



MAHARASTRA STATE POWER GENERATION CO. LTD

1X660 MW BHSAWAL TPS- Unit # 6

**TECHNICAL SPECIFICATION FOR TG HALL 170/30 T
(DOUBLE GIRDER) EOT CRANES**

SPECIFICATION NO.: PE-TS-415-501-A501



BHARAT HEAVY ELECTRICALS LTD
(A Govt. of India Under taking)
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA (U.P.)
INDIA



TITLE

1X660 MW BHUSAWAL TPS

DOUBLE GIRDER EOT CRANES ABOVE 100T

CONTENTS

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section

Date

Page 1 of 2

CONTENTS

Section	Title	Page No.
I	Specific Technical requirement	1-26
IA	Specific Technical Requirement (Mechanical)	
-	Customer specification	27-71
-	Annexure I- Makes of sub-vendor items	72-78
-	Annexure II- Mandatory spares	79
-	Annexure III- Maintenance Tools and Tackles	80
-	Annexure IV- Painting Specification	81
-	Annexure V- Drawings/ documents to be submitted after award of contract	82-86
-	Annexure VI-Packing Procedure	87
-	Annexure VII- Procedure for Load & Overload testing of Double Girder EOT at Manufacturer's Works.	88-89
-	Annexure VIII- Format for O&M manual	90-92
-	Standard Quality Plan	93-102
-	Crane Clearance Diagram	103-105
IB	Specific Technical Requirement (Electrical)	106-139
IC	Data Sheet A	140-153
II	Standard Technical Requirement	154-179
-	Standard Technical Requirement (Mechanical)	
-	Site Storage and Preservation Guidelines	180-195
-	General Technical Requirement	196- 323
III	Documents to be submitted by the bidder	324-325
IIIA	List of documents to be submitted with the bid	
IIIB	Compliance cum Confirmation Certificate	326
IIIC	Electrical Load data	327
IIID	Pre-bid Clarification Schedule	328
IIIE	Deviation Format (Cost of withdrawal)	329
IIIF	Supply Price Percentage breakup	330
IIIG	Input Drawing	331

**TITLE****1X660 MW BHUSAVAL TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T****SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section I

Date JAN '19

Page 1 of 1

SECTION – I**SPECIFIC TECHNICAL REQUIREMENTS****SUB-SECTION IA – Specific Technical Requirement (Mechanical)****SUB-SECTION IB – Specific Technical Requirement (Electrical)****SUB-SECTION IC – Data Sheet A**



TITLE

1X660 MW BHUSAWAL TPS

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section I A Date JAN -19

Page 1 of 1

SUB-SECTION IA

SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section I A	Date JAN' 19
		Page 1 of 2	

SCOPE OF ENQUIRY/INTENT OF SPECIFICATION

- 1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design (i.e. preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles fill of lubricants & consumables along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, trial run at site and carrying out performance guarantee/Functional/Demonstration tests at site (As applicable), and OPERATION AND MAINTENANCE SERVICE including manpower, supervision, consumables etc. for operation & maintenance of cranes for 24 crane-months for each crane after commissioning & final handing over to end customer (after O & M service) in flawless condition of crane(s) for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. **Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection & commissioning and load testing of the cranes and its accessories.**
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section	I A Date JAN' 19
		Page 2 of 2	

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

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

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

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

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

Note:

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

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (<http://dms-server.bhelpem.com/Wrench%20Web%20Access/Login.aspx>).



TITLE

1X660 MW BHUSAWAL TPS

DOUBLE GIRDER EOT CRANES ABOVE 100T

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-415-501-A501

VOLUME: II B

REV 00

Section I A **Date** JAN '19

Page 1 of 1

PROJECT INFORMATION

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 2
REV: R0	MASTER SPECIFICATIONS	Page 17 of 555

CONTENTS

<u>CLAUSE NO.</u>	<u>DESCRIPTION</u>
1.0	INTRODUCTION
2.0	APPROACH TO SITE
3.0	LAND
4.0	SOURCE OF COAL
5.0	SOURCE OF WATER
6.0	ASH DISPOSAL AREA
7.0	PROJECT INFORMATION

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 2
REV: R0	MASTER SPECIFICATIONS	Page 19 of 555
1.0 <u>INTRODUCTION</u> The proposed 1x 660 MW Bhusawal Thermal Power Project will be set up by Maharashtra State Power Generation Co. Ltd. (MAHAGENCO) in Dipnagar near Bhusawal, Maharashtra, India. The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given herein under is for general guidance and shall not be contractually binding on the Owner. All relevant site data/information as may be necessary shall have to be obtained /collected by the Bidder. 2.0 <u>APPROACH TO SITE</u> Deepnagar is well connected by rail and road. By road, it is about 8 Km from Bhusawal city. Nearest railway station is at Bhusawal. The nearest Airport is at Aurangabad. The nearest sea port is at Mumbai. The site is located on the Mumbai-Nagpur Highway. 3.0 <u>LAND</u> Bhusawal Thermal Power Plant is already having 1x62.5 MW + 2x210 MW Units and Two (2) Units of 500 MW each are under execution stage. About 108.94 Hectares of land is acquired by MAHAGENCO near existing TPS. It is proposed to install 1x 660 MW unit on this land. 4.0 <u>SOURCE OF COAL</u> Indian coal would be sourced from Machaakata coal blocks in Orissa state. The Coal will be received at Plant site directly by rail. The coal from the railway wagons would be unloaded by means of wagon tipplers and will be either bunkered or stacked in the stock pile at site. 5.0 <u>SOURCE OF WATER</u> The main source of water is considered Ozerkheda Reservoir which is located at around 18 km from plant site.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 2
REV: R0	MASTER SPECIFICATIONS	Page 20 of 555
6.0 <u>ASH DISPOSAL AREA</u> The ash generated from 1 x 660 MW unit shall be disposed off in slurry form to the existing Ash Pond located at Velhala, approx. 12 Km from the site.		
7.0 <u>PROJECT INFORMATION</u>		
7.1	Client / Owner	: Maharashtra State Power Generation Co. Ltd.
7.2	Consultant	: Procon Engineers, Navi Mumbai (Division of Nimoto Consulting Engineers Pvt. Ltd.)
7.3	Project Title	: BHUSAWAL T.P.S. UNIT – 6 : 1X660 MW
7.4	Location	: Dipnagar, Near Bhusawal, Maharashtra, India
7.5	Nearest railway station	: Bhusawal
7.6	Nearest Airport	: Aurangabad
7.7	Nearest Harbour	: Mumbai
7.8	Access Roads	: NH 6 (Mumbai-Nagpur Highway)
7.9	Elevation above MSL	: 210 M
7.10	Longitude/latitude	: 75°51'10" East /21° 02' 30" North
7.11	Seismic Zone	: Zone III as per IS:1893
7.12	<u>AMBIENT TEMPERATURE</u>	
7.12.1	Mean of daily maximum temperature	: 48.25 °C (during May)
7.12.2	Mean of daily minimum temperature	: 18 °C (during January)
7.12.3	Highest temperature recorded	: 48.7°C

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1		Section – 2
REV: R0	MASTER SPECIFICATIONS		Page 21 of 555
7.12.4	Lowest temperature recorded	: 13°C	
7.13	Wet bulb temperature	: 27°C (Maximum)	
7.14	Rainfall	: 112 mm average annually	
7.15	Wind Speed	: 0 to 39 Km/hr	
7.16	Wind direction	: East North East to West South West	
	<u>ELECTRICAL</u>		
7.17	<u>MAIN POWER SOURCE FROM GRID</u>		
7.17.1	Rated Voltage	: 400kV	
7.17.2	Voltage variation	: ± 10 %	
7.17.3	Frequency Variation	: ± 5 %	
7.17.4	Rated Short Circuit Level	: 50 kA, Three Phase Symmetrical	
7.18	<u>AUXILIARY POWER SUPPLY</u>		
	Auxiliary electrical equipment shall be suitable for operation on the following supply system:		
7.18.1	Motors above 1000 kW & other Power devices	: 11kV, 3Ph, 3wire, 50Hz system	
7.18.2	Motors below 1000 kW & above 160kW & other power devices	: 3.3kV, 3 ph, 3 wire 50 Hz, Non Effectively earthed	
7.18.3	Motors upto 160 kW & other power devices	: 415V, 3 ph, 4 wire 50 Hz	
7.18.4	Motor Starting Methods	: Direct on Line	
7.18.5	(a) Lighting fixtures, Space heaters, and single Phase motors	: 240V, 1 phase, 50 Hz Supply through suitably rated transformers to limit the short circuit level to 9kA – 1 sec.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 2
REV: R0	MASTER SPECIFICATIONS	Page 22 of 555
(b) Control & : 240V, 1 Phase, 50 Hz from UPS Instrumentation 7.18.6 Short circuit levels of 11kV, 3.3 kV and 415V system equipments The equipment shall be suitable for the following short circuit levels (a) 11kV Switchgears : 44 kA/3 sec (b) 3.3kV Switchgears : 40 kA/3sec (c) 415V PCC/ : 50 kA/1sec PMCC/ MCC (d) Lighting : 9 kA/1sec Distribution Boards & 240V A.C. supply 7.18.7 Auxiliary DC supply The auxiliary DC supply will be used for control, indication & protection, Turbine lube oil system, AVR, Emergency DC lighting of power plant and Control & Instrumentation etc. (a) Voltage : (i) 220V DC for utility purpose (ii) 24V DC for Control and Instrumentation (b) Voltage variation : + 10 %, - 15 % 7.18.8 Emergency power supply (a) Purpose : (i) Standby power to normal incomer of emergency MCC (ii) Alternate power source to Fire water Pumps (b) Rated voltage and frequency : 415 V, 3 phase, 3 wire, 50 Hz.		

CONSULTANT : PROCON ENGINEERS

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

1.0.0. SCOPE OF WORK

1.1.0. SCOPE OF SUPPLY

1.1.1. Equipment and services to be furnished by the bidder for the Two (2) nos. 170 T /30T capacity double girder EOT Cranes for TG Hall with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the EOT crane complete for efficient operation shall also be under the bidder’s scope of work.

