD--	25.05.17
CHD.	PKK/GB	--SD--	25.05.17
APPD.	PK	--SD--	25.05.17

TITLE : CRANE_CLEARANCE_DIAGRAM_FOR FILTER_WATER_PUMP_HOUSE

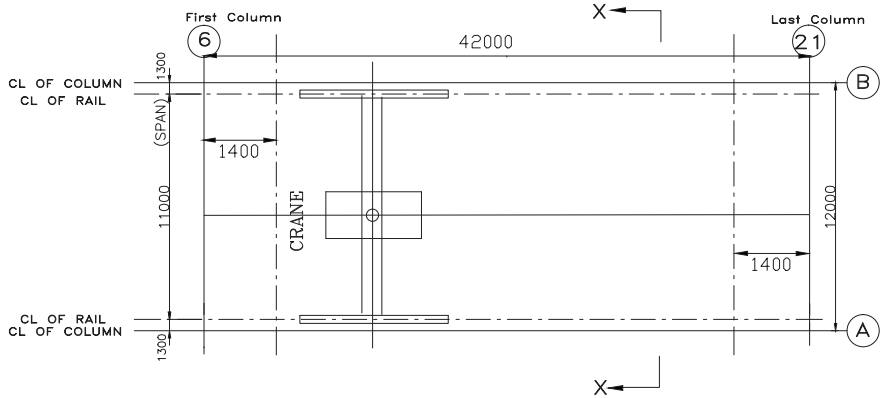
UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A003 | REV. R0



SL NO.	TECHNICAL SPECIFICATIONS PARAMETERS	
9.	CREEP SPEED SHALL BE ACHIEVED THRU' VVVF DRIVES	
8.	CLASS	M5
7.	DUTY	INDOOR DUTY
6.	QTY.	1 NO
5.	BAYLENGTH	42 MTRS
4.	LIFT	5 MTRS
3.	WHEEL LOAD (WITHOUT IMPACT) PER PAIR	6 T
2.	SPAN	11 MTRS
1.	SAFE WORKING LOAD	10 T



LT WHEEL LOAD
(WITHOUT IMPACT)



KEY PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. "*"MARKED DIMENSIONS ARE TENTATIVE & ANY CHANGE IN COLUMN SIZE SHALL AFFECT CRANE SPAN & APPROACHES
3. LIFT & SPAN ARE TENTATIVE & MAY VARY BY +/– 1000 MM.

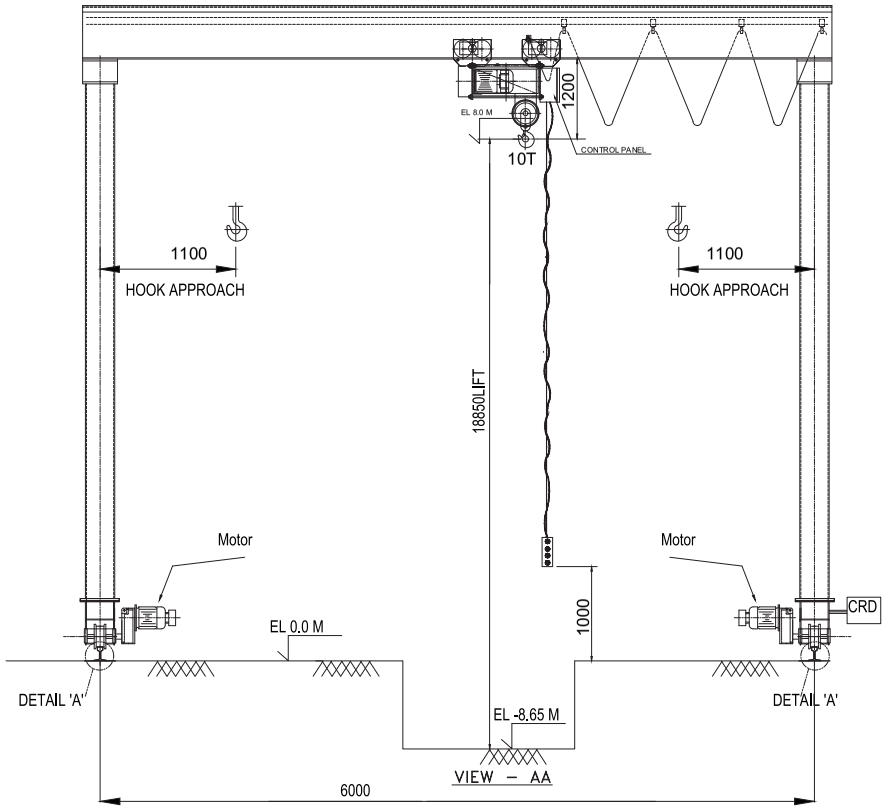
COMPUTER FILE NAME : TAL5

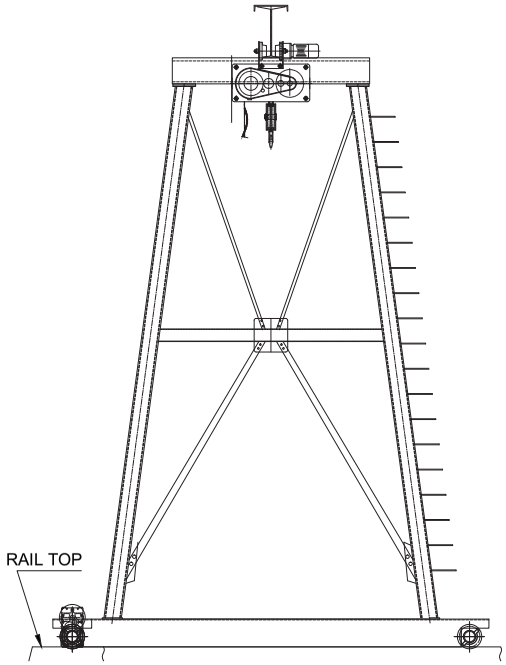
CUSTOMER:	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO) 2X660 MW ENNORE SEZ STPP
OWNER'S CONSULTANT:	DESEIN PRIVATE LIMITED
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

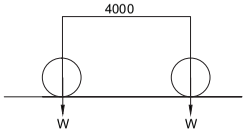
DEPT CODE		NAME	SIGN	DATE
M	DRN	BS		
	DESN	BS		
	CHD	PKK/GB		
	APPD	PK		

TITLE: CRANE CLEARANCE DIAGRAM FOR 10T CAPACITY SINGLE GIRDER O/H CRANE FOR WORKSHOP BUILDING

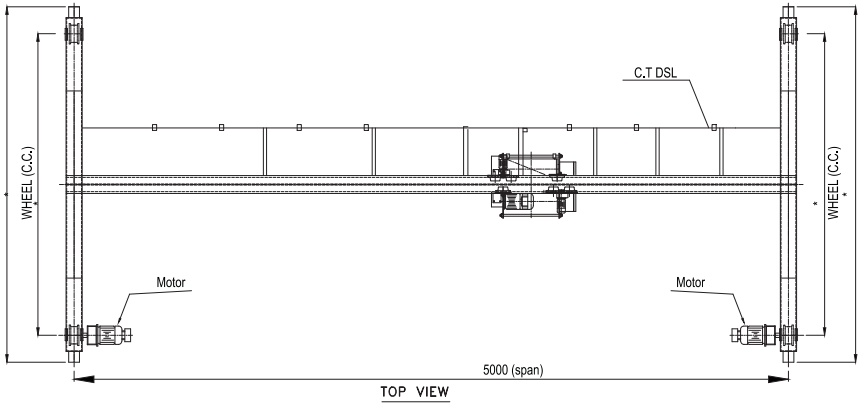
DEPT. | SCALE | DRAWING NO. PE-DG-412-524-A004
SIGN | SHEET 1 | REV. 0



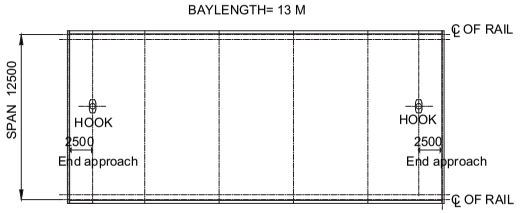




LT WHEEL LOAD WITH OUT IMPACT (W=5 T Max)



TOP VIEW



PLAN

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 - SOLE PLATE FOR FIXING OF RAILS SHALL BE IN BHEL SCOPE

CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA STATE, INDIA
1x800 MW KOTHAGUDAM TPS STAGE-VII UNIT#12, PALONCHA

OWNER'S CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

	DEPT	NAME	SIGN	DATE
CODE	DRN.	BS		
M	DSGN.	BS		
	CHD.	PKK		
	APPD.	DB		

TITLE: CRANE CLEARANCE DIAGRAM FOR 10T CAPACITY SINGLE GIRDER GANTRY CRANE FOR SEA WATER PUMP HOUSE SCREEN & GATE HANDLING

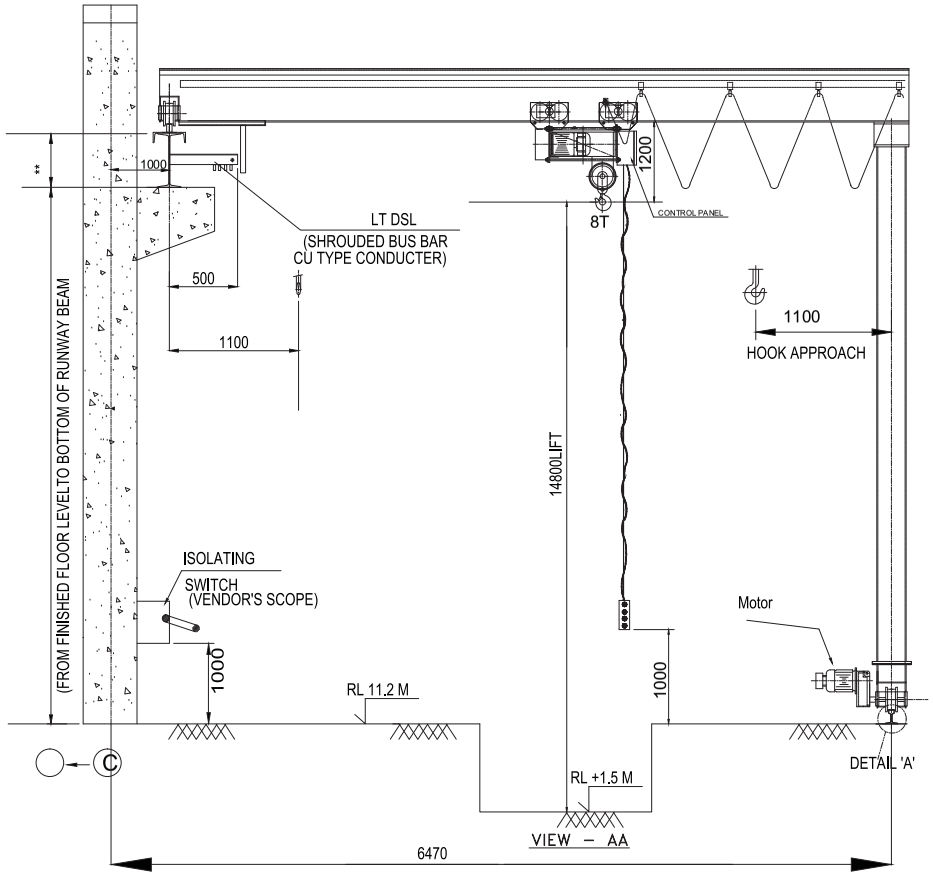
DEPT. | SCALE | DRAWING NO. PE-DG-412-524-A005
SIGN | SHEET 1 | REV. 0

