TELANGANA STATE POWER GENERATION CORPORATION LTD (TSGENCO)

5X800MW YADADRI TPP

TECHNICAL SPECIFICATION FOR SINGLE GIRDER CRANES

SPECIFICATION NO.: PE-TS-417-524-A001

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

INDEX

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 including freight in line with drawings/ documents/ test procedures approved by BHEL/ Customer for SINGLE GIRDER CRANE **for 5X800 MW YADADRI THERMAL POWER PROJECT.**

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)	Span (m)	Lift (m)	Travel (m)
1	AIR COMPRESSOR HOUSE- STAGE-I (INDOOR)	US	1	8	10.3	5.9	32.3
2	AIR COMPRESSOR HOUSE- STAGE-II (INDOOR)	US	1	8	12.3	5.9	36.85
3	DG BUILDING-1&2 (INDOOR)	US	2	10	13.55	6.377	27.04
4	DG BUILDING- 3 (INDOOR)	US	1	10	13.55	6.377	19
5	WORKSHOP (INDOOR)	EOT	1	8	10.8	5	44
6	RAW WATER PUMP HOUSE (INDOOR)	US	1	5	5.8	16	29.3
7	OUTSIDE RAW WATER PUMP HOUSE (OUTDOOR)	SEMI-GANTRY	1	5	2.9	13	29.3
8	RAW PUMP HOUSE SCREEN & GATE HANDLING (OUTDOOR)	GANTRY	1	5	4.5	11.2	20.5
9	CLARIFIED WATER PUMP HOUSE (INDOOR)	US	1	5	5.6	12.8	79.25
10	FIRE WATER PUMP HOUSE (INDOOR)	US	1	5	6.3	4.5	44
11	CW PUMP HOUSE SCREEN & GATE HANDLING-UNIT-1,2 (OUTDOOR)	SEMI-GANTRY	2	5	7.35	14	38.15
12	CW PUMP HOUSE SCREEN & GATE HANDLING-UNIT-3,4,5 (OUTDOOR)	SEMI-GANTRY	2	5	7.35	14	49.75
13	STORE BUILDING (INDOOR)	EOT	17	10	12.8	8	30

Note- Bidder to note that there may be change in lift and/or span upto (+/-)500 mm during detailed engineering for cranes listed at sl no. 5, 7, 10, 11, 12 & 13.

Bidder to note that 4/2 rope reeving arrangement shall be provided in SG cranes mentioned at sl no-8, 11 & 12 in above scope table.

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 / LT drive arrangement
5. VVVF Drives for hoisting Motion.
6. Electrical equipments (control panel, pendent, power & control cables etc.)
7. Types of DSL:
   a. PVC Shrouded Conductor (Cu) Bus Bar Type DSL with accessories for entire bay length (with current collector & mounting brackets)
   b. Flexible cable with Taut wire / Festoon cable arrangement for CT motion for all cranes.
   c. Cable reeling drum is to be provided for long travel of Gantry crane.
8. Limit switches
9. Earthing arrangement.
10. Painting of crane.
11. First fill of lubricant.
12. O & M Manual, drawings and documents.
13. Main isolating switch and power cable from 1.5M above ground / operating floor to down shop lead.
14. Power cable with cable tray, clits & other accessories.
15. Control transformer with standby arrangement.
16. End stoppers (4 nos. for each crane)
17. All fasteners (nuts, bolts, washer required for complete assembly of cranes.
18. Suitable platforms shall be provided for on cranes for maintenance purpose.
19. All components of the crane should be provided with protective cover (canopy).
20. The crane shall be provided with suitable manual arrangement (for anchoring to prevent any motion due to storm)

21. For all outdoor duty Cranes, necessary weathering protection to be provided for all equipment prone to damage due to weather specifically electrical components.
22. Pendent should be independent of the movement of crab/ hoist.

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 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 shall be as per 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 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. **Number of drawing and documents for submission**

The number of prints / copies required for various drawing and documents are listed in as Annexure V, Section IA of technical specification. Bidder shall follow the same.

4.0.0. **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.

5.0.0 **Make of Sub - Vendor items**

Indicative list of makes of bought-out items will be as per Annexure I, section IA. 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.

6.0.0 **INFORMATION TO BE FURNISHED BY BIDDER ALONG WITH THE OFFER**

As detailed in "List of documents to be submitted with bid", section-III.

7.0.0 **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

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.

a) 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: 5x800 YADADRI STPP
BHEL		ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: Single Girder Crane
			DATE	P.O.NO –
		CAPACITY: -	PAGE Page 1 of 4	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/QCR /UT report	_/	P	V	V	

	MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 5x800 YADADRI STPP
		ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: Single Girder Crane
			DATE	P.O.NO –
		CAPACITY: -	PAGE Page 2 of 4	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
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	

	MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 5x800 YADADRI STPP
BHEL		ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: Single Girder Crane
			DATE	P.O.NO –
		CAPACITY: -	PAGE Page 3 of 4	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	

	MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 5x800 YADADRI STPP
		ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: Single Girder Crane
			DATE	P.O.NO –
		CAPACITY: -	PAGE Page 4 of 4	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.

VOLUME : IIIF

SECTION-II

MISCELLANEOUS CRANES

CONTENTS

ATTACHMENTS

VOLUME : IIIF

SECTION-II

MISCELLANEOUS CRANES

1.00.00 **GENERAL INFORMATION**

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

2.00.00 **CODES AND STANDARDS**

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

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

2.13.00 IS : 15560 - Point Hook with Shank up to 160 tones - Specification

2.14.00 All electrical installation work shall comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended upto date.

2.15.00 ANSI-830.2.0 - Safety codes for overhead and Gantry Cranes.

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

3.00.00 SCOPE OF WORK

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

3.01.01 The required no. of E.O.T cranes as indicated in Annexure-I having duty and service conditions as specified hereinafter alongwith all accessories.

3.01.02 Runway rails for entire runway length alongwith rail clamps, all inserts, insert plates, anchor bolts, nuts, buffers & stops, limit switches etc. as required.

3.01.03 Runway conductors for the entire runway length complete with all insulators, supports, support brackets, fixing clamps, bolts, nuts etc. as specified and as required to complete the installation. Power supply cabling including isolating switch complete alongwith electrical items, attachments and accessories as required to feed power to the runway conductor.

3.01.04 All protective devices, anti-collision limit switches etc. as required for the crane.

3.01.05 All facilities, accessories and attachments for single ~~and tandem~~ operation of the cranes.

3.01.06 Bridge and trolley current collectors and bridge cross conductors alongwith all wirings etc. for the crane as specified and as required to complete the scope of work.

3.01.07 Crane components shall be provided with lifting lugs, eye-bolts etc. at suitable locations for handling assembling, lifting and placing into position.

4.00.00 SPECIFIC PERFORMANCE REQUIREMENTS

4.01.00 **Capacity**

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

$Y = 1.10\ a$

4.02.00 **Highest Position**

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

4.03.00 **Lowest Position**

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

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

4.04.00 **Horizontal Clearance**

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

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

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

5.00.00 **DESIGN & CONSTRUCTION**

5.01.00 **General**

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

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

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

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

5.01.05 Castings and forgings shall be of tested quality and shall conform to their respective material specifications and shall be free from flaws and objectionable imperfections, machined true and in a workman like manner.

5.01.06 No wood or other combustible material shall be used unless specifically approved by the Owner/Consultant.

5.01.07 Proposals for repair or any similar operations involving plugging, welding, boring or addition of metal to the original castings or forgings shall be submitted to the Purchaser and his approval must be obtained before any such work is carried out. Drawing showing details and location of such repairs shall be submitted to the Purchaser.

5.01.08 All fabrication by welding shall be carried out by qualified and certified welders as per IS : 1181.

5.01.09 Design shall provide for easy maintenance of all parts, particularly the wheel bearings on end-trucks.

5.01.10 Temperature Effects

Where any portion of the structure is not free to expand or contract under variation of temperature, allowance shall be kept for stress resulting from these conditions; the co-efficient of expansion for each degree centigrade variation of temperature above and below normal being taken as 0.000012 for mild steel. The maximum range of variation of temperature shall be as given in the Lead Specification. Cl. 8 of Section II of IS: 800-1962 Code of practice for use of structural steel in General Building construction - shall also apply.

5.01.11 Maximum use shall be made of shop fabricated sub-assemblies.

5.01.12 Alternative design to those prescribed in specifications will be considered only if found technically suitable and acceptable to the Owner in the light of requirements and accompanied by substantial reduction in cost.

5.01.13 Material of Construction

The material of construction of the major components of the crane shall be as indicated in the Data Specification Sheet. Manufacturers are however free to use alternative material, which are superior for the intended service. But in all cases they are required to obtain prior concurrence of Owner after furnishing chemical and physical properties of the offered material and any other information that may be asked for by the Purchaser.

5.01.14 Load Indication

The crane bridge shall have permanent inscription in English on each side, readily legible from operating floor, stating manufacturer's name, serial no., the year of manufacture and the safe working load.

5.02.00 **Structural Design Consideration**

5.02.01 Minimum thickness of metal

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

5.02.02 Accessibility for maintenance

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

5.02.03 Ruling dimensions and ratio

a) For compression members, the slenderness ratio shall not exceed 120. In case of other load carrying members and subsidiary members the slenderness ratio shall not exceed 180.

b) For girders, the following values of maximum span to depth ratio shall be governing :

Plate girders : Span/depth = 18

Lattice girders : Span/depth = 12

5.02.04 Connections

a) Unless otherwise specified, only rivetted or welded joints shall be used.

b) Where welding or riveting is not practicable, turned and fitted bolts shall be used, preferably as per IS-1364 and IS-1367.

c) Minimum number of rivets or turned and fitted bolts in a connection shall not be less than two.

d) Black bolts shall not be used in main structures and high tensile bolts shall not be used unless approved by the Owner. Bolts shall preferably be not used in tension.

e) Where bolts pass through sections having tapered flanges, tapered flats shall be welded to inside of the flanges. Tapered washers shall not be used.

f) Transverse fillet welds on load carrying members shall be avoided. If side fillets are used in end connections, the length of each side fillet should not be less than the edge distance between the fillets.

g) Butt welds on structural members under tensile stress shall be checked by Radiographic examination as and when directed by the Owner/Consultant.

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

5.02.05 Deflections and Camber

a) The total maximum vertical deflection of the girders for the live load plus trolley and not including impact or dead load of the girder shall not exceed limit of Span/900.

b) The girders shall be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.

5.03.00 **Bridge Girder and End Carriage**

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

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

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

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

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

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

ends.

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

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

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

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

5.04.00 **Trolley Frame**

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

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

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

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

5.05.00 **Platforms and Ladders**

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

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

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

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

5.05.05 Access to operator's cabin from bridge girder platform shall be by staircase having adequate width and proper sloping.

5.06.00 **Operation**

The crane shall be operated ~~either from cabin in the crane bridge or~~ from a pendant control station as specified in Data Specification Sheet.

5.06.01 Operator's Cabin

a) The operator's cabin shall be closed type, suitable for indoor service & complete with light, air-conditioning & seat. The cabin shall be located on one end of the crane bridge and under one of the bridge girders, so that it is offset to one side. The cabin shall be provided with guarding hand rails and the floor shall be covered with electric insulating carpet. A clear headroom of 2000 mm shall be ensured within the cabin.

b) A foot operated type warning gong shall be provided within the cabin. The cabin shall be of ample size to contain controllers, protective pannel, main isolating switch and other accessories required for operating the crane. A ten (10) lbs. capacity portable CO_2 fire extinguisher shall be provided in the cabin.

c) Provision shall be there for emergency exit of the Crane Operator at three convenient positions in case of power failure.

5.06.02 Pendant Station

a) The pendant station shall have the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 metre above the operating floor.

b) With pendant operation, foot operated bridge travel brake and the drum controllers need not be provided.

5.07.00 **Repair Cage**

5.07.01 A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. In case, the trolley current collectors are located below trolley rail level on the inside webs of the bridge girders, guards shall be provided on the trolley to prevent the hoisting ropes from coming in contact with conductors as well as a repair cage shall be provided on the trolley to attend these conductors.

5.07.02 Repair cages shall also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels.

5.07.03 The repair cages shall be adequately sized, guarded for safety and correctly

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

5.08.00 **Lifting Hook Block Assembly**

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

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

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

5.09.00 **Gearing**

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

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

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

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

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

5.10.00 **Bearing**

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

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

shall be tried to the maximum extent possible and a detailed scheme for the same shall be furnished alongwith the tender.

5.10.03 Suitable drip pans shall be provided as required to collect oil and grease which may drop from operating parts. All drip pans shall be accessible for draining and cleaning.

5.10.04 All bearings of the gearing shall be antifriction type. Angular contact ball or taper roller bearings shall be used wherever necessary. The bearings shall correctly locate the shafts while allowing for thermal expansion of the shafts. Bearings shall be enclosed in suitable housing with proper holes and plugs to prevent any ingress of dirt and to permit easy lubrication of the bearings.

5.11.00 **Guarding**

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

5.11.02 Protection guards to live electrical wirings/conductors shall be provided.

5.11.03 Suitable guards to revolving shafts and coupling, long travel cross shafts and gears, shall be provided.

5.11.04 The sheaves of the hook block fitted with two sheaves or fewer shall be guarded to prevent tapping of a hand between a sheave & the running rope.

5.11.05 Effective means of guiding the wire ropes over the sheaves shall be provided so as to prevent dismounting of rope from the sheave grooves even when a slack rope condition is developed.

5.11.06 All openings in footwalk flooring, for access to bottom chord platform, if any, and to other inspection platforms, shall be provided with covers having suitable locking means to avoid any accidental opening.

5.11.07 All electrical panels, resistance boxes shall have suitable rain/ dust hoods over them to prevent water and building construction material falling on them, as it is apprehended that erection and commissioning of the crane might have to be taken up before completion of the building roof.

5.12.00 **Runway Rails**

5.12.01 Crane runway rails with bolts and nuts and complete with shims, anchor bolts, inserts and other fixtures for fixing the rails to crane girders shall be under the scope of supply of the present specification.

5.12.02 The length of the rail supplied shall be sufficient to cover the whole of runway length. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.

5.12.03 The rail section shall be as per IS: 3443.

5.13.00 **Trolley Rail**

5.13.01 The specification includes the supply of trolley travel rails complete with fixtures for fixing the rails to the body of crane.

5.13.02 The length of the rail supplied shall be adequate for maximum permissible trolley travel. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.

5.14.00 **Rail Joints and Fixing**

5.14.01 The rails shall be butt jointed by either thermit welding or fusion welding process. The Contractor shall get his proposal for edge-preparation of rails, welding procedure and sequence, approved in advance by the Purchaser/Consultant.

5.14.02 The schemes of securing the rails to the gantry girder/bridge structure with clamps, bolts and nuts, their alignment etc. shall be subject to the approval of the Purchaser/Consultant.

5.15.00 **Tolerances**

The limits of tolerance as specified in the Data Specification Sheet shall be observed.

5.16.00 **Rail End Stops**

Rail end stops of adequate design shall be provided on both ends of the runway. The end stop location and arrangement shall be such that the unavailable length of runway (for crane operation) on any end is a minimum.

5.17.00 **Drive Mechanism**

5.17.01 Equal driving effort shall be applied at each drive wheel of bridge and trolley to prevent one end from travelling faster than the other.

5.17.02 For bridge, the torsional deflection in the cross shaft shall be limited to safe value as per applicable code.

5.17.03 For bridge drive, the motor shall be located at mid position of the span. If twin motors are used for drive, motors shall be equidistantly located at each wheel end. Suitable interlock shall be provided to prevent single motor operation at any time.

5.17.04 Trolley drive shall be achieved by single motor in which the motor shall drive a common output shaft through proper gearbox and tractive power shall be transmitted to the geared wheels by means of pinions mounted on both ends of the output shaft.

5.17.05 All machineries for the drive unit shall be properly aligned. Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement wherever necessary. Wherever components of considerable amount of inertia is directly mounted on the high speed shaft(e.g. brake drum, couplings, etc.) they shall be balanced statically

to minimise vibration.

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

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

5.18.00 Crane Electricals

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

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

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

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

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

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

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

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

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

5.19.00 **Drive Motors**

5.19.01 For general technical requirements of motors refer to Volume-V, AC & DC

Motors..

5.19.02 Motors shall be slip ring wound rotor type, designed for crane duty requirement of frequent starting. Reversing and plugging motors of single girder EOT crane shall also be squirrel cage type. All motors shall be suitable for VVVF operation.

5.19.03 Motors shall suit the duty class S4.

5.20.00 **Brakes**

Selection and design of brakes shall be such as to meet the following requirements

5.20.01 Service Brake

a) Double-shoe type service brakes shall be provided for each motion of the crane and its hoists. The service brakes shall apply automatically when power supply to the drive motor is cut-off or fails.

b) Service brakes for main hoist motion shall be electro- hydraulic thruster type for all double girder cranes either cabin or pendant operated and electromagnetic disc. type for single girder crane; adequately sized to arrest motion and hold at rest any load upto and including test load at any position of the lift.

5.20.02 Hoist Control Braking Means

Hoist motion (both main and auxiliary) shall be provided with a self-contained sturdy braking system, electro- hydraulic thruster type, to control the speed of hoisting as well as lowering down to 10% rated speed. The braking system shall be reasonably uniform and effective with all loads (from no-load to full-load) on hooks.

5.21.00 **Main Disconnect Switch**

5.21.01 Main disconnect switch shall be metal-clad, 3-pole, load-break type in IP-54 enclosure, complete with compression brass glands and lugs.

5.21.02 The switch shall be provided with "Power On" red indication lamp (Clustered LED type) and shall be suitably located so that it can be manually operated from the operating floor level.

5.21.03 Power leads shall run from the main disconnect switch to the runway conductors.

5.22.00 **Runway Conductors (Down Shop Leads)**

5.22.01 The runway conductors shall be four (4) in number for three phase supply and ground.

5.22.02 The runway conductors shall be of M.S.angle sections, liberally sized so as not to exceed current density of 0.42 Amps/sq.mm. However, for small

capacity cranes having lower spans i.e. compressor house crane, flexible copper cable will be used.

5.22.03 Sufficient allowance (minimum 20%) for wear and tear shall be provided over the calculated conductor size.

5.22.04 The runway conductors shall be supported on brackets and insulators from the crane girder with sufficient spacing in between the conductors.

5.22.05 The collector system per conductor shall be top-running type having spring loaded cast iron/carbon metallic shoes to maintain adequate contact pressure.

5.23.00 **Cross-Conductors on Bridge**

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

5.23.02 Alternatively cross conductors of M.S. angles with shoe collectors, similar to the arrangement of runway conductors may be offered.

5.24.00 **Power Distribution Equipment**

5.24.01 From the main collector shoes, wiring shall be extended to two (2) nos., 3-pole, load-break, safety disconnect switches -one at the bridge near the collector and the other in operator's cabin within easy reach.

5.24.02 The safety switches shall be capable of cutting-off the supply to all power driven and associated equipment of the crane but not the auxiliary loads such as fans, lights etc.

5.24.03 From the safety disconnect switches, wiring shall be extended to a protective panel, containing the following as a minimum :

a) One triple pole incoming supply disconnect switch.

b) One triple pole main magnetic contactor with HRC fuse backup, ON-OFF push buttons and RED-GREEN indication lamps (LED type).

c) Motor feeders, each comprising of triple pole fuse switch unit with thermal overload (hand reset) relays for short circuit and over load protection in all three phases of the motor.

d) Outgoing feeders with double-pole switch fuse units for auxiliary loads such as control supply, lights, fans, etc. with atleast one spare feeder.

5.25.00 **Voltage Drop**

5.25.01 All conductors and cables/wires shall be so sized that the voltage drop measured between the main disconnect switch and motor terminals shall not exceed 3% of rated voltage.

5.25.02 The voltage drop shall be computed using the total running current of all

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

5.26.00 **Safety Interlocks**

5.26.01 Disconnect Switch

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

b) Main/ safety disconnect switch shall have provision of pad-locking in OFF position.

5.26.02 Main Contactors

a) The main contactor shall be electrically interlocked so that it can not close unless all the motor overload relays are RESET and all controllers are in OFF position.

b) The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

5.27.00 **Emergency Switch**

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

5.28.00 **Crane Controls**

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

5.28.01 Hoist Motions (both main ~~and auxiliary~~)

a) VVFC or Conventional rotor resistance control shall be used in both hoisting and lowering directions, with a minimum of five (5) speed steps in each direction.

b) Hoist control shall be designed to achieve "Inching Speed" of 10% the rated speed in both hoisting and lowering directions with loads (no-load to full-load) on hook.

5.28.02 Travel Motions (both bridge and trolley)

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

However, the clause no. 5.28.01 & 5.28.02 is applicable for all cabin operated cranes. For double girder cranes having slip ring hoist, CT & LT motors, ~~the~~

speed steps are basically occurring during starting. In normal operation, there are no speed steps in between rated speed & micro speed in hoist motion and no speed steps in CT/LT motion. For single girder cranes, there are no speed steps in CT/LT motion and no speed steps between rated speed and micro speed in hoist motion.

5.28.03 General

a) All controls shall be designed to be fail-safe on loss of power.

b) Control circuits shall be suitable for 240V 1ph 50Hz supply and complete with suitable dry type control transformer with isolation facility and primary/secondary fuses.

c) Individual control/resistor panel shall be furnished for each motion for ease of inspection and maintenance.

5.29.00 **Controllers**

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

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

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

5.30.00 **Resistors**

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

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

5.31.00 **Limit Switches**

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

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

a) A screw type limit switch with self reseting features which will act in case of overhoisting.

b) A gravity operated hand-reset type limit switch as a back-up protection against over-hoisting.

5.31.03 Track type limit switches shall be provided on the bridge and trolley to prevent overtravelling in either directions.

5.32.00 **Panels**

5.32.01 All protection and control panels required for Cranes shall meet the technical requirements of “Electrical Equipment & Accessories, Volume-V”.

5.33.00 **Illumination**

5.33.01 Crane lighting and space heating systems shall be designed for 240V 1ph 50 Hz supply and receptacle system 24V 1ph 50 Hz supply. Suitable dry type transformers (2x100%) shall be furnished for the purpose, complete with isolation facility and primary/secondary protection using Moulded Case Circuit Breaker (MCCB).

5.33.02 The lighting distribution board shall be located in the operator's cabin. Branch circuits for lighting and receptacles shall be individually protected by switch fuse units.

5.33.03 CFL fixtures shall be used for lighting operator's cabin and bridge platform. Four (4) 250W high-bay sodium vapour fixtures shall be provided below bridge for illumination of the working zones.

5.33.04 All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.

5.33.05 24V - 5A - 3 pin industrial socket outlets shall be provided – two (2) in operator's cabin and minimum four (4) on the bridge along the walkway.

5.33.06 One (1) portable 40W handlamp with plug shall be furnished with adequate length of flexible cable for inspection of crane components.

5.33.07 Operator's cabin shall be provided with one (1) electric fan.

5.33.08 One (1) heavy duty type industrial siren shall be provided with each crane. The siren shall be operated from foot-switch in the operator’s cabin.

5.33.09 Conduit wiring system shall be used for lighting circuits.

5.34.00 **Wiring**

5.34.01 All power, control and auxiliary circuit wiring shall be furnished and installed as per best installation practice. The design shall be such as to maximise shop wiring and minimise field wiring.