1.1.2. Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

1.1.3. Crane shall include but not be limited to the following: -

- a. Bridge girders
- b. End carriages with wheels
- c. Crab (trolley)
- d. Cross Travel & Long Travel drive arrangement
- e. All electrical equipment including cables, junction box, VVVF drive, RRC & pendent and panels etc. as per datasheet A.
- f. PVC Cu insulated shrouded bus bar conductor type DSL
- g. Earthing arrangement
- h. Fill of lubricants till handing over.
- i. Painting of cranes and accessories including touch up painting at site.
- j. Temporary cables for operation of each crane during erection stage of the plant (Half the bay length + 25m)
- k. Rail including all accessories and end stopper
- l. Maintenance tools & Tackle
- m. Erection & Commissioning spares
- n. Mandatory Spares
- o. Operator’s cabin.
- p. Main Isolating switch in enclosure at operating floor for disconnecting supply to DSL. Termination of incoming cable (from BHEL) into isolating switch shall be in Vendor’s scope. For maintenance of cranes, 2 nos. isolating switches are to be provided at extreme ends of bay for both the phase.

Page 12 of 331



TITLE

1X660 MW BHUSAWAL TPS

**DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section IA

Date JAN'19

- q. Slings and cradle for load testing on returnable basis
- r. Storm brake (Hydraulic rail clamp) (2 nos. per crane)

1.1.4 Maintenance Tools and Tackles

As per Annexure III, section-IA of this specification

1.1.5 Mandatory Spares

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

1.1.6 Erection and Commissioning spares

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. Fill of lubricants; oil etc. till commissioning of the cranes shall also be supplied by the bidder.

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

1.2.0 Services to be provided by the bidder

1.2.1. Packing, forwarding and transportation to site

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

1.2.3. Arranging test load at site

Collecting the test load at site within a radius of 1-2 KM from owner's storage to final testing bed of crane shall be under bidder's scope of work. Test load in the form of rolled steel, plates, girder, angle etc., as available at the site shall be made available by the purchaser. The test load shall be put back to the place from where it was lifted by the vendor, after the load testing. Load testing sling, cradles and any other item required by the vendor during the load testing shall be arranged by the vendor at no extra cost to the purchaser. Slings & cradles will be allowed to be taken back by the vendor, after completion of the test at site.

1.2.4 Erection and Commissioning

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

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

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

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

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

1.3.0. **PAINTING & COLOUR SCHEME**
As per Annexure IV, section-IA of this specification

2.0.0. **Works Excluded**
Supply feeder and cable from feeder / MCC to isolating switch.
Gantry girder
Dead load for load/ overload testing at site
Space for storage.
Exclusion, if any, mentioned in GCC, SCC.

3.0.0. **Drawing and documents submission schedule along with number of prints.**
Drawing and documents submission schedule along with number of prints / copies required for various drawing and documents are listed in Annexure –V, section-IA of this specification.

4.0.0. **Deviations**
If the offer submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the format of “Cost of withdrawal of deviation” attached in Section III and furnishing full particular of such deviations. Deviations are to be furnished with mention to specific clause number (reasons / explanations for such deviations shall be furnished). Notes / comments etc. is not acceptable. If there are no deviations from the tender document, bidder shall mention “**NO DEVIATION**’ in cost of withdrawal of deviation format.

5.0.0. **Makes of Sub - Vendor items**

Page 14 of 331

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

Makes of bought out items as per Annexure-I, section IA of the specification is for reference only. Sub vendor list shall be subject to customer approval and same shall not have any impact on manufacturing, delivery schedule and cost of the crane.

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

7.0.0. Performance Test requirement

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

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

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

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

7.1.0 Testing at site

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

i. Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.

ii. Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated. Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177

iii. All Other tests as per IS-3177.

iv. Load & overload test along with deflection test of lifting beam in line with BHEL approved MQP for lifting beam (if applicable).

v. Speed test at rated load for hoisting, CT and LT mechanism.

vi. Brake test.

vii. Any other test as per IS-3177

Page 15 of 331

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

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

8.0 Consumables

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

OPERATION AND MAINTENANCE SERVICES SHALL INCLUDE BUT NOT LIMITED TO

FOLLOWING (FOR TG HALL CRANE ONLY) ANNEXURE A

- 1.0 Scope covers operation and maintenance service including manpower, supervision, consumables etc. for complete operation and maintenance of two numbers 170/30 T Double Girder Crane for Power House area for two years after successful erection, commissioning & load testing. The O & M period shall be started after successful load testing at site.
- 2.0 For Operation of the Crane An experienced crane operator or shall be available for each crane as and when required by BHEL for at least 16hrs a day, daily.
- 3.0 For Maintenance of the Crane
 - a) Break-Down Maintenance
 - i) In case of any break-down of the crane during the contract period, service engineer shall be made available at site within 72 hrs.
 - ii) All the critical spares and consumables, as deemed necessary by the manufacturer shall be made available at the site. No delay in crane maintenance shall be allowed by BHEL due to non-availability of required spare at site.
 - b) Preventive Maintenance
 - i) Following work should be carried out quarterly

Bridge and Trolley wheel assembly	Checking for wear, flat spots and cracks in flange. Ensure drive wheels are of the same diameter.
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TITLE
1X660 MW BHUSAWAL TPS
**DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**
SPECIFICATION NO. PE-TS-415-501-A501
REV 00
Section IA
Date JAN'19

Runway	Checking alignment and elevation of gantry track. Checking rail clamp bolts.
Machine Bolts	Checking all foundation bolts of Electrical and Mechanical equipment for tightness.
Structural Bolts	Checking for tightness. They should also be checked after the first month of operation.
Flexible Couplings	Checking pins and teeth for wear, cleaning and greasing.
Cross-shaft Plummer Blocks	Dismantling cap. Cleaning and checking oil seals and to be packed with fresh grease.
Trolley Collectors	Checking of cable trolleys / cabling / chain. Ensuring connection of trolley wheels is kept through entire length of span.
Brakes	All Brake assembly will be checked for loose connection, earthing connection, linings for wear, leakages and adjustments to ensure brake is not rubbing the brake drum during operation. Greasing pins and operation adjustment of brakes.
Resistor Connections	Checking, tightening connections at grid joints and at cable terminations.
Control Station	Clean out control cabinets. Checking of all connection at push buttons, master controllers contact tips, cams and terminals.
Control Panels	All Control Panels will be checked for loose connection and cleaning the contactor contacts, if required will be replaced.
Electrical Motors	All motion motors connection will be checked for loose contacts in terminal box loose crimping of wire lugs, loose contacts on slip ring assembly with carbon brush. Earthing connection with motor.
Safety Switches	All limit switches will be checked for desired operation and limits. Emergency switches will be checked.
Main Collectors	Checking of worn collector shoes, sag in main runway wiring, ensuring contact is kept through entire length runway properly.
Electrical connections	Checking throughout electrical equipment for loose



TITLE

1X660 MW BHUSAWAL TPS

**DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section IA

Date JAN'19

	connection such as selector switches, junction boxes, min isolator switch etc.
Lubrication	All gear box and thrusters' oil level will be checked. All bearings, couplings' grease will be checked.
Testing	After completion of checking and required rectification, trolley will be checked for idle operation, for brake operation, limit switch operation & safety switch operation. All motor currents will be checked on no load.

ii) Following work should be carried out annually

Gear Boxes	Oil seals will be checked, if required will be replaced. Gear and pinion teeth will be checked. Drain the oil cleaning gear box and refill fresh oil.
Motor	All motors' insulation test and meagre test will be carried out.
Resistance Box	All resistance boxes' step resistance value will be checked.

iii) Besides the quarterly and annual preventive maintenance schedule mentioned above, operator shall carry out any daily, weekly, monthly maintenance schedule as deemed necessary and shall operate the crane only when the fitness of the crane for operation has been ensured.

4.0 Bidders' scope of work shall also include, arranging the statutory clearance from the concerned Government body/Authority as and when required for renewal of license till handing over. It shall be bidder's responsibility to ensure the presence of competent authority at the time of testing and obtaining the clearance and acceptance certificate from the concerned authority. Necessary fees/expenditure as required shall be borne by the supplier.

5.0 The training to the operation and maintenance staff pf the customer shall be imparted (min 1 week or as agreed during contract execution stage whichever is higher.



TITLE
1X660 MW BHUSAWAL TPS
DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-415-501-A501
REV 00
Section IA **Date** JAN'19

QUALITY ASSURANCE AND INSPECTION REQUIREMENT

**TITLE****1X660 MW BHUSAWAL TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section IA

Date JAN'19

1.1.0. Inspection and Testing

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

1.1.1. Inspection and testing at Manufacturer's works

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

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

STAGE INSPECTION

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

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

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps



TITLE

1X660 MW BHUSAWAL TPS

**DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section IA

Date JAN'19

2. Defects giving indication larger than '4 (four) mm diameter equivalent flow' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flow.'
3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flow which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia. equivalent flow which cannot be separated at testing sensitivity if the back echo is reduced by 40%.
4. Defects giving indication of 2 to 4 mm dia. equivalent flow, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws except for wheels for which Defects giving indication of 3 to 6 mm dia. Equivalent flow, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws Ultrasonic test on Castings shall be carried out as per ASTM E 609.

Wherever, the Quality plan calls for witness of Ultrasonic test by BHEL or BHEL's representative, the material shall be offered for UT in proof machined condition as stated above and hard stamping and subsequent stamp transferring by BHEL shall be followed at subsequent stages to ensure trace ability.

- v. Gear boxes shall be checked at No load for backlash, tooth contact, noise, temperature rise and vibration as per attached Procedure No. PEM (Q)/001.
- vi. Test certificates shall be furnished for verification of Type tests including environmental tests - for electrical and electro-mechanical items. If Type tests for items with similar / identical construction are not available, arrangement shall be made to conduct the same in the presence of BHEL/ Customer's representative (as required).
- vii. Acceptance and routine tests (HV and insulation) for all electrical and electro-mechanical components and system as per governing specification

FINAL INSPECTION- Testing At Works.