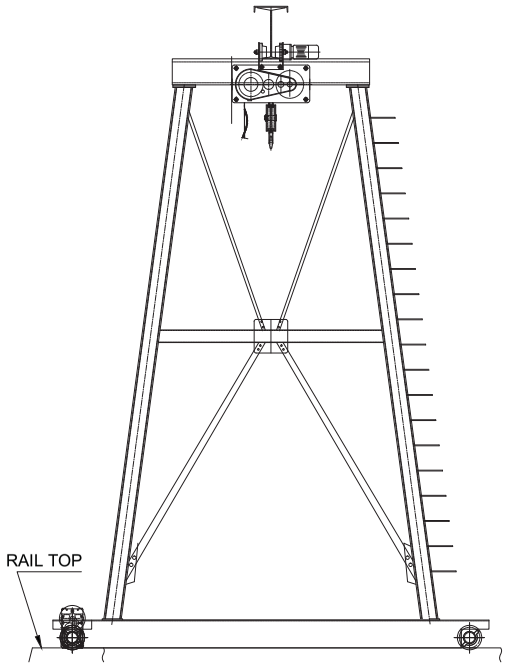
COMPUTER FILE NAME : TAL5

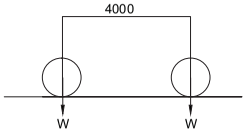
Fold-2 | ALL DIMENSIONS ARE IN MM | FIRST ANGLE PROJECTION | Fold-1

DRAWING NO. PE-DG-412-524-A006

CUSTOMER'S DRAWING NO.







LT WHEEL LOAD WITH OUT IMPACT (W=4.5 T)

NOTE-

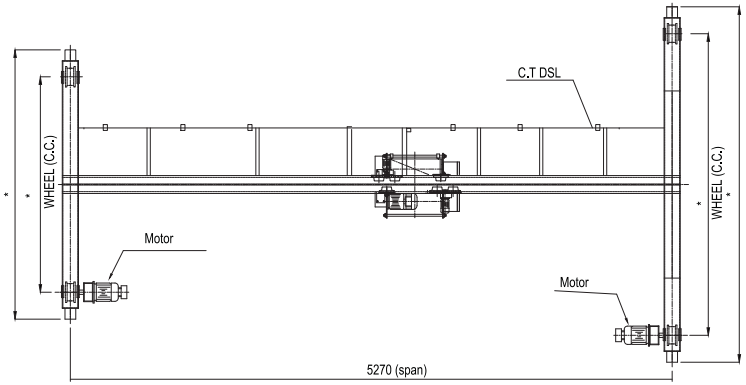
1 - ALL DIMENSIONS ARE IN MM.

2 - DSL(LT) => SHROUDED BUS BAR CONDUCTOR

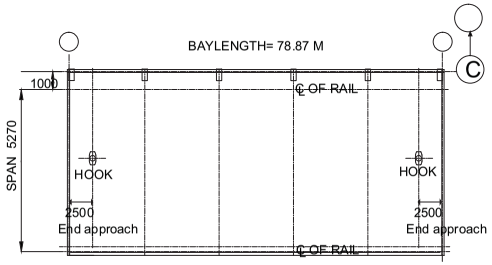
3 - ** SUBJECT TO FINALISATION OF STRUCTURE

4 - DIMENSION MARKED AS(*) IS TO BE GIVEN BY THE VENDOR

5 - CRANE SHALL BE OUTDOOR TYPE



TOP VIEW



PLAN

CUSTOMER:	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO) 2X660 MW ENNORE SEZ STPP
OWNER'S CONSULTANT:	DESEIN PRIVATE LIMITED
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN:	BS		
	DSGN:	BS		
	CHD:	PKK		
	APPD:	DR		

TITLE: CRANE CLEARANCE DIAGRAM FOR 8T CAPACITY SINGLE GIRDER SEMI GANTRY CRANE FOR CWPH SCREEN & GATE HANDLING

DEPT. | SCALE | DRAWING NO. PE-DG-412-524-A006 | SHEET 1 | REV. 0

COMPUTER FILE NAME : TAL5

Fold-2

DESIGN PARAMETERS	
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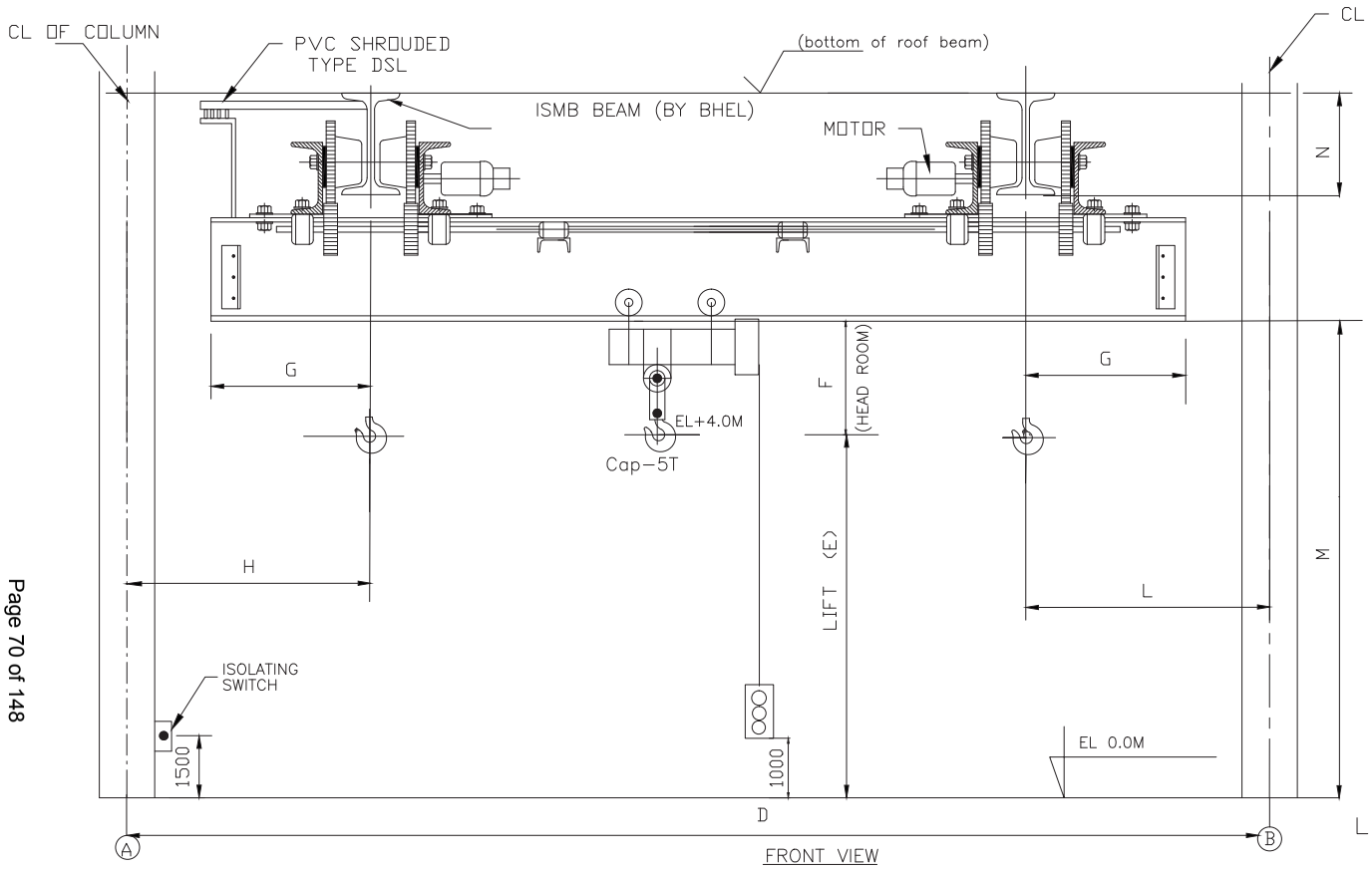
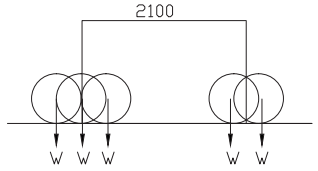
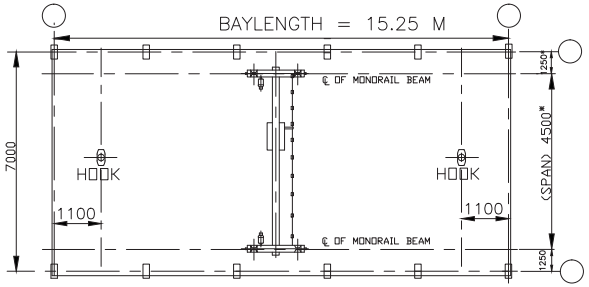
B	*
C	*
D	7000
E	4000
F	*
G	750
H	1250*
L	1250*
M	*
N	*



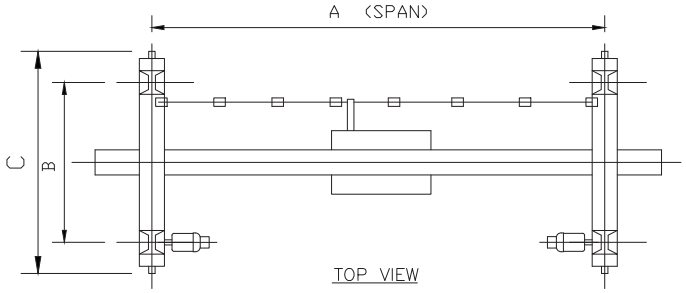
FRONT VIEW



LT WHEEL LOAD WITH OUT IMPACT (W=2.25T APPROX.)