5.34.02 All wiring shall be done with 1100V grade fire resistance PVC insulated wire in conduits or by 1100V grade PVCA PVC cables with extruded inner sheath.

5.34.03 Conductors shall be stranded aluminium for power and stranded copper for control. Minimum conductor size shall be not less than 2.5 sq.mm copper or equivalent.

5.34.04 Conduits shall be heavy gauge, rigid steel, hot-dip galvanised, cut square, reamed, threaded and screwed tight at all joints. Conduit entry to pull box or enclosure shall have double locknuts and insulating bushing. No running thread shall be used.

5.34.05 Solderless connectors shall be used for all connections. No splices shall be permitted in wire or cable. No taps or connections shall be made in fittings or junction boxes.

5.34.06 All wires and cables shall be identified with permanent markers at terminations as per approved wiring diagram.

5.35.00 **Grounding**

5.35.01 The crane rails, structures, motor frames, metal enclosures of all electrical equipment, conduit and tray system shall be effectively grounded in accordance with Indian Electricity Rules.

5.35.02 Bonding of structures and crane rails shall be provided as required to ensure electrical continuity.

5.35.03 The crane grounding system shall be connected to station ground mat. For this purpose, the Purchaser will provide ground conductor (50 x 6mm M.S. flat) at two agreed locations.

6.00.00 **INSPECTION AND TESTING**

6.01.00 **Tests at shop**

6.01.01 The cranes shall be subject to full load and overload tests as per IS-3177. after complete assembly and wiring. In case of non availability of facilities for carrying out “full load and over load testing” no load testing of the crane in fully assembled condition may be carried out after obtaining consent from owner.

6.01.02 The crane shall be subject to deflection test as per IS : 3177.

6.01.03 If the hoisting drum offered is of welded construction. The seams shall be fully radiographed.

6.01.04 The inspection and testing of butt welded joints shall be performed in accordance with the provisions of the relevant Indian Standards or equivalent standard. Butt welded joints subject to direct tension shall be 100% radiographed. All 'T' joints shall be covered with spot radiography. Should any of the spots be found defective then radiography to be extended to 100% area.

6.01.05 All electrical equipment and components thereof shall be subject to routine tests as per relevant Indian Standards. Type test certificate on any electrical equipment shall be submitted if desired by the Purchaser. Otherwise, type tests shall have to be performed on the equipment to prove the design.

6.01.06 Reports of all shop tests shall be submitted to the Purchaser/ Consulting Engineer for review.

6.02.00 **Tests at site**

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

a) All tests as per IS-3177, including insulation test and tests for operation.

b) Deflection tests as per IS-3177

c) Overload tests at 125% of working load as per IS-3177

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

6.03.00 **Erection and Commissioning**

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

7.00.00 **DRAWINGS, DATA AND INFORMATION**

7.01.00 The following drawings and data are required with the proposal.

7.01.01 Crane clearance diagram filling in the various dimensions.

7.01.02 General Arrangement Drawings of the E.O.T. crane assembly.

7.01.03 Detail drawing showing the features of the components of the crane bridge and trolley.

7.01.04 Drawings and data on the crane runway rail, and its method of attachment to runway main girder and general arrangement of runway rail end stops.

7.01.05 Schematic drawings of hoisting mechanism, cross travel mechanism and long travel mechanism indicating all components as well as rope receiving arrangement and relative positions of equaliser sheaves.

7.01.06 A detailed write-up on the crane control system operation including tandem operation. Drawings and data sheets showing the particulars of the controllers, switches, contactors, relays, other control devices and limit switches.

7.01.07 A comprehensive write-up and/or Brochures on the details of the manufacturing facilities and the test facilities in the shop of the supplier.

7.01.08 For Mandatory Spares, Spares required for erection and commissioning, Recommended Spares, Special Tools and Tackle, fixtures etc., as required for regular operation and maintenance of the equipment offered and supply of

first charge of lubricating oil, inhibitor oil and also adequate quantity of the consumables, please refer Technical Specification Volume-II A.

7.01.09 Other relevant data and particulars.

7.02.00 The following drawings and data shall be submitted for review of Owner/ Consulting Engineers by the successful bidder.

7.02.01 Drawings showing general arrangement, clearance requirement, assembly, cross sectional data and materials of construction for :

a) E.O.T. Crane Unit

b) Bridge Assembly and Components

c) Bridge End Trucks and Wheel Assembly

d) Trolley

e) Trolley Wheel Assembly

f) Drive and Transmission Unit for Bridge Travel, Trolley Travel, Main Hoist and Auxiliary Hoist.

g) Suspension Unit for Main Hook Block and Auxiliary Hook Block.

h) Main Hook Block

i) Auxiliary Hook Block

7.02.02 Drawing showing layout of controllers and protective panels inside the operator's cabin/pendant station.

7.02.03 Leaflets on proprietory items such as motors, brakes, gear box, coupling etc.

7.02.04 Design calculation of the following :

Bridge girder, Rope drum, Machinery shafts, Gear box, Motor rating, Brake capacity, Bearing life, Wheel loading etc.

7.02.05 Drawings, characteristics curves and other data for each drive motor.

7.02.06 Drawings on runway rails and their end stops showing fixtures to fix them on Purchaser's runway girder.

7.02.07 Material test certificates for all items including hooks and wire rope.

7.02.08 Reports on various tests at shop and at site.

7.02.09 Control and protection scheme along with crane wiring drawing as well as a schematic drawing of control wiring indicating ratings and specifications for motors, contactors, resistors, fuses, etc.

7.02.10 As built drawing/electrical control schematic including tandem operation features of turbine hall cranes.

7.03.00 **Instruction Manual**

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

i) Instruction for erection

ii) Instruction for pre-commissioning check up, operation, abnormal conditions, maintenance, repair and protection.

iii) A detail write up on the crane control system including tandem operation for tubine hall cranes and also on the interlocks provided.

iv) Recommended inspection points and periods of inspection.

v) Schedule of preventive maintenance.

vi) Replaceable part's list with ordering information.

vii) Recommendation for type of lubricants, lubricating points, frequency of lubrication and lubricant changing schedule.

ANNEXURE-II

DATA SPECIFICATION SHEET

GENERAL INFORMATION

Location : As per Annexure I.

Working condition : Indoor

GUARANTEED PERFORMANCE REQUIRED

Capacity :

(Safe working load)

a) Main Hoist (T) 125T (minimum) Final capacity to be decided by bidder

b) Aux. Hoist (T) 25T (minimum) Final capacity to be decided by bidder

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

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

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

Main hoist	1 m/min.
Aux. hoist	3 m/min.
Trolley travel	10 m/min.
Bridge travel	15 m/min.
Range of speed control for main and auxiliary hoist and for each motions (for any load from zero to SWL)	Down to 10% of corresponding rated speed.

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

Main hoist	3 m/min
Aux. hoist	NA

Trolley travel	10 m/min
Bridge travel	15 m/min

GUARANTEED PERFORMANCE REQUIRED (Contd.)

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

SCOPE OF SUPPLY

Crane structures complete	:	Yes
All drive motors and driving gears	:	Yes
Running rails including all clamps, anchors, bolts, nuts, sheams, inserts, end stops and other fixtures	:	Yes
Operator's Cabin	:	Yes, For Turbine Hall crane
Pendant Station	:	Yes, For other cranes
Portable fire extinguisher/CO_2 bottle in operator's cabin	:	Yes
Runway conductors (d.s.l.) and power collectors complete with all supports, insulators, brackets, fixtures etc.	:	Yes
Complete electrical work including main disconnect switch, all controls and interlocks, with necessary wiring, grounding, protective panels etc.	:	Yes
Lower limit switches for hoists	:	Yes
Illumination of crane, operator's cabin etc.	:	Yes
Air Conditioning in operator's cabin	:	Yes
Lifting lugs, eye bolts etc. for handling of crane parts	:	Yes
Erection and commissioning service	:	Yes
All equipment, accessories and		

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

DESIGN AND CONSTRUCTION

Duty Class (Turbine Hall) : Mechanism class - M-5 as per IS-3177 and IS-807
Electrical Service class - 4 as per IS-3177

Duty Class (Other than Turbine Hall) : Mechanism class - M5 as per IS-3177 and IS-807

Operation : Cabin for Turbine Hall
Pendant station for others.

No. of Trolleys : One

Span between runway rail centres :
Net runway length :
Elevation of top of runway rails :
Elevation of bottom of building roof structures :

} To be decided by the bidder.

Main hook positions -

a) Elevation - Highest :
- Lowest :

b) Minimum approach from runway rail centre lines :

c) Minimum end approach from runway rail stops :

Auxiliary hook positions -

a) Elevation - Highest :
- Lowest :

b) Min. approach from runway rail centre lines :

c) Min. approach from runway rail stops :

} To be decided by the bidder.

Clear space between runway rail

DESIGN AND CONSTRUCTION

Runway conductors -

a)	Material	:	As specified earlier
b)	Maximum allowable current density	:	Bidder to indicate
	End Truck		
a)	I-Section acceptable	:	No
b)	Single flanged wheels acceptable	:	No

Permissible tolerance -

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

Schedule of Brakes

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

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

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

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

MATERIAL OF CONSTRUCTION

Bridge girder	:	IS-2062
Other structural members	:	IS-2062
Lifting hooks	:	As per IS-15560 (For Turbine Hall) As per IS-8610 (Other than Turbine Hall)

VOLUME : IIA

SECTION-IV

GENERAL TECHNICAL REQUIREMENTS (As Applicable)

1.00.00 **CODES AND STANDARDS**

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.

1.06.00 Successful Bidder to furnish two (2) sets of latest of national/inter-national codes and standards to owner.

2.00.00 **RESPONSIBILITY FOR DESIGN**

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.

2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.

2.04.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.

2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.00.00 **NAME PLATES (RATING PLATES)**

3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.

3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.

4.00.00 **SAFETY AND SECURITY**

4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and

property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

5.00.00 **GUARDS**

5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.00.00 **LOCATION AND LAYOUT REQUIREMENTS**

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

a) The minimum width of clear access corridors around equipment shall be 1.2 meter.

b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.

c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.5m shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified

elsewhere in this specification shall be complied with.

f) All rail/road crossings for pipe/cable racks shall be done with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.

g) Cubicle for operating personnel shall be located at safe place near the equipment.

h) Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Employer's prior approval.

i) Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered to. Any departure from this suggestive layout is primarily not recommended.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common

components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 MATERIALS

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Owner to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 LUBRICATION

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00 **LUBRICANTS AND CONTROL FLUIDS**

10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of the unit.

10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 **OPERATION AND MAINTENANCE**

11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.

The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.

11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 **PLANT LIFE AND MODE OF OPERATION**

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

Cold start-up (>72 hrs. shutdown)	:	6 per year
Warm start-up (between 10 to 72 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	160 per year

13.00.00 **PACKAGING & MARKING**

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

a)	Width of the Package (from centre-line of rails - 1.6 metres on both sides)	:	3.2 Meters
b)	Height of the package from rail top	:	4.47 Meters

The above indicates the dimensions which can be normally transported on the

wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00 **PROTECTION**

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of

piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

15.01.00 Environment Protection

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

15.01.01 For Liquid Effluent

a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.

b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

15.01.02 For Air Emission

a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm^3 (with worst coal and one field out at TMCR).

b) NO_x - 365 ppm Max. or 750 mg/Nm^3 (Equivalent NO_2).

c) SO_2 - Concentration based standard 2000 mg/Nm^3. Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

15.02.00 **Noise Level Requirement**

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

16.00.00 **INSPECTION AND TESTING**

16.01.00 **Inspection and Tests during Manufacture**

16.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

16.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

16.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

16.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the

consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

16.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner's Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer along with Defect Map.

16.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.

16.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material or any other test as required by approved QAP/ Material specification.

16.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure or as required by design code of that part, for a period not less than one hour.

16.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

16.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.

16.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

16.02.00 **Performance Tests at Site**

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

a) International Standards Organisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers (ASME).

d) American National Standards Institute (ANSI).

e) American Society for Testing and Materials (ASTM).

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

j) National Electrical Manufacturer's Association (NEMA).

k) Japanese Electro-technical Committee (JEC).

l) Institute of Electrical and Electronics Engineers (IEEE).

m) Federal Occupational Safety and Health Regulations (OSHA).

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

q) Tubular Exchanger Manufacturer's Association (TEMA).

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission (IEC) Publications.

t) Power Test Code for Steam Turbines (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

x) Electric Power Research Institute (EPRI).

y) Standards of Manufacturer's Standardization Society (MSS).

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

ff) Emission regulation of Central Pollution Control Board (CPCB).

gg) Pollution Control regulations of Dept. of Environment, Govt. of India

hh) Central Board of Irrigation and Power (CBIP) Publications.

ii) The Air Prevention and Control of Pollution Act.

jj) The Environmental Protection Act

kk) The Public Liability Insurance Act.

ll) The Forest Conservation Act

mm) The Wildlife protection Act.

nn) The EIA Notification, 1994.

oo) IS: 14665-Specification for Electric Traction Lift

pp) Any other statutory Codes/Standards/Regulations

ANNEXURE VI

DISTRIBUTION SCHEDULE

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

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

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

TSGENCO : Telangana State Power Generation Corporation Limited

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

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 CRANES

Sl. No.	Description Quantity	Quantity (for each capacity and type of crane)
1.	One set consisting of 2 nos. bearing for:	
	a) CT wheel	1 set
	b) LT wheel	1 set
2.	One set consisting of 2 nos. brake linings with rivets for:	
	a) MH brake	1 set
	b) CT brake	1 set
	c) LT brake	2 set
3.	One set consisting of 2 nos. brake shoes with lining for:	
	a) MH brake	1 set
	b) CT brake	1 set
	c) LT brake	2 set
4.	One set consisting of 6 nos. carbon brushes for:	
	a) MH motor	1 set
	b) CT motor	1 set
	c) LT motor	2 set
5.	One set consisting of 3 nos. brush holders for:	
	a) MH motor	1 set
	b) CT motor	1 set
	c) LT motor	2 set
6.	Fixed and moving contacts for each type of conductor	1 set
7.	No volts coil for each type of conductor	1 set
8.	Overload relay for:	
	a) MH motor	1 No.
	b) CT motor	1 No.
	c) LT motor	2 Nos.
9.	Motor bearings:	
	a) MH motor	2 Nos.
	b) CT motor	2 Nos.
	c) LT motor	4 Nos.
10.	Bearing for:	
	a) MH Main Pulley	2 Nos.
	b) MH Eq. Pulley	2 Nos.
11.	415 Volt Motor (Up to 30 KW rating)	
11.1	Driving end and non-driving end bearing	3 set for each type and rating of motor
11.2	Cooling fan	2 Nos. for each type and rating of motor
11.3	Motor terminal block	5 Nos. for each type and rating of motor
11.4	Complete set of coupling	1 set for each application
12.1	Back-up panels mounted devices (Selector switches/ push buttons/ indicators etc)	5% of installed capacity
12.2	Lamp/ LEDs	100% of total quantity

12.4	MCBs	10% of each type and rating
12.5	Fuse/ Fuse holder	10% of each type and rating
13	VVVF Drive	1 no.
14	Line Choke	1 no.
15	DBR	1 no.
16	Air Break Power- Contactor	1 SET

Note:

1. "One (1) set of each type & size" is defined as 100% requirement for one Single girder crane.
2. All mandatory spares to be interchangeable with the original equipment.
3. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as per the list.
4. Any item which is quoted as "not applicable" in the above list and is found to be "applicable" at a later date shall be supplied by the Bidder without any commercial implications.
5. Any change or variation in equipment or systems during detailed engineering stage which would cause changes / variations in the essential spares, shall be supplied by Bidder without any commercial implications.
6. Mandatory spares shall not be dispatched before dispatch of corresponding main equipment.
7. Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.
8. Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
9. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
10. 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.
11. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.
12. Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range.
13. Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for one unit of 800 MW in the station (project), unless specified otherwise.
14. Quantity of spares of common facilities shall be calculated by multiplying the specified percentage of installed quantity by a factor of 2/5.
15. In case of Bought Out items, itemised spares list may be vendor specific and may differ from the list of spares mentioned above. In such cases, the quoted price shall be considered for applicable items only without any change in the contract price.

ANNEXURE III
PAINTING PROCEDURE / COLOR SCHEME

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.

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

Primer : Red oxide Zinc chromate as per IS: 2074 (Alkyd medium) - 1 coat, DFT 35µ per coat.

Intermediate : Red oxide Zinc chromate as per IS: 2074 (Alkyd medium) - 1 coat, DFT 35µ per coat.

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

Total DFT : 120µ

Electrical /Control Panel:

Surface preparation: Seven tank process

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

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

Total DFT : 110 - 145µ

Color Shade:

SL. No	Item Description	Color Shade	Remarks
1	Crane Structure	Smoke Gray shade 692 as per IS-5	
2	Bottom block assembly	Smoke Gray shade 692 as per IS-5	
3	Hooks	Lemon yellow, shade 356 as per IS-5	With 100 mm wide black zebra strip
4	End carriage sweep	Smoke Gray shade 692 as per IS-5	
5	Motors	Smoke Gray shade 692 as per IS-5	
6	Control Panels	Smoke Gray shade 692 as per IS-5	

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-V0-417-524-A001	Manufacturing Quality Plan with sub vendor list for single girder EOT crane	APPROVAL	2
2	PE-V0-417-524-A002	GA.& Data sheet of Single Girder EOT CRANE along with CT festoon cable details	APPROVAL	2
3	PE-V0-417-524-A004	Mechanism Sizing Calculation of SG crane	APPROVAL	2
4	PE-V0-417-524-A005	G.A. drg of Hoist with trolley wheel assembly of SG crane	INFORMATION	3
5	PE-V0-417-524-A006	Bottom Block assembly of SG crane	INFORMATION	3
6	PE-V0-417-524-A007	GA and fixing arrangement for LT DSL & Rail for Single Girder crane	INFORMATION	3
7	PE-V0-417-524-A008	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
8	PE-V0-417-524-A009	Long travel Machinery Assembly with LT wheel assembly of SG crane	INFORMATION	4
9	PE-V0-417-524-A010	Detailed BOM/BOQ for crane	INFORMATION	6
10	PE-V0-417-524-A011	General arrangement of panel & pendent push button	INFORMATION	4
11	PE-V0-417-524-A012	Cable sizing calculation and schedule of SG crane	APPROVAL	3
12	PE-V0-417-524-A019	O & M Manual	INFORMATION	8
13	PE-V0-417-524-A016	Erection procedure for Single girder crane	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) Bidder to follow the end customer Technical specification at Section-IA of this Technical specification for the number of prints/hard copies to be provided.

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

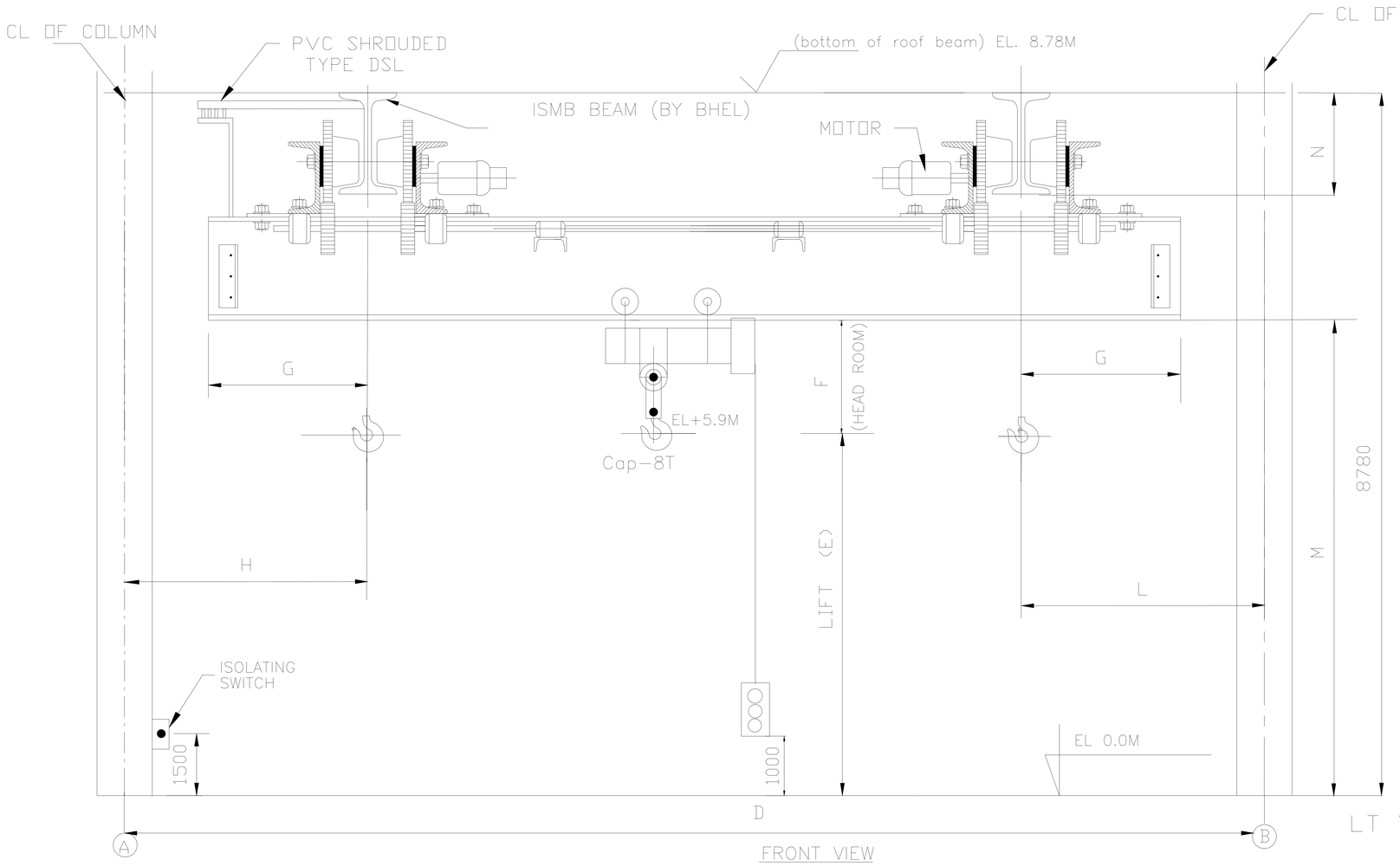
The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition, the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement.

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.