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

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

a) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.

b) Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated.

c) Electrical tests for brakes, panel, electrical equipment etc. as per IS - 3177

d) All Other tests as per IS-3177.

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

Refer Testing requirement as mentioned at ANNEXURE-VII.

Page 22 of 331


TITLE
1X660 MW BHUSAWAL TPS
**DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**
SPECIFICATION NO. PE-TS-415-501-A501
REV 00
Section IA
Date JAN'19
Procedure No. PEM (Q)/001
SHOP TEST PROCEDURE FOR GEAR BOX

1.0.0	Scope: Acceptance Norms for Crane Gear Boxes
1.1.0	This procedure lays down the Acceptance norms for the Gear boxes for EOT crane. This standard also covers vertical gear boxes. Reduction Gears shall be tested for reduction ratio, backlash & contact pattern. Gear Box shall also be subjected to No load run test to check for oil leakage, temp. rise, noise and vibration.
2.0.0	The following dimensions shall be checked:
2.1.0	i. Diameter and keyway dimensions of input and output shafts. ii. Projection of input and output shafts beyond foundation holes and Centre lines of gear box. iii. Centre distance between input and output shafts. iv. Centre Height. v. Distance between foundation holes with respect to center line of the output shaft and distance of foundation holes from center line of the gearbox. vi. Overall dimensions
3.0.0	Backlash
3.1.0	The back lash shall be checked by dial gauge preferably (refer Figure –1). Lead wire may be also be used but final decision in case of dispute shall be taken by using dial gauge. The backlash shall be within the limits specified in the drawing. If the value of the backlash allowed is not specified in the drawing, the allowed backlash shall be a given in Table-1
4.0.0	Area of Contact:
4.1.0	Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2) For final stage of Hoist gearing: h / H shall be more than 30% $(a - c) / b$ shall be more than 40% For all other gears: h / H shall be more than 40% $(a - c) / b$ shall be more than 50%
5.0.0	Running Test

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

5.1.0	The gear boxes shall be run under no-load condition at the rated speed for minimum four hours in each direction and the following are to be checked: i. All bolts at the joints remain tight ii. All gear mesh lines are getting enough lubrication iii. All bearings are getting enough lubrication iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour. v. Vibration : Maximum limit 125 microns (peak to peak) vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm. vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.
6.0.0	General
6.1.0	In addition to the above specific points, the following general points shall be ensured: i. Inspection pockets are provided as required. ii. Gear box casings are provided with at least two fit bolts/dowels at the parting line. iii. Dip sticks with minimum / maximum level markings are provided. iv. Drain plugs are provided at convenient locations preferably at vertical wall of the housing. v. Breathers are provided. vi. Lifting lugs or eye bolts are provided as required. vii. Wherever bearings have splash lubrication, oil retainers are provided. viii. Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint. ix. In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided. Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.

Page 24 of 331



TITLE
1X660 MW BHUSAWAL TPS
DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-415-501-A501
REV 00
Section IA
Date JAN'19

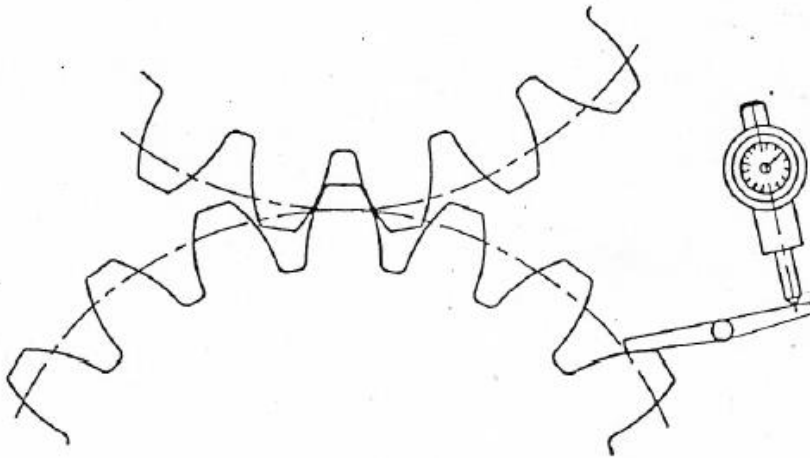


FIG.1 MEASUREMENT OF BACKLASH

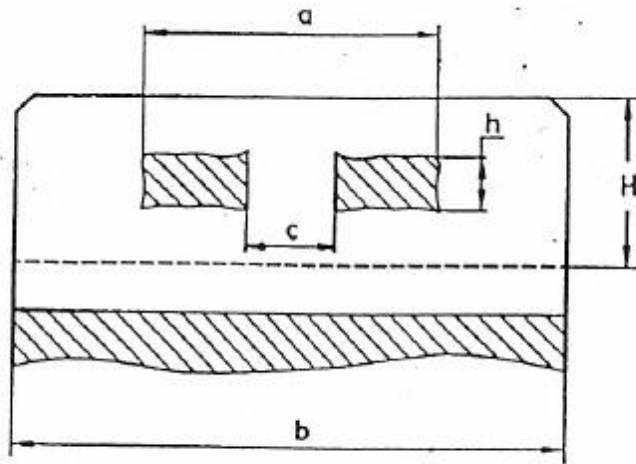


FIG.2 AREA OF CONTACT OF GEAR TEETH



TITLE

1X660 MW BHUSAWAL TPS

**DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section IA

Date JAN'19

Table-1

Backlash for Gearing specified by module
(Clause 3.1.0)

Centre distance in mm		Tolerances in microns		
Above	Upto	Minimum	Maximum	
			For gears other than Drum gears	For Drum gears
			For all modules 1 to 50	For all modules 2.5 to 50
-	50	85	240	280
50	80	105	320	380
80	120	130	360	420
120	200	170	470	530
200	320	210	540	640
320	500	260	660	740
500	800	340	820	880
800	1250	420	970	1040
1250	2000	530	1200	1280
2000	3150	710	1500	1670
3150	5000	850	1810	1980

**TITLE****1X660 MW BHUSAWAL TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T****SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section

IA

Date JAN'19

SECTION – IA**CUSTOMER SPECIFICATION**

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 9 of 328
VOLUME III-I SECTION – 1 EOT CRANES, ELEVATORS & HOISTS		

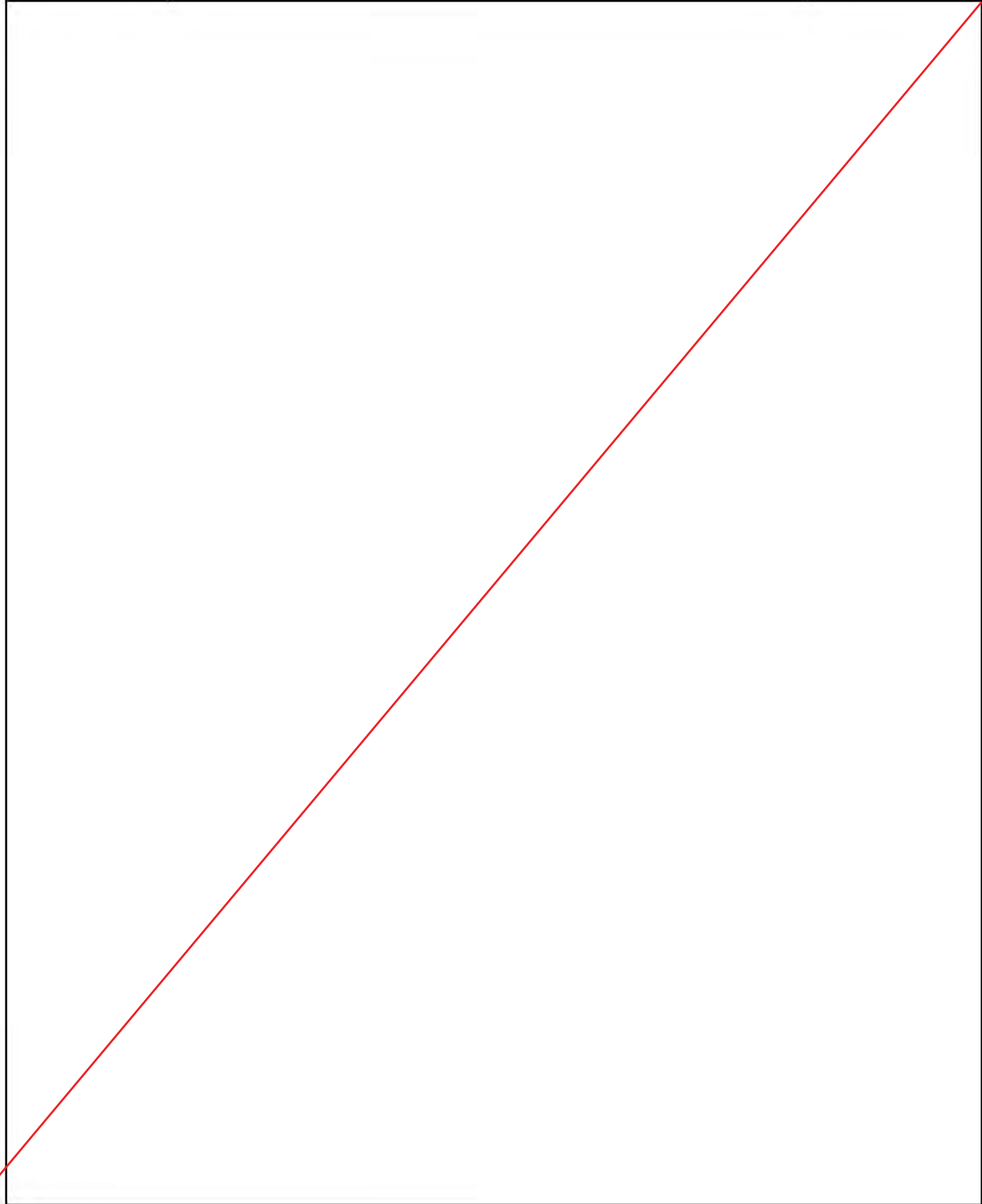
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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 10 of 328