KEY PLAN



TOP VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL '*' DIMENSIONS ARE TENTATIVE & SHALL BE FINALISED DURING DETAILED ENGG.
3. LIFT & SPAN ARE TENTATIVE & MAY VARY BY +/- 1000 MM.

REVIEWED										
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)
2X660 MW ENNORE SEZ STPP

DESEIN PRIVATE LIMITED

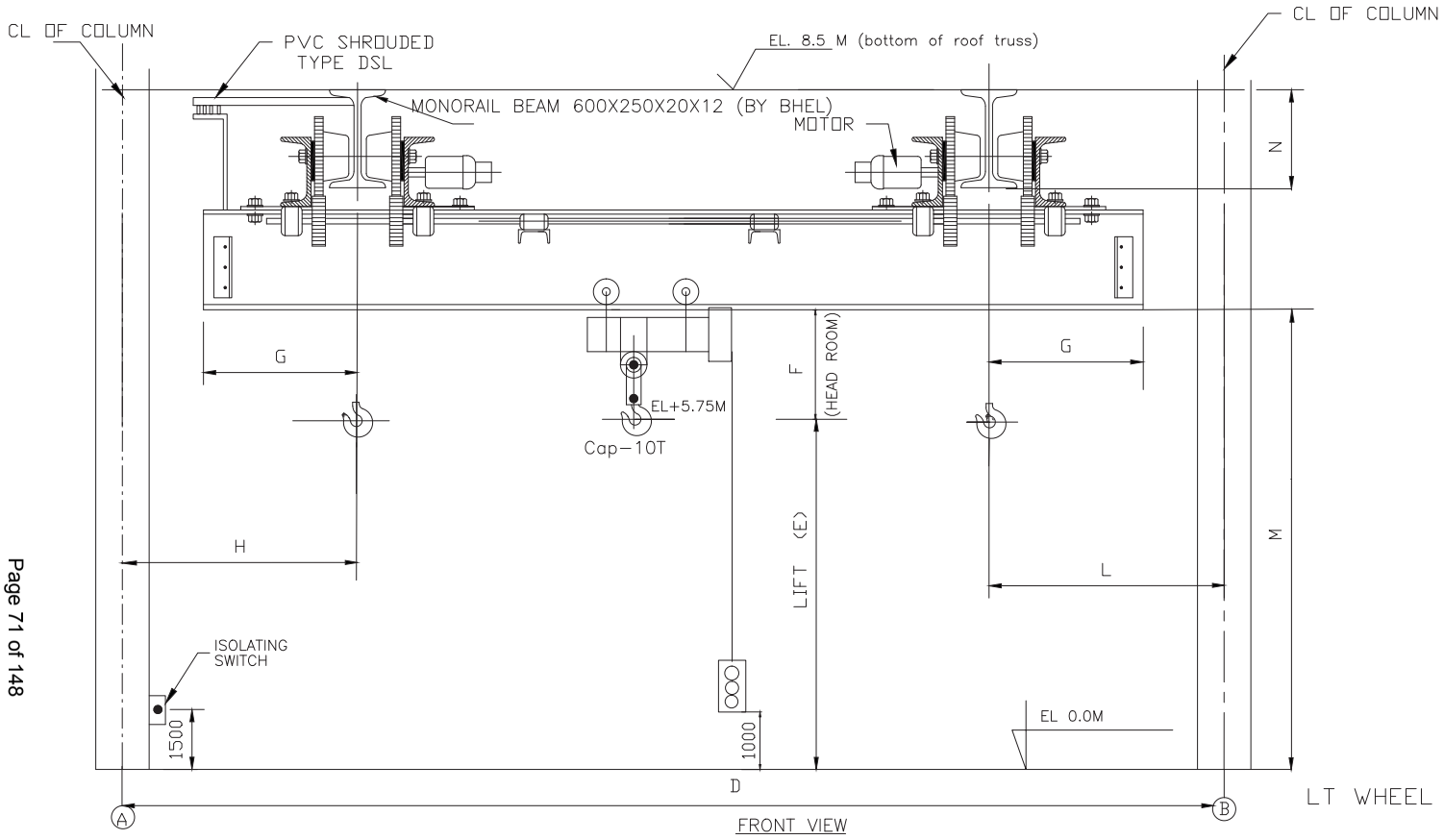
BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

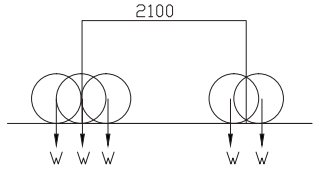
	NAME	SIGN	DATE
DRN.	BS	--SD--	25.05.17
CHD.	PKK/GB	--SD--	25.05.17
APPD.	PK	--SD--	25.05.17

TITLE : CRANE_CLEARANCE_DIAGRAM_FOR CLARIFIED_WATER_PUMP_HOUSE

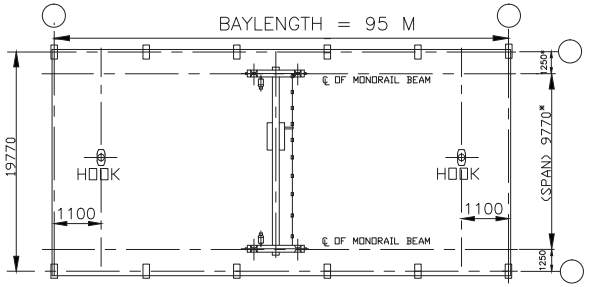
UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A007 | REV. R0

DESIGN PARAMETERS	
A	9770*
B	*
C	*
D	19770
E	5750
F	*
G	750
H	1250*
L	1250*
M	*
N	*

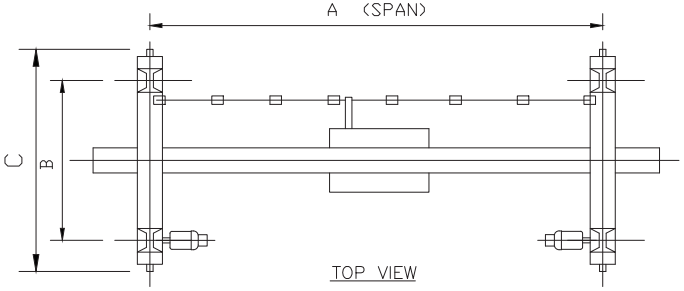




LT WHEEL LOAD WITH OUT IMPACT (W=3.25T APPROX.)



KEY PLAN



TOP VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL '*' DIMENSIONS ARE TENTATIVE & SHALL BE FINALISED DURING DETAILED ENGG.
3. LIFT & SPAN ARE TENTATIVE & MAY VARY BY +/- 1000 MM.

REVIEWED										
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)
2X660 MW ENNORE SEZ STPP

DESEIN PRIVATE LIMITED

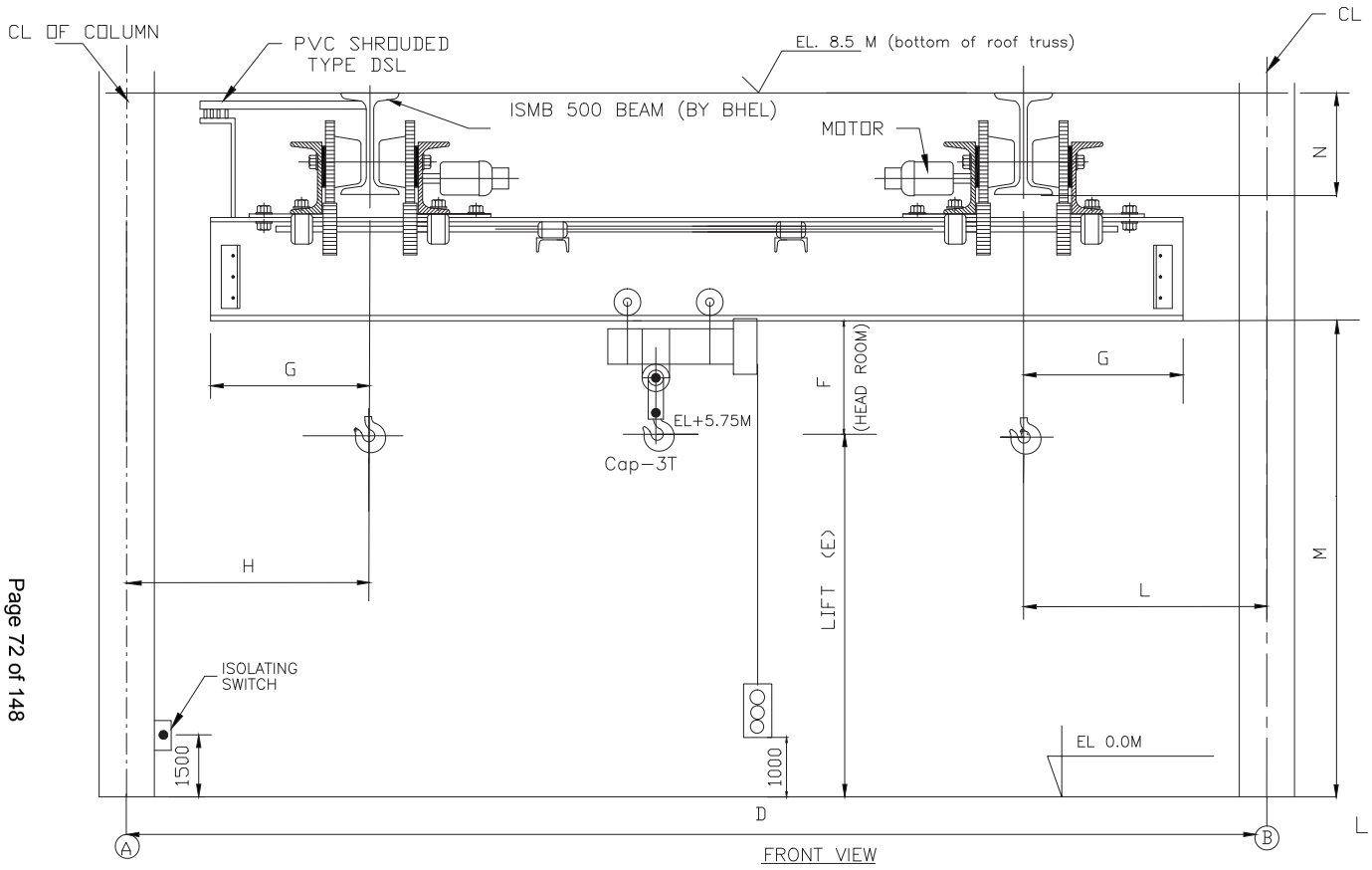
BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