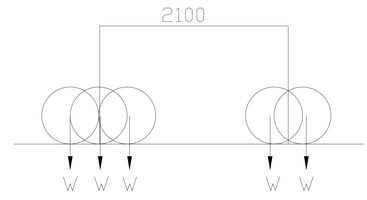
ANNEXURE –VIII

INPUT DRAWINGS

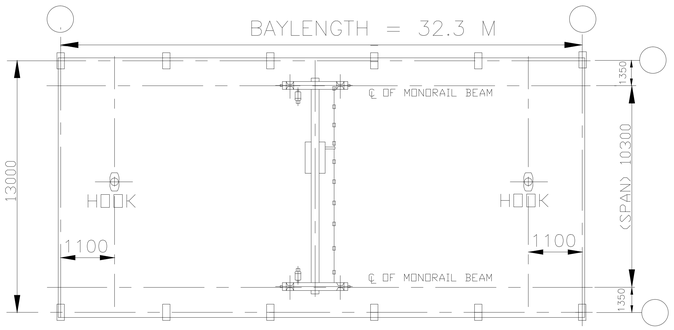
DESIGN PARAMETERS	
A	10300
B	*
C	*
D	13000
E	5900
F	*
G	750
H	1350
L	1350
M	*
N	*



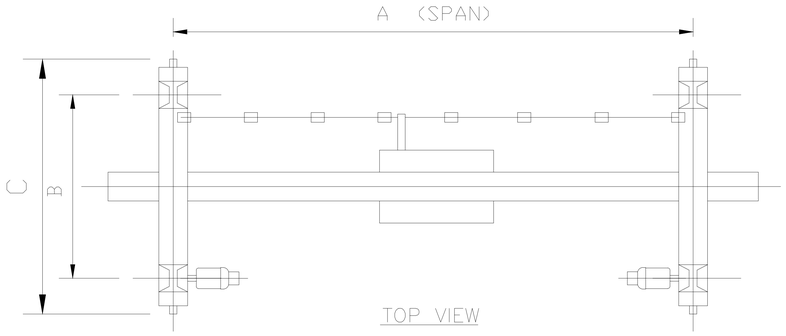
FRONT VIEW



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

TELANGANA STATE POWER GENERATION CORPORATION LIMITED (TSGEDCO)
5X800 MW YADADRI STPP, NALGONDA

TATA CONSULTING ENGINEERS LTD

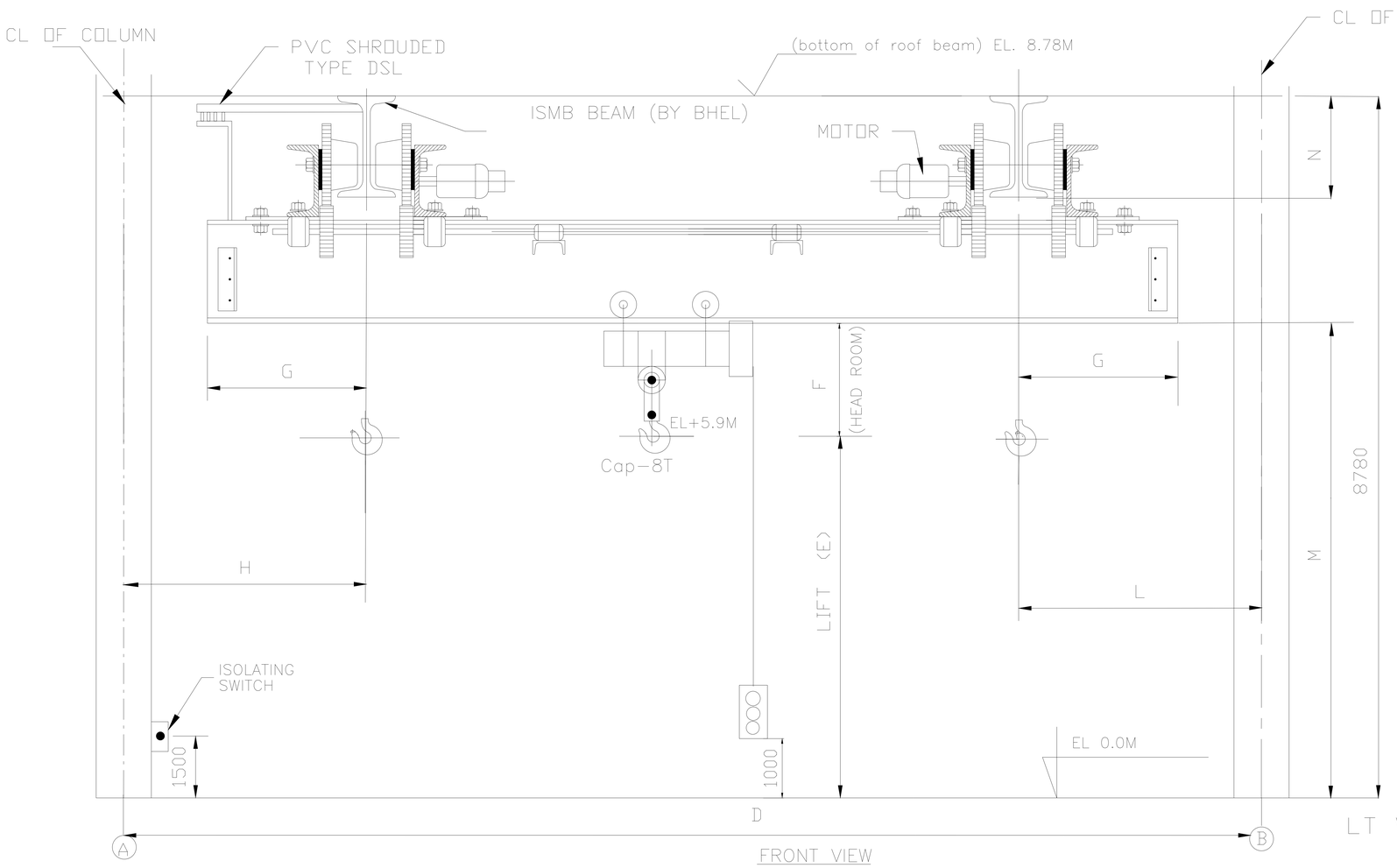
BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

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

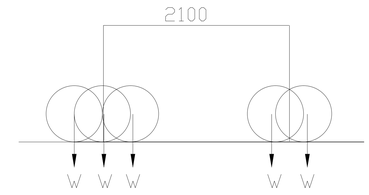
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR AIR_COMPRESSOR_HOUSE_1

UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A001 | REV. R0

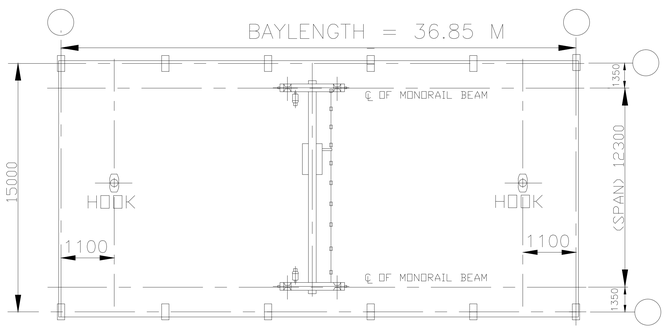
DESIGN PARAMETERS	
A	12300
B	*
C	*
D	15000
E	5900
F	*
G	750
H	1350
L	1350
M	*
N	*



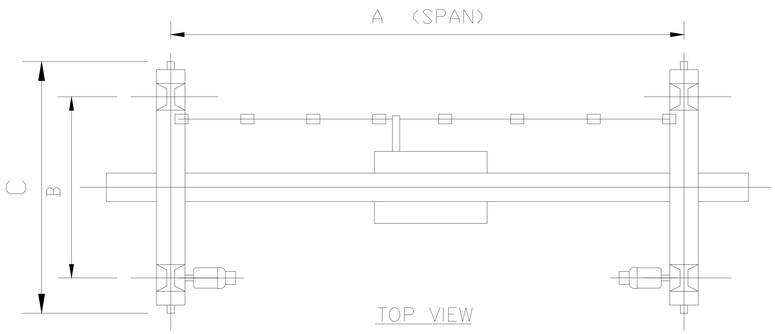
FRONT VIEW



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

TELANGANA STATE POWER GENERATION CORPORATION LIMITED (TSGEDCO)
5X800 MW YADADRI STPP, NALGONDA

TATA CONSULTING ENGINEERS LTD

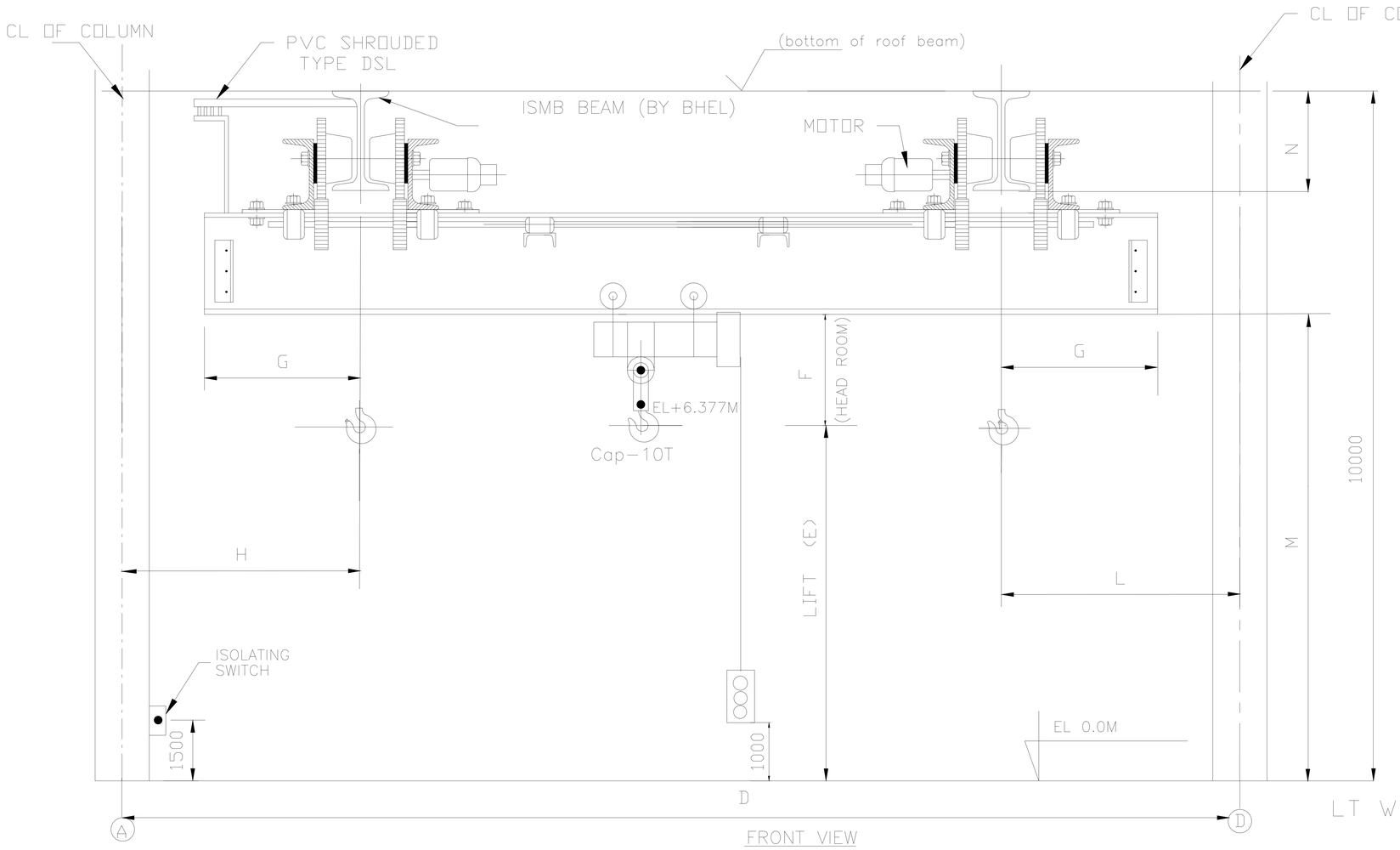
BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

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

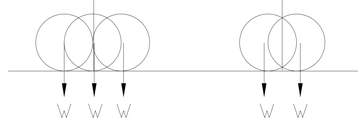
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR AIR_COMPRESSOR_HOUSE_2

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

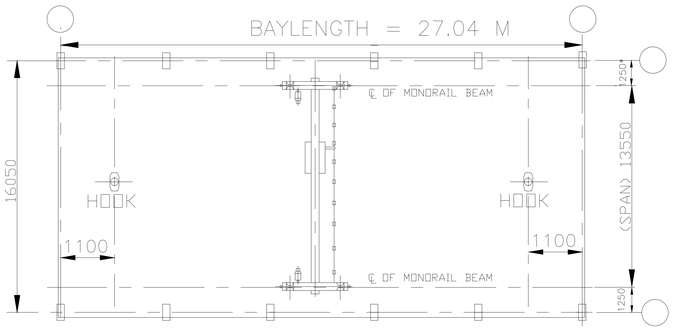
DESIGN PARAMETERS	
A	13550*
B	*
C	*
D	16050*
E	6377
F	*
G	750
H	1250*
L	1250*
M	*
N	*



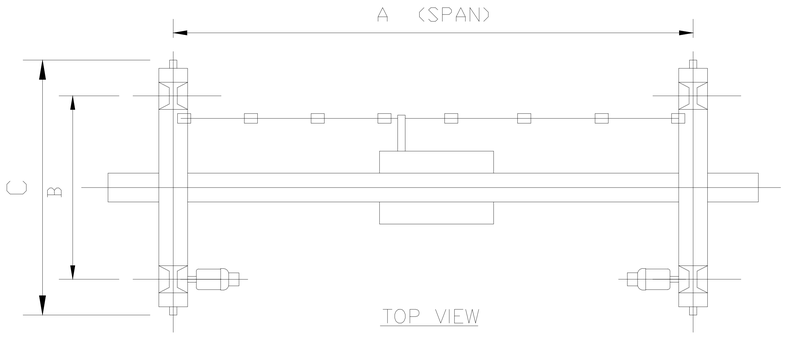
FRONT VIEW



LT WHEEL LOAD WITH OUT IMPACT (W=2.5T 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

TELANGANA STATE POWER GENERATION CORPORATION LIMITED (TSGEDCO)
5X800 MW YADADRI STPP, NALGONDA

TATA CONSULTING ENGINEERS LTD

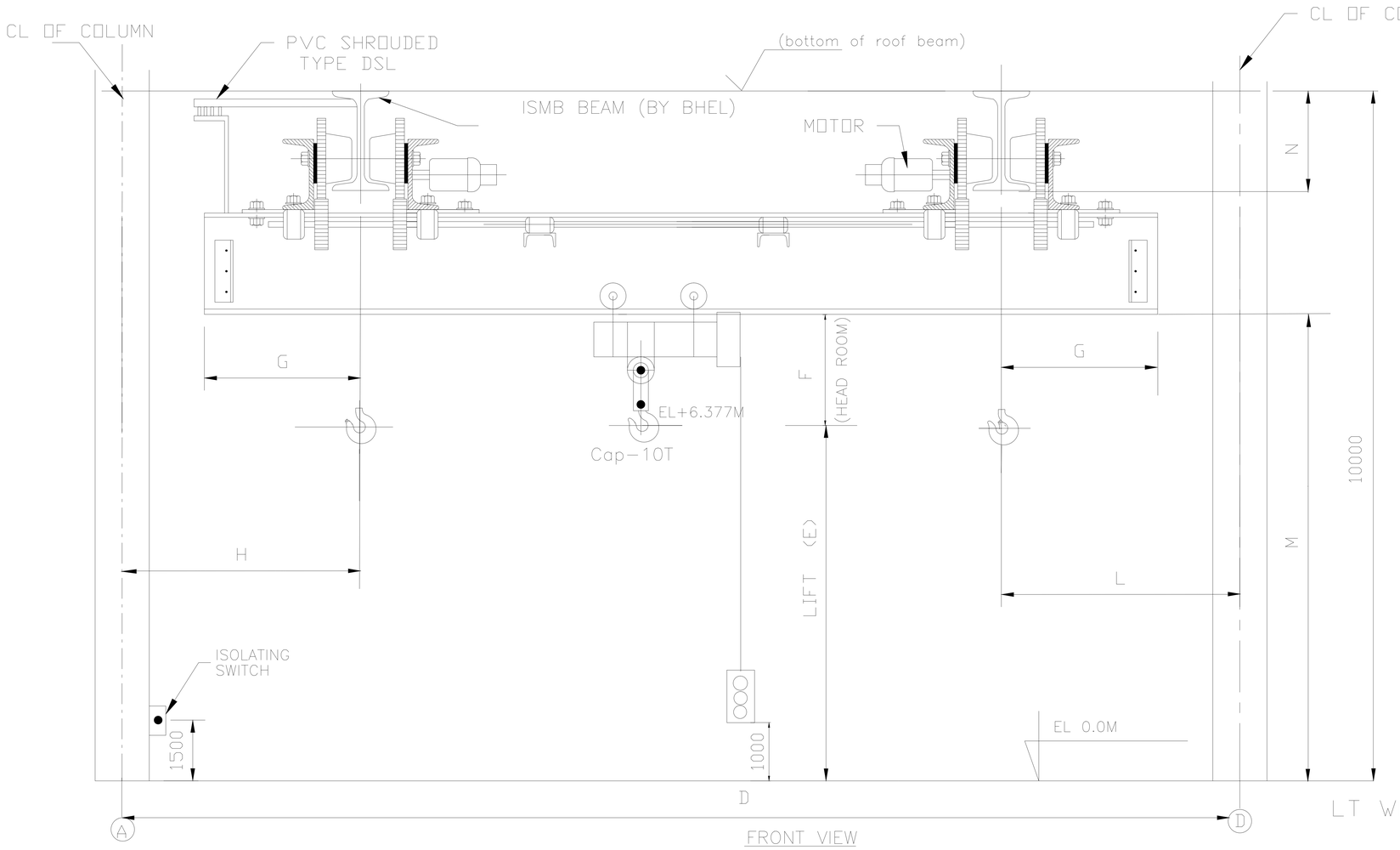
BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

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

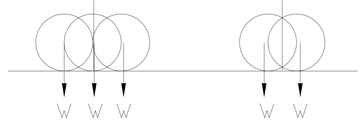
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR DG_BUILDING_1&2

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

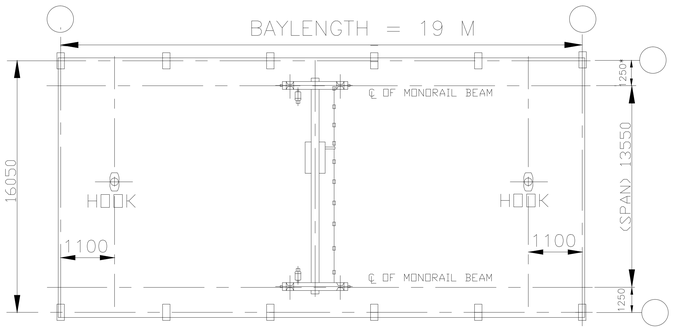
DESIGN PARAMETERS	
A	13550*
B	*
C	*
D	16050*
E	6377
F	*
G	750
H	1250*
L	1250*
M	*
N	*



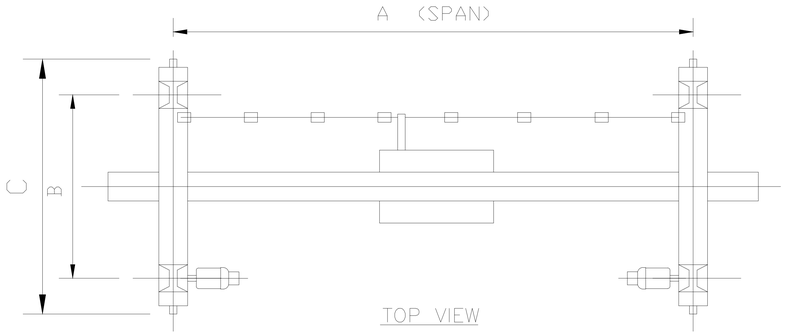
FRONT VIEW



LT WHEEL LOAD WITH OUT IMPACT (W=2.5T 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

TELANGANA STATE POWER GENERATION CORPORATION LIMITED (TSGEDCO)
5X800 MW YADADRI STPP, NALGONDA

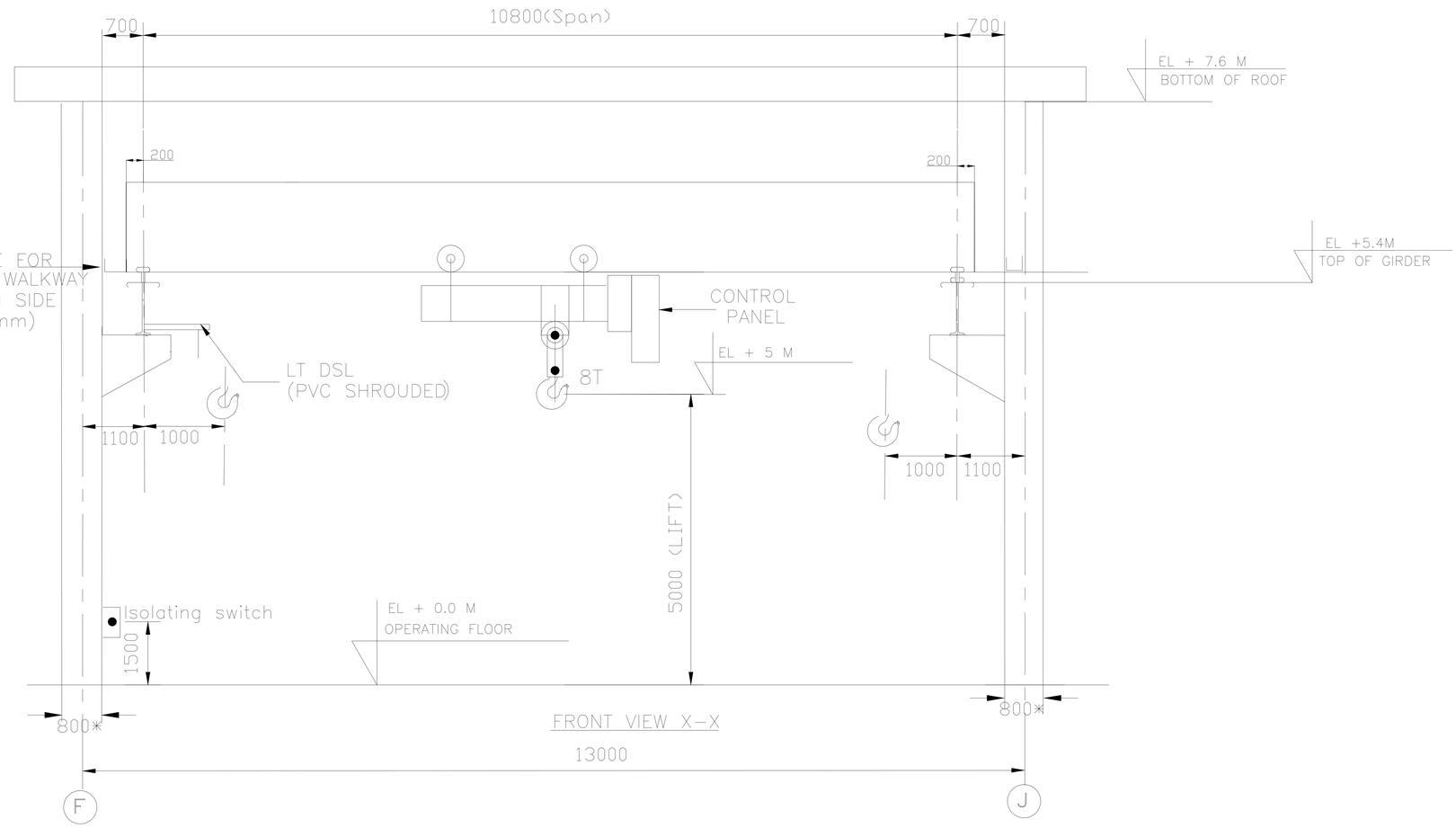
TATA CONSULTING ENGINEERS LTD

BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

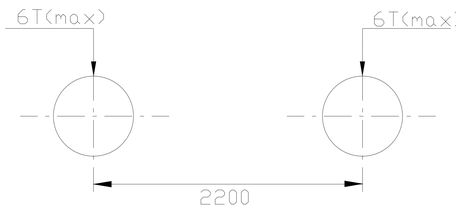
	NAME	SIGN	DATE
DRN.	BS	--SD--	
CHD.	PKK	--SD--	
APPD.	GB	--SD--	