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 11 of 328
 <u>SECTION</u> <u>DESCRIPTION</u> SECTION – 1/A EOT CRANES & MISCELLANEOUS CRANES SECTION – 1/B ELEVATOR SECTION – 1/C HOISTS		

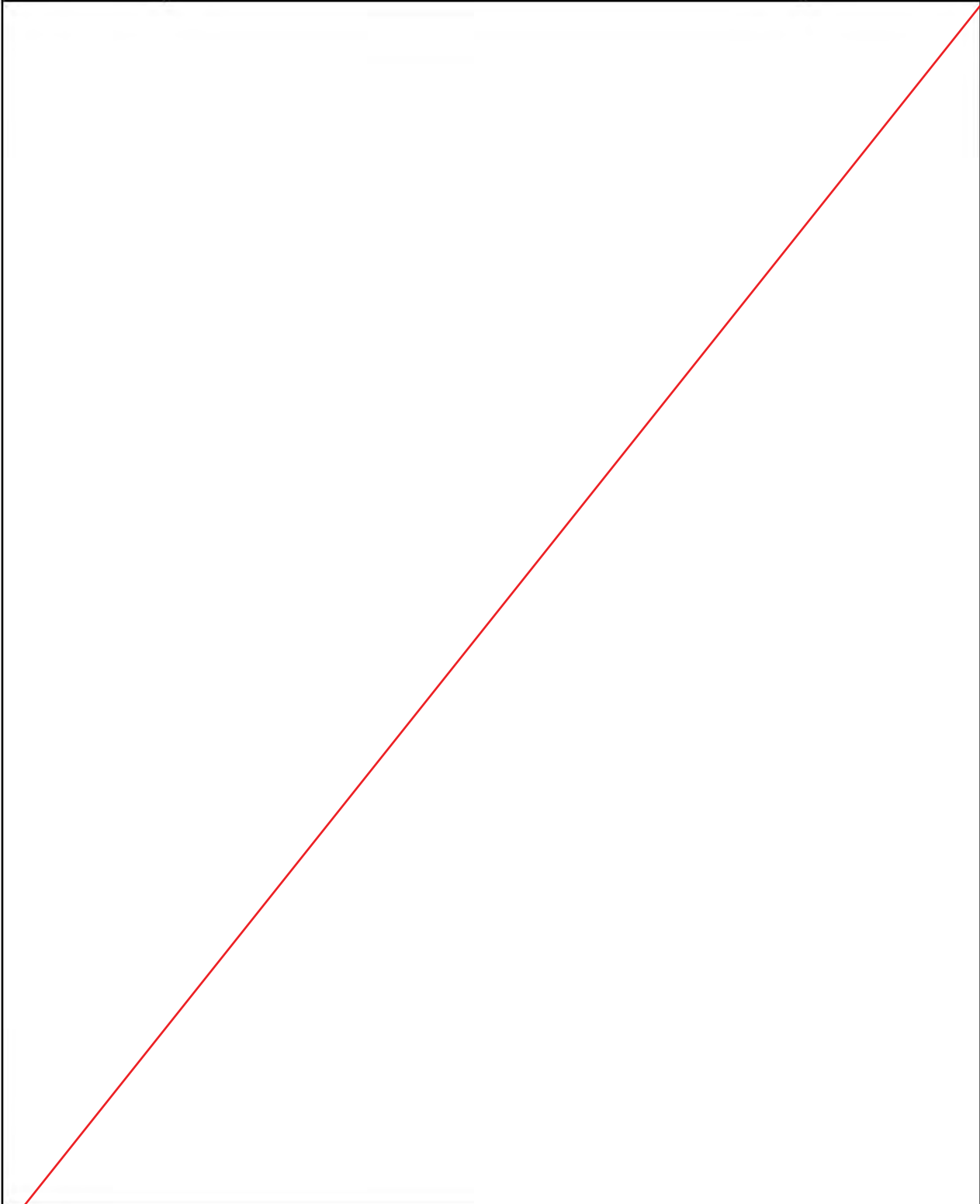
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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 12 of 328
		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 13 of 328
VOLUME III-I SECTION – 1/A EOT CRANES & MISCELLANEOUS CRANES		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 14 of 328
		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 15 of 328

CONTENTS

<u>CLAUSE NO.</u>	<u>DESCRIPTION</u>
1.0	INTRODUCTION
2.0	CODES AND STANDARDS
3.0	SCOPE OF WORK
4.0	PERFORMANCE REQUIREMENTS
5.0	DESIGN & CONSTRUCTION
6.0	DRAWINGS, DATA AND INFORMATION
ANNEXURE-I	LIST OF E.O.T. CRANES
DATA SHEET-A	DATA SPECIFICATION SHEETS

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 16 of 328

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 /A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 17 of 328

1.0

INTRODUCTION

1.1

This section covers the Electric Overhead Traveling Cranes (EOT) which will be required for handling various power plant equipment for erection and maintenance purposes for 1 X660 MW Power project.

2.0

CODES AND STANDARDS

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

2.1

CMAA Specification No. 70

:

Specification for Top Running Bridge & Gantry type Multiple Girder Electric Overhead Travelling Crane.

2.2

ANSI/ AISC 360-05

:

Specification for Structural Steel Buildings.

2.3

IS : 807

:

Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.

2.4

IS : 3177

:

Code of Practice for Design of Overhead Traveling Cranes and Gantry Cranes other than Steel Works Cranes.

2.5

IS : 1835

:

Round Steel Wires for Ropes.

2.6

IS : 2266

:

Steel Wire Ropes for General Engineering Purposes.

2.7

IS : 3443

:

Crane Rail Sections.

2.8

IS : 3815

:

Point Hook with Shanks for General Engineering Purpose.

2.9

IS : 5749

:

Forged Ramshorn Hooks.

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1		Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS		Page 18 of 328
2.10	IS : 816	: Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.	
2.11	IS : 823	: Code of Practice for Use of manual Metal Arc Welding of Mild Steel.	
2.12	IS : 1181	: Qualifying Tests for Metal Arc Welders (Engaged in Welding Structures other than pipes).	
2.13	IS : 1323	: Code of Practice for Oxy-Acetylene Welding for Structural Work in Mild Steel.	
2.14	IS : 9595	: Recommendations for metal arc welding of carbon & carbon - manganese steel.	
2.15	IS : 3813	: Specification for 'C' Hooks for use with Swivels.	
2.16	Hooks shall conform to BS: : 482/2903/3017		
2.17	All electrical installation work shall comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended upto date.		
2.18	ANSI-B 30.2.0 - Safety codes for overhead and Gantry Cranes. In case of any contradiction between the above mentioned codes and standards and this technical specification, the later shall prevail.		
3.0	<u>SCOPE OF WORK</u>		
3.1	The required number of E.O.T. cranes as indicated in Data Sheet-A having duty and service conditions as specified hereinafter along with all accessories.		

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 /A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 19 of 328
3.2	Runway rails for entire runway length along with rail clamps, all inserts, insert plates, anchor bolts, nuts, buffers & stops, limit switches etc as required.	
3.3	Runway conductors for the entire runway length complete with all insulators, supports, support brackets, fixing clamps, bolts, nuts etc and as required to complete the installation. Power supply cabling including isolating switch complete along with electrical items, attachments and accessories as required for feeding power to the runway conductor.	
3.4	All protective devices, anti-collision limit switches etc as required for the crane.	
3.5	All facilities, accessories and attachments for single and tandem operation of the cranes.	
3.6	Bridge and trolley current collectors and bridge cross conductors along with all wirings etc for the crane as required.	
3.7	Crane components shall be provided with lifting lugs, eye-bolts etc at suitable locations.	
3.8	Down shop leads (DSL) with fire protection sheathing with all fixing arrangement & isolators.	
3.9	Operator's Cabin or pendant push button, Radio Remote Control as applicable.	
3.10	Illumination of crane and working area with lamp below trolley which shall be swiveling type.	
3.11	Provision of monkey ladders for approach at convenient locations.	
4.0	<u>PERFORMANCE REQUIREMENTS</u>	
4.1	<u>CAPACITY</u>	
4.1.1	The safe working load (Y) for E.O.T. cranes shall be computed as $Y = 1.25 a$	

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 20 of 328
Where a = Weight of single heaviest equipment expected to be handled. (Excluding Generator Stator subject to a minimum capacity of 130 Tonnes for EOT crane at TG Hall) 4.2 <u>HIGHEST POSITION</u> The highest position reached by the lifting hooks shall 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 shall be at least one meter. 4.3 <u>LOWEST POSITION</u> 4.3.1 The lifting hooks of the turbine hall cranes should reach up to the ground level (0 m). The auxiliary hooks should reach up to the condenser pit level. 4.3.2 In case of all other E.O.T. cranes, the lifting hooks shall reach up to the floor of its operating area or sump pits as necessary. 4.4 <u>HORIZONTAL CLEARANCE</u> 4.4.1 The lifting hooks in vertical position shall reach at least 2.5 m in case of all cranes. 4.4.2 Either the main or the auxiliary hook in vertical position should reach at least up to 1.0 m for all cranes. 4.5 If safe and reliable handling necessitates more operating space for the E.O.T. cranes, the same shall be provided. 5.0 <u>DESIGN & CONSTRUCTION</u> 5.1 <u>GENERAL</u> 5.1.1 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.		