	NAME	SIGN	DATE
DRN.	BS	--SD--	25.05.17
CHD.	PKK/GB	--SD--	25.05.17
APPD.	PK	--SD--	25.05.17

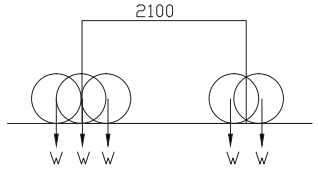
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR HEAVY_MATERIAL_STORE

UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A008 | REV. R0

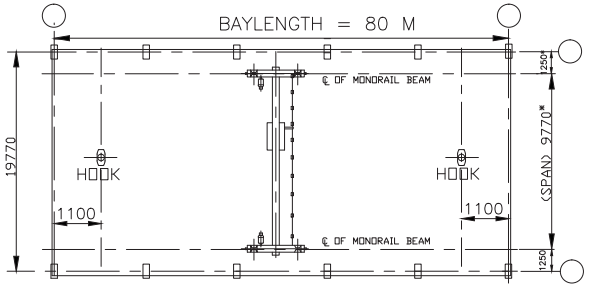
DESIGN PARAMETERS	
A	9770*
B	*
C	*
D	19770
E	5750
F	*
G	750
H	1250*
L	1250*
M	*
N	*



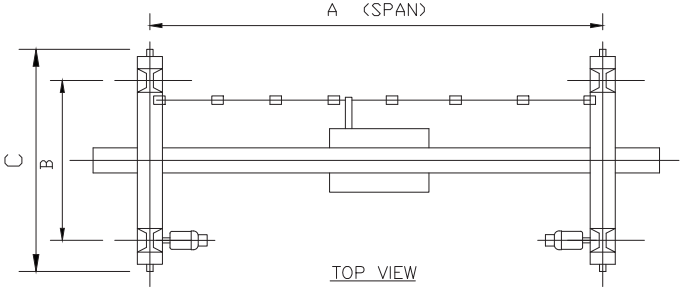
FRONT VIEW



LT WHEEL LOAD WITH OUT IMPACT (W=2.00T APPROX.)



KEY PLAN



TOP VIEW

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL '*' DIMENSIONS ARE TENTATIVE & SHALL BE FINALISED DURING DETAILED ENGG.
3. LIFT & SPAN ARE TENTATIVE & MAY VARY BY +/- 1000 MM.

REVIEWED										
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO)
2X660 MW ENNORE SEZ STPP

DESEIN PRIVATE LIMITED

BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

	NAME	SIGN	DATE
DRN.	BS	--SD--	25.05.17
CHD.	PKK/GB	--SD--	25.05.17
APPD.	PK	--SD--	25.05.17

TITLE : CRANE_CLEARANCE_DIAGRAM_FOR LIGHT_MATERIAL_STORE

UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A009 | REV. R0

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

IB – Specific Technical Requirement (Electrical)

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) Erection and Commissioning spares.
e) Erection & Maintenance tools & tackles.
f) Electrical load requirement for ELECTRIC HOISTS System.
g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
h) 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.
i) 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.
j) Motors shall meet minimum requirement of Electric motor specification.
k) All routine tests and type tests reports as per applicable standards shall be furnished at contract stage.
l) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.
m) LV Power Cables and Control Cables shall be as per cable annexure.
n) Cable trays shall be as per attached Cable Tray Annexure.
o) Panel shall be as per attached Panel Annexure.
p) Technical requirements shall be as per specifications listed in Clause 4.1 to 4.9. In case of any discrepancy between Basic technical Particulars for HT or LT motors and BHEL standard specification, Basic technical particulars for HT or LT motors shall prevail.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 **DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

3.1 The electrical specification without any deviation from the technical/ quality assurance requirements stipulated shall be deemed to be compiled by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of Compliance cum compliance sheet & cost of withdrawal sheet along with unpriced schedule.

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 Basic Technical Particulars of HT/LT motors.
4.4 Testing Requirements.
4.5 Quality Plan for LV Motors.
4.6 Load Data Format.

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

PACKAGE: SINGLE GIRDER EOT CRANES & ELECTRIC HOISTS

SCOPE OF VENDOR: SUPPLY

PROJECT :

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
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. Cables from isolating switch to hoist shall be in vendor 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.

Bidder to follow the end customer Technical specification at Section-IA of this Technical Specification for details of Motors for SG Cranes.

SPECIFIC ELECTRICAL REQUIREMENT FOR EOT CRANES/ ELECTRIC HOIST

SL.NO.	PARAMETERS	UNIT	ENNORE	
	MOTOR			
1	DESIGN AMBIENT TEMP	DEG. C	50	
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, ± 10%	
3	FREQUENCY WITH VARIATION	Hz	50 (+) 3% to (-) 5%	
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%	
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	160 kW	
6	SYSTEM FAULT LEVEL AND ITS DUARTION	KA	50 KA, 1 Sec	
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec	
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B	
9	MIN. STARTING VOLTAGE		85%	
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		Upto 200W	
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.	
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1.0m in line with IS 12065	
13	TYPE OF STARTER PROVIDED IN MCC		N.A.	
14	DOP OF ENCLOSURE		Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.	
15	SPACE HEATER REQUIREMENT		30KW & ABOVE	
16	PAINT SHADE		Shall be confirmed during detailed engineering.	
17	SPECIAL REQUIREMENT		Type test to be conducted on the identical motor in the last 5 years or after the last design change, which ever is earlier. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design. All motors shall be subjected to routine tests as per IS: 325. The motors shall generally conform to IS 325/IEC-60034.	

CHAPTER – 16

LV CABLES

1.00.00 CODES AND STANDARD

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

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

	Part-3 : Tests on bunched wires or cables (catagory -B)
SS-4241475 classF3	Swedish Chimney test
NES-715-1	Temperature index

2.00.00 TECHNICAL REQUIREMENTS

2.01.01 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.01.02 Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

2.01.03 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.

2.01.04 XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250°C.

2.01.05 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

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

Calculated nominal dia of cable under armour	**Size and Type of armour**
i) Up to 13 mm	1.4mm dia GS wire
ii) Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
iii) Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
iv) Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
v) Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
vi) Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

2.01.07 The aluminium used for armouring shall be of H4 grade as per IS:8130 with maximum resistivity of 0.028264 ohm mm^2 per meter at 20 deg C. Aluminium armouring shall be same as indicated above for galvanized steel.

2.01.08 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire

2.01.09 Cable Identification

1. Outer sheath shall be of PVC (of suitable grade) & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

   (a.) Oxygen index of min. 21 (As per NES-715-1)

   (b.) Acid gas emission of max. 20% (As per IEC-60754-I).

   (c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

2. Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:

   1 core - Red, Black, Yellow or Blue

   2 core - Red & Black

   3 core - Red, Yellow & Blue

   4 core - Red, Yellow, Blue and Black

3. For reduced neutral conductors the core shall be black.

4. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.

   (a.) Cable size and voltage grade - To be embossed

(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre- To be embossed / printed

The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

5. Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow, Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

2.01.10 All cables shall meet the fire resistance requirement of IEEE - 383 with cable installations made in accordance with clause “Flammability test” and as per Category-B of IEC 60332 Part -3.

2.01.11 Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.

2.01.12 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc, are not acceptable.

3.00.00 Cable selection & sizing

3.01.00 Cables shall be sized based on the following considerations:

i. Rated current of equipment.

ii. Maximum voltage drop limits under steady state and during starting for motor being fed from 415V switchgear restricted to 5% and 15% respectively.

Maximum voltage drop limits under steady state and during starting for motor being fed from 415V MCC restricted to 3% and 15% respectively.

Maximum voltage drop limits under steady state for feeder (i.e. Outgoing feeders being fed from 415V switchgear) restricted to 3%.

iii. For cables to motors and feeders protected by MCCBs the cross section will be chosen according to the tripping time of MCCBs.

3.02.00 Derating Factors

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

i. Variation in ambient temperature for cables laid in air
ii. Grouping of cables
iii. Variation In ground temperature and soil resistivity for buried cables.

3.03.00 Cable lengths shall be considered in such ways that straight through cable joints are avoided.

3.04.00 Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried.

3.05.00 All LV power cables except trailing cables shall be XLPE insulated FRLS.

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

3.07.00 Multicore control cables will generally have spare conductor (s) in accordance with the following chart and cores of a single cable will not be split for different auxiliary/equipment:

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

4.00.00 CONSTRUCTIONAL FEATURES

04.01.00 1.1 KV Grade Power Cables

(d.) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor for cables including 10 sq. mm and above and copper conductor for cables below 10 sq.mm, XLPE insulated, PVC inner-sheathed (as applicable), armoured, FRLS PVC outer-sheathed conforming to IS: 7098. (Part-I).

(e.) 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90°C continuous conductor temperature and 250 deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968

4.02.00 1.1 kV Grade Copper Conductor Fire Survival Power Cables

4.02.01 1100 volt grade, 90 Deg.C rating, Power cables with stranded Copper conductor, heat resistance elastomeric insulation generally conforming to Type IE-2 of IS: 6380-1984, extruded Halogen free or very low Halogen elastomeric inner sheath, generally conforming to Type SE-3 of IS-6380-1984, round wire/strip armour and extruded outer sheath of elastomeric material generally conforming to Type SE-3 of IS: 6380-1984.

4.02.02 The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988.

4.02.03 The cables shall be rated for 3 hours fire rating.

4.02.04 Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130.
A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.

4.02.05 The insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.

4.02.06 The suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass fiber binder tape shall be applied over the laid up cores.

4.02.07 Fire Survival Power & Control cables shall be provided for the following services:

(a.) DC emergency lube oil pump.
(b.) Turbine lube oil pump/barring gear.
(c.) Jacking oil pump.
(d.) Scanner air fan.
(e.) Incoming & outgoing cables for DC lighting distribution board.
(f.) Fire /smoke detection system.
(g.) DC seal oil pump.
(h.) DC emergency lighting cables for Main Plant Building.
(i.) Batteries to charger and DC distribution board.
(j.) Emergency turbine trip by push button in control room.
(k.) Boiler turbine: Generator inter-trip which includes the interconnecting cables between
1. Boiler master fuel trip and turbine trip relays
2. Generator trip relays and turbine trip relays
3. Generator trip relays and 400 kV circuit breaker
4. Generator trip relays and generator field breaker.
5. Generator trip relays and UAT breaker.

4.03.00 1.1 KV Grade Control Cable

Control cable shall be multi core, minimum 2.5 sq.mm cross section, stranded copper conductor, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situation where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.

Voltage Transformer leads shall be checked for voltage drop, which shall be limited to within 1 % for all cases other than tariff metering, for which the voltage drop shall be limited to 0.2 %. In case the voltage drop with 4 sq.mm Cu conductors exceeds this value, higher conductor sizes shall be used.