TITLE : CRANE_CLEARANCE_DIAGRAM_FOR DG_BUILDING_3

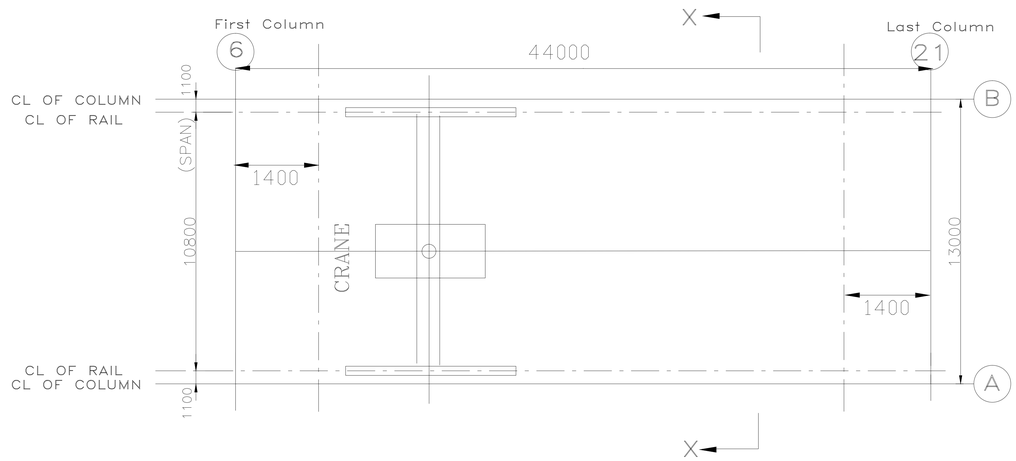
UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A004 | REV. R0



SL NO.	TECHNICAL SPECIFICATIONS PARAMETERS	
9.	CREEP SPEED THRU' VVVF DRIVES IN HOISTING MOTION ONLY	
8.	CLASS	M5
7.	DUTY	INDOOR DUTY
6.	QTY.	1 NO
5.	BAYLENGTH	44 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:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA (TSGEDCO) 5x800 MW YADADRI TPS, NALGONDA
OWNER'S CONSULTANT:	TATA CONSULTING ENGINEERS LIMITED, BANGALORE
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

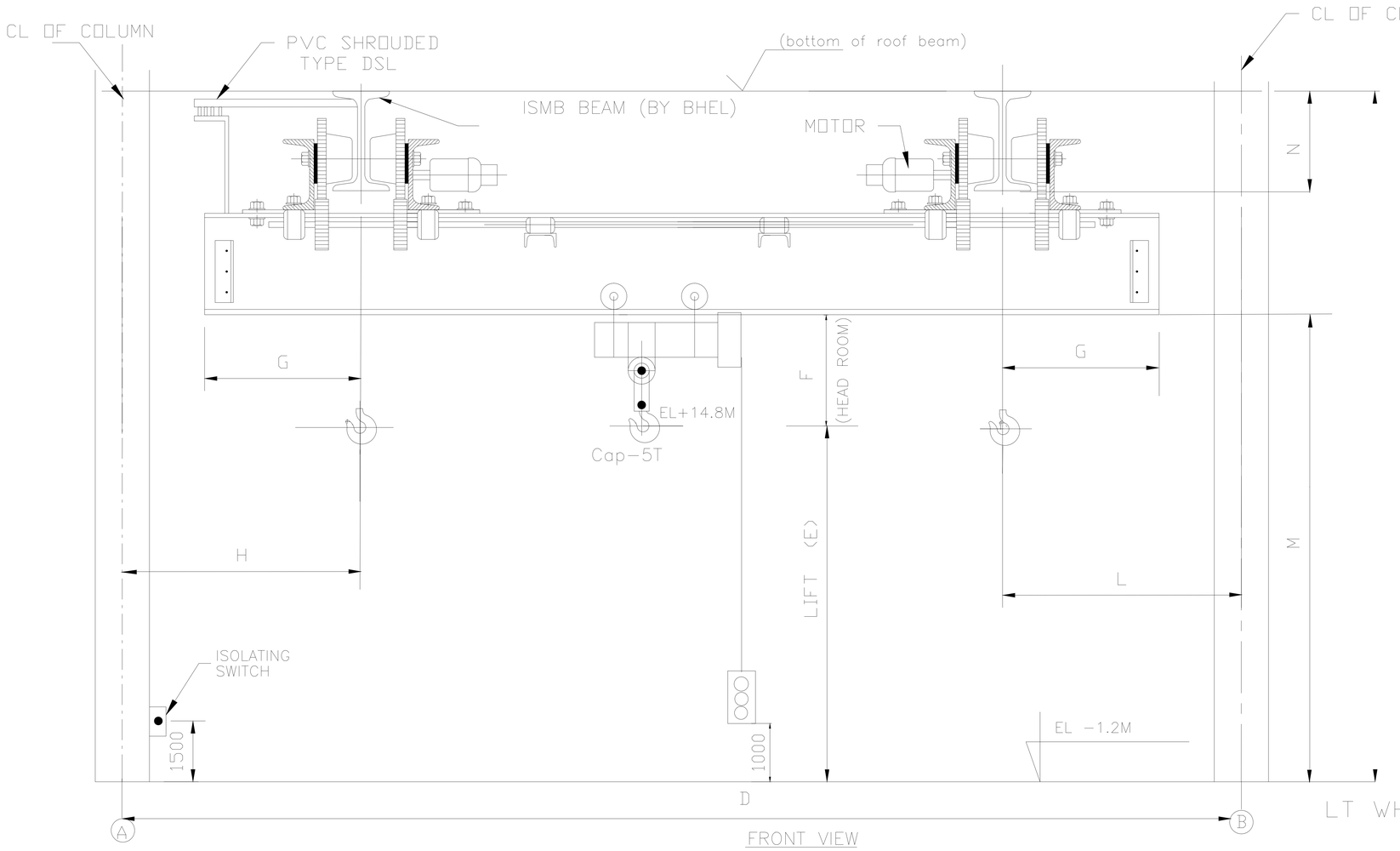
DEPT CODE		NAME	SIGN	DATE
M	DRN	BS		
	DESN	BS		
	CHD	PKK/GB		
	APPD	PK		

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

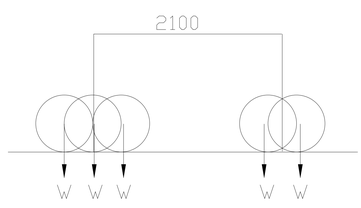
DEPT. | SCALE | SIGN | DRAWING NO. PE-DG-417-524-A005 | SHEET 1 | REV. 0

COMPUTER FILE NAME : TAL5

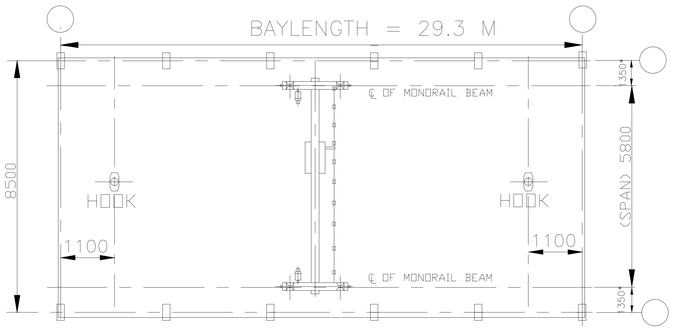
DESIGN PARAMETERS	
A	5800*
B	*
C	*
D	8500*
E	16000
F	*
G	750
H	1350*
L	1350*
M	*
N	*



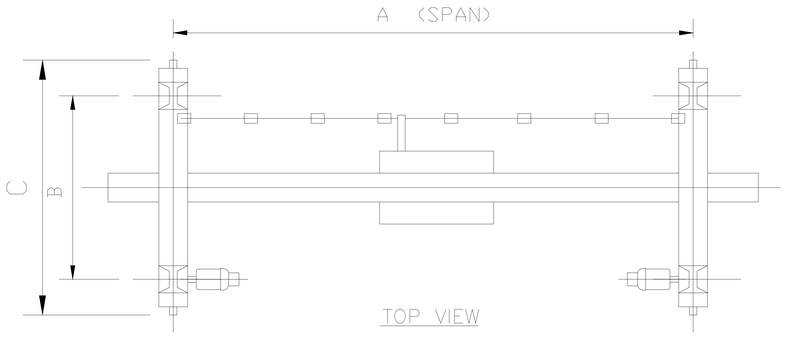
FRONT VIEW



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

TELANGANA STATE POWER GENERATION CORPORATION LIMITED (TSGEDCO)
5X800 MW YADADRI STPP, NALGONDA

TATA CONSULTING ENGINEERS LTD

BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

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

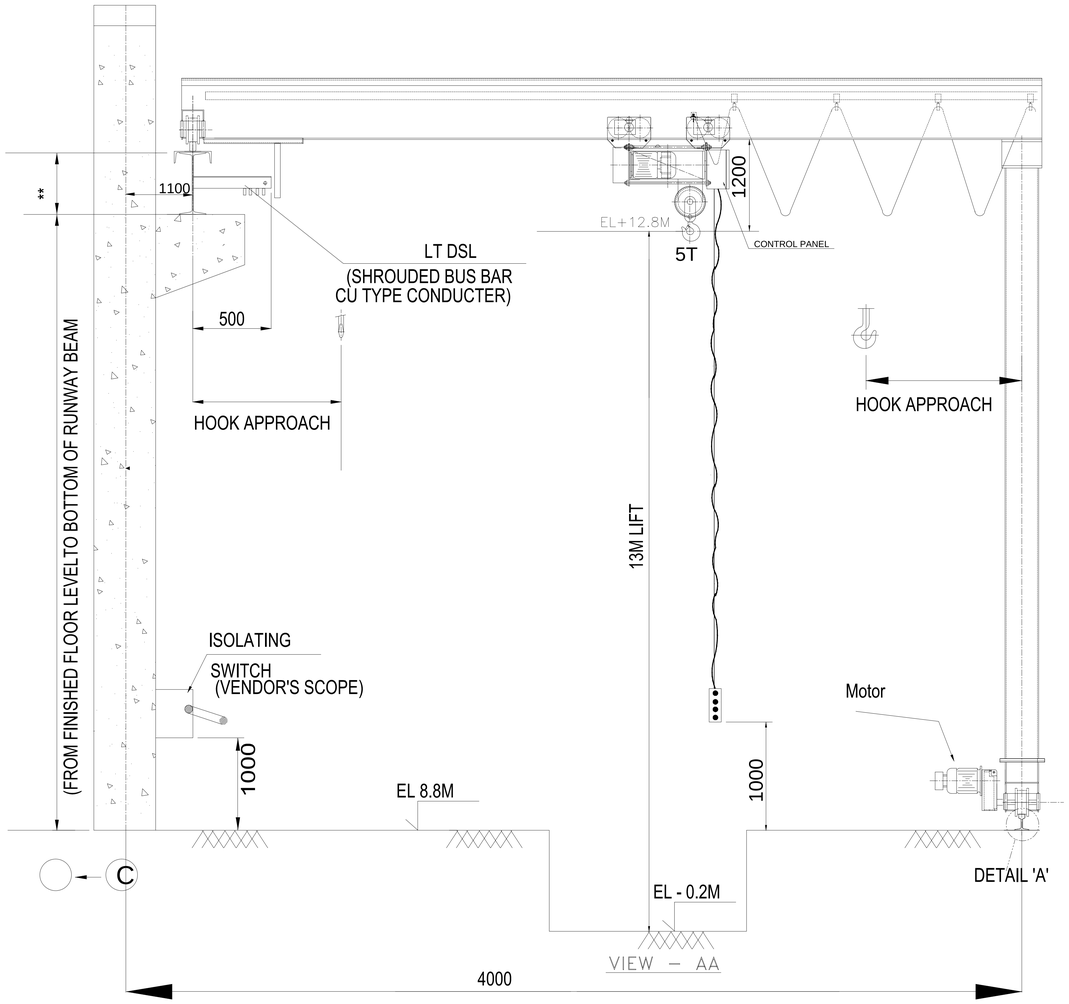
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR RAW_WATER_PUMP_HOUSE

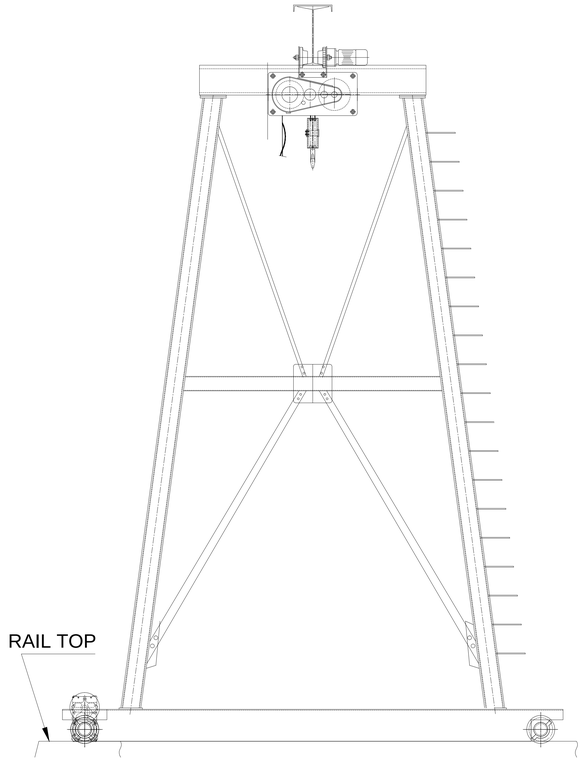
UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A006 | REV. R0

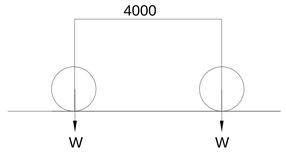
Fold-2 | ALL DIMENSIONS ARE IN MM | FIRST ANGLE PROJECTION | Fold-1

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

CUSTOMER'S DRAWING No.







LT WHEEL LOAD WITH OUT IMPACT (W=4 T)

NOTE-

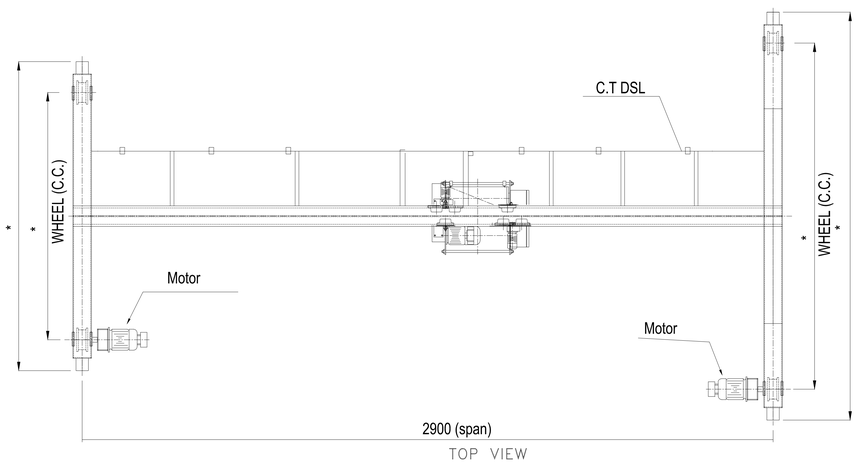
1 - ALL DIMENSIONS ARE IN MM.

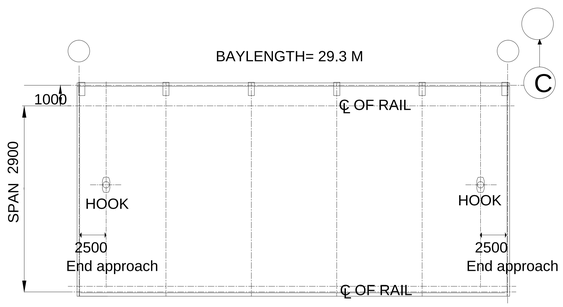
2 - DSL(LT) => SHROUDED BUS BAR CONDUCTOR

3 - ** SUBJECT TO FINALISATION OF STRUCTURE

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

5 - CRANE SHALL BE OUTDOOR TYPE





PLAN

CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA (TSGENCO) 5x800 MW YADADRI TPS, NALGONDA				
OWNER'S CONSULTANT:	TATA CONSULTING ENGINEERS LIMITED, BANGALORE				
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA				
	M	DEPT CODE	NAME	SIGN	DATE
		DRN	BS		
		DESN	BS		
		CHD	PKK		
		APPD	GB		
TITLE: CRANE CLEARANCE DIAGRAM FOR 5T CAPACITY SINGLE GIRDER SEMI GANTRY CRANE FOR OUTSIDE RWPH					
		DEPT.	SCALE	DRAWING NO. PE-DG-417-524-A007	
		SIGN		SHEET 1	REV. 0

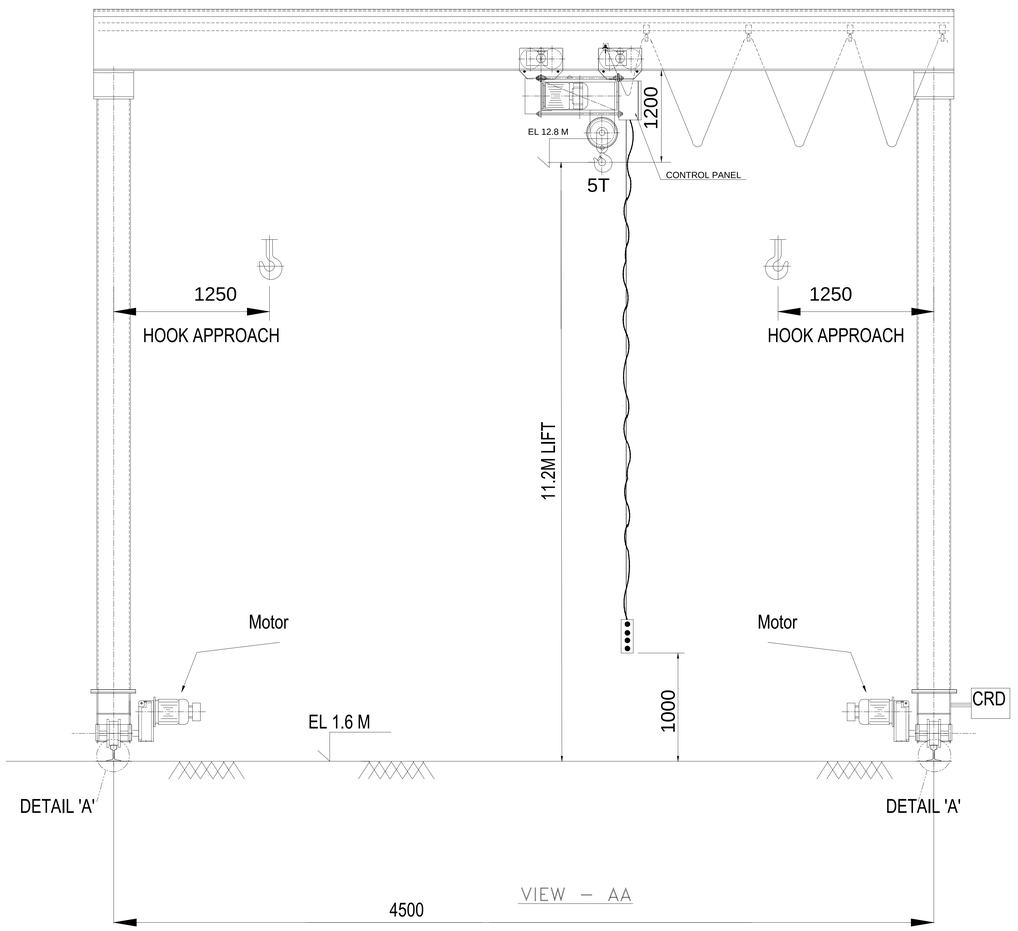
COMPUTER FILE NAME : TAL5

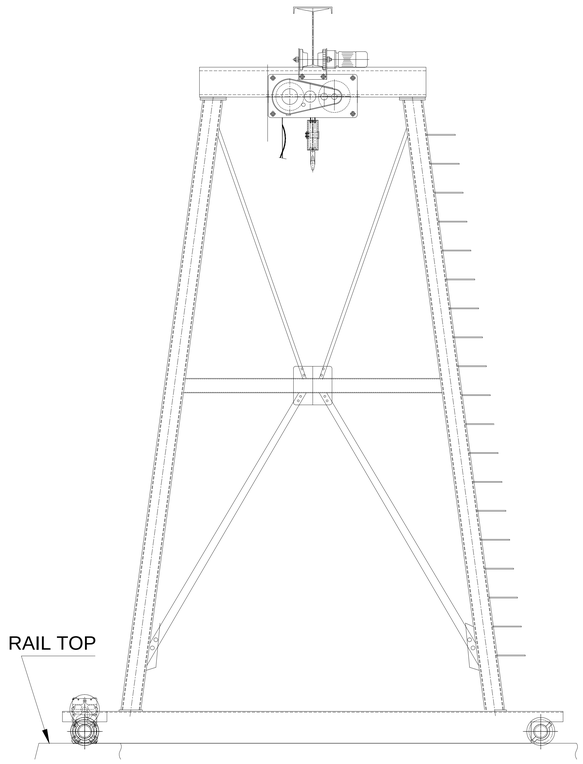
Fold-2 | ALL DIMENSIONS ARE IN MM | FIRST ANGLE PROJECTION | Fold-1

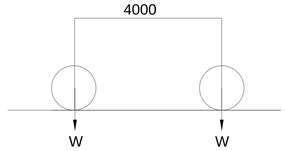
DRAWING No. PE-DG-412-524-A005

CUSTOMER'S DRAWING No.