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 21 of 328
5.1.2 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. 5.1.3 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. 5.1.4 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. 5.1.5 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. 5.1.6 No wood or other combustible material shall be used unless specifically approved by the Owner/consultant. 5.1.7 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 Owner 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 Owner. 5.1.8 All fabrication by welding shall be carried out by qualified and certified welders as per IS: 1181. 5.1.9 Design shall provide for easy maintenance of all parts, particularly the wheel bearings on end-trucks. 5.1.10 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		

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 22 of 328
for mild steel. Clause 8 of Section II of IS : 800-1962 Code of practice for use of structural steel in General Building construction - shall also apply. 5.1.11 Maximum use shall be made of shop fabricated sub-assemblies. 5.1.12 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. 5.1.13 Material of Construction The material of construction of the major components of the crane shall be as indicated in the Data Sheet-A. 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 Owner. 5.1.14 Load Indication The crane bridge shall have permanent inscription in English on each side, readily legible from operating floor, stating manufacturer's name, serial number, the year of manufacture and the safe working load. 5.2 <u>STRUCTURAL DESIGN CONSIDERATION</u> 5.2.1 Minimum thickness of metal For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8 mm thick. For tubes having both ends sealed, the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes, the minimum thickness shall be 8 mm. The chequered plates for platforms shall be minimum 6 mm thick. 5.2.2 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.		

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 23 of 328
5.2.3 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: 18 Lattice girders: 12 5.2.4 Connections (a) Unless otherwise specified, only riveted 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 shall 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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 24 of 328
(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 $(2/3)^{rd}$ 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 (10) 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. 5.2.5 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. 5.3 <u>BRIDGE GIRDER AND END CARRIAGE</u> 5.3.1 The crane shall have single girder or double girder as required. 5.3.2 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 free from projections etc as far as possible to minimize dust collection on it. 5.3.3 Single girder cranes shall be provided with suitable truss for supporting the bridge drive machinery and motor. 5.3.4 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. Steel sections shall be welded to the trucks 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		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 25 of 328
girder crane shall be provided with suitable truss for supporting bridge device machine & motor. 5.3.5 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. 5.3.6 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. 5.3.7 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. 5.3.8 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. 5.3.9 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. 5.3.10 In bridge girder strength calculations, the trolley rails and chequered plates shall not be considered as load carrying members. 5.4 <u>TROLLEY FRAME</u> 5.4.1 The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains,		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 26 of 328
welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction. On bottom of trolley frame, on each side shall be a double spring bumper to engage stops at each end of the bridge. 5.4.2 Equalizer sheaves shall be mounted on the trolley frame in such a manner that deflection resulting from the force on the sheaves is not directly transmitted to the hoisting mechanism. 5.4.3 Sheaves shall be so arranged on the trolley that rope reeving arrangement resulting there from will ensure a lifting of the load in almost a vertical line with minimum of swing or side-movement. 5.5 <u>PLATFORMS AND LADDERS</u> 5.5.1 Safe means of access shall be provided to every place where any person engaged in the examination or maintenance of the crane has to work. Adequate handholds and footholds shall be provided, as necessary. 5.5.2 One meter 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 shall be provided 5.5.3 Every platform shall be provided with steel chequered plate top and be securely fenced with one to two metres high double tier hand rails of 32 mm diameter GI pipe and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely. 5.5.4 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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 /A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 27 of 328
5.6 <u>OPERATION</u> The crane shall be operated either from cabin in the crane bridge or from a pendant control station or from Radio Remote Control (for TG floor crane) as specified in Data Specification Sheet. 5.6.1 Operator's Cabin (a) The operator's cabin shall be open type, suitable for indoor service and complete with light, fan and 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. 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 panel, main isolating switch and other accessories required for operating the crane. A ten (10) lbs. capacity portable CO₂ fire extinguisher shall be provided in the cabin. (c) Provision shall be made at three convenient positions for emergency exit of the Crane Operator, in case of power failure. 5.6.2 Pendant Station (a) The pendant station shall locate 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. 5.7 <u>REPAIR CAGE</u> 5.7.1 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,		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 28 of 328
guards shall be provided on the trolley to prevent the hoisting ropes from coming in contact with conductors. Also a repair cage shall be provided on the trolley to attend these conductors. 5.7.2 Repair cages shall also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels. 5.7.3 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. 5.8 <u>LIFTING HOOK BLOCK ASSEMBLY</u> 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. 5.9 <u>GEARING</u> 5.9.1 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 60°C). The housing shall be of sufficient design not to permit a temperature in excess of 90°C for the oil bath and shall be adequately supported and readily removable without disturbing the gear assembly.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 29 of 328
5.9.2 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. 5.9.3 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. 5.9.4 Spur and helical gears only shall be used for reduction gearing. 5.9.5 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 <u>BEARING</u> 5.10.1 The type of bearings for various parts shall be as per IS-3177 and standard of manufacturer. 5.10.2 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 centralized lubrication of bearings shall be provided to the maximum extent possible and a detailed scheme for the same shall be furnished along with the tender. 5.10.3 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. 5.10.4 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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 30 of 328
5.11 <u>GUARDING</u> 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. 5.11.1 Protection guards to live electrical wirings/conductors shall be provided. Top and bottom of DSL (down shop lead) for the entire routs of DSL shall be covered by 14 SWG M.S. sheet with adequate structure duly painted to avoid accident. 5.11.2 Suitable guards to revolving shafts and coupling, long travel cross shafts and gears shall be provided. 5.11.3 The sheaves of the hook block fitted with two sheaves or fewer shall be guarded to prevent trapping of hand between a sheave and the running rope. 5.11.4 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. 5.11.5 All openings in foot walk 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. 5.11.6 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 <u>RUNWAY RAILS</u> 5.12.1 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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 31 of 328
5.12.2 5.12.3 5.13 5.13.1 5.14 5.14.1	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. The rail section shall be as per IS: 3443. <u>WIRE ROPES</u> The wire ropes shall be of suitable diameter as per Suppliers design of crane. The rope shall confirm to I.S. 1835, I.S. 1804 and I.S. 2266. The rope shall be parallel right hand lay having 6 x 37 constructions with hemp core. However, this should be in relation with Drum diameter as per IS: 3177. The rope selection procedure shall be as per IS 3177 cl. no. 8.3.2. <u>ROPE DRUMS</u> The drum shall be fabricated from Mild Steel Plate of weldable quality IS: 2062. All fabricated rope drums shall be stress relieved. All butt welds shall be subjected to 100% radiography. The plate material for this drum shall be accepted only after this plate has been successfully passed in ultrasonic testing. It should be sufficiently wide to accommodate in one layer the length of rope required for specified lift and in addition not fewer than two dead turns at each anchored end and one spare groove at opposite end. The drum shall be flanged at both ends and flanges shall project a distance not less than two rope diameters above the rope. A spur or other wheel secured to the drum may be regarded as forming one of the flanges. Rope anchorage shall be readily accessible. (a) Strength of drum Drums shall be designed to with-stand the compressive stress caused by wound on rope and the local bending stress caused in the drum at the groove when the rope is wound on. The bending stress due to the beam action of the drum shall also be taken into consideration.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 /A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 32 of 328
(b) Diameter The drum diameter measured at the bottom of the groove shall be not less than the appropriate value specified in IS: 3177. (c) Drum Grooves The lead angle of rope shall not exceed 5° (1 in 12) on either side of helix angle of groove in the drum. Rope drums shall be machine grooved and the contour at the bottom of groove shall be circular over an angle of 120°. The radius of the groove shall be larger than the radius of rope as per IS: 3177. The depth of groove shall not be less than 0.35 times diameter of rope. The clearance between the adjacent turns of ropes shall be as per of IS: 3177. The drum gear shall be cast steel as per IS: 2707 Gr. II. It shall be suitably heat treated for resistance to wear. 5.15 <u>ROPE SHEAVES</u> (a) Material The sheaves (Pulleys) shall be of carbon steel casting having chemical and mechanical properties as per IS: 1030 (Class 11). (b) Grooving Sheaves shall be machine grooved to a depth not less than 1.5 times the diameter of rope. The grooves shall be preferably hardened and finished smoothly and be free from surface defects liable to injure the rope. The contour at bottom of the groove shall be circular over an angle of approximately 130° +5°. The radius of this part of groove shall be larger than the radius of rope by an appropriate amount as per IS: 3177.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 33 of 328
(c) Diameter of Sheaves The diameter of the sheaves at the bottom of the groove shall not be less than that of the drums as specified in IS: 3177. (d) Lead Angle The angle between the rope and a plane perpendicular to the axis of the pulley shall not exceed 5° (1 in 12). (e) Sheave Guards Sheaves shall be provided with guards to retain the ropes in the grooves, if necessary. 5.16 <u>TROLLEY RAIL</u> 5.16.1 The specification includes the supply of trolley travel rails complete with fixtures for fixing the rails to the body of crane. 5.16.2 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. 5.17 <u>RAIL JOINTS AND FIXING</u> 5.17.1 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 Owner/Consultant. 5.17.2 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 Owner/Consultant. 5.18 <u>TOLERANCES</u> The limits of tolerance as specified in the Data Sheet-A shall be observed.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 34 of 328
5.19	<u>RAIL END STOPS</u> 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.	
5.20	<u>DRIVE MECHANISM</u>	
5.20.1	Equal driving effort shall be applied at each drive wheel of bridge and trolley to prevent one end from travelling faster than the other.	
5.20.2	For bridge, the torsional deflection in the cross shaft shall be limited to safe value as per applicable code.	
5.20.3	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.	
5.20.4	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.	
5.20.5	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.	
5.20.6	Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed. For other details the clause no. : 5.22.00 below shall be referred to.	
5.20.7	Along with the drive mechanisms adequate brakes shall be provided as detailed in clause no. : 5.23 below selection and design of brakes shall be	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 35 of 328
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. 5.21 <u>CRANE ELECTRICALS</u> 5.21.1 The crane(s) shall be furnished complete with all electrical equipment, accessories and cabling/wiring as may be necessary for the efficient and safe operation of the crane. 5.21.2 The crane electricals shall be designed for satisfactory operation from the available power supply as given in the Data Sheet-A. 5.21.3 All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion. 5.21.4 All electrical equipment shall be laid out so that they are readily accessible for inspection and maintenance. 5.22 <u>DRIVE MOTORS</u> 5.22.1 All crane motors shall be totally enclosed, fan cooled type, having class-B stator insulation and class-F rotor insulation for slip ring motors & class-B insulation for squirrel cage motor with temperature rise limited to class-B operation in all cases. 5.22.2 Motor enclosures shall conform to the degree of protection IP-55. 5.22.3 Motors shall be slip ring wound rotor type, designed for crane duty requirement of frequent starting, reversing and plugging. 5.22.4 Motors shall suit the duty class S4, cyclic duration factor 40% and number of cycles per hour 150. Motor pull out torque shall not be less than 2.75 times rated torque. 5.22.5 Each motor more than 30 KW rating shall be provided with space heater, sized to maintain motor internal temperature above dew point when the motor is idle.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 36 of 328
5.22.6	Motor shall be selected as per electrical service class-M8 as per IS-3177 (latest edition).	
5.23	<u>BRAKES</u>	
	Selection and design of brakes shall be such as to meet the following requirements	
5.23.1	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.	
5.23.2	Hoist Control Braking Means Hoist motion (both main and auxiliary) shall be provided with a self-contained sturdy braking system, preferably of 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.	
5.24	<u>MAIN DISCONNECT SWITCH</u>	
5.24.1	Main disconnect switch shall be metal-clad, 3-pole, load-break type in IP-54 enclosure, complete with compression brass glands and lugs to suit Owner's power supply connection.	
5.24.2	The switch shall be provided with "Power On" red indication lamp (LED type) and shall be suitably located so that it can be manually operated from the operating floor level.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 37 of 328
5.24.3	Power leads shall run from the main disconnect switch to the runway conductors.	
5.25	<u>RUNWAY CONDUCTORS (DOWN SHOP LEADS)</u>	
5.25.1	The runway conductors shall be four (4) in numbers for three phase supply and ground.	
5.25.2	The runway conductors shall be of M.S. angle sections, liberally sized so as not to exceed current density of 0.42 Amps/mm ² . 14 SWG M.S. sheet protection guard shall be provided for the entire routes of DSL conductors (top & bottom) with adequate structures.	
5.25.3	Sufficient allowance (minimum 20%) for wear and tear shall be provided over the calculated conductor size.	
5.25.4	The runway conductors shall be supported on brackets and insulators from the crane girder with sufficient spacing in between the conductors.	
5.25.5	The collector system per conductor shall be top-running type having spring loaded cast iron/carbon metallic shoes to maintain adequate contact pressure.	
5.26	<u>CROSS-CONDUCTORS ON BRIDGE</u>	
5.26.1	Cross conductors on bridge shall be flexible trailing cable system mounted on retracting supports (festoon type).	
5.26.2	Alternatively, cross conductors of M.S. angles with shoe collectors, similar to the arrangement of runway conductors may be offered.	
5.27	<u>POWER DISTRIBUTION EQUIPMENT</u>	
5.27.1	From the main collector shoes, wiring shall be extended to one (1), 3-pole, load-break, safety disconnect switches -at the bridge near the collector.	
5.27.2	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.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 38 of 328
5.27.3 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. 5.28 <u>VOLTAGE DROP</u> 5.28.1 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. 5.28.2 The voltage drop shall be computed using the total running current of all crane motors that can operate simultaneously and with rated crane load. 5.29 <u>SAFETY INTERLOCKS</u> 5.29.1 Disconnect Switch (a) The operating handle of the main/ safety disconnect switch shall be mechanically interlocked with enclosure cover such that the same cannot be opened unless the switch is in OFF position. (b) Main/safety disconnect switch shall have provision of pad-locking in OFF position.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 /A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 39 of 328
5.29.2 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. 5.30 <u>EMERGENCY SWITCH</u> Mushroom type emergency STOP push buttons to open the main contactor shall be furnished - at least two on bridge platform within easy reach. 5.31 <u>CRANE CONTROLS</u> Fully magnetic control shall be furnished complete with master controller (applicable for pendent operated controlled cranes) for each motion, complete with contactors, time lag relays, plugging protections, resistors and other accessories to meet the following control requirement : 5.31.1 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. 5.31.2 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. For double girder cranes having slip ring hoist, CT & LT motors, the speed steps are basically occurring during starting. In normal operation, there are		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 40 of 328
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. 5.31.3 General (a) All controls shall be designed to be fail-safe on loss of power. (b) Control circuits shall be suitable for 240V, single phase, 50 Hz 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. 5.32 <u>CONTROLLERS</u> 5.32.1 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. 5.32.2 Each controller shall bear suitably engraved inscription of motions controlled in English and of direction of motions by arrows. 5.33 <u>RESISTORS</u> 5.33.1 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 250° C. 5.33.2 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.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 /A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 41 of 328
5.34 <u>LIMIT SWITCHES</u> 5.34.1 The limit switches shall be totally enclosed type IP-55 with properly designed actuators and shall be readily accessible for adjustment and repair. 5.34.2 Each hoist shall be furnished with two (2) limit switches: (a) A screw type limit switch with self resetting features which will act in case of over hoisting. (b) A gravity operated hand-reset type limit switch as a back-up protection against over-hoisting. 5.34.3 Track type limit switches shall be provided on the bridge and trolley to prevent over travelling in either directions. 5.35 <u>PANELS</u> 5.35.1 Protective and control panels shall have IP-54 gasketed enclosure, fabricated from sheet steel, minimum 2 mm thick, suitably reinforced to provide structural rigidity. 5.35.2 The panels shall be front connected type with front hinged door for access to wiring and terminals. Engraved name plates shall be furnished for all panels and also for the equipment and device mounted thereon. 5.35.3 All panels shall be factory wired and terminated on suitable terminal blocks for external cable connection. All internal wiring shall be identified with numbering ferrules at both ends as per relevant wiring diagram. Terminal blocks shall have 20% spare terminals. 5.35.4 Control wiring shall be carried out with 1100 Volt grade flexible, heat resistant, insulated switchboard wires with minimum 2.5 sq.mm stranded copper conductor. 5.35.5 Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater, suitable for operation on 240V 1-ph 50		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 42 of 328
Hz supply. Lamps and heater circuits shall have individual ON-OFF switches. 5.36 <u>SWITCH</u> 5.36.1 All switches shall be hand operated, air break, heavy duty, quick make-quick break type, capable of safely breaking the full load current of connected motor/feeder. 5.36.2 Incoming supply disconnect switch shall be interlocked with panel door so that the same cannot be opened unless the switch is in OFF position. Device to defeat this interlock shall also be included. 5.37 <u>FUSE</u> 5.37.1 All fuses shall be of HRC cartridge type, mounted on plug-in fuse base and provided with visible operation indicator. 5.37.2 All accessible live parts shall be adequately shrouded so as to eliminate the danger of accidental contacts with live parts while changing the fuse. 5.38 <u>CONTACTORS</u> 5.38.1 Contactor shall be suitable for crane duty, with current rating not less than connected motor full load current. All reversing contactors shall be mechanically and electrically interlocked. 5.38.2 Contactors shall have facility for easy inspection and replacement of parts. Arc chutes shall be provided where necessary. 5.38.3 Each contactor shall be provided with three positive acting, ambient temperature compensated, thermal overload relays with adjustable settings to suit the motor current. 5.38.4 The relays shall be hand-reset type, suitable for resetting with compartment door closed.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 43 of 328
5.39	<u>PUSH BUTTON AND LAMP</u>	
5.39.1	Push button shall be spring return type, with 2 NO + 2 NC contacts, rated 10A 240V A.C.	
5.39.2	Indicating lamps shall be LED type with series resistor. Lamps and lens shall be replaceable from front.	
5.40	<u>ILLUMINATION</u>	
5.40.1	Crane lighting and space heating systems shall be designed for 240V, 1ph, 50 Hz supply and receptacle system for 240V, 1ph, 50 Hz supply. Suitable dry type transformers shall be furnished for the purpose, complete with isolation facility and primary/secondary fuses.	
5.40.2	40W Fluorescent fixtures shall be used for lighting bridge platform. Four (4) 250W high-bay sodium vapour fixtures shall be provided below bridge for illumination of the working zones.	
5.40.3	All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.	
5.40.4	24V - 5A - 3 pin industrial socket outlets shall be provided - minimum four (4) on the bridge along the walkway.	
5.40.5	One (1) portable 40W hand lamp with plug shall be furnished with adequate length of flexible cable for inspection of crane components.	
5.40.6	One (1) heavy duty type industrial siren shall be provided with each crane.	
5.40.7	Conduit wiring system shall be used for lighting circuits.	
5.41	<u>WIRING</u>	
5.41.1	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.	