4.04.00 1.1 kV Copper Conductor Fire Survival Control Cables

4.04.01 Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS 8130/1984 amended up to date.

4.04.02 A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.

4.04.03 The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.

4.04.04 An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores.

4.04.05 The armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 3975 amended up to date.

4.04.06 The outer sheath shall be of special low smoke and very low Halogen content (Acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

4.04.07 The colour of outer sheath shall be black or any other natural colour agreed mutually between Owner and Contractor.

4.04.08 The minimum sizes of L.T. cable to be chosen are as below:
AL-16 mm^2 (3 core) & Cu – 2.5 mm^2 (3 core)

In power cables maximum conductor size to be used will be 300 sq. mm & 630 sq.mm for multi core and single core cables. In case of multi core cables not more than 3 runs to be used or otherwise single core cable to be used.

4.05.00 Cable Drums

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

5.00.00 TESTS

5.01.00 Type Tests:

5.01.01 The reports for the following type tests shall be submitted on one size each of LV Power cables :

S.No.	Type Tests	Remarks
a)	**For Conductor**	
1.	Annealing test	For copper conductor only.
2.	Tensile test	For aluminium conductor only.
3.	Wrapping test	For aluminium conductor only.
4.	Resistance test	
b)	**For Armour Wires/ Formed Wires**	
1.	Measurement of Dimensions	
2.	Tensile Test	
3.	Elongation test	
4.	Torsion test	For round wires only
5.	Winding test	For Formed wires only
6.	Resistance test	
7(a)	Zinc Coating test	For G.S. Formed wires /wires only.

7(b)	Wrapping test	For Al. Formed wires /wires
c)	**For XLPE insulation & PVC Sheath**	
1.	Test for thickness	
2.	Tensile strength & elongation tests before ageing and after ageing	
3.	Ageing in air oven	
4.	Loss of mass test	For PVC sheath only
5.	Hot deformation test	For PVC sheath only
6.	Heat shock test	For PVC sheath only
7.	Shrinkage test	
8.	Thermal stability test	For PVC sheath only
9.	Hot set test	For XLPE insulation only
10.	Water absorption test	For XLPE insulation only
11.	Oxygen index test	For outer sheath only
12.	Smoke density test	For outer sheath only
13.	Acid gas generation test	For outer sheath only
d)	For completed cables	
1.	Insulation resistance test (Volume resistivity method)	
2.	High voltage test	
3.	Flammability test as per clause “Flammability test”	
4.	Flammability test as per IEC - 332 Part-3 (Category -B)	

5.01.02 Flammability Test

(f.) This test shall generally be carried out as per IEEE 383. The cable installation to be tested shall consist of as many cables as are necessary to give atleast 10 kg of organic material per metre run.

(g.) The following cable installation shall be tested :

(1.) Installation with single / multi core cables in touching formation.

(h.) Size of cables, number of cables, number of layers and laying arrangements for each installation shall be subject to Owner's approval.

(i.) The size of the cables selected (measured by total cross sectional area of the conductor) shall have maximum organic material per sq. mm of total cross sectional area of all the conductors.

5.01.03 Acceptance Tests

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

S. No.	No. of drums in the lot	No. of drums to be taken as sample
1.	Upto 100	10% (Subject to minimum of 1 drum)
2.	101 to 300	13
3.	301 to 500	20
4.	Above 500	32

The following shall constitute acceptance tests :

1. Item No. 1 to 14, 16, 19, 20, 22, 23, 24, 25 of list of type tests specified in 9.03.01 of chapter 15.
2. Fire resistance test as per SS 4241475 (F3 category)
3. One length per size / lot for surface finish and length measurement
4. Lay length / sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Band marking.

5.01.04 Routine Tests

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

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

IC – Data Sheet A

DATA SHEET A

TECHNICAL DATA SHEET FOR
SINGLE GIRDER OVERHEAD / UNDERSLUNG/ SEMIGANTRY/ GANTRY EOT CRANE

S.N.	Description	Technical Particulars	
1.0.0	**GENERAL**		
1.1.0	**Name of Manufacturer**		
	a) EOT Crane	*	
	b) Runway conductors	*	
1.2.0	**WEIGHT OF EQUIPMENTS**		
	a) Crane weight (Kgs.)*	*	
	b) Weight of DSL (Kgs.)*	*	
1.3.0	**Design, fabrication and testing of crane conform to standard / code**	Mechanical and Electrical as per IS: 3177-1999 (Reaffirmed 2006) & Structure design in accordance to IS 807:2006. Hoists of crane as per IS 3938 (latest edition).	
1.4.0	**Number of cranes**	As per scope list attached in Section IA.	
1.5.0	**Crane Classification**	Group M5 of IS: 3177 – 1999 (latest edition) for Mechanical, Structural & Electrical.	
1.6.0	**Type of service**	Indoor/ outdoor (As per scope list attached in Section IA)	
1.7.0	**Type of Crane**	OVERHEAD / UNDERSLUNG/ SEMIGANTRY/ GANTRY EOT CRANE (As per scope list attached in Section IA.)	
1.8.0	**Capacity (SWC)**	As per scope list attached in Section IA.	
1.9.0	**Span and lift**	As per crane clearance diagrams attached	
1.10.0	**Load test**	As per IS: 3177	
1.11.0	**Over Load Test**	(125% of rated capacity-SWC)	
1.12.0	**Deflection Test**	Shall be carried out at SWL	
1.13.0	**Crane structure**	Fabricated from rolled section (Box section/ I- section)	
1.14.0	**Design ambient temperature**	50^0 C	
1.15.0	**Runway Rail**	ISMB (Shall be provided by CIVIL contractor) for underslung crane + rail for single girder EOT, gantry & semi-gantry cranes)	
1.16.0	**End carriage**		
1.16.1	Material	M.S. as per IS: 2062, GR B	
1.17.0	**Main girder**		
1.17.1	Type & Size	Fabricated from rolled section (Box section/ I- section)	
1.17.2	Material	M.S. as per IS: 2062, GR B	
1.17.3	Type of connection to end carriage	As per manufacturer's standard.	
1.18.0	**Vertical Deflection**	Vertical deflection shall be as Span / 900 (maximum)	
1.19.0	**Power supply**	415V $\pm$ 10%, 3 phase, 4 wire, 50 Hz,+3% -5% variation. Combined voltage and frequency variation 10% (Shall be arranged by Purchaser at 1.5 M above floor level / operating level)	
1.20.0	**Control Supply**	110V (Shall be derived through Control Transformer by vendor)	
2.0.0	**CRANE PERFORMANCE**		
2.1.0	**Operation**	Electrical -- From floor by means of Pendant Push Button controller suspended from panel	
2.2.0	**Crane speed with full load**	Main speed	Creep speed (M/Min)
	a) Main Hoist (Full speed)	1.5 M/Min	10% of main speed (thru' VVVF drives)
	b) Cross travel (CT)	1.5 M/Min	10% of main speed (thru' VVVF drives)
	c) Longitudinal bridge travel(LT)	1.5 M/Min	10% of main speed (thru' VVVF drives)
2.3.0	**Hoisting Mechanism**	Gear	
2.3.1	Arrangement of drive from motor to rope drum (main)	Through geared steel coupling and gear box	
2.4.0	**Type of power transmission**	Gear	
2.5.0	**WIRE ROPE**		

2.5.1	Make	As per Sub-vendor list		
2.5.2	Core / Construction	Fibre/ Steel core as per IS-2266 / 6 X 36		
2.5.3	Wire rope dia. (mm)	*		
2.5.4	Wire rope fall	*		
2.5.5	Material	Extra flexible Plough steel, 6 X 36 construction		
2.5.6	Tensile strength	As per IS-2266		
2.5.7	Min. Breaking load	*		
2.5.8	Conform to (Std. / code)	IS-2266		
2.5.9	Factor of safety	5.25 as per IS 3177		
2.6.0	**LOAD HOOK / HOOK BLOCK**			
2.6.1	Make	As per sub-vendor list		
2.6.2	Type of load hook	Plain shank, Trapezoidal section-forged as per IS: 15560, with safety latch.		
2.6.3	Material of load hook	Class 1A/ Class3 steels as per IS 1875		
2.6.4	Type of Bearing of hook suspension	Thrust ball bearing		
2.6.5	Make of Bearing of hook suspension	*		
2.6.6	Type and Material of hook suspension.	Fabricated		
2.6.7	Hook can swivel	Yes		
2.6.8	Locking device on swivelling hook	To be provided		
2.6.9	Standard conforming to	IS: 15560		
2.7.0	**ELECTRIC HOIST**			
2.7.1	Model No.	*		
2.7.2	Duty	Class II (M5) as per IS: 3938 (latest edition)		
2.8.0	**Type of DSL (Power conductors)**			
2.8.1	Long travel	1. PVC Shrouded Conductor (GI) Bus Bar Type DSL with accessories for entire bay length (with current collector & mounting brackets) (except for gantry crane) 2. Cable Reeling Drum (CRD) along LT travel for gantry crane.		
2.8.2	Cross traverse	Flexible cable with Taut wire / Festoon cable arrangement for CT motion for all cranes.		
2.8.3	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.		
2.8.4	Length	Suitable for entire bay length.		
2.9.0	**MOTORS**	M.H.	C.T.	L.T.
2.9.1	Make	As per sub-vendor list		
2.9.2	Rating (KW)	*		
2.9.3	RPM	*		
2.9.4	Qty.	1	1	2
2.9.5	Minimum number of poles	6	6	6
2.9.6	Type	TEFC, 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. S4 duty, 40%CDF Pull out torque shall be minimum 275% of rated torque.		
2.9.7	Rated capacity (KW)	The motor shall be suitable for 150 starts / hr and 40% CDF. Motor nameplate rating at 50 C shall have Motor rating will be calculated keeping margin of at least 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.		
2.9.8	Enclosure	IP-55		
2.9.9	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%		