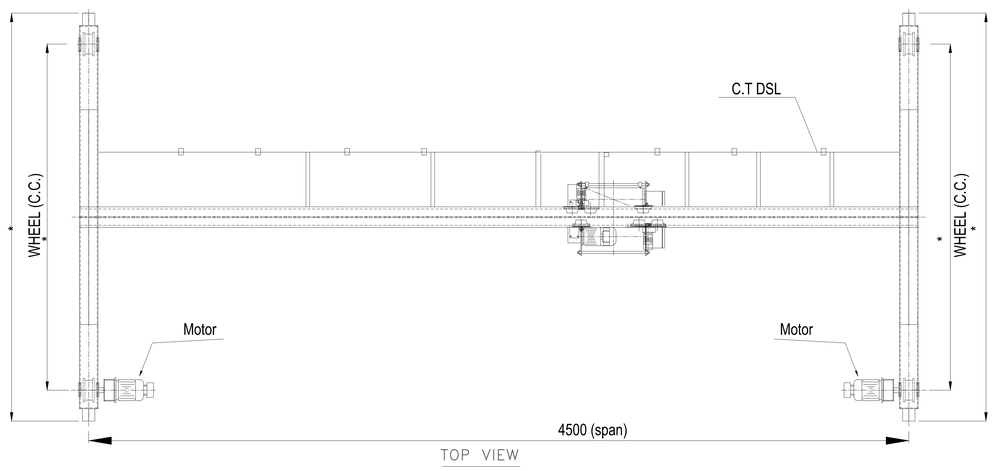
COMPUTER FILE NAME : TAL5

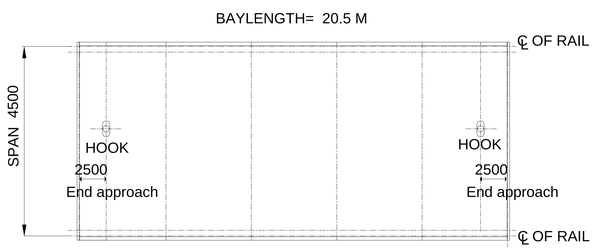






LT WHEEL LOAD WITH OUT IMPACT (W=5 T Max)





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, INDIA (TSGENCO)
5x800 MW YADADRI TPS, NALGONDA

OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED, BANGALORE

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

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

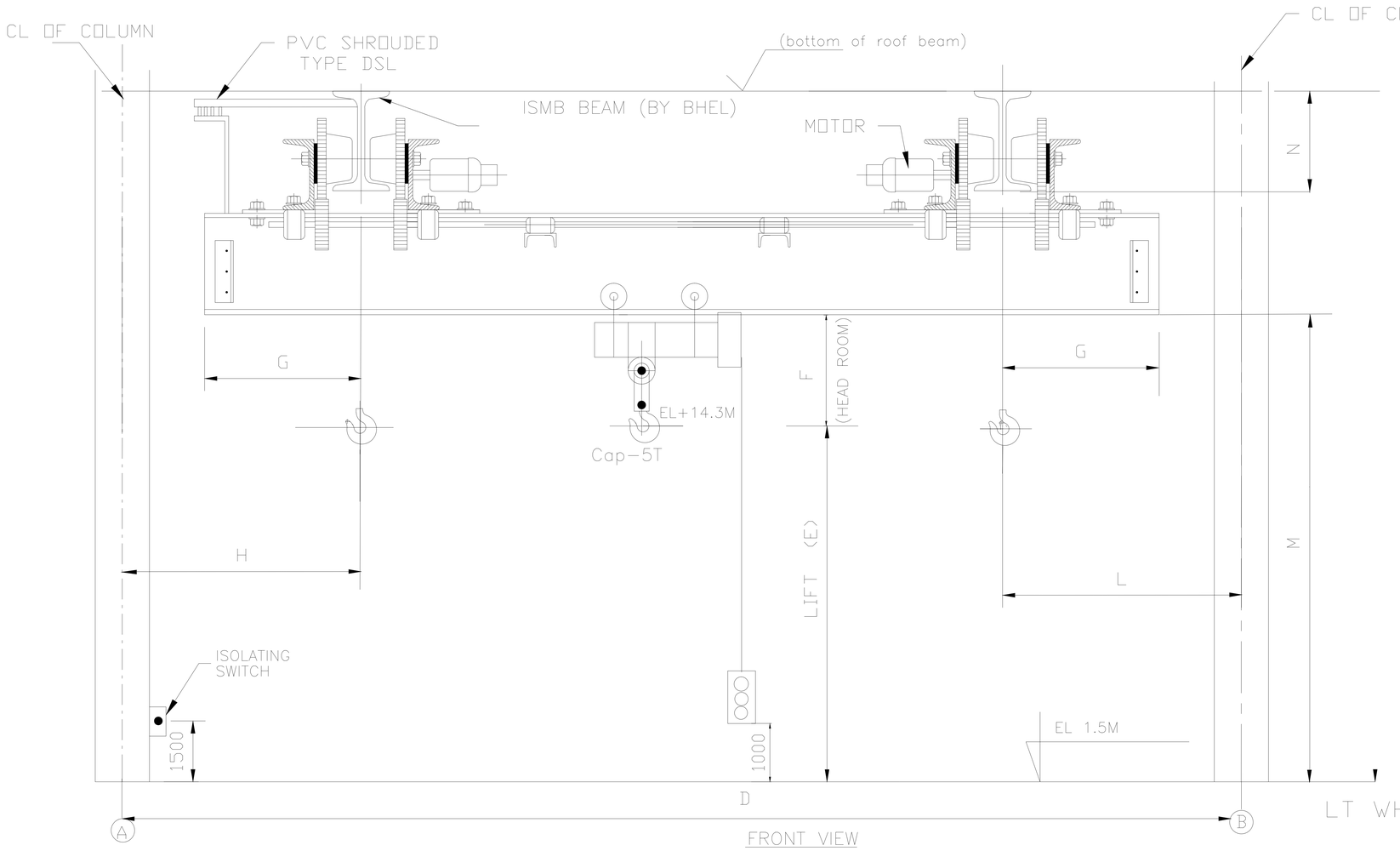
TITLE CRANE CLEARANCE DIAGRAM FOR 5T CAPACITY SINGLE GIRDER GANTRY CRANE–RAW WATER PUMP HOUSE SCREEN&GATE HANDLING

DEPT. | SCALE | DRAWING NO. PE-DG-417-524-A008

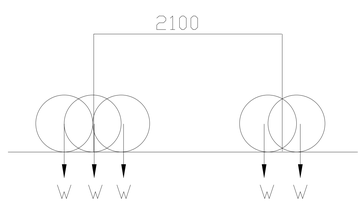
SIGN | SHEET 1 | REV. 0

Fold-2

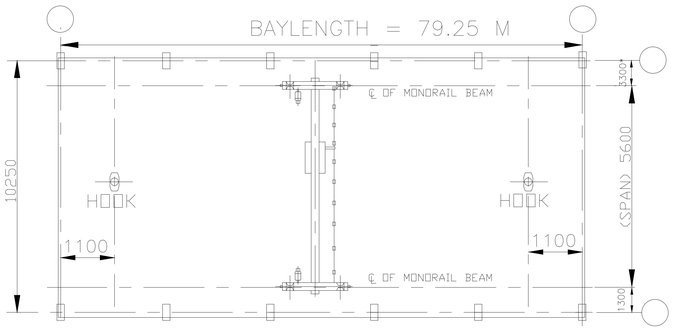
DESIGN PARAMETERS	
A	5600*
B	*
C	*
D	10250*
E	12800
F	*
G	750
H	1300*
L	3300*
M	*
N	*



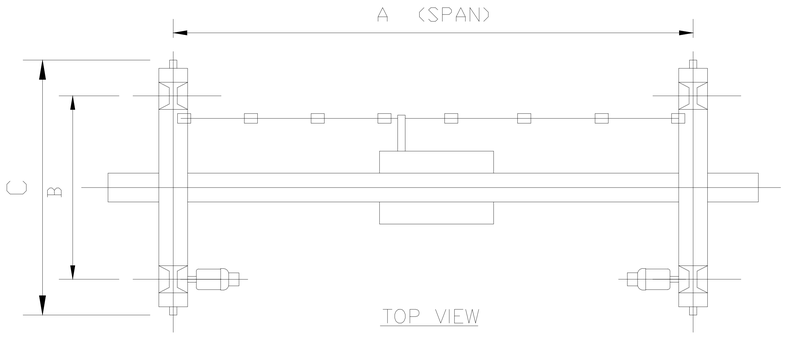
FRONT VIEW



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

TELANGANA STATE POWER GENERATION CORPORATION LIMITED (TSGEDCO)
5X800 MW YADADRI STPP, NALGONDA

TATA CONSULTING ENGINEERS LTD

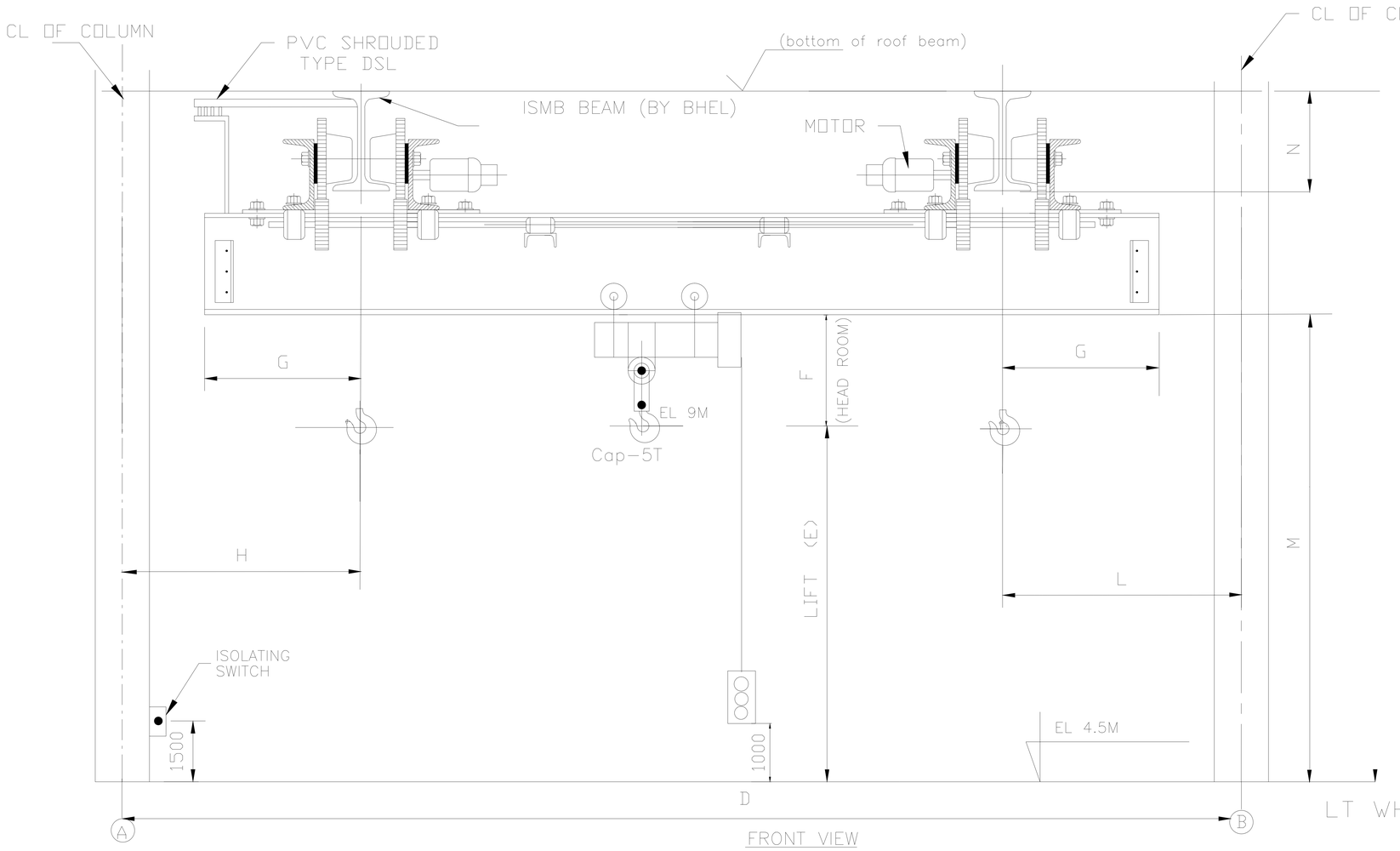
BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

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

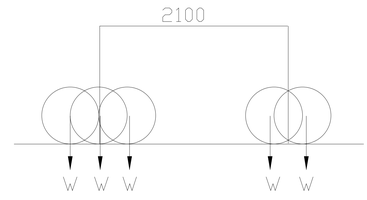
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR CLARIFIED_WATER_PUMP_HOUSE

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

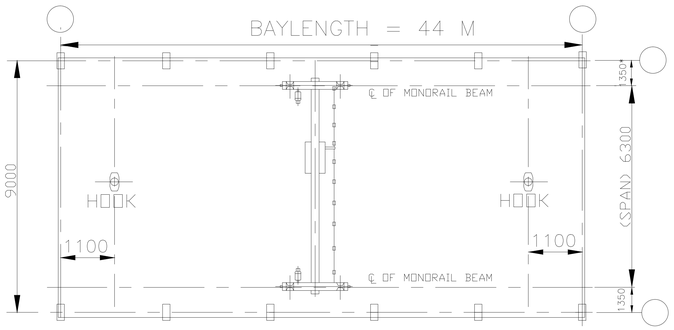
DESIGN PARAMETERS	
A	6300*
B	*
C	*
D	9000*
E	4500
F	*
G	750
H	1350*
L	1350*
M	*
N	*



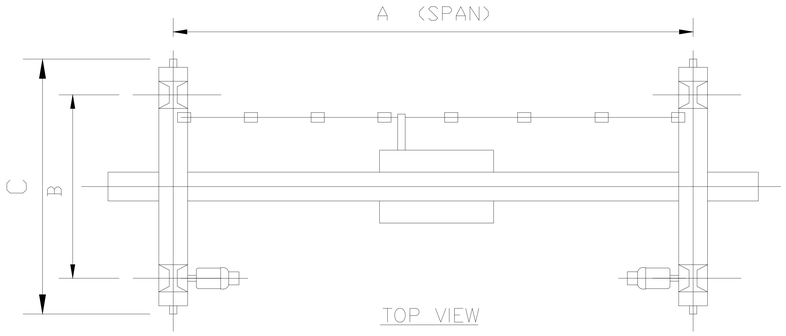
FRONT VIEW



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

TELANGANA STATE POWER GENERATION CORPORATION LIMITED (TSGEDCO)
5X800 MW YADADRI STPP, NALGONDA

TATA CONSULTING ENGINEERS LTD

BHARAT HEAVY ELECTRICALS LTD.
Project Engineering Management
Noida

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

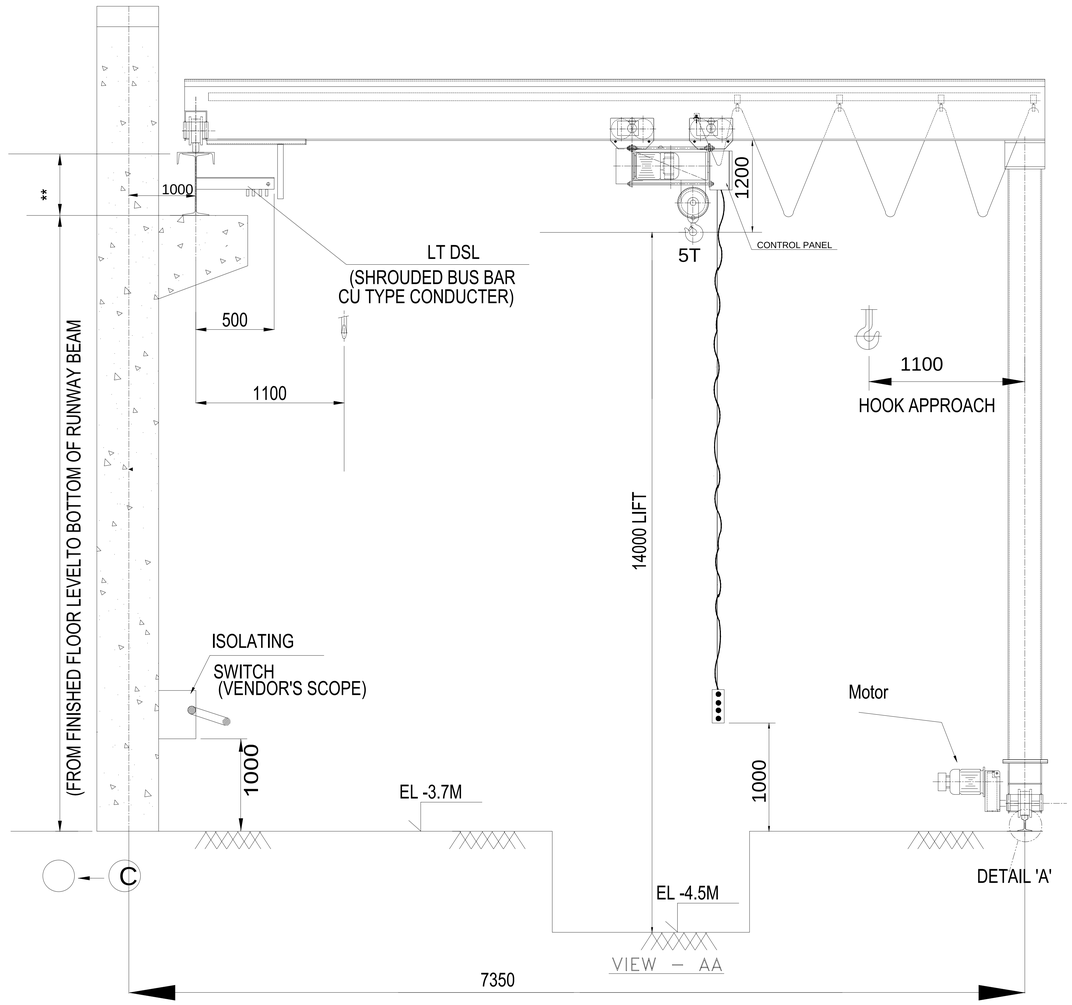
TITLE : CRANE_CLEARANCE_DIAGRAM_FOR FIRE_WATER_PUMP_HOUSE

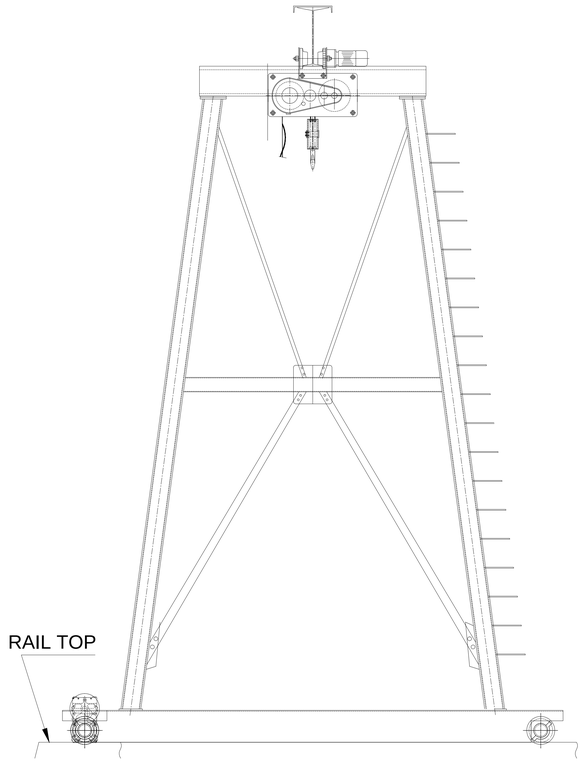
UNIT : PEM | SCALE : NTS | BHEL DWG. NO. : PE-DG-412-524-A010 | REV. R0

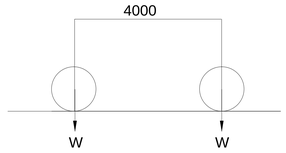
Fold-2 | ALL DIMENSIONS ARE IN MM | FIRST ANGLE PROJECTION | Fold-1

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

CUSTOMER'S DRAWING No.







LT WHEEL LOAD WITH OUT IMPACT (W=4 T)

NOTE-

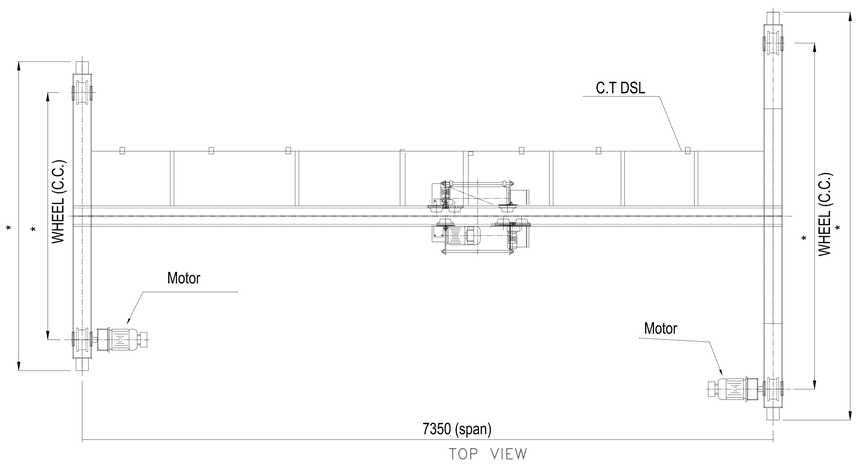
1 - ALL DIMENSIONS ARE IN MM.