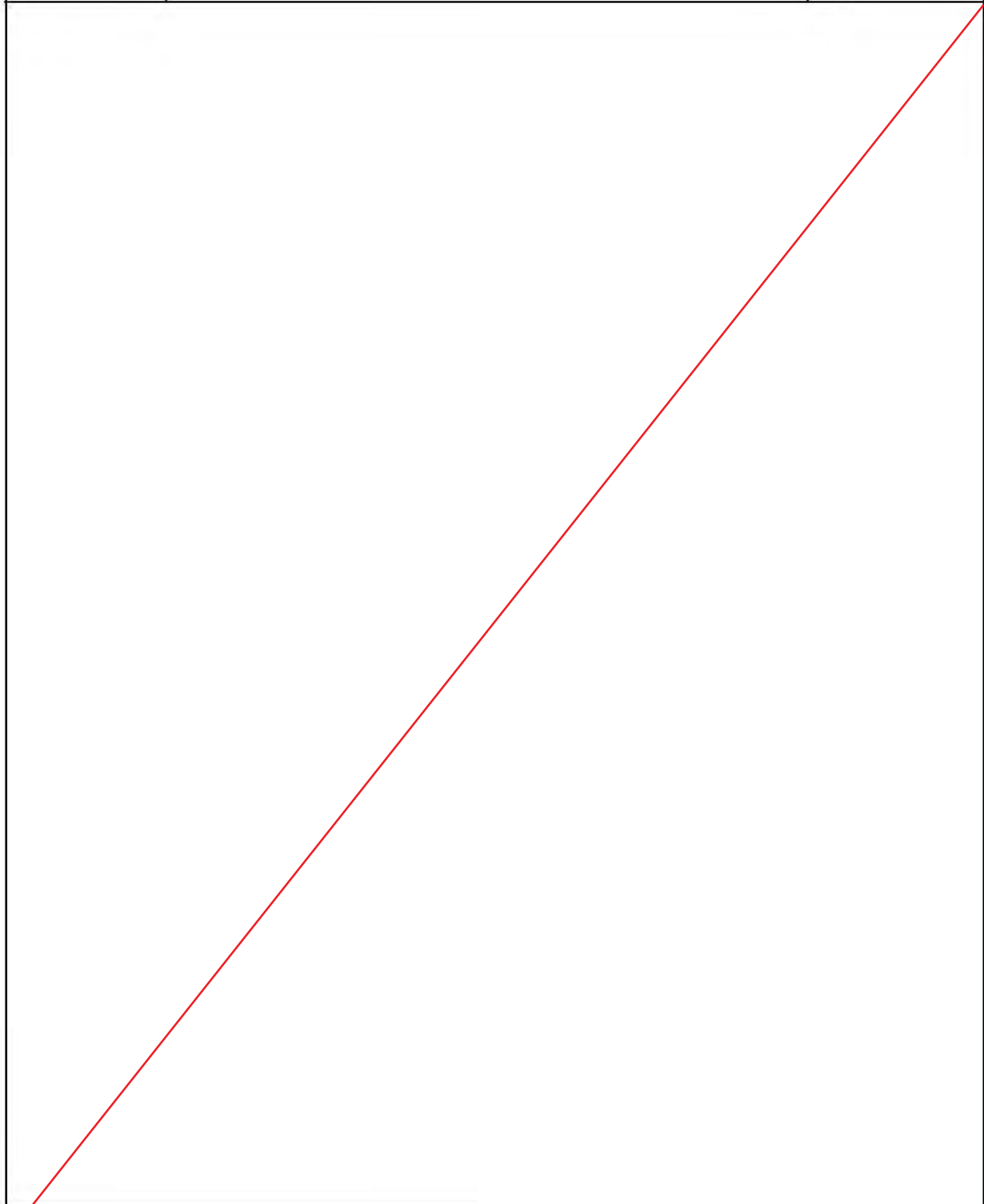
CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 44 of 328
5.41.2	All wiring shall be done with 1100 V grade PVC insulated wire in conduits or by 1100 V grade PVCA PVC cables with extruded inner sheath.	
5.41.3	Conductors shall be stranded aluminium for power and stranded copper for control. Minimum conductor size shall be not less than 2.5 mm ² copper or equivalent.	
5.41.4	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.	
5.41.5	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.	
5.41.6	All wires and cables shall be identified with permanent markers at terminations as per approved wiring diagram.	
5.42	<u>GROUNDING</u>	
5.42.1	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.	
5.42.2	Bonding of structures and crane rails shall be provided as required to ensure electrical continuity.	
5.42.3	The crane grounding system shall be connected to station ground mat. For this purpose, the Owner will provide ground conductor (50 x 6mm M.S. flat) at two agreed locations.	
6.0	<u>DRAWINGS, DATA AND INFORMATION</u>	
6.1	For Drawing, Data and Information required along with BID refer Volume-VIII .	