2.9.10	Number of start	150 starts/Hr.		
2.9.11	Class of insulation	Class 'F' for sq. cage motors with temp rise limited class B		
2.9.12	Over load protection provided	YES, In built feature of VVVF drives.		
2.9.13	Ambient Design temperature	50°C		
2.9.14	Space heater requirements	For motors of rating 30 KW and above		
2.10.0	**LIMIT SWITCHES (automatic reset type)**			
2.10.1	Location	M.H.	C.T.	L.T
2.10.2	Qty.	2	1/2	1/2
2.10.3	Type	Snap action type	Two way lever type/ One way lever type/ roller type	Track type
2.10.4	Material of contact	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.		
2.10.5	Make	As per Sub-vendor list		
2.10.6	Control Voltage	110V		
2.10.7	Degree of protection	IP-55		
2.10.8	Conform to code	All limit switch shall be conform to IEC-60947-5-1		
2.11.0	**Control panel**	A suitable control panel will be provided comprising of main contractor, motor contactor, single phase preventor with overload relays, transformer, fuses, MCCB's, etc. Rectifier panel for brake shall also be provided.		
2.12.0	**BRAKES**			
2.12.1	Location	M.H.	C.T.	L.T.
2.12.2	Qty. / Motor	1	1	1
2.12.4	Type	All brakes will be Electromagnetic type (DCEM)		
2.12.5	Capacity	150% FLT	125% FLT	125% FLT
2.12.6	Size / rating	*		
2.12.7	Make	As per sub-vendor list		
2.13.0	**GEAR (HOISTING)**			
2.13.1	Make	As per sub-vendor list		
2.13.2	Classification	M5 duty		
2.13.3	Type	Spur / Helical		
2.13.4	Material	Gear:EN8/20MnCr5/16MnCr5 Pinion:EN9/En19, Casing: Fabricated steel gear boxes, Stress relieved		
2.13.5	Lubrication	Oil splash		
2.13.6	Reduction	*		
2.13.7	Bearing Make	*		
2.13.8	Bearing Type	Antifriction deep groove ball / roller bearing		
2.13.9	Hardness (BHN)	As per IS 3177 (Latest Edition) (minimum hardness difference between gear and pinion shall be 20 BHN)		
2.13.10	Noise level	85 db at 1.5 m from source		
2.13.11	Standard conforming to	IS: 4460		
2.13.12	Type of mounting of gear box	Horizontal / Vertical		
2.14.0	**GEAR (L.T. & C.T.)**			
2.14.1	Location	C.T.	L.T.	
2.14.2	Make	As per sub-vendor list		
2.14.3	Type	Spur / Helical	Spur / Helical	
2.14.4	Material (gear / Pinion)	Gear:EN8/20MnCr5/16MnCr5 Pinion:EN9/En19, Casing: Fabricated steel gear boxes, Stress relieved		
2.14.5	Lubrication	Grease	Grease	
2.14.6	Reduction	*	*	
2.14.7	Bearing Make	As per sub-vendor list		

2.14.8	Bearing Type	Antifriction deep groove ball / roller bearing	Antifriction deep groove ball / roller bearing
2.14.9	Hardness (BHN)	As per IS 3177 (Latest Edition) (minimum hardness difference between gear and pinion shall be 20 BHN)	
2.14.10	Noise level	85 db at 1.5 m from source	
2.14.11	Standard conforming to	IS: 4460	
2.14.12	Type of mounting of gear box	Horizontal / Vertical	
2.15.0	**WIRE ROPE DRUM**		
2.15.1	Material	Fabricated from M.S. as per IS: 2062, Gr B and stress relieved or seamless pipe ASTM A106 / 53 Gr B	
2.15.2	Diameter	*	
2.15.3	Length	*	
2.15.4	Type	Flanged	
2.15.5	Type of grooves	Machined grooved identical Right hand and Left hand	
2.15.6	Numbers provided	One	
2.16.0	**WHEELS**		
2.16.1	Location	C.T.	L.T.
2.16.2	Diameter (mm)	*	*
2.16.3	Qty	*	*
2.16.4	Hardness	300-350 BHN	
2.16.5	Material	EN8 / EN9	EN8 / EN9
2.16.6	Bearing make	As per sub-vendor list	
2.16.7	Bearing Type	Antifriction deep groove ball bearing	Antifriction deep groove ball bearing
2.16.8	Flange	Single flanged taper/straight tread. (For underslung crane) and double flanged for overhead crane, Gantry & semi-gantry cranes)	
2.16.8.1	Conform to IS	3177	
2.16.8.2	Wheel Base	*	
2.16.9	Arrangement of lubrication	Grease	
2.16.10	Numbers provided	As per manufacturer's standard.	
2.17.0	**SHEEVE**		
2.17.1	Material	As per IS 3177	
2.17.2	Groove dia/ O.D. .(mm)	*	
2.17.3	Bearing make	As per sub-vendor list	
2.17.4	Bearing Type	Antifriction deep groove ball bearing	
2.18.0	**CONTROL PANEL**	* Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate thickness shall be minimum 3mm. * Gland plate shall be double brass compression type.	
2.18.1	Qty	One/ crane	
2.18.2	Make	As per sub-vendor list	
2.18.3	Material & size	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.	
2.18.5	DOP	IP 55	
2.18.6	Type	Local relay based control system	
2.18.7	Location	Mounted with respective hoists.	
2.19.0	**ISOLATING SWITCH**		

2.19.1	Qty	One (1) no at 1.5 m from operating floor.				
2.19.2	Make	As per sub-vendor list				
2.19.3	Rating	*				
2.19.4	Panel of Isolating switch	One No. isolating switch panel shall be provided for each single girder crane. Location of isolating switch panel shall be at respective operating floor of the area.				
2.20.0	**PENDANT PUSH BUTTON**	Up /down / forward / Reverse push buttons along with Start/stop and emergency push button shall be provided on the pendent. Indicative marking for easy operation shall be provided.				
2.21.0	**Cables**	Power	Control			
2.21.1	Make	As per Sub-vendor list				
2.21.2	Material	Aluminium	Copper			
2.21.3	Type	XLPE insulated (except trailing cable)	PVC insulated			
2.21.4	Size	Min. 3CX10 mm2 for Aluminium	Min. 1.5 mm2			
2.21.5	Dearing factor to be considered	YES	YES			
2.21.6	Voltage grade	1100V				
2.21.7	Voltage drop	Cable from main isolating switch (1.5M above operating floor) to motor terminal shall be so sized that the voltage drop does not exceed 3% of rated voltage with cranes at extreme position.				
2.22.0	**END STOPPER (LT)**					
2.22.1	Qty.	4 Nos.				
2.22.2	Material	As per IS 2062				
2.23.0	**BUFFER**					
2.23.1	Location	CT	LT			
2.23.2	Qty	4	4			
2.23.3	Material	Spring or rubber buffers shall be provided on the trolley & end carriage				
2.24.0	**PAINTING**	Refer painting specification				
2.25.0	**Control for Hoisting operations**	Thru' VVVF drives				
a.	Speed control	Thru' VVVF with at least with 1024 pulse incard, droop control for synchronization and crane software. The rating of VVF shall be decided considering 250% of full load current of respective drive motor based on in panel rating with derated at 50 Deg C ambient temperature.				
b.	Starting torque of VVVF	Up to 200% without encoder.				
c.	Starting current	Less than 150 % of rated torque.				
d.	Temperature	VVVF system shall be capable of withstanding up to 50 o C without de rating.				
e.	Additional feature	In-built Electrical Overload protection for drive				
2.26.0	**Bearings**	**Crane hook**	**Trolley wheels**	**Rope drum**	**Gear box**	**Any other assembly**
2.26.1	Type	Antifriction ball / roller bearings				
2.26.2	Lubrication	Grease lubrication				
2.27.0	**Earthing**					
2.27.1	Material of earthing	G.I / Copper				
2.28.0	**Transformer**					
2.28.1	Quantity	2 X 100 % for control				
2.28.2	Voltage Rating	Control 415/110V				

Note:

- **Bidder to confirm the compliance of technical details as mentioned against each item. Deviation, if any shall be brought out clearly.**
- **The bidder shall fill Technical details against each item marked (*), during detailed engineering only.**
- **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.**

SECTION-II

STANDARD TECHNICAL REQUIREMENT

IIA STANDARD TECHNICAL REQUIREMENT MECHANICAL)
IIB STANDARD TECHNICAL REQUIREMENT (ELECTRICAL)

SECTION – II

STANDARD TECHNICAL REQUIREMENTS

IIA – Standard Technical Requirement (Mechanical)

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.
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

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**

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 in 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 grove 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

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.

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 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.

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.

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.

TECHNICAL SPECIFICATION FOR VVVF DRIVE

1.0 General

a) This part of the specification describes the general requirements for the Variable Voltage Variable frequency Drives, herein referred to as AC Drives, for use with standard IEC design AC squirrel cage induction motors. The nominal values, the standard documents and the drive's minimum performance are defined in this part. **To avoid any mismatch between the motor and its control equipment, the AC Drive shall be capable of auto adjustment by automatic measurement of the motor parameters with/without motor rotation.**

i. Speed control of EOT crane shall be through Variable Voltage Variable Frequency System (VVVF) with minimum 6 (six) pulse design.

ii. Necessary input & output devices to be provided to reduce harmonics, as per IEE519, at supply side of the drive at the switchgear.

iii. All necessary protections e.g. Input Phase Loss, Earth Fault, Over Voltage, Output Short Circuit, Load Loss, Input Transient Protection, Overload etc. to be provided.

iv. VVVF system shall be capable of generating suitable starting torque (220% typical) with / without encoder, however starting current shall not exceed 150% of the rated torque.

v. VVVF system shall be capable of withstanding upto 50 deg C. ambient temp without derating

vi. Squirrel cage Induction motor with VPI insulation shall be provided with VVVF system.

vii. Protective Pane Provided with isolating switch, power contactor control and indication to switch ON/OFF power to starter panels, control and lighting transformer.

viii. Starter Panel:

Separate VVVF system panels to be provided for CT, LT and hoist motion

(a) Contactors: AC 4 duty for reversing application AC 3 duty for non-reversing application

(b)Switches: AC 23 for motor application, AC 22 for other application.

(c)Fuses: HRC

(d)Overload relay: Temperature compensated, bimetallic with single phasing preventor.

ix. Panel shall be fabricated out of 1.6 mm thick rolled sheet steel. IP 52degreeof protection. Paint shade shall be RAL 9002 for front & rear and RAL 5012 for side

covers. Space heaters to be provided.

2.0 User interface

2.1 General

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

2.2 Inputs and outputs

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

Analogue Inputs : 1 x Programmable differential voltage input ± 10V,
1 x Programmable current input 0(4) - 20mA
1 x Programmable voltage input 0 – 10V

Analogue Output : 1 x Programmable analogue outputs 0(4) - 20mA or 0 – 10V

Logic inputs : 6 x Programmable logic Inputs isolated from the mains

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

All the control terminals shall be clearly marked.

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

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

2.3 Programming terminal

A. The AC drive shall have a keypad /display for programming and controlling purposes. An IP54 or IP65 remote mounting shall be possible at a distance of 10m.