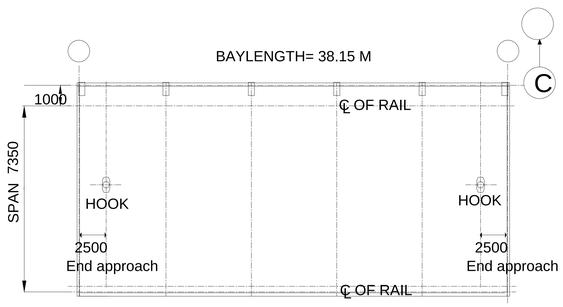
2 - DSL(LT) => SHROUDED BUS BAR CONDUCTOR

3 - ** SUBJECT TO FINALISATION OF STRUCTURE

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

5 - CRANE SHALL BE OUTDOOR TYPE





PLAN

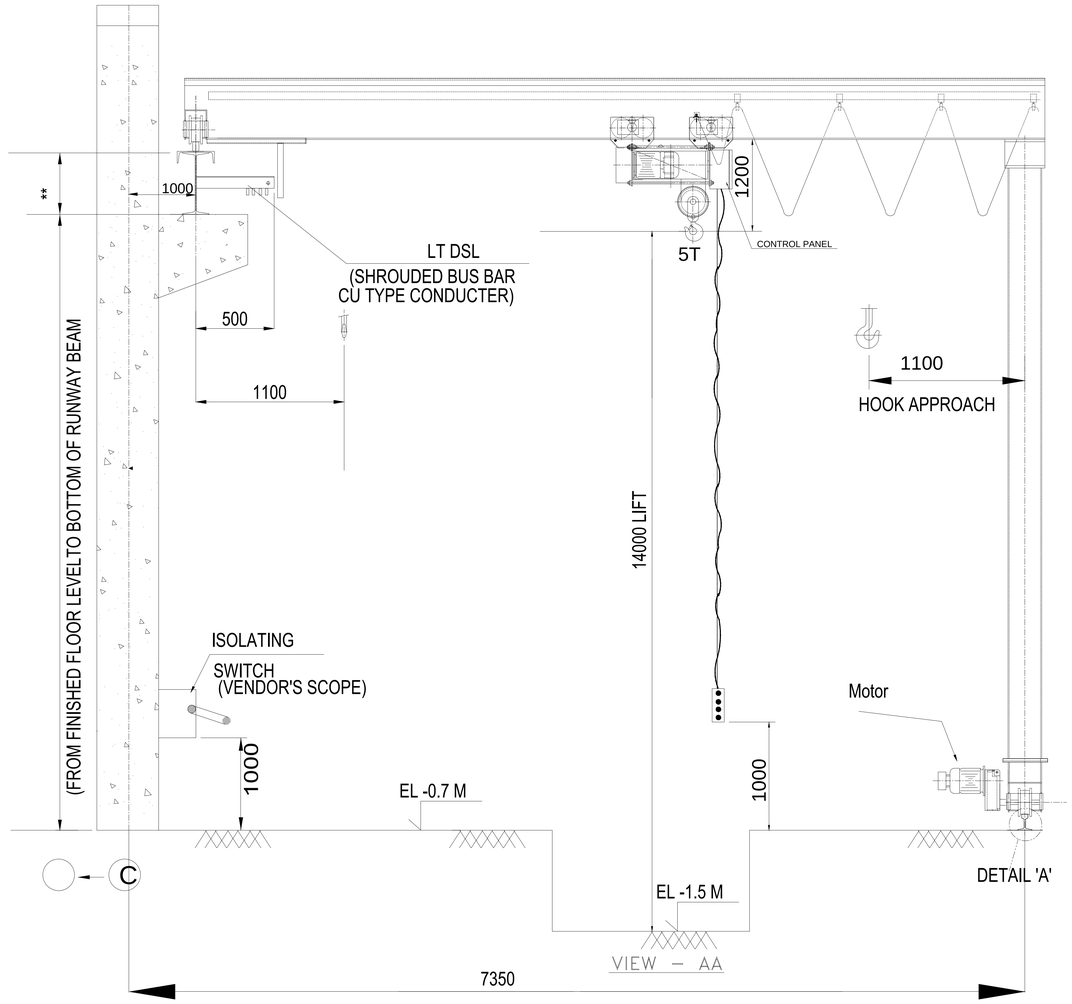
COMPUTER FILE NAME : TAL5

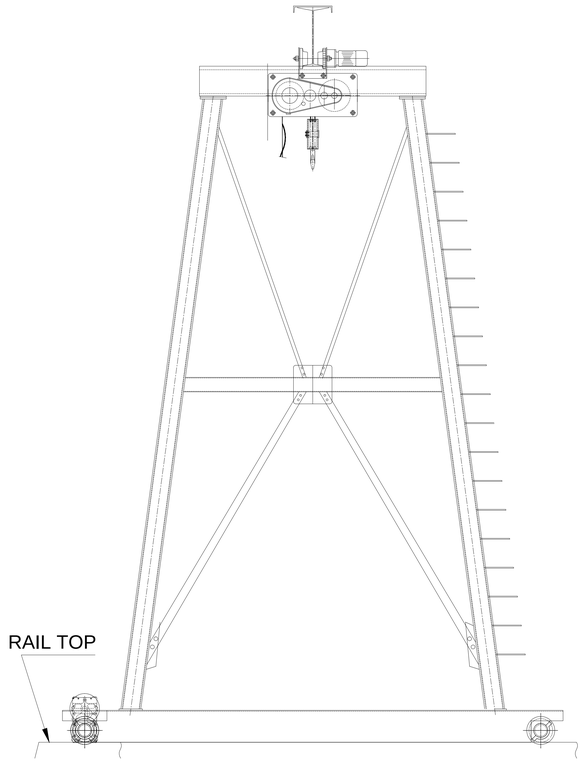
CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA (TSGENCO) 5x800 MW YADADRI TPS, NALGONDA			
OWNER'S CONSULTANT:	TATA CONSULTING ENGINEERS LIMITED, BANGALORE			
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA			
	M	DEPT CODE	NAME	SIGN / DATE
		DRN	BS	
		DESN	BS	
		CHD	PKK	
		APPD	GB	
TITLE: CRANE CLEARANCE DIAGRAM FOR 5T CAPACITY SINGLE GIRDER SEMI GANTRY CRANE FOR CWPH SCREEN & GATE HANDLING				
		DEPT.	SCALE	DRAWING NO. PE-DG-417-524-A011
		SIGN		SHEET 1 / REV. 0

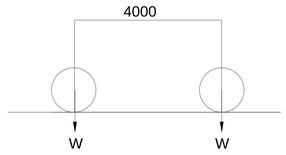
Fold-2 | ALL DIMENSIONS ARE IN MM | FIRST ANGLE PROJECTION | Fold-1

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

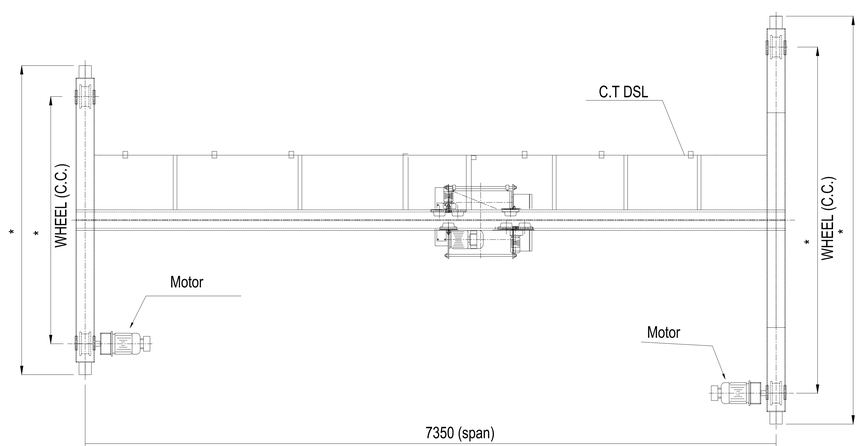
CUSTOMER'S DRAWING No.



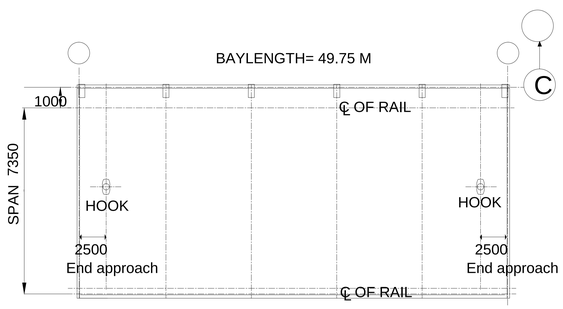




LT WHEEL LOAD WITH OUT IMPACT (W=4 T)



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

COMPUTER FILE NAME : TAL5

CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA (TSGENCO) 5x800 MW YADADRI TPS, NALGONDA
OWNER'S CONSULTANT:	TATA CONSULTING ENGINEERS LIMITED, BANGALORE
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

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

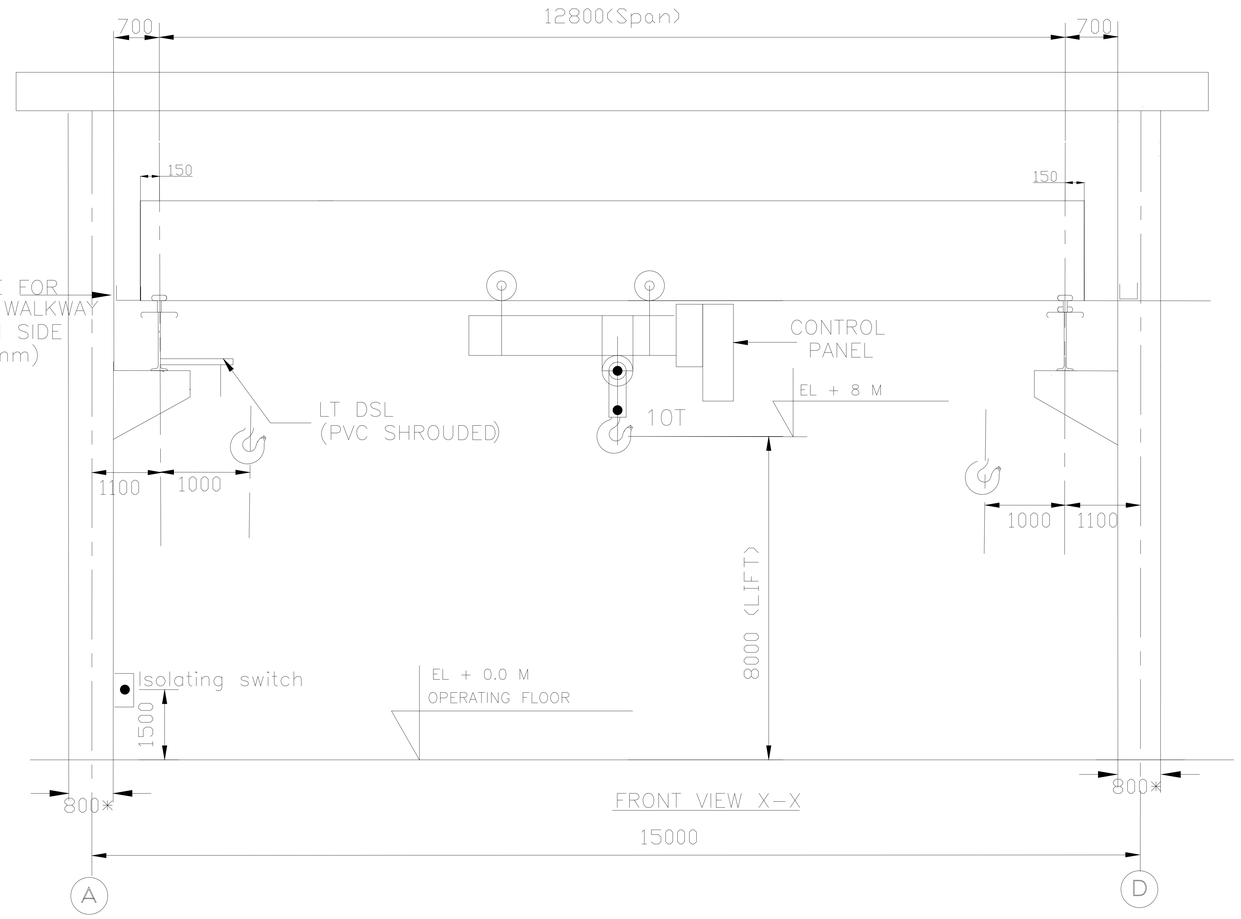
TITLE: CRANE CLEARANCE DIAGRAM FOR 5T CAPACITY SINGLE GIRDER SEMI GANTRY CRANE FOR CWPH SCREEN & GATE HANDLING

DEPT. | SCALE | SIGN

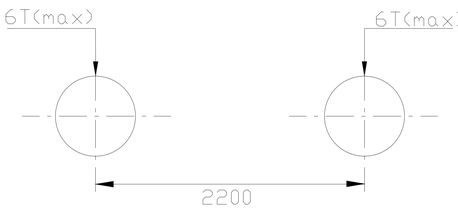
DRAWING NO. PE-DG-417-524-A012

SHEET 1 | REV. 0

Fold-2



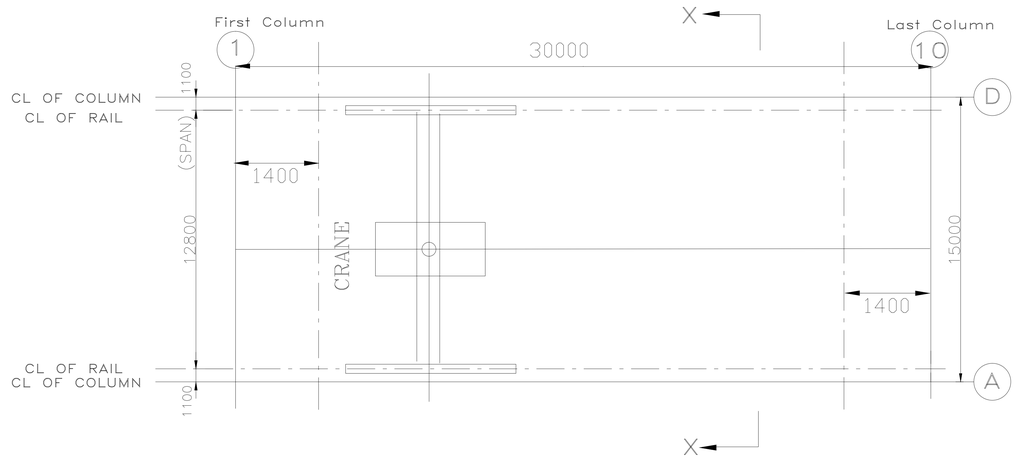
9.	CREEP SPEED THRU' VVVF DRIVES IN HOISTING MOTION ONLY	
8.	CLASS	M5
7.	DUTY	INDOOR DUTY
6.	QTY.	17 NOS
5.	BAYLENGTH	30 MTRS
4.	LIFT	8 MTRS
3.	WHEEL LOAD (WITHOUT IMPACT) PER PAIR	6 T
2.	SPAN	12.8 MTRS
1.	SAFE WORKING LOAD	10 T
SL NO.	TECHNICAL SPECIFICATIONS PARAMETERS	



LT WHEEL LOAD
(WITHOUT IMPACT)

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.



KEY PLAN

CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA (TSGEDCO) 5x800 MW YADADRI TPS, NALGONDA
OWNER'S CONSULTANT: TATA	TATA CONSULTING ENGINEERS LIMITED, BANGALORE
BHEL	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 STORE BUILDING

DEPT. | SCALE | SIGN | DRAWING NO. PE-DG-417-524-A013 | SHEET 1 | REV. 0

COMPUTER FILE NAME : TAL5

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

IB – Specific Technical Requirement (Electrical)

TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA STATE, INDIA

5x800 MW YADADRI TPS, NALGONDA

SG CRANES & HOISTS TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

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

CONTENTS

BASIC TECHNICAL FEATURES FOR LT MOTORS

(FOR BHEL–PEM SCOPE PACKAGES)

CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA 5 x 800 MW YADADRI TPS, NALGONDA
OWNER'S CONSULTANT:	
JOB NO. 417 STATUS CONTRACT DISTRIBUTION	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

DEPT CODE		NAME	SIGN	DATE
I	DRN	HC	s.d.	07.12.17
	DESN	HC	s.d.	07.12.17
	CHD	AS	s.d.	07.12.17
	APPD	PD	s.d.	07.12.17

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

TITLE: BASIC TECHNICAL FEATURES FOR LT MOTORS

DEPT.	SCALE	DRAWING NO.
SIGN		PE–DC–417–565–E003

SHEET 1 OF 7 REV. 00

1.0 This document covers the basic technical features of low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in **5 x 800 MW YADRADRI TPS.**

2.0 CODES AND STANDARDS

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

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

3.0 DESIGN REQUIREMENTS

3.1 **Service Conditions**

The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash. For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.
The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Upto 0.2 kW	240V/415 V	240V415 V
Above 0.2 kW & up to 175kW	415 V	415 V

3.2.1 Supply voltage & variations shall be as follows:-

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

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

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

3.3 **Motor Rating**

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

3.4 **Starting Requirements**

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

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

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

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

3.4.3 Continuous duty LT motors up to 175 KW Output rating (at 50 deg. C ambient temperature), shall be Premium efficiency (IE3) as per IEC: 60034-30/ IS: 12615 and the locked rotor current of motors shall as per IS 12615.
However, as per system requirement drives rated in the range of 160-210 KW may be considered in either 415V or 3.3 KV

3.4.4 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

3.4.5 The following frequency of starts shall apply

i) Three cold starts in succession with the motor being initially at a temperature not exceeding the ambient temperature.

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

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

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

a) For motors with starting time upto 20 sec.

- at least 3 sec. more than starting time.

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

- at least 5.0 sec. more than starting time.

c) For motors with starting time above 45 secs.

- at least 10%. more than starting time.

The starting time of the motor referred above is at minimum permissible voltage. Wherever the above requirements are not complied with, speed switches of approved make & type shall be provided to bypass the locked rotor protection for a pre-selected time during starting of motors. The speed switches shall have one NO & one NC contacts having maximum interrupting capacity of 5 Amps at 240V AC and 0.25 amps at 220 V DC.
Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

3.5 **Running Requirements**

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

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

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

3.6 **Stress during bus Transfer**

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

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

4.0 SPECIFIC REQUIREMENTS

4.1 **Enclosure**

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

4.2 **Cooling**

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

4.3 **Winding and Insulation**

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

Tropical Protection

All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

All fittings and hardware shall be corrosion resistant.

4.4 **Bearings**

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

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

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

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

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

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

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

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

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

4.5 **Noise & Vibration**

4.5.1 For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.

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

4.6 **Motor Terminal Box**

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

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

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

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

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

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

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

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

4.6.9 The gland plate for single core cable shall be non-magnetic type. A suitable cable adopter box shall be provided if the cable size does not allow the direct termination in the main TB.

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

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

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

4.7 **Grounding**

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

4.8 **Rating Plate**

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

a) Temperature rise in Deg.C under rated condition and method of measurement.
b) Degree of protection.
c) Bearing identification no. and Type of lubrication, Quantity and frequency/ time interval
d) Location of insulated bearings.

5.0 ACCESSORIES

5.1 SPACE HEATERS

Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement. The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle. The minimum cable size for space heater shall be 2.5 sq.mm copper cable.

5.2 DELETED

5.3 INDICATOR/ SWITCH

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

Hot and cold air temperature of the closed air circuit for CACA motor.

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

5.4 ACCESSORY TERMINAL BOX

5.4.1 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

5.4.2 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.

DRAIN PLUG

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

5.5 LIFTING PROVISIONS

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

5.6 DOWEL PINS

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

7.0 PAINTING

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

8.0 TESTING

8.1 Type Tests

For LT Motors, type test reports for type tests as per IS: 12615/ IEC: 60034 conducted on equipment similar to those proposed to be supplied shall be submitted. The type Test should have been conducted within last 5 years from enquiry date.

8.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 12615/ IEC: 60034 in the presence of customer or customer representative.

9.0 **Variable Frequency Drive motor details:**

i) The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.
ii) The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
iii) The Motor shall be designed to operate continuously at any speed over the range 20-100 % of rated speed.
iv) The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.
v) Motors required to be transferred to DOL, by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL, bypass mode shall be limited to value in motor specifications.
vi) The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.
vii) The motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800-4.
viii) The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.

REV: 00 DATE: 18.01.2018

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

PACKAGE: SINGLE GIRDER EOT CRANES & ELECTRIC HOISTS

SCOPE OF VENDOR: SUPPLY

PROJECT : **5X800 MW YADADRI TPS**

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

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.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS 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	20	21
ANNEXURE-II																				

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)/ CUSTOMER

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)

LOAD DATA (ELECTRICAL)					
JOB NO.	417	ORIGINATING AGENCY		PEM (ELECTRICAL)	
PROJECT TITLE	5X800MW YADADRI TPS	NAME		DATA FILLED UP ON	
SYSTEM	Compressed Air System	SIGN.		DATA ENTERED ON	
DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

1.0	Design ambient temperature	:	50 ^{o}C
2.0	Maximum acceptable kW rating of LV motor	:	175 KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP55
5.0	Details of supply system		
	a) Rated voltage (with variation)	:	240V, 415V $\pm$ 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal box	:	50 kA for 0.25 sec
	f) LV System grounding	:	Solidly
6.0	Class of insulation	:	Class ‘F’,with temp rise limited to class B.
7.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
8.0	Power cables data	:	Shall be given during detailed engg.
9.0	Earth Conductor Size & Material	:	Shall be given during detailed engg.
10.0	Space heater supply (30KW & ABOVE)	:	240 V, 1Φ , 50 Hz
11.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
12.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
13.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS-12615
	b) Permissible tolerance, if any	:	As per IS-12615
14.0	Terminal box	:	Suitable to rotate at 90 degrees
15.0	Paint shade	:	Shade 631 of IS-5

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	

CABLE SCHEDULE FORMAT **ANNEXURE III**

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

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

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

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

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

(B) CABLE VOLTAGE CODES:
A = 11KV (Power cables)

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

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

(C) CABLE CODES

PVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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

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

			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		QUALITY PLAN	BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 1 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	

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

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 2 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 3 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	 W	 V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	

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

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

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

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

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

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 6 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 7 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
	SHEET 9 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

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

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

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

		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 P	AGENCY W	AGENCY V	REMARKS
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

VOLUME : V-B

SECTION-IX

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

CONTENT

ATTACHMENTS

SECTION-IX

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

1.00.00 **SCOPE OF WORK**

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

1. Main Power House Building

2. Boiler area, ESP stack

3. Transformer yard

4. All auxiliary buildings (including electrical rooms of respective buildings) and structures as detailed in the Lead Specification.

5. Overhead interplant cable trestle and pipe cum cable trestle.

6. All electrical equipment as described in Volumes V-A & V-B.

7. 400kV Switchyard.

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

2.00.00 **SCOPE OF SUPPLY**

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

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

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

a) Galvanised steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, etc.

b) Galvanised steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanised sheet steel junction boxes, cable fixing clamps, nuts & bolts, etc. as required.

c) Cable termination and jointing kits as necessary.

d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.

e) Mild steel rods, galvanised steel flats, galvanised steel rods, lead coated copper tube suitably brazed with galvanised steel Bend ring galvanised steel wires, etc. required for grounding and lightning protection system shall be supplied in standard lengths.

f) Fire Stop mortal seal, fire retardant cable coating system.

g) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the contractor without any extra charge to the Purchaser.

2.01.02 a) Main Ground Mat

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

b) Grounding Electrode

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

c) Column Grounding

i) Concrete Columns

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

ii) Steel Columns

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

d) Risers

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

e) Electronic Equipment Grounding

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

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

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

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

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

2.01.03 a) Air Terminal

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

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

b) Horizontal Air Terminal

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

c) Down conductor

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

d) Electrode (for Lightning protection)

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

e) Risers (for Lightning protection)

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

f) Shielding Mast

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

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

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

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

2.04.00 **Scope of Services**

The scope includes but is not limited to the followings;

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

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

a) Power Cables

b) Cables laid in trench

c) Control, instrument and special cables

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

e) Supply and Erection of Grounding system.

f) Supply and Erection of Lightning Protection system.

3.00.00 **GENERAL REQUIREMENTS**

3.01.00 **Codes and Standards**

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

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

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

3.02.00 **Erection Schedule**

3.02.01 The entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the tenderer for this purpose.

3.02.02 The erection schedule, as approved by the Owner's Engineer shall be strictly followed by the contractor. If, for any reason beyond the control of the Contractor, the work is held-up then the Contractor shall bring it to the notice of the Owner's Engineer without any delay.

4.00.00 **DESIGN CRITERIA**

4.01.00 **Grounding System**

4.01.01 Grounding shall follow the relevant standards/codes amended till date as below:

a) Indian Electricity rules

b) National Electrical Code

c) Code of Practice of Earthing IS 3043

d) Protection of building and allied structures against lightning IS 2309

e) IS- 732, IS 226, IS 2629, IS 2633 & IS 4759

f) IEEE -80-2000, IEEE-665

The station grounding system shall be an interconnected network of MS conductor and MS ground rods. The system shall be provided to protect plant personnel and equipment from the hazards, which can occur during power system faults and lightning strikes

4.01.02 The main objectives of grounding system are to :

a) Provide safety to personnel from contact of dangerous potential caused by ground fault.

b) Ensure sufficient grounding current for effective relaying.

c) Stabilize circuit potential with respect to ground.

Design Basis

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

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

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

a) Major items of equipment, such as generator, switchgear, transformer, motor, relay panels and control panels etc shall have integral ground buses or connection points which shall be connected to the under ground grid.

b) Electronic panels and equipment, where required, shall be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations. Where practical, electronics ground loops shall be avoided. Where this is not practical, isolation transformers shall be furnished. All indoor and outdoor electrical equipment and associated non current carrying system, metal works, support structures, buildings columns, fence, neutrals, masts, arrestors, etc shall be connected to the plant ground system.

c) Instrumentation cable screens shall be single point bonded to the instrument earth network to minimize the effects of electrical interference.

d) For Signal/case/intrinsically safe signal, grounding of control room instruments, separate earth pit not connected to main ground grid shall be used. Control cabinets shall be connected to this separate earth pit.

e) A grounding conductor (steel wire armor) shall be routed parallel to all power conductors operating above 240 volts.

f) All ground wires installed in conduits shall be un-insulated.

g) Embedded grounding grid of 75x10mm GI flat at basement/grade slab as well as upper floor/suspended slabs shall be provided.

h) In addition mild steel ground pads at different locations i.e. on wall/floor/ceiling inside the buildings/tunnels/trenches shall be provided. These pads will be in turn connected to below ground level earth mat through galvanized steel flat or riser. Each ground pad shall have provision for connection of at least two 75x10mm GI flats.

i) Treated earth pit shall be provided for system earthing at locations where generator and transformer neutrals are grounded. Two separate earthing leads shall be provided for each of the transformer and generator neutrals and shall be directly connected to a separate treated earth pit which in turn shall be connected to two different runs of earth grid. Heavy duty 50mm G.I. pipe shall be provide for treated earth pits with charcoal, salt, etc. as per IS:3043.

j) Dedicated treated earth pit shall be provided for lightning protection system.

k) Clean earthing for instrumentation shall be provided with dedicated earthing system and separate treated earth pits below the main control room, feed water pump house in turbine house etc.

l) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

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

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

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

4.01.04 Ground Grid Conductor

a) Ground grid conductor of mild steel rod shall be used.

b) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years.