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 /A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 45 of 328
<u>ANNEXURE-I</u> <u>LIST OF E.O.T. CRANES</u>		
<u>SR.NO.</u>	<u>LOCATION</u>	
1.0	Turbine Hall – Two (2)	
Note: The list indicated are minimum as conceived by Owner/ Owner's Consultant; Bidder shall estimate and suitably include in case any other areas need EOT cranes.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 46 of 328
		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1		Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS		Page 47 of 328
<u>DATA SPECIFICATION SHEETS</u> <u>DATA SHEET- A</u>			
SR. NO.	ITEM		
1.0	<u>GENERAL INFORMATION</u>		
1.1	Location	As per Datasheet-A.	
1.2	Type	Bidder to indicate	
1.3	Quantity	Bidder to indicate	
1.4	Working condition	Indoor	
2.0	<u>GUARANTEED PERFORMANCE REQUIRED</u>	Crane at Sr. No. 1 in Annexure I	Crane at Sr. No. 2 to 13 in Annexure I
2.1	<u>CAPACITY</u> : (Safe working load)		
2.1.1	Main Hoist (T)	** To be decided by the bidder.	
2.1.2	Aux. Hoist (T)	** To be decided by the bidder.	
2.2	<u>RATED SPEED</u> : (for any load from zero to SWL)		
2.2.1	Main hoist	1 m/min	3 m/min
2.2.2	Auxiliary hoist	3 m/min	5 m/min
2.2.3	Trolley travel	10 m/min	15 m/min
2.2.4	Bridge travel	15 m/min	25 m/min
2.3	Range of speed control for main and auxiliary hoist each motions (for any load from zero to SWL)	Down to 10% of corresponding rated speed.	Down to 10% of corresponding rated speed.

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1		Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS		Page 48 of 328
SR. NO.	ITEM		
3.0	<u>DESIGN AND CONSTRUCTION</u>		
3.1	<u>DUTY CLASS</u>		
3.1.1	Mechanism class	Class 2 as per IS-3177 and IS-807	
3.1.2	Electrical Service class	Class 4 as per IS-3177	
3.2	Operation	Cabin with Pendant Station or Radio Remote Control for Crane at Sr. No. 1 in ANNEXURE-I, Pendant Station for Cranes at Sr. No. 2 to 13 in ANNEXURE-I	
3.3	Span between runway rail centres	To be decided by the bidder.	
3.4	Net runway length	To be decided by the bidder.	
3.5	Elevation of top of runway rails	To be decided by the bidder.	
3.6	Elevation of bottom of building roof structures	To be decided by the bidder.	
3.7	<u>MAIN HOOK POSITIONS</u> -		
3.7.1	Elevation- Highest	To be decided by the bidder.	
3.7.2	- Lowest	To be decided by the bidder.	
3.7.3	Min. approach from runway rail centre lines	To be decided by the bidder.	
3.7.4	Min. approach from runway rail stops	To be decided by the bidder.	
3.7.5	Clear space between runway rail centre line and nearest side obstruction/ wall	To be decided by the bidder.	
3.8	<u>AUXILIARY HOOK POSITIONS</u> -		
3.8.1	Elevation- Highest	To be decided by the bidder.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 49 of 328
SR. NO.	ITEM	
3.8.2	- Lowest	To be decided by the bidder.
3.8.3	Min. approach from runway rail centre lines	To be decided by the bidder.
3.8.4	Min. approach from runway rail stops	To be decided by the bidder.
3.8.5	Clear space between runway rail centre line and nearest side obstruction/wall	To be decided by the bidder.
3.9	<u>RUNWAY CONDUCTORS</u> -	
3.9.1	Material	As specified earlier
3.9.2	Maximum allowable current density	Bidder to indicate
3.10	<u>END TRUCK</u>	
3.10.1	I-Section acceptable	No
3.10.2	Single flanged wheels acceptable	No
3.11	<u>PERMISSIBLE TOLERANCE</u> -	
3.11.1	Difference in levels of crane rail top measured between two adjacent columns	1.0 mm
3.11.2	Crane rail gauge	± 3.0 mm
3.11.3	Relative shift of ends of adjacent rails in plan and elevation after welding	1.0 mm
3.11.4	Deviation of crane rail axis from centre line of web of supporting girder	± 3.0 mm
3.12	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:	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd		MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-I
		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 1 /A
REV: R0		MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS	Page 50 of 328
SR. NO.	ITEM		
3.12.1	Main Hoist	Two (2) Electro-hydraulic thruster type brake	
3.12.2	Auxiliary Hoist	Two (2) Electro-hydraulic thruster type brake	
3.12.3	Cross Traverse	Two (2) Electro-hydraulic thruster type brake	
3.12.4	Long Traverse	(a) Two (2) Electro- hydraulic thrusters type brake	
		(b) Two (2) Hydraulic thrusters (foot operated)	
3.12.5	Main Hoist (creep)	One (1) electro hydraulic thruster type brake	
3.12.6	Auxiliary Hoist (creep)	One (1) electro hydraulic thruster type brake	
	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.		
4.0	<u>MATERIAL OF CONSTRUCTION</u>		
4.1	Bridge girder	IS-2062 Grade B	
4.2	Other structural members	IS-2062 Grade B	
4.3	Lifting hooks	As per IS-15560/ or As per IS-8610	
4.4	Sheaves, drums	Cast steel/MS/C.I. as per IS 3938 (or) C.I. (IS-210, FG-260)	
5.0	<u>SCOPE OF SUPPLY</u>		
5.1	Crane structures complete	Yes	

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1		Section – 1 / A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS		Page 51 of 328
SR. NO.	ITEM		
5.2	All drive motors and driving gears	Yes	
5.3	Running rails including all clamps, anchors, bolts, nuts, sheams, inserts, end stops and other fixtures	Yes	
5.4	Operator's Cabin	Yes, for crane no.1 (as applicable for others)	
5.5	Pendant Station	Yes, For crane nos. 2 to 13	
5.6	Portable fire extinguisher/CO ₂ bottle in operator's cabin	Yes, for crane nos. 1	
5.7	Runway conductors (D.S.L.) and power collectors complete with all supports, insulators, brackets, fixtures etc	Yes	
5.8	Complete electrical work including main disconnect switch, all controls and interlocks, with necessary wiring, grounding, protective panels etc.	Yes	
5.9	Lower limit switches for hoists	Yes	
5.10	Illumination of crane, operator's cabin etc.	Yes, for crane no. 1(as applicable for others)	
5.11	Fan in operator's cabin	Yes, for crane no. 1(as applicable for others)	
5.12	Lifting lugs, eye bolts etc. for handling of crane parts	Yes	
5.13	Erection and commissioning service	Yes	
5.14	All equipment, accessories and consumables required for erection, testing and commissioning	Yes	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: III-I
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1		Section – 1 /A
REV: R0	MATERIAL HANDLING AND MISCELLANEOUS EQUIPMENTS		Page 52 of 328
SR. NO.	ITEM		
5.15	Final painting	Yes	
5.16	First charge of oil, lubricants, grease etc.	Yes	
5.17	Spare parts	Yes	
5.18	Tools & Tackles	Yes	
5.19	Suitable arrangement below gear box shall be provided for collection of oil spillage	Yes	