B. Password protection shall be provided to avoid unauthorized tampering with the set parameters.

C. The programming terminal shall be able to display the commercial reference of the AC drive and of the options, the software version, the serial number

D. Direct keypad entry shall be provided to observe the following actual parameters. Any one of the following parameters or actual values shall be selected to be always displayed: -

i. Input Voltage
ii. Input Frequency
iii. Output Frequency
iv. Output Power
v. Output Current
vi. Motor Speed

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

i. Drive Status

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

i. Run
ii. Stop
iii. Local / Remote selection.
iv. Forward/Reverse (if function enabled)
v. Accelerate
vi. Decelerate
vii. Parameter setting

2.4 Application programming

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

2.5 PC Tools

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

3.0 Software features

A. Restart

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

B. Brake logic control

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

4.0 Preferred makes:

As per attached sub-vendor list.

SECTION – II

STANDARD TECHNICAL REQUIREMENTS

IIB – Standard Technical Requirement (Electrical)

BASIC TECHNICAL FEATURES

FOR HT/LT MOTORS

(FOR BHEL-PEM SCOPE PACKAGES)

REV	DATE	ALTD	CHD	APPD
02	13.05.15	RKG/ AB	SL	RG

REVISED AS PER TANGEDCO COMMENTS DATED 10.04.2015

REV	DATE	ALTD	CHD	APPD
01	13.03.15	BKR -SD-	SL -SD-	RG -SD-

REVISED AS PER TANGEDCO COMMENTS DATED 13.02.2015

PROJECT	2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS,CHENNAI
OWNER	TAMIL NADU GENERATION & DISTRIBUTION CORPOARATION LIMITED
OWNER'S CONSULTANT	DESEIN PRIVATE LIMITED, DESEIN HOUSE,NEW DELHI
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA

BHARAT HEAVY ELECTRICALS LTD.
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
E	DRN	BKR		
	DSGN	BKR	-SD-	13.01.15
	CHD	SL	-SD-	13.01.15
	APPD	RG	-SD-	13.01.15

TITLE: BASIC TECHNICAL FEATURES FOR HT/LT MOTORS

DRAWING NO. PE-DC-412-565-E003

SHEET 1 OF 7 REV. 02

1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in **2 x 660 MW ENNORE SEZ STPP.**

2.0 CODES AND STANDARDS

The motors shall generally conform to IS 325/IEC-60034. LT motors above 10 kW with continuous duty (S1) shall be energy efficient IE2 conforming to IS-12615: 2011.

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Above 1500 kW	11 KV	11 KV
Above 160 kW up to & including 1500 kW	3.3 KV	3.3 KV
From 200W up to & including 160 kW	415 V	415 V
Below 200W	240V	240V

3.2.1 Supply voltage & variations shall be as follows:-

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

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

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 degree C and relative humidity of 85%. Maximum continuous motor ratings shall have at least a 10% margin above the maximum load demand of the driven equipment under entire operating range including voltage & frequency variation.

3.4 Starting Requirements

3.4.1 Motor shall start smoothly and rapidly. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% of the motor's full load torque.

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

Minimum Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

3.4.3 The locked rotor current of the HV (11 kV) motors (except MDBFP motors) shall not exceed 650% of full load current inclusive of tolerance as per IS: 325 and for MV (3.3 kV) motors locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT motors (except energy efficient motors) locked rotor current shall not exceed 700% of full load current inclusive of tolerance as per IS: 325. For LT energy efficient motors above 10kW with S1 duty, locked rotor current shall be as per IS: 12615-2011.

3.4.4 The following frequency of starts shall apply to HV (11 kV), MV (3.3 kV) & LT motors

i) Two nos. consecutive cold starts in quick succession with third start after 5 minutes in cold condition.

ii) Two nos. consecutive hot starts in the interval of 15 minutes in hot condition.

3.4.5 Locked motor withstand time of motors under hot condition at highest voltage limit shall be as follows:

a) For motors with starting time up to 20 sec.

- at least 2.5 sec. more than starting time.

b) For motor with starting time above 20 secs but not exceeding 45 secs.

- at least 5.0 sec. more than starting time.

c) For motors with starting time above 45 secs.

- at least 10% more than starting time.

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

3.5 Running Requirements

3.5.1 Motors shall run satisfactorily at a supply voltage of 80% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

3.6 Stress during bus Transfer:

3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.6.2 Motor windings shall be adequately braced to satisfactorily withstand the mech. Stresses during above condition.

3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.

3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.7 Noise level

The maximum noise level for motors shall be in line with IS 12065.

3.8 Vibration

The maximum vibration for motors shall be in line with IS: 12075.

3.9 Crane duty motors will be of squirrel cage induction motor and shall suit the duty class S4, cyclic duration factor 60% and 300 starts. Crane duty motors shall be provided with VVFD for speed control.

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4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of Protection

4.1.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Canopy shall be provided for outdoor motors. CW motors (in case of screen prot. Drip proof) shall conform to degree of protection IP: 23 as per IS: 4691. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.

4.1.2 The stator laminations shall made from suitable silicon steel/magnetic steel sheet varnished on both sides and pressed to form a rigid core.

4.1.3 The rotor shall be of rigid cage construction with die cast aluminium / copper alloy / copper bars firmly wedged in bar slots and brazed to the end rings. The rotor cage shall be designed to operate satisfactorily under respective starting and load duty cycle.

4.2 Enclosure and Cooling

4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) enclosures or Closed Air circuit Air (CACA), the method of cooling conforming to IC-0141 or IC-0151 or IC-0161 of IS: 6362 up to 3000 kW motor. CW Motors may be screen protected drip proof (SPDP).

4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.2.3 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.3 Class of Insulation

HV/MV/LT motors shall have class F insulation. The temperature rise of all motors shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.

4.4 Bearings

4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For HV/MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.

4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.

4.4.3 After taking all motor driven equipment loads and thrust (if any) into account, the bearings shall be suitable for min. 20,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.

4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.

4.4.5 For motors below 15 kW shall be provided with sealed ZZ bearing.

4.4.6 Motors rated above 1000kW shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.

4.5 Terminals and Terminal Boxes

4.5.1 Motors of rating 90 kW and up to 160kW will be controlled by air circuit breaker with numerical protection. For all motors of rating up to 90kW shall be provided with MCCBs. The terminal box of motors for HV (11 kV), MV (3.3 kV) & LT motors shall be designed for the maximum fault current for a duration of at least 0.25 secs. 11kV & 3.3kV motors terminals shall be able to withstand 44kA for 0.25 seconds.

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4.5.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.5.3 For HV/MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.

4.5.4 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A,C,B or V, W & U respectively.

4.5.5 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.

4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) with double compression tinned brass glands shall be provided in terminal boxes.

4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180 and 90 degree for HT and LT motors respectively.

4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.

4.6 Grounding

Two separate earthing terminals suitable for connecting G.I. strip grounding conductor shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.7 General

4.7.1 Motors provided for similar drives shall be interchangeable.

4.7.2 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the direction of rotation of the motors.

4.7.3 Motors for Fuel oil unloading and drain oil pumps located in hazardous areas shall be with flame-proof enclosures in accordance with IS 2148 / IEC 60079.

a) Fuel oil area: Group - IIB.

b) Hydrogen generation plant area: Group - IIC

4.8 Neutral terminal box of motors rated 1000kW and above shall provision of mounting Neutral CTs of PS class identical to the CTs to be provided at switchgear end. Further the neutral terminals of HV motors rated below 1000kW shall be accessible. 1

5.0 ACCESSORIES

5.1 SPACE HEATERS

All motors rated 30KW and above shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

The leads from space heaters of each motor shall be brought out to a separate terminal Box. Space heaters shall be mounted inside the motor in accessible places so that their removal and replacement is simple.

5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)

5.2.1 HV/MV motors stator windings shall be provided with 12 nos. Simplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of winding temperature. The leads from RTDs of each motor shall be brought out to a separate terminal Box.

5.2.2 For HV/MV motors, each bearing shall be provided with 1 no. Duplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of bearing temperature. The leads from these RTDs shall be brought out to a separate terminal Box or the terminal box same as for winding RTDs.

5.3 DIAL TYPE TEMP. INDICATORS

5.3.1 For HV/MV motors, each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.

5.4 Vibration monitoring pads

5.4.1 Provision shall be made in all HV/MV motors for mounting vibration detectors.

6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325. In addition bearing identification number and type of lubricant is to be indicated.

7.0 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

8.0 TESTING

8.1 Type Tests

For HT & LT Motors, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

8.2 Routine Tests

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

CHAPTER – 12

MOTORS

1.00.00 DESIGN CRITERIA

1.00.01 For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 85% shall be considered. The equipment shall operate in a highly polluted environment.

1.00.02 Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

1.00.03 Rating

The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.

All motors shall be continuously rated (S1 duty). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

1.00.04 Starting Voltage requirement for all motors (except mill motors):

1. 85 % of rated voltage for motors up to 1000 kW
2. 80 % of rated voltage for above 1000 kW and up to 4000 kW
3. 75 % of rated voltage for above 4000 kW

For Mill Motors:

1. 85 % of rated voltage for motors above 1000 kW
2. 90 % of rated voltage for motors up to 1000 kW

1.00.05 Canopy shall be provided for outdoor motors.

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

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

1.03.00 Voltage and frequency variations:

Frequency: (+) 3% and (-) 5%

Voltage : **i. AC**

a. ± 6% for 11 kV/3.3 kV

b. ±10% for 415 V

Combined 10 % (absolute sum)

ii. DC- +10% to -15% for 220 V DC

1.04.00 All LV motors above 10 kW with S1 duty shall be compulsorily of Energy efficient level IE 2 as per IS 12615: 2011.

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

1.06.00 Type

AC Motors:

(a.) Squirrel cage induction motor suitable for direct-on-line starting.

(b.) Crane duty motors shall be slip ring type induction motor

DC Motors

(a.) Shunt wound.

1.07.00 Temperature Rise

Air cooled motors

70°C by resistance method

Water cooled

80° C over inlet cooling water temperature mentioned elsewhere, by resistance method.

1.08.00 Degree of Protection

Degree of protection for various enclosures shall be as follows :

i) Indoor motors – IP 54

ii)	Outdoor motors	–	IP 55
iii)	CW motors (in case of screen prot. Drip proof)	–	IP 23
iv)	Cable box – indoor area	–	IP 54
v)	Cable box – outdoor area	–	IP 55

2.00.00 CODES AND STANDARDS

2.01.00 All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC and CBIP standards/Publications. In case any other standard is followed that ensures equal or better quality, may be accepted. However the English version of the Standard adopted shall be submitted.