4.01.05 Underground Grid

a) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80 & IEEE 665.

b) The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than 0.5 ohm.

c) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.

d) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.

e) All ground grid conductor connections will be welded type.

f) Main Plant ground grid shall be connected with the switchyard and other auxiliary building /area ground grid at least at two (2) points.

g) For test pits, the Electrode will be 100 mm dia. Heavy duty C.I. pipe with perforations. Electrodes installed in test pits will have disconnecting facilities

4.01.06 Above Ground Connections

a) Galvanised steel flats shall be used for all connections above earth.

b) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.

c) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.

d) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.

4.01.07 Equipment Ground Lead

Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.

4.01.08 The minimum ground conductor sizes for various equipment and structures are given in Annexure-B.

4.01.09 Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.

4.02.00 **Lightning Protection System**

Lighting protection system design shall be as per IS:2309

4.02.01 The main purposes of lightning protection system are to :

a) Provide protection to structures from lightning strokes.

b) Provide a low resistance-conducting path to lightning discharge.

4.02.02 Lightning protection shall be provided for Power House building, auxiliary building , chimney, cooling tower and other structures.

4.02.03 Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS:2309.

4.02.04 For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.

4.02.05 System Design

a) Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.

b) Horizontal air termination shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.

c) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.

d) Down conductors will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.

e) An earth electrode will be provided at the connection point of the down conductor with the station ground.

f) Galvanised steel rods and flats will be generally used for air termination and connections. All connections will be welded type.

g) For air terminals of chimney, lead coated copper tube suitably brazed with G.S. Band ring shall be provided.

4.03.00 **Cabling System**

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

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

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

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

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

5.00.00 **SPECIFIC REQUIREMENTS - SUPPLY**

5.01.00 **Equipment and Material**

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

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

5.01.03 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

5.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

5.02.00 **Pre-fabricated Cable Trays**

5.02.01 Cable trays shall be pre-fabricated ladder type sheet steel with hot dip galvanising furnished in standard length of 2.5 metres.

5.02.02 Cable trays shall be of standard width specified in Annexure-A and drawings.

5.02.03 Cable trays shall be complete with all necessary hot dip galvanised sheet steel accessories such as coupler plates, ground continuity connections and associated nuts, bolts, washers, hangers, clamps, etc. Also horizontal / vertical bends, horizontal / vertical Tee, Reducers, Horizontal cross-pieces, protective covers shall be supplied along with straight runs in order to take care of cable tray alignments in different routes.

5.02.04 All fittings like horizontal/ vertical elbow, horizontal crosspiece, reducer, horizontal tee, etc. should be pre-fabricated. Each fitting shall be provided with two nos. hot dip galvanised side coupler plates & associated bolts, nuts and washers on each side.

5.02.05 Cable trays, fittings & accessories as well as elbows, reducers, tees, crosses, etc. shall be fabricated out of 14 gauge (2 mm thick) hot rolled mild steel sheets.

5.02.06 Contractor shall supply 14 gauge (2 mm thick) perforated type hot rolled mild steel sheet covers for vertical cable shafts up to a height of 2.5 metres from floor level. The perforated covers used for the vertical raceways may be of one or more pieces along the width of the raceway, depending on the width of the raceway and shall be bolted to the structural framework of the raceway.

5.02.07 The cable trays, fittings and accessories including all bolts, nuts, screws, washers, etc. shall be hot dip galvanised after fabrication as per IS:2629. Galvanising shall be uniform, clear, smooth and free from acid spots. Should the galvanising of the samples be found defective, the entire batch of steel will have to be re-galvanised at Contractor's cost.

The amount of zinc deposited shall not be less than 610 gms per square metre of surface area and in addition the thickness of the zinc deposit at any spot whatsoever, shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elcometer or any other instrument and reject any component, which shows thickness of zinc at any location to be less than 75 microns.

5.02.08 The Contractor shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and that such tests are adequate to demonstrate that the equipment will comply with the requirement of this specification.

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

Deflection Test

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

5.02.09 For other details refer CABLING NOTES AND DETAILS annexed to this specification.

5.03.00 **Conduits and Accessories**

5.03.01 Conduits shall be of rigid steel, hot-dip galvanised, furnished in standard length of 5 metres, threaded at both ends.

5.03.02 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.

5.03.03 Each piece of conduit shall be straight, free from blister and other defects, internal surface shall be of smooth finish and covered with capped bushings at both ends.

5.03.04 The contractor shall provide and install all rigid steel conduits, mild steel pipes, flexible conduits rigid PVC pipes, etc. complete with accessories such as tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work.

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

5.03.06 For sizes above 63 mm mild steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. Pipes shall be manufactured by electric welding process. These pipes shall be of heavy duty class as per IS:1239 and shall have ISI mark. Pipes shall be supplied in lengths of approximately 5 metres. Pipes, fittings & accessories shall be hot dip galvanised both on inside and outside.

5.03.07 Flexible conduits shall comply with IS:3480. They shall be made with bright, cold-rolled, annealed and electro-galvanised mild steel strips. Flexible conduits shall be used between embedded conduits/pipes and the motor terminals. Flexible conduits shall also be used between fixed conduit and any equipment terminal boxes where vibration is anticipated or equipment that require regular removal.

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

5.04.00 **Junction Boxes**

5.04.01 Glass Fibre Reinforced Junction Boxes

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

b) Design

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

c) Enclosure

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

d) Doors

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

e) Protection Class :

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

f) Mounting clamps and accessories :

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

g) General :

i) JBs shall have small canopy at the top.

ii) There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage in to the junction box shall be avoided and it shall fall outside.

iii) Cable entry shall be from bottom side only.

iv) Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

5.04.02 Steel Junction Boxes :

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

b) Design :

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

c) Enclosure :

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

d) Doors :

The doors shall be hinged and lockable. The doors shall have industrial heavy – duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

e) Protection Class :

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

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

f) Mounting clamps and accessories:

Suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required

5.04.03 The junction boxes shall have the following indelible marking

- Circuit nos. on top by white-stenciled paint at site.
- Circuit nos. with ferrules (inside) as per approved drawing.
- Danger sign in case of 415V circuit.

5.05.00 **Terminals**

5.05.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.

5.05.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.

5.06.00 **Cable Termination & Jointing Kits**

5.06.01 The Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables, etc. along with all accessories & consumables required for making termination and joints complete. All the materials and components of the termination/joints shall be suitable and compatible with the type of cables for which the terminals/ joints are intended.

5.06.02 The straight through joints of H.T. and L.T. cables shall be of Tapex/ Paracast/Parawrap type/approved make.. The end termination kits for H.T. cables shall be of Raychem/3M/Elastimold type/approved make. Cable joint or end terminations on Electrical equipment shall be suitable for Indoor & Outdoor use, as the case may be.

5.06.03 Glands and lugs required for termination of H.T., L.T. and instrumentation cables shall be supplied by the Contractor in required quantity.

5.07.00 **Cable Glands**

Cable glands shall be tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Cable glands shall match with the sizes of different HT/LT/Control cables.

5.08.00 **Cable Lugs**

Cable lugs shall be suitable for termination of different cross-sections of H.T./L.T./Control/Instrumentation cables and shall be of following types :

i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

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

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

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

5.09.00 **Consumables and Hardware**

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

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

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

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

5.10.00 **Testing Equipment**

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

a) Insulation Tests

i) Power operated Meggar - 1 KV and 10 KV grade

b) Hand driven earth Resistance Meggar, range 0-1/3/30 ohms.

c) High potential testing set - roller mounted type

d) Tong testers of suitable ranges.

e) Contact resistance measuring set for micro-ohms.

f) Torque wrench of various sizes.

g) Multimeters, test lamp, field telephone with buzzer set, different gauges, etc.

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

6.00.00 **METHODS AND WORKMANSHIP**

6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/ electricians skilled in the trade involved.

6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.03.00 All details on installation shall be electrically and mechanically correct.

6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

7.00.00 **INSTALLATION**

7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.

7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits, etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/ termination kits, lugs, glands, ferrules, tapes, etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.

7.01.04 Grounding installation work shall mean erection, jointing/ brazing/ welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.

7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors, etc. of lightning protection system.

7.02.00 **Cable Trays**

7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.

7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.

7.02.03 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.

7.02.04 The cable trays shall be supported in general at a span of exceeding 1.25 metres horizontally and 1.0 metre vertically.

7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing & maintaining the cables.

7.02.06 Complete cable tray support structure after installation shall be inspected/ tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.

7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship, etc.

7.02.08 The Contractor shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.

7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.

7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.

7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.

7.02.12 Cable tray/conduit system will be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.

7.02.13 Cable tray/conduit system will be constructed to prevent drainage of water into equipment or building.

7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.

7.02.15 Different voltage grade cables will be laid in separate trays when trays are run in tier formation. Power cables will normally be on top trays and control/instrumentation cable on bottom trays.

7.03.00 **Cable and Conduits**

7.03.01 The Contractor shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.

7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.

7.03.03 Approximate lengths of cable and conduit runs will be shown by the contractor in the cable schedule for guidance only. Before commencement of work the Contractor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.

7.03.04 The Contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.

7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.

7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the owner's Engineer.

7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.

7.04.00 **Conduit and Accessories**

7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.

7.04.02 The Contractor shall furnish all conduits complete with accessories as required.

7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the Contractor.

7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.

7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.

7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.

7.04.07 Pull boxes will be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.

7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting, etc. Conduits shall be supported at least every 2000 mm.

7.05.00 **Cables : Storage and Handling**

7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.

7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.

7.05.03 In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.

7.05.04 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending.

7.05.05 The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.

7.05.06 While laying cable, cable rollers shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. Cables shall not be dragged on ground or along structure while laying out from cable drums.

7.05.07 Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.

7.05.08 Empty cable drums shall be returned to the Owner.

7.06.00 **Cable Laying**

7.06.01 Cables will generally be laid on ladder type prefabricated cable trays, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle as per approved drawing. For outdoor area cable rack shall be used in Pipe Bridge for outdoor area cable interconnection. Cables shall be run in concrete trenches in transformer yard and switchyard only and in those electrical rooms at ground level, which are without any spreader room below. Cables buried directly in ground are not acceptable except for street lighting cable.

In indoor pumps, mechanical equipment areas overhead cable trays shall generally be used.

A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables. Cables for redundant equipment system shall be run in separate trays, as far as possible.

7.06.02 Cables laid on trays and risers shall be neatly dressed and clamped with self-locking type fire resistant nylon ties at an interval of 750 mm. for horizontal and vertical runs, in case of both power, control and instrumentation cables.

7.06.03 All single core power cables for 3 Ph. AC circuits shall be laid in trefoil formation and suitably clamped with self-locking type fire resistant nylon ties at an interval of 750 mm.

7.06.04 All H.T. multicore power cables and L.T. multicore power cables with cross-sectional area including & above 95 sq.mm shall be clamped individually by self-locking type fire resistant nylon ties.

7.06.05 L.T. power cables of cross sectional area less than 95 sq. mm. and all control and Instrumentation cables shall be clamped in bunches with self-locking type fire resistant nylon ties. The number of cable in one bunch shall not exceed eight (8).

7.06.06 Prior to laying of cables inside the indoor and outdoor trenches, the contractor shall properly clean the trenches.

7.06.07 For underground crossing of railways, road, etc. additional protection shall be provided in form of hume pipe or concrete encased rigid steel conduits (duct bank.

7.06.08 After completion of installation and prior to connection, all power cables shall be subjected to a high potential test.

7.07.00 **Cable Tags & Markers**

7.07.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, bends, every 30.0M and exit from any equipment, junction box. When a cable/conduit passes through a wall, tags shall be fitted on both sides of the wall.

7.07.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire. For single core cable the wire shall be of non-magnetic material.

7.07.03 The location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.

7.07.04 The Contractor shall furnish and install all tags and markers stated above.

7.08.00 **Cable Termination and Connection**

7.08.01 The termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.

7.08.02 The work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of Contractor's procurement.

7.08.03 Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.

7.08.04 Cable joint kits for all cables shall be supplied by Contractor under this specification. Responsibility for proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by Contractor.

7.08.05 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.

7.08.06 The Contractor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.

7.08.07 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the contractor.

7.08.08 Control/instrumentation cable cores entering control panel/ switchgear/ MCC, etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.

7.08.09 The Contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.

7.08.10 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.

7.08.11 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

7.08.12 All cable entry Points shall be properly sealed and made vermin and dust proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.

7.09.00 **Termi-point Connection**

a) The conductor (solid or stranded) is forced against the contact area of the 2.4 x 0.8 mm or 1.6 x 0.8 mm connection pin by means of a tin-coated bronze clip, which maintains a constant pressure. In the Maxitermi-point method, 2.4 x 0.8 mm pins is used without exception.

b) The conductor is "shot" onto the pin together with the clip. The resulting friction causes both the wire and the contact area of the pin to be cleaned and any oxide layers to be penetrated.

c) Apart from this the wire and the clip are deformed in such a way that a gas-tight connection with very good electrical and mechanical properties is established.

d) A special manually or pneumatically driven gun is required. Up to 3 adjacent connections can be "shot" onto one pin. In most cases only one clip at the base of the pin is attached. The sections above usually remain vacant. Any part of a connection pin may be reused several times after removal of the existing clip connection. Contact areas below existing connections that have become vacant can be reused by pushing the connections above the vacant space downwards, so that the new connection can be "shot" on above the top connection. The single jumper wires need not be specially prepared as the end insulation is stripped within the tool.

e) This connection method requires special insulation of the wires. The diameter of solid conductors is 0.8 mm the cross-section of stranded conductors 0.5 Sq.mm.

f) The conductor is deformed greatly when attached and is to be shortened by 3 mm when disconnected and reused.

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

7.10.00 **Cable Joints**

7.10.01 Cable shall be installed without joints as far as practicable.

7.10.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.

7.11.00 **Grounding**

7.11.01 The Contractor shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc. The grounding work shall be carried out as per provisions of I.E. rules Indian standards and enclosed grounding and lightning protection notes and details.

7.11.02 The grounding shall be done by conductors of adequate sizes (size shall be selected by the bidder with supporting calculation) and the same shall be connected to the risers of main ground mat.

7.11.03 For fabricated cable trays, a separate ground conductor (50x6 mm G.S. flat) shall run along the entire length of each route of cable tray being suitably clamped on the cable tray. Individual cable trays of each section shall be connected to above ground conductor through 50x6 mm G.S. flat to maintain continuity of ground path.

7.11.04 All ground conductor connections shall be made by electric arc welding/ brazing unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers. The rods/connection shall be coated with cold galvanizing /weather resistance anti corrosive paints.

7.11.05 All ground conductors shall be painted black for easy identification.

7.11.06 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.

7.11.07 Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

7.11.08 If there is no provision to ground the L.T. transformer neutral at transformer end, to make an effectively earthed 415V system the neutral bus of all 415V distribution boards shall be connected to ground grid at two different and distinct points.

7.11.09 The underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth of minimum 1 metre below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300

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

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

7.12.00 **Painting**

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

7.13.00 **Galvanising**

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

7.14.00 **Excavation and Back Filling**

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

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

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

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

7.15.00 **Steel Fabrication**

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

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

7.16.00 **Cleaning up of Work Site**

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

7.16.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

8.00.00 TESTS

8.01.00 Shop Tests

8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

8.01.02 Tests on panels/junction boxes shall include :

a) Wiring continuity tests.

b) High voltage and insulation tests.

c) Operational tests.

8.02.00 Site Tests

8.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.

8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.

Cable cores shall be tested for :

a) Physical damage

b) Continuity

c) Correctness of connections as per relevant wiring diagram

d) Insulation resistance to earth

e) Insulation resistance between conductors

f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.

8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

8.03.00 Test Certificates

8.03.01 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 To be submitted with the Bid

9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.

9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.

9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.

9.01.04 Layout of Grounding system & lightning protection system showing connection and other details along with backup design calculations and detailed write up.

9.01.05 Bill of materials for grounding and lightning protection system.

9.01.06 Drawing showing details of equipment grounding.

9.02.00 **To be submitted after Award of Contract**

9.02.01 Make, type & catalogue number of cable termination kits, joints & accessories.

9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.

9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.

9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.

9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.

9.02.06 Bill of material for grounding system and lightning protection system.

9.02.07 Drawing showing details of equipment grounding system.

9.02.08 Cable schedule and inter-connection charts for the entire power plant.

ANNEXURE-A

NOTES AND DETAILS FOR CABLING SYSTEM

1.00.00 **GENERAL**

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

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

a) Indian Electricity Rules, 1956, with up to date amendment.

b) I.S. Code of Practice.

2.00.00 **CABLE ROUTING/LAYING**

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

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

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

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

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

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

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

2.01.08 Low level signal cables and other special Instrumentation and Control cables shall run in separate trays. In general, a minimum of 1500 mm clearance shall be maintained between these cables and noise generating equipment (large motors, generators, transformers etc.).

2.01.09 The cable spreaders of each unit shall be compartmentalized by provision of fire proof partition wall.

2.01.10 The floor of the cable spreader rooms will have to be made water proof so that water does not percolate to lower levels in the event of fire fighting operations. Adequate arrangement for efficient drainage of water shall be provided. The cable raceways should also be suitably curved to avoid water entry through this place.

2.01.11 Cabling System for CHP

a) Cable in CHP area shall be generally routed through the conveyor gallery / tunnel, TP / Buildings by separate supporting structures, Pipe cum cable bridge. The cables shall be laid in vertical trays.

b) In substation & switchgear room cable shall be laid in horizontal cable trays installed in cable vault room.

c) Cables may also be routed through hume pipes to enter into various buildings from the nearest overhead cable trestle/substation building.

d) Overhead cable trestle/cable bridge shall be provided for routing of cables between the following Sub-Stations/buildings:

i) Main CHP Substation Building and Crusher House.

ii) Main CHP Substation Building and Pump House (if required).

iii) Wagon Tippler Substation Building and TP.

The bottom of the steel supporting structure shall be generally at 2.5m above the grade level except for road crossing and rail crossing where the same shall be 6.5 m and 9.0m respectively above grade level.

e) Cable trays shall be laid out horizontally in sub-station buildings and pump-house whereas the same shall be installed vertically inside transfer points, crusher house, conveyor gallery/tunnel etc. The cable trestle shall have a minimum 600mm clear walk way all along its routes and shall have maintenance platforms as required.

f) Separate trays shall be provided for H.T., L.T., control and instrumentation cables. LT mutlicore Power cables shall be laid in single layer & touching formation and single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meter while control and instrumentation cables shall be laid in maximum of two layers formation. Single core HT power cables shall be laid on trefoil formation with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meter and Multi core power cables shall be laid in single layer & touching formation. Normally cable trays shall be designed with 70% fill-in criteria and

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

2.02.00 **Cable Trays/Supports**

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

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

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

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

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

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

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

2.03.00 **Conduits**

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

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

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

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

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

2.03.05 Conduit runs shall be provided with necessary bends as required.

2.04.00 **Installation**

2.04.01 The Contractor shall install terminate and connect up all cables and conduits with supporting arrangements as per drawings, cable schedules and interconnection chart/drawings.

2.04.02 The HV power cables of 11 KV/3.3 KV shall be laid in trays or racks as follows :

a) In single layer only.

b) Multi core cables to be laid in touching with each other.

c) Single core cables to be laid in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centerlines and clamp every two meter.

2.04.03 1100V grade power cables shall be laid in single layer in trays.

2.04.04 1100V grade mutlicore power cable shall be laid in touching formation to each other.

2.04.05 1100V grade Single core cables to be laid in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centerlines and clamp every two meter.

2.04.05 Control and Instrumentation cables can be laid up to a maximum of two layers in each tray.

2.04.06 Normally cable trays shall be designed with 70% fill-in criteria and conduit 40% fill-in criteria. Same cable laying philosophy shall be considered in other areas of the plant, if not specifically mentioned.

2.04.07 The trays shall be run with a vertical spacing of 300 mm for overhead cable trays as well as inside cable trenches. A minimum of 225 mm clearance shall be provided between the top of tray and beams, cold piping, 500 mm clearance for hot piping/object to facilitate installation of cables in tray.

2.04.08 Adequate pull boxes shall be provided in conduit run to facilitate cable pulling in long runs and also to ensure that there will be no more than 270 Deg. bends between pull points.

2.04.09 Cable tray/conduit system shall be installed to accommodate cable manufacturer's recommended maximum pulling tension and minimum bending radius.

2.04.10 All openings in the floor and wall for cable access shall be sealed after installation of the cable system with non-inflammable materials, as follows :

i) Fire stop/Penetration seal shall be installed in the cable spreaders and cable raceways.

ii) Similarly in the trenches fire stop/penetration seals shall be provided at suitable interval to avoid spread of fire.

iii) For all H.T., L.T., Relay and Control panels, Control desk, instrumentation panels, battery charger, D.C. Dist. boards and other miscellaneous panels, fire-stops should be provided below base plate.

2.04.11 All floor/wall openings for cable entry to the electrical equipment and accessories shall be sealed with non-inflammable materials, after completion of cable installation. Thickness of such materials shall be equal to the thickness of floor/wall unless specified otherwise.

2.04.12 The portion of galvanised steel, which, if required, undergoes any welding at site shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

2.04.13 Refer Clause No. 3.00.00 below for details of fire-proof sealing and fire protection coating.

2.05.00 **Identification**

2.05.01 The complete cabling system shall be properly identified. Methods for identification of cabling system shall be furnished to the successful EPC Contractor shall strictly adhere to the said methods.

2.05.02 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

2.05.03 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate, projected above ground level.

2.05.04 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, at each bend and at every thirty (30) metres in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, MCC, control & relay panels etc. wherever required for cable identification, such as where a number of cables enter together through a gland plate.

3.00.00 **FIRE-PROOF SEALING / FIRE PROTECTION COATING SYSTEM**

3.01.00 The Fire proof sealing / fire stop system / fire protection coating system is required to prevent spreading of fire from one placed to other place (or one zone to other zone) through the openings in wall / floor, cables laid in trays / racks and openings below Electrical Switchgear / MCC / Distribution boards / Cabinets / Panels, etc. The fire proof sealing system shall conform to the latest edition including amendments of BS-476.