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	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

ANNEXURE-I
MAKES OF SUB-VENDOR ITEMS

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

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
10.	HRC FUSES	SIEMENS		
		L&T		
		ENGLISH ELECTRIC		
		GE POWER		
		EATON (BUSSMANN)		
		ABB		
11.	ISOLATING SWITCH	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR		
		ABB		
12.	SWITCH FUSE UNITS	SIEMENS		
		L&T		
		CONTROL & SWITCH GEAR	-	
		ABB		
13.	TIME DELAY RELAYS	SIEMENS		
		L&T		
		ABB		
		BCH		
		SCHNEIDER (Earlier TELE MACHANIQUE)		
14.	TRANSFORMERS	INDCOIL		
		LOGICSTAT		
		KAPPA		
		AUTOMATIC ELECTRIC		
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS		
		BAJAJ		
		CROMPTON		
16.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
17.	HOOTERS	BEACON		
		OSC		
		TARGET		
		KHERAJ		
18.	LIGHTING SWITCHES	ANCHOR		
		ELLORA		
		BAJAJ		
		PHILIPS		
19.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	

	TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
		REV 00	
		Section IA	Date JAN'19

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
20.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	
		APAR INDUSTRIES LTD., CMI LTD	MUMBAI	
		CMI LIMITED	FARIDABAD	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DELTON CABLES LTD	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		ELKAY TELELINKS LTD	NEW DELHI	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		INCOM CABLES (P) LTD	NEW DELHI	
		KEI INDUSTRIES LTD	NEW DELHI	

		TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
			REV 00	
			Section IA	Date JAN'19
SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		NICCO CORPORATION LTD	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		SPM POWER & TELECOM PVT. LTD	HYDERABAD	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
21.	TRAILING CABLES	UNIVERSAL CABLES LTD	SATNA	
		NICCO	KOLKATA	
		UNIVERSAL	SATNA	
		INCAB		
		ICL	NEW DELHI	
		APAR INDUSTRIES LTD	MUMBAI	
		CMI LTD	FARIDABAD	
		KEI INDUSTRIES LTD	NEW DELHI	
22.	XLPE POWER CABLES	SUYOG ELECTRICALS LTD	VADODARA	
		APAR INDUSTRIES LTD	MUMBAI	
		CORDS CABLE INDUSTRIES LTD	NEW DELHI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	

		TITLE 1X660 MW BHUSAWAL TPS DOUBLE GIRDER EOT CRANES ABOVE 100T SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-415-501-A501	
			REV 00	
			Section IA	Date JAN'19
SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MANSFIELD CABLES COMPANY LTD	NOIDA	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SPECIAL CABLES PVT. LTD	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD	SOLAN	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		THERMO CABLES LTD	HYDERABAD	
		TIRUPATI PLASTOMATICS PVT. LTD	JAIPUR	
23.	XLPE CONTROL CABLES	APAR INDUSTRIES LTD	MUMBAI	
		CABLE CORPORATION OF INDIA LTD	MUMBAI	
		CRYSTAL CABLE INDUSTRIES LTD	KOLKATA	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GEMSCAB INDUSTRIES LTD	NEW DELHI	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		PARAMOUNT COMMUNICATIONS LTD	NEW DELHI	
		POLYCAB WIRES PVT. LTD	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD	VADODARA	
		SRIRAM CABLES PVT. LTD	NEW DELHI	
		TORRENT CABLES LTD	AHMEDABAD	
		UNIVERSAL CABLES LTD	SATNA	
24.	CABLE GLAND	COMMET		
		SUNIL&CO		
		ARUP ENGINEERING		
		JAINSON		
		DOWELL		
25.	PUSH BUTTONS	SIEMENS		
		L&T		
		BCH		
		SCHNEIDER		

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			REV 00	
			Section IA	Date JAN'19
SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
26.	LIMIT SWITCHES	SPEED-O-CONTROL ELECTROMAG		
27.	MASTER CONTROLLER	SPEED-O-CONTROL ELECTROMAG		
28.	SAFETY SWITCHES	ALSTOM L&T SIEMENS		
29.	PENDENT PUSH BUTTON STATION	OEM		
30.	INDICATING LAMPS	TECKNIC BCH SIEMENS STANDARD		
31.	MCB	MDS INDO COPP STANDARD SIEMENS L&T ABB SCHNEIDER		
32.	PANELS	OEM RITTAL PYROTECH		
33.	RESISTANCE BOXES	ENAPROS OEM		
34.	FIRE EXTINGUISHERS	ASKA EQUIPMENTS LTD. ASHOKA ENGINEERING COMPANY KANADIA FYR FYTER PVT. LTD NITIN FIRE PROTECTION INDUSTRIES LTD NEW ENGINEERING CORPORATION SAFEX FIRE SERVICES LTD UNITED FIRE EQUIPMENTS PVT. LTD ZENITH FIRE SERVICES (INDIA) PVT LTD		
35.	VVVF	YASKAWA ABB SIEMENS SCHNIEDER FUJI ELECTRIC MITSUBISHI ELECTRIC		

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		REV 00	
		Section IA	Date JAN'19

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
36.	SHROUDED DSL	SUSHEEL		
		STROMAG		
37.	ANTI COLLISION DEVICE	ELECTRONIC SWITCHES INDIA		
38.	LOAD CELL	IPA		
		SARTORIUS		
39.	RRC	ACROPOLIS ENGINEERING	-	
		SNT CONTROLS	-	
40.	GEAR BOX	OEM		* = Applicable for Geared Motors only
		ELECON ENGINEERS		
		SHANTI GEARS		
		PBL*		
		NAW*		
		NORD*		
		SEW*		
41.	RAIL	BONGFILIOLI*		
		JSPL		
		SAIL		

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL
2. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.


TITLE
1X660 MW BHUSAWAL TPS
**DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**
SPECIFICATION NO. PE-TS-415-501-A501
REV 00
Section IA
Date JAN'19

ANNEXURE-II MANDATORY SPARES

MANDATORY SPARES: (One set common for both cranes).

Sl. no	Description	Quantity	Quantity & Unit
1	Carbon brushes for each motor	3	Three (3) sets
2	Brush holders for each motor	1	One (1) set
3	Bearing for each motor	1	One (1) set
4	Bearings for each reduction gear unit	1	One (1) set
5	Bearings for cross travel and long travel wheels	1	One (1) set
6	Linings for each brake shoe complete with rivets	2	Two (2) sets
7	Contactors of each type and rating	2	Two (2) each
8	Timers of each type	2	Two (2) each
9	Limit switches and switches of each type	1	One (1) set each
10	Sockets of each type	1	One (1) set each
11	Double roller collectors	3	Three (3) sets
12	Porcelain insulators of each type	2	Two (2) sets each
13	Contacts for master controllers	2	Two (2) sets
14	Brake springs for main and auxiliary hoist brakes	3	Three (3) sets
15	Coils for all contactors	1	One (1) set each
16	V3F DRIVE		
16.1	Thysrister	12	Twelve (12)
16.2	Ignition Transformer	12	Twelve (12)
16.3	Firing card	4	Four (4)
16.4	Control Transformer	2	Two (2)
16.5	Auxiliary contactor	2	Two (2) each

Note: -

- 1) "One (1) Set is defined as 100% requirement for one crane for the entire cranes of similar size & capacity.
- 2) All essential spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is not applicable for particular equipment then suitable applicable alternate spare have been offered / shall be supplied without any financial implication.

**TITLE****1X660 MW BHUSAWAL TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section IA

Date JAN'19

ANNEXURE III - TOOLS & TACKLES

A complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied. Each tool and wrench shall be stamped so as to be identified, easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and minimum the following shall be provided.

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

Note: - One set of tool and tackles with O&M manual in the toolbox shall be supplied. Further in addition to above mentioned items, if any other items is required for maintenance of cranes, the same shall also be included as a part of maintenance tools by the bidder.

**TITLE****1X660 MW BHUSAWAL TPS****DOUBLE GIRDER EOT CRANES ABOVE 100T
SPECIFIC TECHNICAL REQUIREMENTS**

SPECIFICATION NO. PE-TS-415-501-A501

REV 00

Section IA

Date JAN'19

ANNEXURE IV: PAINTING SPECIFICATION**1. Painting specification detail:**

Surface Preparation	Degreasing and Mechanical cleaning with wire brush or hand tool (SA1/ ST2/ ST3 as applicable).
Primer coat:	Painting with inorganic Zinc phosphate primer (DFT -75 microns, No. of coat-1).
Intermediate coat	Epoxy based finish polyamide cured painting (DFT-75 Micron, No. of coat-3, i.e. 25 microns per coat).
Finish coat	Final coat of epoxy based finish polyamide cured painting (DFT-75 micron, no. of coat-3, i.e 25 microns per coat).
Total DFT	220 microns

2. Color Shade:

SL. No	Item Description	Color Shade	Remarks
1	Crane Structure	Golden Yellow shade 356 as per IS-5	Colour band-Black
2	Trolley and hook	Crimson shade 540 as per IS-5	-
3	Motors	Light Gray shade 631 as per IS-5	-
4	Control Panels	Light Gray (Powder coated) as per IS-5	-
5	Gear Box	Light Blue (RAL : 5012)	-