2.02.00 Major Standards, which shall be followed, are listed below. Any other applicable Indian standards for any component part even if not covered in the list shall also be followed

1.)	Three phase induction motors	:	IS:325, IEC:60034
2.)	Single phase AC motors	:	IS:996, IEC:60034
3.)	Crane duty motors	:	IS:3177, IEC:60034
4.)	DC motors/generators	:	IS:4722
5.)	Degree of protection by enclosures for rotating electrical machines	:	IS: 4691 IS: 4728 IS: 6362 IS: 2253
6.)	Noise levels for rotating electrical machines		IS: 12065
	Mechanical Vibrations for rotating electrical machines		IS: 12075

3.00.00 OPERATIONAL REQUIREMENTS

3.01.00 Starting Time

3.01.01 For motors with starting time up to 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs more than starting time .

3.01.02 For motors with starting time more than 20 secs and up to 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs more than starting time.

3.01.03 For motors with starting time more than 45 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.

3.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.

3.01.05 Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.

3.02.00 Torque Requirements

3.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

3.02.02 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

4.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

4.00.01 Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.

4.00.02 All motors shall be suitable for direct on line starting through any type of breaker.

L All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below

(a) Fuel oil area : Group - IIB

(b) Hydrogen generation plant area : Group - IIC

4.00.03 Winding and Insulation

(a) Type : Non-hygroscopic, oil resistant, flame resistant

(b)	Starting duty	:	Two hot starts in succession, with motor initially at normal running temperature
(c)	11 kV / 3.3 kV AC motors	:	Class F: with winding temperature rise limited to class B. They shall withstand 1.2/50 micro sec switching surges of 4U+5 KV (U=Line voltage in KV). The coil inter-turn insulation shall be suitable for 0.3/3 micro sec. surge of 32 KVp and 12 kVp for 11 kV ad 3.3 kV system respectively followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.
(d)	415V AC & 220V DC motors	:	Class 'F' with temperature rise limited to class 'B'

4.00.04 Motors rated above 1000 kW shall have insulated bearings to prevent flow of shaft currents.

4.00.05 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.

4.00.06 Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.

4.00.07 In MV/HV motors, 12 nos. simplex or 6 nos. duplex RTDs (two per phase), each having D.C. resistance of 100 ohms at 0°C, embedded in the stator winding at locations where highest temperatures may be expected, shall be provided. The material of the ETD's shall be platinum. Each bearing shall be provided with dial type thermometer with adjustable alarm contact and resistance type temperature detector. All HV motors shall be provided with shaft grounding rings for bearing protection and earthing shaft current.

4.00.08 MV/HV motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage and shall be capable of either two starts in quick succession with third start after 5 minutes in cold condition or two starts at 15 minutes intervals in hot condition, both cases with voltage and frequency variation within specified limits.

4.00.09 Locked rotor current of the MV motors shall be limited to 600% (subject to IS tolerance) of the full load current of the motors and for HV motor shall be limited to 450% (inclusive of IS tolerance) of full load current of the motor.

Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.

4.00.10 MV Motors shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. These differential protection CTs shall be supplied loose by 11/ 3.3 kV switchgear manufacturer.

4.00.11 Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.

4.00.12 HV motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.

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

4.00.14 The motors shall be suitable for bus transfer schemes provided on the 11 kV, 3.3 kV/415V systems without any injurious effect on its life.

4.00.15 All motors below 15 kW shall be provided with sealed ZZ bearings.

4.00.16 For motors rated 1000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

4.00.17 All motors shall be provided with an emergency stop push button near the motor as per the Indian Statutory regulations.

4.00.18 The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.

4.00.19 Neutral in case of HV motors shall be kept accessible.

4.00.20 Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.

4.00.21 Well spacious working platforms shall be provided around the motor area for carrying out maintenance & testing works. Platform shall be minimum of 300 mm below the level of motor base plate.

4.00.22 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.

4.00.23 For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box..

4.00.24 Lube oil pressure transmitters shall be provided to DCS for remote monitoring. Lube oil pressure very low trip to HV equipment shall be 2 out of 3 logic.

4.00.25 Capillary type temperature gauge cum switch shall be provided for DE / NDE of HV Motors

4.00.26 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.

4.00.27 Lifting Provisions

Motor weighing 25 kg or more shall be provided with eye bolt or other adequate provision for shifting. Electrical hoists shall be provided for motors above 1000 kgs for maintenance of the same.

4.00.28 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

4.00.30 Painting

Motor including fan shall be painted with corrosion proof paints of colour shade Siemens grey (RAL 7032).

4.00.31 Local Push Button Stations

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

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

5.00.00 LIST OF TESTS TO BE CONDUCTED FOR HV, MV and LV MOTORS

5.01.00 TYPE TESTS

(a) No load saturation and loss curves up to approximately 115% of rated voltage

(b) Momentary overload test

(c) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

(d) Surge withstand test on the sample coil after placing it in stator core at (4U + 5 KV) and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only, where U is the line to line voltage in kV.

(e) Surge-withstand test with 0.3/3 micro sec. wave on each type of 3.3/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out

the turns suitably. The power frequency test voltage shall be decided during detailed engineering.

f) Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only)
g) Measurement of resistance of windings of stator and wound rotor.
h) Reduced voltage running up test at no load (for squirrel cage motors up to 37kw only)
i) Full load test to determine efficiency, power factor and slip.
j) Insulation resistance test
k) Test for vibration severity of motor
l) Test for noise levels of motor
m) Test for degree of protection by enclosure
n) Temperature rise test at limiting values of voltage and frequency variations
o) Over speed test

5.02.00 ROUTINE TESTS

The following shall constitute the routine tests.

a) Insulation resistance test
b) Measurement of resistance of windings of stator and wound rotor.
c) No load test
d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage
e) Reduced voltage running up test (for squirrel cage motor)
f) Open circuit voltage ratio of stator and rotor windings (for slip ring motors); rotor;
g) High voltage test

6.00.00 INSPECTION AND TESTING AT SITE

6.01.01 Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer:

(a.) Blowing hot air in case of big motors.
(b.) Putting the motor in electric oven in case of smaller motors.
(c.) Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.

6.01.02 Site Test

(a.) Measurement of vibration.
(b.) Measurement of insulation resistance and polarization index.
(c.) Measurement of full load current.
(d.) Test running of the motors, checking the temperature rise and identifying the hot spot etc.

6.01.03 3.3 kV motors shall be tested for insulation by 500/1000V megger and its value should not be less than the safe minimum insulation of ≥ 20 MΩ resistance at 60 deg. C. In case the insulation is low, the following method of drying has to be adopted:

a. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals that full load current flows in the stator, keeping the stator winding temperature below 90 deg. C. In this a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. Value becomes steady.

b. By blasting hot air from external source, Maximum temperature of winding while drying should be 70 deg. C to 80 deg. C. (Thermometer) or 90 deg. C. to 95 deg. C. by resistance method. Heating should be done slowly till steady temperature of winding is reached after 4 to 5 hours and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, after steady temperature is reached, at an interval of 2 hours. In case it is essential, the drying process can be supplemented by blower.

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

1.0 INTENT OF SPECIFIATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

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

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

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

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

NAME OF VENDOR					
				REV.	
NAME	SIGNATURE	DATE	SEAL		

	QUALITY PLAN	CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
	SHEET 1 OF 2	SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3

BHEL	**PARTICULARS**	**BIDDER/VENDOR**
	NAME	
	SIGNATURE	

	QUALITY PLAN	CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :					
		BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :					
	SHEET 2 OF 2	SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

SECTION-III

DOCUMENTS TO BE SUBMITTED BY BIDDER

IIIA	LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID
IIIB	COMPLIANCE CUM CONFIRMATION CERTIFICATE
IIIC	ELECTRICAL LOAD DATA
IIID	PRE BID CLARIFICATION SCHEDULE

SECTION – III

DOCUMENTS TO BE SUBMITTED BY THE BIDDER

IIIA – List of documents to be submitted with bid

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 at GCC (General condition of contracts) (if applicable)

Or

In case of no deviation, bidder to mention "No deviation" on signed and stamped copy of Deviation sheet & furnish No deviation certificate.

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

c) Signed/ Stamped copy of Compliance cum Confirmation Certificate (refer Sec-IIIB)

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.

e) Electrical load list, duly signed and stamped

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.

SECTION – III

DOCUMENTS TO BE SUBMITTED BY THE BIDDER

IIIB – Compliance cum Confirmation Certificate

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.

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.

SECTION – III

DOCUMENTS TO BE SUBMITTED BY THE BIDDER

IIIC – Electrical Load data

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
SINGLE GIRDER CRANE FOR AIR COMPRESSOR BUILDING (8T)		100A	S	1	0	D	S	-	I	N								
SINGLE GIRDER CRANE FOR DG BUILDING (8T)		100A	S	1	0	D	S	-	I	N								
SINGLE GIRDER CRANE FOR FILTER WATER PUMP HOUSE (5T)		63A	S	1	0	D	S	-	I	N								
SINGLE GIRDER CRANE FOR WORKSHOP BUILDING (10T)		100A	S	1	0	D	S	-	I	N								
SINGLE GIRDER CRANE FOR SEA WATER INTAKE PUMP HOUSE TWS SCREEN & GATES HANDLING (10T)		100A	S	1	0	D	S	-	I	N								
SINGLE GIRDER CRANE FOR CW PUMP HOUSE SCREENS & GATES HANDLING (8T)		100A	S	1	0	D	S	-	I	N								
SINGLE GIRDER CRANE FOR CLARIFIED WATER PUMP HOUSE (5T)		63A	S	1	0	D	S	-	I	N								
SINGLE GIRDER CRANE FOR PERMANENT STORE (HEAVY MATERIAL STORE) (10T)		100A	S	1	0	D	S	-	I	N								
SINGLE GIRDER CRANE FOR PERMANENT STORE (LIGHT MATERIAL STORE) (3T)		63A	S	1	0	D	S	-	I	N								

NOTE:-Signed and stamped copy of this electrical load data shall be furnished by bidder along with bid. In event of ordering, above load data shall be considered as final and inputs for switchgear sizing shall be furnished to concerned electrical agency based on this electrical load data. Hence, no change in this load data shall be accommodated during detail engineering.

NOTES:

1. **COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)**
2. **ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V**
   : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

BHEL	**LOAD DATA (ELECTRICAL)**	**JOB NO.**	**412**	**ORIGINATING AGENCY**		**PEM (ELECTRICAL)**
		PROJECT TITLE	**2X660 MW ENNORE TPS**	**NAME**		**DATA FILLED UP ON**
		SYSTEM	**SINGLE GIRDER CRANES**	**SIGN.**		**DATA ENTERED ON**
		DEPTT. / SECTION	**ELECTRICAL**	**SHEET 1 OF 1**	**REV. 00**	**DE'S SIGN. & DATE**

SECTION – III

DOCUMENTS TO BE SUBMITTED BY THE BIDDER

IIID – Pre-bid Clarification Schedule

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