3.02.00 **Scope of Work**

3.02.01 The scope of work includes but is not limited to the following supply and services:

i) Fire Stops in wall / floors.

ii) Fire stops below switchgear / MCC / Switchboards, junction boxes / panels / cabinets, etc. which are floor mounted type.

iii) Fire retardant coating to be applied for installed cables.

iv) Minor civil / structural works for installation of the entire work.

v) All necessary erection materials, consumables and sundry items to complete the entire work for satisfactory and trouble free operation.

vi) Any special tools & tackles.

vii) Conducting the type test of fire proof sealing system in presence of Owner's engineers.

viii) All relevant Drawings, Data sheets and instruction manuals.

ix) Fire proof barrier walls.

x) Fire proof doors.

3.03.00 **Design Criteria**

3.03.01 Fire Proof Sealing System

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

i) Life expectancy should not be less than 30 years from the date of installation.

ii) Free from shrinkage or cracking or asbestos in composition and should achieve smoke and gas tightness during fire and should be modifiable.

iii) Not to generate toxic gas and harms to the personnel handling the system.

iv) Prohibition of production of acid or alkali during gas generation.

v) Will not produce suffocating / corrosive gas.

vi) Repellant to paste / rodent / termite.

vii) Expansion co-efficient - very low which is to be comparable with masonry concrete.

viii) Not soluble / reactive to acid, water, alkali.

ix) Thermal conductivity - low.

x) The material in contact with the cables in the fire-proof sealing system shall be compatible with the material used for outer sheath of cables.

xi) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.

xii) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.

xiii) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.

xiv) The F.P.S. system shall maintain its integrity and perform satisfactory even after

a. Remaining in water for a long time.

b. Accelerated thermal aging.

c. Sustaining vibrations.

xv) The design and construction of F.P.S. system shall specifically take into account the fact that under seismic disturbances, normal load, short circuit and fire conditions, the cable / cable trays will be subject to movement, expansion and oscillation and this shall not result in any damage or cause dislocation of the F.P.S. system or the material constituting the FPS System.

xvi) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not contain volatile solvents which may cause a fire hazard during application.

xvii) The fire rating shall not be less than one (1) hour and the system shall be stable after applicable of water jet in the exposed side in order to extinguish fire.

3.03.02 Fire Protection coating to be applied on installed Cables:

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

i) At fire stops in walls and floors on either side upto 500 mm length.

ii) At fire stop below Electrical Switchgears/ MCCs/ Panels/ Cabins, etc. on one side coating of 500 mm length, i.e., on the cable vault side / cable trench side.

iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/ cable trench.

iv) In fire risk areas and where specified at suitable intervals as decided upon side conditions in open cable routes.

v) Where necessary and specified at site intervals along cable routes in cable trenches.

vi) The coating shall be applied evenly on the cables only.

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

i) Asbestos free, non-volatile, not eatable by vermin, harmless and non-irritant to skin of human.

ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.

iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEEE - 383.

iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum size cable at 180°C.

v) The limiting oxygen index of the material shall not be less than 60% as per ASTMD - 2863.

vi) Life expectancy equivalent to the cable installations.

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

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

3.05.00 **Type Test On Penetration Seals**

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

i) Fire rating test.

ii) Hose Stream test.

iii) Accelerated aging test.

iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test.

v) Temp. rise test for cable in the fire stop.

vi) Water absorption test followed by fire rating test.

vii) Flame Resistance test for fire retardant coating material.

viii) Anti-rodent test.

3.05.02 Fire Rating Test

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

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

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

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

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

i) The system is deemed to have failed to maintain stability if there is a total collapse of the penetration seal.

ii) In case cracks are seen on the face of the penetration seal or cracks through the sealing system through which the flame / or gas can pass,

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

iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall deemed to have failed in respect of insulation characteristics.

iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

3.05.04 Hose Stream Test:

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

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

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

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

3.05.05 Accelerated aging test

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

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

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

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

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

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

3.05.06 Fire Rating test After Accelerated Aging:

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

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

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

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

3.05.07 Temperature rise test for cable in the fire stop:

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

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

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

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

3.05.08 Water Absorption Test:

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

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

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

3.05.09 Flame Resistance Test for fire Retardant Coating Material:

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

3.05.10 Anti-Rodent Test:

Physical tests:

a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.

b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of inspect / vermin such as rate for about 20 days.

c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition

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

3.05.11 Test Certificates

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

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

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

3.05.12 Testing Charges

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

SECTION-IV

TECHNICAL SPECIFICATION
FOR
CABLES

1.00.00 **SCOPE OF SUPPLY**

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

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

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

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

1.03.00 All relevant drawings, data and instruction manuals

2.00.00 **CODES & STANDARDS**

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

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

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

3.00.00 **DESIGN CRITERIA**

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

3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.

3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

3.05.00 The outer sheath shall have flame retardant low smoke halogen evolution (FRLSH) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.

3.06.00 Core identification for multicore cable shall be provided by colour coding.

3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 General Description

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 Drum Length and Tolerance

The cables shall be supplied in non-returnable packing steel drum for 11 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is $\pm$5%.

4.03.00 Non-Standard Length

Non-standard lengths upto 5% of the total ordered quantity may be accepted. However the Contractor will be required to obtain approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.04.00 Cable identification

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

a) TSGENCO

b) Manufacturer's name or trade mark

c) Voltage grade

d) Year of manufacture

e) Type of insulation, e.g. XLPE/PVC/HR85/IE2 etc.

f) No. of core and size of cables.

g) Type of improved fire performance, e.g. FR/FRLSH/FS

h) IS number

4.05.00 **Packing**

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

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

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

a) TSGENCO

b) Manufacturer's name or trade make

c) Type of cable & voltage grade

d) Year of manufacture

e) Type of insulation e.g. XLPE/HRPVC/IE2

f) No. of core and size of cables

g) Cable code e.g. FRLSH/FS

h) Length of cable on drum

i) No. of length on drum, if more than one

j) Direction of rotation, by arrow

k) Approx. gross mass.

l) IS/IEC number and ISI mark

4.06.00 **Joints and Terminations**

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

4.07.00 **Selection Criteria**

4.07.01 a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.

b) While sizing power cables, following aspects shall be reckoned:

i) Ground/Ambient Air temperature

ii) Depth of Laying.

iii) Power Cables touching each other.

c) Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time 0.16 Sec. for outgoing feeder, 0.5 Sec. for Tie feeder and 1.0 Sec. for Incomer.

d) HT cables shall be sized based on the following considerations:

Rated current of the equipment and ground/ambient temperature.

Touching/spacing of cable.

Laying on multi-tier racks, trench

Depth of laying.

The voltage drop of the cable , during motor starting condition , shall be limited to 15% and during full load running condition shall be limited to 3 % rated voltage. For BFP motor, the voltage drop during motor starting condition shall be limited to 20% and for Mill motor shall be limited to 10%. Other outgoing feeder / transformer feeder shall be limited to 3% rated voltage.

Short circuits withstand capability

e) For fuse/MCCB/Breaker protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered for loads fed from 415V PMCC. Incase of other out going line feeder voltage drop shall be limited to 3%.

f) For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.

g) As per national electric code (NEC) current rating capacity of motor feeder/cables should be 125% of full load current.

h) For welding receptacle, 3% running drop shall only be considered.

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

AL - 16 mm^2 (3 core) & 16mm^2 (2 core) Cu - 2.5 mm^2

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

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

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

1100V Power Cable	:	240 Sq mm XLPE AL
3300V Power Cable	:	185 Sq mm XLPE AL
11000V Power Cable	:	240 Sq mm XLPE AL

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

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

a)	Aluminium	:	6 Sq mm.
b)	Copper	:	2.5 Sq mm.

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

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

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

9 or 10	1-12/C
Above 10	Two or more of above cables

4.07.08 Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

a) Power.

b) Control, interlock and indication.

c) Metering and measuring.

d) Alarm and annunciation.

e) C.T. Cables.

f) V.T. Cables.

4.08.00 **Cable Identification**

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

a) Manufacturer's name or trade mark

b) Manufacturer's name or trade mark

c) Voltage grade

d) Year of manufacture

e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc.

f) No. of core & size of cables

g) Type of outer sheath e.g. FRLSH, FS etc.

4.09.00 Selected sizes of power and control cables are given in Annexure-G.

4.10.00 Fire Survival Cables shall be used for important auxiliaries / area as recommended in Standard Technical Specification by CEA for the following services. The fire survival time of these cables shall not be less than 3 hours at 750 deg. C.

i. DC emergency lube oil pump

ii. DC hydrogen seal pump

iii. Turbine lube oil pump/barring gear

iv. DC emergency lighting for main building and service building

v. DC cables for battery to charger & DC distribution boards

vi. Jacking oil pump

vii. Emergency turbine trip in control room

viii. Boiler Turbine : Generator inter trip which include the interconnection between

- Boiler master fuel trip and turbine trip relays
- Generator trip relays & turbine trip relays
- Generator trip relays & generator breaker
- Generator trip relays & field breaker
- Generator trip relays & unit auxiliary transformer breaker
- Incomer cables for DG board, emergency board, DC lighting board etc.

5.00.00 **TESTS**

5.01.00 **Shop Tests**

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

5.01.01 Routine tests on each drum of cables.

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

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

5.02.00 **Additional Tests**

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

5.02.01 Oxygen index test (both C1 & C2)

The Oxygen index shall not be less than 29.

5.02.02 Temperature Index Test (both C1 & C2)

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

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

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

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

5.02.04 Halogen acid gas evolution test (for Category C2)

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

5.02.05 Smoke density test (for Category C2)

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

5.02.06 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.02.07 Test for rodent & termite repulsion property

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

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

a) Swedish Chimney test – SS: 424-14-75

b) IEEE std.383 – 1974 latest

c) IEC std. 332-1, 332-3 and IEC 331

6.00.00 DRAWINGS, DATA & MANUALS

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

6.02.00 **To be submitted with the Bid**

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

b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.

c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.

d) Type test reports on 11 KV & 3.3 KV Power, LT FRLSH Power & control, FS power and control cables.

e) Filled-up proposal particulars.

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

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

ANNEXURE-A

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

1.0 11000/11000V & 3300/3300V grade 90^0C continuous rating under normal condition and 250^0C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V/3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen.

1.1	Conductor	:	Stranded and compacted aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS: 8130.
1.2	Conductor Screen	:	Extruded semi-conducting compound.
1.3	Insulation	:	Extruded cross linked polyethylene (XLPE) conforming to IS: 7098 (Part-2)
1.4	Insulation Screen	:	Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
1.5	Core Identification	:	By coloured strips applied on (For three core cables) cores.
1.6	Inner Sheath	:	Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC.
1.7	Armour	:	Galvanised single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
1.8	Overall Sheath	:	Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.9	Drum	:	Steel Drum

ANNEXURE-B

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

1.0 1100 V grade, 90ºC continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.

1.1	Conductor	:	Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm^2 conforming to IS:8130.
1.2	Insulation	:	Extruded cross-linked polyethylene (XLPE) conforming to IS: 7098 (Part-1)
1.3	Core Identification	:	By color coding
1.4	Inner Sheath	:	Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
1.5	Armour	:	Galvanized single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
1.6	Overall Sheath	:	Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.7	Drum	:	Conforming to IS-10418 (Wooden drum)

ANNEXURE-C

RATINGS AND REQUIREMENTS
CONTROL CABLES

1.0 1100 V grade 85ºC continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.

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

ANNEXURE-D

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

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

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

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

ANNEXURE-E

RATINGS AND REQUIREMENTS
FLEXIBLE TRAILING CABLES

i) 3300 V Unearthed Grade

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

ii) 1100 V Grade

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

ANNEXURE-F

CABLE SIZES

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

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

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

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

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

1.00.00 **GENERAL TECHNICAL REQUIREMENTS**

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

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

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

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

1.05.00 Thermocouple Extension & Compensating Cable

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

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

22. Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1

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

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

1.06.00 Instrumentation multi Paired Signal Cable

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

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

Core to core- 2.0 KV for 1 min.

Core to screen- 2.0 KV for 1 min.

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

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

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

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

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

1.08.00 Control & power Cable

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

1.09.00 Optical Fiber Cable

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

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

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

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

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

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

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

Specification for G.652 Monomode Fiber:

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

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

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

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

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

s. FRLS Test

1.10.00 Coaxial Cable

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

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

IC – Data Sheet A

DATA SHEET A

TECHNICAL DATA SHEET FOR SINGLE GIRDER EOT CRANE

S.N.	Description	Technical Particulars
		As mentioned at Annexure-A, Sec-IA of Technical specification
1.0.0	**GENERAL**	
1.1.0	**Name of Manufacturer**	
	a) EOT Crane	*
	b) Crane motors	*
	c) Control Equipments	*
	d) 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**	IS-3177 & 807 (latest edition)
1.4.0	**Number of cranes**	As mentioned at Annexure-A, Sec-IA of Technical specification
1.5.0	**Crane Classification**	M5: Mechanical, Structural as per IS:3177 & IS:807 M5: Electrical as per IS 3177
1.6.0	**Type of service**	As mentioned at Annexure-A, Sec-IA of Technical specification
1.7.0	**Type of Crane**	As mentioned at Annexure-A, Sec-IA of Technical specification
1.8.0	**Capacity (SWC)**	As mentioned at Annexure-A, Sec-IA of Technical specification
1.9.0	**Span**	As per CCDs
1.10.0	**Lift**	As per CCDs
1.11.0	**Over Load Test**	125% of rated capacity-SWC
1.12.0	**Crane structure**	Single girder box construction
1.13.0	**Design ambient temperature**	50^0 C
1.14.0	**End carriage**	
1.14.1	Material	M.S. as per IS: 2062, GR B
1.14.2	Manufacturer	*
1.15.0	**Main girder**	
1.15.1	Type & Size	I Beam / Box section (Fabricated)

1.15.2	Material	M.S. as per IS: 2062, GR B
1.15.3	Vertical Deflection	1/900 of span
1.15.4	Manufacturer	As per approved Sub-vendor list
1.16.0	**Trolley**	
1.16.1	Material	M.S. Fabricated
1.17.0	**Power supply**	415V ±10%, 3 phase, 4 wire, 50 Hz +5%, -5% variation. Combined voltage and frequency variation 10% (Shall be arranged by Purchaser at 1.5 M above floor level / operating level)
1.18.0	**Control Supply**	110V (Shall be arranged by vendor)
1.19.0	**Load test**	As per IS: 3177
1.20.0	Runway Rail	By Bidder for overhead, gantry & semi-gantry cranes
2.0.0	**CRANE PERFORMANCE**	
2.1.0	**Operation**	Electrical -- From floor by means of suspended Pendant Push Button. Independent movement of pendent (wrt hoist) is required for outdoor cranes.
2.2.0	**Crane speed with full load**	
	a) Hoist (Full speed)	3 M/Min
	b) Hoist (Creep speed)	(10% of main speed through VVVF drive)
	c) Cross travel (CT)	10 M/min
	d) Longitudinal bridge travel (LT)	15 M/min
2.3.0	**Hoisting Mechanism**	Gear
2.4.0	**Type of power transmission**	Gear
2.5.0	**WIRE ROPE**	RHO lay construction
2.5.1	Make	As per approved Sub-vendor list
2.5.2	Core / Construction	Steel / Fibre core as per IS-2266 / 6 X 36/ 6 X 37
2.5.3	Wire rope dia. (mm)	*
2.5.4	Wire rope fall	*
2.5.5	Material	Plough steel
2.5.6	Tensile strength	180-200 Kg /mm^2
2.5.7	Min. Breaking load	*
2.5.8	Conform to (Std. / code)	IS-2266
2.5.9	Factor of safety	6
2.6.0	**LOAD HOOK / HOOK BLOCK**	Swiveling type with locking device & safety switch.

2.6.1	Make	As per approved sub-vendor list		
2.6.2	Type of load hook	C shank, Trapezoidal section-forged as per IS: 15560, swiveling type with safety latch.		
2.6.3	Material of load hook	Forged steel, Class II of 1875		
2.6.4	Type of Bearing of hook suspension	Antifriction ball/roller Thrust bearing		
2.6.5	Make of Bearing of hook suspension	*		
2.6.6	Type and Material of hook suspension.	M.S. Fabricated		
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**			
2.8.1	Long travel	PVC shrouded bus bar conductor type Cu		
2.8.2	Cross traverse	Flexible cable with Taut wire / Festoon cable arrangement		
2.9.0	**MOTORS**	**M.H.**	**C.T.**	**L.T.**
2.9.1	Make	As per approved sub-vendor list		
2.9.2	Rating (KW)	*		
2.9.3	RPM	*		
2.9.4	Qty.	1	1	2
2.9.5	Maximum number of poles	6	6	6
2.9.6	Type	TEFC, Sq. cage induction type,S4 duty, 40%CDF		
2.9.7	Enclosure	IP-55		
2.9.8	Number of start	150 starts/Hr.		
2.9.9	Insulation	Class “F”, temp rise limited to class “ B”		
2.9.10	Margin	Motor rating shall be calculated keeping margin of at least 15% over the maximum power requirement in the duty condition specified.		
2.9.11	Over load protection provided	YES		
2.9.12	Ambient Design temperature	50^{o}C		
2.10.0	**LIMIT SWITCHES**			
2.10.1	Location	**M.H.**	**C.T.**	**L.T**
2.10.2	Qty.	1+1	1	1
2.10.3	Type	Snap action + Gravity	Two way lever	Two way lever

2.10.4	Method of actuation	Snap action	Shunt type	Shunt type
2.10.5	Material of contact	Silver Cadmium		
2.10.6	Make	As per approved sub-vendor list		
2.10.7	Control Voltage	110V		
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	DCEM disc type	DCEM disc type	DCEM disc type
2.12.5	Capacity	150% FLT	125% FLT	125% FLT
2.12.6	Size / rating	*		
2.12.7	Make	As per approved sub-vendor list		
2.13.0	**GEAR (HOISTING)**			
2.13.1	Make	As per approved sub-vendor list		
2.13.2	Type	Spur / Helical		
2.13.3	Material	Gear: EN8 / 20 Mn Cr5 / 16 Mn Cr5 Pinion: EN9/ EN 19		
2.13.4	Lubrication	Grease / Oil splash		
2.13.5	Reduction	*		
2.13.6	Bearing Make	*		
2.13.7	Bearing Type	Antifriction deep groove ball / roller bearing		
2.13.8	Hardness (BHN)	As per IS 3177 (Latest Edition)		
2.14.0	**GEAR (L.T. & C.T.)**			
2.14.1	Location	**C.T.**	**L.T.**	
2.14.2	Make	As per approved sub-vendor list		
2.14.3	Type	Spur / Helical	Spur / Helical	
2.14.4	Material	Gear: EN8 / 20 Mn Cr5 / 16 Mn Cr5 Pinion: EN9/ EN19	Gear: EN8 / 20 Mn Cr5 / 16 Mn Cr5 Pinion: EN9/ EN19	
2.14.5	Lubrication	Grease / Oil splash	Grease / Oil splash	
2.14.6	Reduction	*	*	

2.14.7	Bearing Make	As per approved 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)	
2.15.0	**WIRE ROPE DRUM**		
2.15.1	Material	Rolled steel, welded construction / seamless pipe as per ASTM A106 / 53 GR A/B	
2.15.2	Diameter	*	
2.15.3	Length	*	
2.15.4	Type	Flanged/ flangeless	
2.15.5	Type of grooves	Right hand groove or Right hand and left hand groove	
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	200 BHN (Max.)	200 BHN (Max.)
2.16.5	Material	EN8 / EN9	EN8 / EN9
2.16.6	Bearing make	As per approved sub-vendor list	As per approved sub-vendor list
2.16.7	Bearing Type	Antifriction deep groove ball bearing	Antifriction deep groove ball bearing
2.16.8	Flange	Single	Single / Double flanged as per underslung or EOT crane
2.16.8.1	Conform to IS	IS 3177/ 807	
2.16.8.2	Wheel Base	*	
2.17.0	**SHEEVE**		
2.17.1	Material	Cast steel	
2.17.2	Groove dia/ O.D. .(mm)	*	
2.17.3	Bearing make	As per approved sub-vendor list	
2.17.4	Bearing Type	Antifriction deep groove ball bearing	

2.18.0	**CONTROL PANEL**	* Fabricated from CRCA steel sheet min 2 mm thick. * Degree of protection shall be IP 55. * 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	
2.18.2	Make	As per approved sub-vendor list	
2.18.3	Location	On the crane	
2.18.4	Size	*	
2.18.5	Thickness of sheet	2 mm	
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 approved sub-vendor list	
2.19.3	Rating	*	
2.20.0	**PENDANT PUSH BUTTON**	Up /down / forward / Reverse push buttons (glow type). Indicative marking for easy operation shall be provided	
2.21.0	**Cables**	**Power**	**Control**
2.21.1	Make	As per approved sub-vendor list	
2.21.2	Material	Copper	Copper
2.21.3	Type	All cabling shall be XLPE insulated fire resistant (FRLS) cables. Also refer details mentioned for cables elsewhere in Technical specification	
2.21.4	Dearing factor to be considered	YES	YES
2.21.5	Voltage grade	1100V	
2.22.0	**END STOPPER**		
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	Two	Four
2.23.3	Material	Rubber/Spring	Rubber/Spring

2.24.0	**PAINTING**	Refer painting specification mentioned at Annexure-III, Sec-IA of Technical specification
2.25.0	**Control for Hoisting/CT/LT operations**	Thru' VVVF drive for hoisting motion only.
a.	Speed Control	Thru' VVVF with minimum 6 pulse design
b.	Starting torque of VVVF	Upto 400% typical
c.	Starting current	Less than 150 % of rated torque
d.	Temperature	Capable of withstanding upto 50°C without derating

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)

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-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 HOUSE-STAGE-I (8T)		8KW	S	1	0	D	S	-	I	N								
Single girder crane for AIR COMPRESSOR HOUSE-STAGE-II (8T)		8KW	S	1	0	D	S	-	I	N								
Single girder crane for DG BUILDING-1&2 (10T)		10KW	S	2	0	D	S	-	I	N								
Single girder crane for DG BUILDING-3 (10T)		10KW	S	1	0	D	S	-	I	N								
Single girder crane for WORKSHOP (8T)		8KW	S	1	0	D	S	-	I	N								
Single girder crane for RAW WATER PUMP HOUSE (5T)		5KW	S	1	0	D	S	-	I	N								
Single girder crane for OUTSIDE RAW WATER PUMP HOUSE (5T)		5KW	S	1	0	D	S	-	I	N								
Single girder crane for RAW PUMP HOUSE SCREEN & GATE HANDLING (5T)		5KW	S	1	0	D	S	-	I	N								
Single girder crane for CLARIFIED WATER PUMP HOUSE (5T)		5KW	S	1	0	D	S	-	I	N								
Single girder crane for FIRE WATER PUMP HOUSE (5T)		5KW	S	1	0	D	S	-	I	N								
Single girder crane for CW PUMP HOUSE SCREEN & GATE HANDLING-UNIT-1,2 (5T)		5KW	S	2	0	D	S	-	I	N								

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.	417	ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	5X800 MW YADADRI STPP	NAME		DATA FILLED UP ON
		SYSTEM	SINGLE GIRDER CRANES	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 2	REV. 00	DE'S SIGN. & DATE

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	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 CW PUMP HOUSE SCREEN & GATE HANDLING-UNIT-3,4,5 (5T)		5KW	S	2	0	D	S	-	I	N								
Single girder crane for STORE BUILDING (10T)		10KW	S	17	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.	417	ORIGINATING AGENCY	PEM (ELECTRICAL)
		PROJECT TITLE	5X800 MW YADADRI STPP	NAME	DATA FILLED UP ON
		SYSTEM	SINGLE GIRDER CRANES	SIGN.	DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 2 OF 2 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